Analysis of the Effect Oriented "the One Belt and One Road" OFDI Effect on the Total Factor Productivity in China

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Abstract

Using the provincial panel data from 2006 to 2016, a segmented model is established to examine the impact of OFDI in the “Belt and Road” approach on total factor productivity in Chinese relevant provinces. The intrinsic mechanism of OFDI impact on total factor productivity is analyzed through panel threshold models.The study found that: (1) there is no reverse spillover effect of Belt and Road Initiative along the country's investment, but has a promoting effect on the total factor productivity in China, mainly achieved through the expansion of market size, share development costs; (2) human capital, technological innovation, economic development level and the degree of openness, based water facilities The domestic factors of equality have a significant impact on the promotion effect of OFDI on TFP. Therefore, China should adopt the "The Belt and Road countries along the OFDI, take the initiative to develop economic partnership with countries along, in the production output and complementary resources at the same time, strengthen the construction of the domestic market factors, driven by innovation to further enhance the total factor productivity in china.

Keywords

The Belt and Road；OFDI；Total factor productivity；Effect；Countermeasure.

1. Introduction

Outward Foreign Direct Investment（OFDI） is an investment activity in which multinational corporations (MNCs) invest certain factors of production in another country and acquire corresponding management rights. In September 2013, general secretary Xi Jinping put forward the initiative of "one belt and one road" as the main content of "policy communication, facilities interconnection, trade liberalization, financing and people's hearts". Over the past 4 years since the implementation of the strategy, China has accumulated more than US $50 billion in the amount of OFDI in the countries along the "one belt and one road". The amount of OFDI in 2016 has reached US $14 billion 500 million, accounting for 12% of China's total foreign investment in that year, and 56 economic and trade cooperation zones have been established in 20 countries. Under this background, we examine the impact of OFDI on China's total factor productivity. The empirical analysis of the mechanism and internal factors of this impact is of great practical significance for examining the effect of China's "one belt and one road" external investment and finding out the path and paradigm of effectively improving the productivity of China's all essential factors.

The present study seldom examines the effect of OFDI on the total factor productivity of China along the "one belt and one way" country, and analyzes more from the perspective of reverse spillover effect.However, the countries along the belt and road are generally in the developing stage, and their technical level is much lower than that of China. Therefore, the mechanism of OFDI to the total factor productivity of the countries along the "one belt and one road" is different from that of the developed countries OFDI.Therefore, this paper intends to take the relevant provinces of China as the main body involved in the "one belt and one way" direct investment, and use the nonlinear panel threshold model to analyze the impact and internal mechanism of direct investment on the total factor productivity in China.

2. Literature review

Scholars at home and abroad generally believe that OFDI affects the total factor productivity of the exporting countries to varying degrees. Kought and Chang (1991) used Japan's investment data in the United States to confirm that Japan's foreign investment drives its own technological progress, and to initiate a worldwide study on how OFDI affects total factor productivity; Coe and Helpman (1995), based on the panel data of developed countries from 1971 to 1990, found that the improvement of a country's total factor productivity depends not only on domestic R&D investment, but also on foreign investment; Braconier (2001) and Branstetter (2000) have proved that OFDI plays a positive role in promoting the total factor productivity of the home country; Lichtenberg and Pattelsberghe (2001), Ren Yanjun (2012) and Lu Wanbo (2015) empirically studied the relationship between OFDI and total factor productivity (TFP), and found that there was a significant positive correlation between OFDI and TFP in countries with higher technological level;Driffield (2003) used panel data of the UK from 1984 to 1992 to prove that investment in highly technology-intensive countries can promote TFP. In terms of the study on the influencing factors of total factor productivity (TFP) by OFDI, Li Mei and Liu Shichang (2012) used the provincial panel data to study the regional difference characteristics of the influence of OFDI on TFP;Ouyang Yanyan (2010) uses PLS model to analyze the main factors affecting total factor productivity of China's OFDI. Some scholars such as Wang Ying (2008), Bai Jie (2009), Rao Hua and Zhu Yanfu (2013) have proposed that OFDI has no significant impact on domestic total factor productivity. Chen Hao and Wu Wen (2016) believe that there is no reverse technology spillover in China's investment in low-tech countries.

In recent years, the research on the "belt and road" OFDI and its impact on total factor productivity are in the ascendant. Meng Qingqiang (2016) thinks that the OFDI performance of the countries along the belt and road is obvious market and resource seeking type; Wu Zhe (2015) using the panel data of 2003-2013 years, the research shows that the impact of OFDI on TFP in the developing countries along the belt and road is not significant at this stage, It needs to go through the process of aid before benefit;Hu Yanxin (2016) proposed that OFDI for the "one belt and one way" country will have a long-term role in promoting TFP in China; Nisha, Wang Yongxing and Jing Weimin (2016) pointed out that the impact of OFDI on total factor productivity in the countries along the line was positively correlated with the level of economic development in China.

3. Theoretical Hypothesis and Model Setting

3.1 Theoretical hypothesis

Based on the above analysis, the impact of OFDI on TFP is different from that of OFDI in developed countries. China enlarges the international market through OFDI and produces scale effect, which helps enterprises to utilize international resources, enhance operational efficiency, and enhance their R&D investment intensity through feedback mechanism, thus promoting technological progress (Xiao Wen, 2014).On the basis of the relevant achievements, this paper proposes a mechanism model of OFDI affecting the total factor productivity of China along the "one belt and one road",as shown in Figure 1.

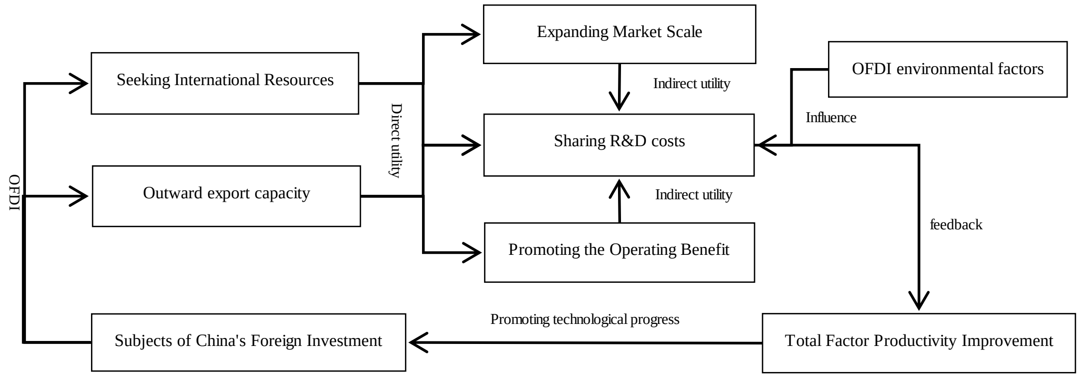


Fig. 1 The mechanism of the influence of OFDI on China's TFP

The OFDI of the "one belt and one way" country has widened the space for China's international market and industrial development. This article intends to further examine and analyze the following problems: Does this kind of OFDI behavior have reverse technology spillover effect for China? How does OFDI affect China's total factor productivity? What are the main factors affecting total factor productivity of OFDI? Therefore, the following hypotheses are put forward in this paper:

Hypothesis 1: there is no reverse technological spillover effect on OFDI in the "one belt and one road" country;

Hypothesis 2: the OFDI of the countries along the "one belt and one road" share the domestic R & D costs and promote the total factor productivity of China;

Hypothesis 3: domestic related factors, such as technological innovation capability, human capital, economic development level, opening up degree and infrastructure level, can play a positive role in the process of OFDI in China.

3.2 OFDI Impact Model on Total Factor Productivity

Based on Cobb-Douglas function, the Solow residual estimation method is used in this paper.

$$Y_{it} = A_0 e^{\gamma T} L_{it}^{\alpha} K_{it}^{\beta} \tag{1}$$

Among them, A_0 stands for technical level,ϒ denotes the coefficient of technological progress ,T denotes the term of time trend,Y_{it} represents the total production value of provinces, municipalities and autonomous regions (provincial administrative units, hereinafter referred to as provinces) during the t period,L_{it} denotes the labour force of i Province during the t period;K_{it} represents the fixed capital stock of i Province in t period;α and β are parameters of production function,and α+β=1.So, Total factor productivity (TFP_{it}) can be solved by $Y_{it} / L_{it}^{\alpha} K_{it}^{\beta}$,Formula (1) is deformed and formula (2) is obtained.

$$\ln(Y_{it} / L_{it}) = \ln A_0 + \gamma T + \beta \ln(K_{it} / L_{it}) + \varepsilon_{it} \tag{2}$$

Formula (2) is regressed to get the values of α and β, and TFP_{it} is solved.

Drawing on the L-P model proposed by Potterie-Lichtenberg (2001), introducing the cross border between home country direct foreign investment and domestic R & D capital, we set up a OFDI model oriented to "one belt and one road", for example: (3):

$$l\mathrm{nTFP_{it}} = C + \beta_1 \mathrm{ln}SDD_{\mathrm{it}} + \beta_2 \ln OFDI_{\mathrm{it}} + \beta_3 (\mathrm{lnOFDI_{it}} * \mathrm{lnSDD_{it}}) + \varepsilon_{it} \tag{3}$$

TFP_{it} represents the total factor productivity of I Province in t period, which is the standard to measure technological progress,SDD_{it} is the R&D capital stock of province i in t period,$OFDI_{it}$ is the stock of i provincial outward foreign direct investment in t period,$OFDI_{it}$*SDD_{it} as a cross-item to represent the impact of FDI on R&D capital stock,ε_{it} is the error term.

In order to further investigate the influence factors of OFDI on TFP in different provinces under the background of "one belt and one road", we introduce threshold variables in model (3) to explore its threshold effect, and get the formula (4):

$$\ln TFP_{it} = C + \beta_1 \ln SDD_{it} + \beta_2 \ln OFDI_{it} + \alpha_1(\ln SDD_{it} * \ln OFDI_{it}) * I(q_{it} \le \gamma) + \alpha_2(\ln SDD_{it} * \ln OFDI_{it}) * I(q_{it} > \gamma) + \varepsilon_{it} \quad (4)$$

In formula (4), q_{it} represents threshold variables(Including human capital level, economic development level, technological innovation level, openness level, infrastructure level),ϒ stands for the unknown threshold,α_1 and α_2 represent the coefficients of absorption capacity at q_{it} <ϒ and q_{it} >ϒ respectively.

3.3 Data Structure and Sources

This paper takes 17 provincial administrative units directly related to the construction of "one belt and one road" as the research object[1]. In terms of host country selection, firstly, according to our country's OFDI stock selection, sorting by quantity, and considering the availability, integrity and reliability of data, 27 countries selected from 64 countries related to "one belt and one road" were selected as research samples[2]. All the research samples are based on empirical data from 2006 to 2016.

(1) Gross Domestic Product (Y), Labor Input (L) and Fixed Capital Stock (K)

Gross Domestic Product Y_{it}: Based on the year of 2006, the actual gross domestic product of each province can be calculated by using the gross domestic product index. The nominal GDP and GDP index of each province comes from China Statistical Yearbook.

Labor Input L_{it}: Indicators of labor input in each province are expressed by the number of employed people at the end of each year. The data are from China Labor Statistics Yearbook.

Fixed Capital Stock K_{it}: Calculate the fixed capital stock of each province by using the perpetual inventory method, e.g. (5):

$$K_{it} = (I_{it} / P_{it}) + K_{it-1}(1-\delta) \quad (5)$$

Among them,I_{it} represents the total amount of fixed capital formation in i province in t period, P_{it} represents the price index of fixed assets investment in i Province in t period, and the depreciation rate of fixed assets is 9.6%. The base period fixed capital stock comes from (Zhang Jun's supplement to the capital stock of various places). The base period is converted to 2006 by the deflation index.

(2) Provincial R&D capital stock (SDD)

The stock of R&D capital in each province is calculated by the method of perpetual inventory, e.g. (6):

$$SD_t = (1-\delta)S_{t-1}^d + RD_t \quad (6)$$

Among them, RD_t is R&D expenditure in t year, converted into R&D expenditure in provinces with unchanged price in 2006 according to consumer price index, and δ is 7.14%. The calculation formula of R&D capital stock in base year is as follows:

$$S_{2006}^d = RD_{2006} / (g+\delta) \quad (7)$$

Among them, G is the average growth rate of R&D expenditure in the provinces from 2006 to 2016, with δ of 7.14%. R&D expenditure comes from China's Statistical Yearbook of Science and Technology, and consumer price index comes from China's Statistical Yearbook

(3) Outward Foreign Direct Investment Stocks of Provinces (OFDI)

At present, the statistics of OFDI data in China can be divided into stock and flow. Because the short-term fluctuation of flow data is large, this paper chooses stock data. According to the statistical bulletin of China's foreign direct investment, we can get the direct investment stock (USD) of our country over the past 2006-2016 years, and convert the R & D expenditure into the constant price in 2006 through the consumer price index. Secondly, the stock data of foreign direct investment expressed in US dollar are converted and added with the average exchange rate of each year to get the total stock data of foreign direct investment expressed in RMB. According to the external investment situation of each province in the "China foreign direct investment statistical bulletin", the proportion of foreign investment of each province is calculated, and the total amount of direct investment stock of each province to the "one belt and one road" state each year is obtained.

(4) Threshold variables

Due to geographical location, economic foundation and policy inclination, there are great differences in China's economic development level, human capital level, technological innovation level and opening up level, which leads to the promotion of China's foreign direct investment on total factor productivity at different levels. Some regions that have crossed the high level threshold can effectively utilize foreign direct investment to promote technological progress, while some regions that have not crossed the threshold may result in crowding-out effect of domestic R&D investment, resulting in the decline of domestic enterprises' R&D capacity, which may affect or even hinder domestic technological progress. According to the existing research, the threshold variables of this paper are economic development level (PGDP), open degree (OPEN), human capital level (H), technological innovation level (T), infrastructure level (IFST) and so on. Among them, the index of economic development level chooses GDP per capita, GDP of each province and population at the end of the year come from China Statistical Yearbook, the index of opening degree chooses the total import and export trade of each province and the proportion of GDP of each province in that year. The total import and export trade comes from China Statistical Yearbook, and the level of human capital is expressed by the average education level. The formula is: 6a+9b+12c+16d, Among them, a, b, c and d represent the proportion of people with primary, junior, senior and higher education in employment respectively. The index of technological innovation level chooses the proportion of patents authorized by each province in the national patent authorization. The data of patents authorized comes from the "China Science and Technology Statistics Yearbook". The index of financial development level chooses the proportion of the end-of-year loan balance of financial institutions in each province's GDP. The end-of-year loan balance of financial institutions comes from the "China Financial Statistics Yearbook". The index of infrastructure level chooses each province. The logarithm of cargo turnover comes from China Statistical Yearbook.

4. Empirical Analysis

4.1 Solution of Total Factor Productivity

Because the construction of "one belt and one road" was formally put forward in 2013, the relevant research should be discussed in a piece wise manner. Correspondingly, the model is divided into three categories. The interval of model one is 2006-2011 years. The interval of model two is 2012-2016 years, and the interval of model three is 2006-2016 years. Model one and two can more directly reflect the changes in the total factor productivity of China's OFDI along the line of "one belt and one road" initiative, and the third part is to observe the impact of OFDI on TFP as a continuous period.

To ensure the validity of the estimation results, this paper uses ADF method to test the unit root of panel data. The test results showed that at 1% significant level,Ln (Y_{it}/L_{it}) and LN (K_{it}/L_{it}) are stationary time series;Using EVIEWS software, the least square method (OLS) is used to estimate formula (2) and the values of α and β are obtained. The results are shown in Table 1.

Table 1 Least Square Method (OLS) Estimation Results

Variable	Model one			Model two			Model three		
	Coefficient	T test value	P value	Coefficient	T test value	P value	Coefficient	T test value	P value
LnA0	0.402249	12.69626	0.0000	0.914067	14.354408	0.0000	0.273035	6.842992	0.0000
β	0.404405	24.40355	0.0000	0.370724	9.40355	0.0000	0.483865	23.62936	0.0000
ϒ	0.033684	12.7456	0.0000	0.02103	3.968329	0.0004	0.013283	4.505617	0.0000
R^2	0.974405			0.937340			0.896645		
α	0.595595			0.629276			0.483865		
β	0.40405			0.370724			0.516135		

The TFP values of different provinces in different periods can be obtained by introducing α and β in Table 1 into $TFP_{it} = Y_{it} / L_{it}^{\alpha} K_{it}^{\beta}$ respectively.

4.2 Empirical Analysis

4.2.1 Feasibility Test

In order to avoid pseudo-regression, LLC, IPS, ADF-Fisher and P P-Fisher unit root tests were carried out on Formula (3). The test results are as follows: Table 2:

Table 2 LLC, IPS, ADF-Fisher, PP-Fisher Unit Root Test

Model	Variable	LLC	IPS	ADF-Fisher	PP-Fisher	Conclusion
Model one	LnTFPit	-2.7779***	-1.44603**	57.2537**	50.7965**	Stable
	LnSDDit	-8.24072***	-2.43909***	47.3886*	75.1015***	Stable
	LnOFDIit	-10.9137***	-8.72909***	45.029*	87.9245***	Stable
	LnSDDit*LnOFDIit	-10.411***	-2.43521***	52.3884**	56.4265***	Stable
Model two	LnTFPit	-5.00045***	-1.86442**	45.3463*	70.0169***	Stable
	LnSDDit	-33.3557***	-102.998***	263.526***	269.003***	Stable
	LnOFDIit	-12.9727***	-2.84384***	46.8010*	64.273+	Stable
	LnSDDit*LnOFDIit	-9.35364***	-2.3708***	45.2188*	67.424***	Stable
Model three	LnTFPit	-5.79413***	-2.94173***	64.3517***	87.8698***	Stable
	LnSDDit	-7.50327***	-4.59819***	86.4331***	96.9721***	Stable
	LnOFDIit	-17.0373***	-9.063***	141.606***	209.253***	Stable
	LnSDDit*LnOFDIit	-16.1029***	-8.49857***	136.737***	199.201***	Stable

Note: ***, ** and * represent significant levels at 1%, 5% and 10% respectively.

According to Table 2 data, all data strongly reject the original assumption that the panel contains unit roots and consider the panel as a smooth process. The pedroni panel cointegration test was carried out on Formula (4). The test results are shown in Table 3.

Table 3 Panel cointegration test

Model	Panel-ADF-Statistic	Group ADF-Statistic	Conclusion
Model one	-6.835535***	-9.591087***	Existence of cointegration relationship
Model two	-7.608175***	-17.81496***	Existence of cointegration relationship
Model three	-6.260575***	-6.317953***	Existence of cointegration relationship

Note: ***, ** and * represent significant levels at 1%, 5% and 10% respectively.

According to the data in Table 3, we use Eviews software to calculate the co-integration relationship between model variables, which shows that formula (3) is correct.

4.2.2 Regression analysis of the model

The method proposed by Davidson-McKinnon (1993) was used to test the endogenesis of model 1, model 2 and model 3. The hypothesis of the test was that $lnSDD_{it}*lnOFDI_{it}$ was not related to its interference term (there was no endogenous deviation in the model),The Davidson-McKinnon test quantities calculated by STATA12.0 were 1.82274, 1.913595 and 0.4461916, respectively. Corresponding P values were 0.1835, 0.1731 and 0.5053 (see table 4),The results show that the original hypothesis of Davidson-McKinnon test can not be rejected in model 1, 2 and 3, so the least square estimation (OLS) method is used to test the results, as shown in Table 4:

Table 4: Least Square Estimation (OLS) Results

Variable	Model one	Model two	Model three
C	-1.184534***	-0.048454	-0.278612***
LnSDD	0.020245	0.090154***	0.058925***
LnOFDI	-0.030378*	-0.166904***	-0.009456
LnSDD*lnOFDI	0.005932**	0.027079***	0.009401***
ADJ-R2	0.814639	0.828586	0.873291
F	148.9609	136.347	420.4179
Davidson McKinnon Test（P）	1.82274 （0.1835）	1.913595 （0.1731）	0.4461916 （0.5053）

Note: ***, ** and * represent significant levels at 1%, 5% and 10% respectively.

The results in Table 4 show that:

the coefficient of external investment stock is always negative in the three models, which indicates that there is no positive reverse spillover effect on the direct investment of the countries along the belt and road, which proves that the hypothesis 1 is reasonable. From model one and model two, we can see that the cross item coefficient of outward direct investment stock and domestic R & D capital stock has increased significantly before and after the strategy of "one belt and one road".

In the Segmented panel data of model one or two, China's R & D capital stock has changed from non significant to significant, indicating that the implementation of the "one belt and one way" strategy has expanded the economic relationship between China and the countries along the border. Technological progress is not only confined to its own R & D investment, but also because of output capacity, market expansion and utilization of international resources, which has brought about production costs. The reduction of R&D cost, combined with conclusion (1), can prove hypothesis 2. In addition, the coefficients of China's R & D capital stock in both three models are positive, indicating that China's technological progress is still dominated by its R & D investment for developing countries along the belt and road.

The regression results show that along with the increasing OFDI stock in China along the "one belt and one road", the scale of transnational production is expanding continuously, and with the increase of R & D investment, the R & D cost can be apportioned to a larger scale product economic base through the function of feedback mechanism, thus enhancing the driving capability of technological innovation in China, and ultimately making the domestic all elements. Productivity increases.

4.2.3 Threshold Regression of the Impact of OFDI on Total Factor Productivity

The above regression results prove that the OFDI of the countries along the "one belt and one road" has played a positive role in promoting TFP in China.It is generally believed that domestic factors affect the promotion of total productivity by OFDI in China. This paper will construct a threshold regression model through five influencing indicators: human capital, technological innovation ability, economic development level, openness and infrastructure level, and analyze the factors affecting total factor productivity in depth, in order to calculate the threshold index that can promote the enhancement of total factor productivity.

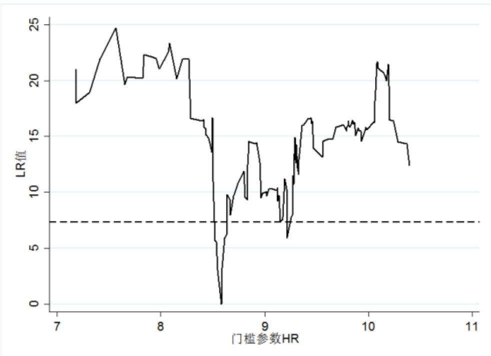
Using STATA14.0, the threshold value of model (4) is determined by grid search method (only considering single threshold), and then the threshold model is established for regression analysis. The results are as follows:

Table 5 Threshold Model Regression Results

Variable	human capital H	Technological Innovation Ability T	Economic Development Level PGDP	Openness to the outside world OPEN	Infrastructure level IFST
Threshold value	8.5838	0.0243	29409.1543	0.1608	8.3213
Single threshold F value	34.14***	18.92***	76.89***	36.77***	21.98***
R2	0.8739	0.8182	0.8062	0.8221	0.847
SSR	4.0522	4.4143	3.302	3.999	4.3371
1%	28.2774	13.7347	50.8457	35.3457	19.3996
5%	24.6018	12.2063	40.0779	32.2259	16.0936
10%	22.8241	11.3428	36.625	30.1726	13.8569
LnSDDit	0.0968067***	0.0831338***	0.0705034***	0.1141761***	0.0788166***
LnOFDIit	0.0577258***	0.0512716***	0.0564551***	0.0274066*	0.548639***
(LnOFDIit*LnSDDit)*I(q≦r)	-0.0072236***	-0.0017893	-0.0264496**	-0.0036568***	-0.0013033
(LnOFDIit*LnSDDit)*I(q>r)	0.0091781***	0.0034768***	0.0909306***	0.0019786*	0.0043333***
C	-0.5202717***	0.0034768**	-0.431095***	-0.5063315***	-0.4228087***

Note: ***, ** and * represent significant levels at 1%, 5% and 10% respectively.

The threshold values of H, T, PGDP, OPEN and IFST variables are calculated by using the sum of squares of minimum residuals, which is the lowest point in LR graph. The threshold values of H, T, PGDP, OPEN and IFST variables are shown in LR Figure 2 to LR figure 6.



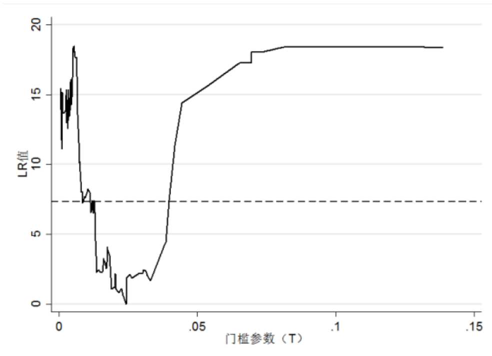
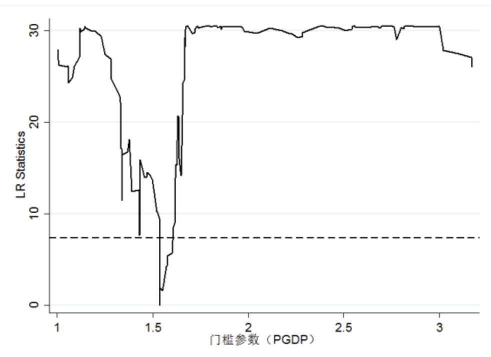


Figure 2 Human Resource Level Threshold LR Figure 3 Threshold LR of Technological Innovation Level



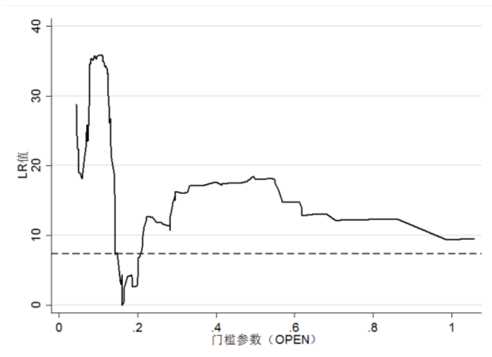


Figure 4. Threshold LR Diagram of Economic Development Level Fig. 5 Opening threshold LR chart

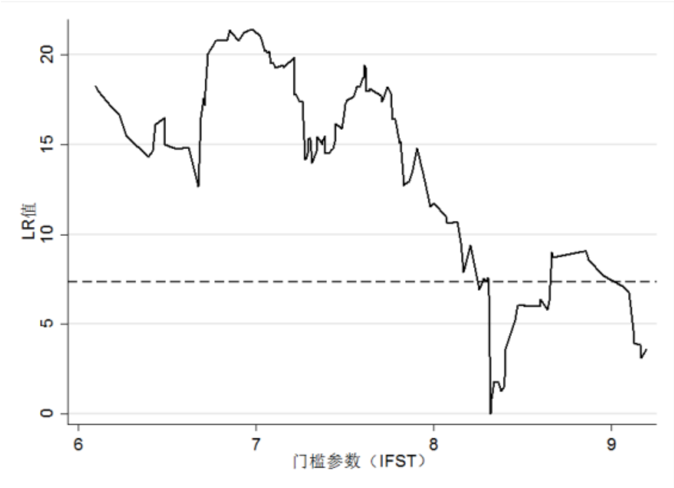


Figure 6 Infrastructure level threshold LR diagram

Human capital level is divided into high and low stages by the threshold value of 8.5838. When crossing the threshold value, the factor of promoting TFP by allocating domestic R&D capital is 0.09781. When the level of human capital rises by 1%, the TFP of each province will increase by 0.09%. On the other hand, the high threshold coefficient of 0.09781 is greater than the low threshold coefficient of - 0.0072236, which also shows that human capital with higher level can effectively share domestic R&D costs through OFDI, and then translate into technological progress to promote TFP. Within the observation interval, all provinces crossed the threshold after 2011.

The technological innovation capability is divided into two stages with the threshold value of 0.0243. When the technological innovation capability is higher than the threshold value, the coefficient of interaction between foreign investment and R&D capital stock is 0.0034768. When the technological innovation capability rises by 1%, the total factor productivity of each province increases by 0.03%.High-tech innovation areas are mainly concentrated in eastern coastal provinces and cities, Since 2006, Shanghai, Guangdong and Zhejiang have crossed the threshold. By 2016, the provinces crossing the threshold are Shaanxi, Heilongjiang, Liaoning, Shanghai, Fujian, Guangdong, Zhejiang and Chongqing. The reason why the provinces cross the threshold is that the eastern coastal cities have relatively rich technological innovation resources, connecting the "maritime Silk Road" in twenty-first Century, and further widening the original innovation environment. Chongqing is affected by national policies as an important link in the central part of the "one belt and one road". Heilongjiang and Liaoning in the Northeast are also opening up to the outside world because of the "one belt and one way" strategy, which has promoted their own R & D capability.

The threshold value of economic development is 29409.1543. When the level of economic development is higher than the threshold value, the coefficient of interaction between OFDI and capital stock is 0.0909306, which indicates that when the level of economic development rises by 1%, the total factor productivity of each province will increase by 0.09%. After 2013, the economic development level of each province has been improved to varying degrees. Especially in the five northwest provinces and the three eastern provinces, the economic growth rate is relatively large, narrowing the economic gap with the eastern coastal areas. By 2016, only the economic development level of Gansu, Guangxi and Yunnan failed to cross the threshold.

The degree of opening to the outside world is divided into two stages according to the threshold value of 0.1608. The regional significance and coefficient of high threshold value are greater than that of low threshold value. Fujian, Shanghai, Guangdong and Zhejiang all crossed the threshold value in the observation sample. Hainan and Chongqing crossed the threshold value after 2010 and 2012 respectively. It proves that although there are differences in the degree of opening between Northwest and Northeast China and the eastern coastal areas, there are differences in the degree of opening to the outside world. Driven by policy and self-reform, the degree of openness is increasing.

Infrastructure level is divided into high and low stages by threshold value 8.3213. The model coefficient of high threshold region is 0.0043333, which is very significant. The model coefficient of low threshold region is -0.0013033, and there is a significant difference between the left and right threshold. The coefficient changes from negative to positive, which shows that infrastructure has a positive impact on TFP. During the sample observation period, most of the provinces crossed the threshold, and the provinces that did not crossed the threshold mainly concentrated in the western region, such as Xinjiang, Ningxia, Qinghai, Heilongjiang, Yunnan and so on.

In addition, from the LR map of each threshold value, LR value below 7.35 means that there is a threshold, and there are significant thresholds for all five indicators. According to the data in the table, the high and low threshold coefficients of each index are positive, and there are significant differences between the high and low threshold coefficients, which proves that there is a significant threshold effect of five indicators on total factor productivity promotion, that is, to verify hypothesis 3 is valid.

5. Main conclusions and suggestions

Direct investment facing the "one belt and one way" country has already produced significant positive effects as China's major strategic deployment. Based on the provincial panel data of 17 provinces in 2006-2016 years, this paper studies the impact of OFDI on TFP in China's "one belt and one road" related provinces, and explores the threshold effect of 5 indicators, such as technological innovation capability, human capital, economic development level, opening up level and infrastructure level, on TFP. The study found that after the implementation of the "one belt and one way" strategy, the cross country coefficient of OFDI stock and R & D capital stock and the coefficient of R & D capital stock in the countries along the route have changed positively, which confirms that the OFDI of the countries along the belt and road has basically shared the R & D cost and promoted the total factor productivity. There is no significant reverse technology spillover in state investment. The empirical analysis of panel threshold model shows that domestic factors such as human capital, technological innovation capability, economic development level, openness and infrastructure level have significant impact on the enhancement effect of OFDI on total factor productivity.

Based on the above research, this paper puts forward the following policy recommendations: (1) OFDI is an important channel to promote total factor productivity. China should continue to respond positively to the "one belt and one way" initiative, actively develop the economic cooperation partnership with the countries along the border, optimize the OFDI selection of all countries along the belt, expand the market scale, and increase the output and supplement of resources. Export positive technology spillovers, share domestic R&D costs internally, and truly achieve two-way technological progress; (2) the "one belt and one road" initiative will play a supporting role in domestic technological progress. Acquiring capital stock from multiple channels will greatly enhance total factor productivity. Therefore, we should optimize the investment mode of R & D capital stock, promote the development of OFDI in China scientifically and reasonably, and optimize location choice continuously.(3) to strengthen the construction of the domestic influential factor market, deepen the degree of opening to the outside world through the implementation of the "one belt and one way" strategy, so as to cultivate the ability of the whole people to innovate, raise the level of national education, enhance the domestic economic level, and improve the infrastructure construction, help to absorb advanced knowledge and technology from abroad, and then promote the formation and development of China's independent innovation capability.

Notes

According to<<Vision and Action of Promoting the Construction of the Silk Road Economic Belt and the Marine Silk Road in the 21st Century>> jointly published by the National Development and Reform Commission, the Ministry of Foreign Affairs and the Ministry of Commerce in 28 March 2015.

The 27 countries covered in this study are Israel, Poland, Lithuania, Latvia, Czech Republic, Slovakia, Hungary, Slovenia, Bulgaria, Croatia, Russia, Ukraine, Montenegro, Serbia, Romania, Mongolia, Singapore, Malaysia, Indonesia, Thailand, Philippines, Iran, Turkey and Saudi Arabia. Berlin, India, Pakistan, Kazakhstan.