Research on OFDI Reverse Spillover Effect of "The Belt and Road" Countries

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Keywords: Outward Foreign Direct Investment (OFDI), reverse spillover, "the Belt and Road"

ABSTRACT. This paper selects the panel data of China's direct investment in 24 countries and regions along "the Belt and Road" from 2007 to 2017, and uses the method of least squares regression to study the reverse spillover of China's direct investment. To determine the size of the reverse overflow and the factors that affect the reverse overflow: First, this paper draws on the LP model to determine the impact of reverse spillovers on China's total factor productivity through direct investment in countries along "the Belt and Road", and thus getting the significance of reverse spillovers. Second, adding human capital, R&D intensity, infrastructure level, economic openness and the interaction term of reverse spillover level to determine the factors that influence the size of the reverse spillover. This study finds that: (1) Direct investment in countries along "the Belt and Road" can significantly increase China's total factor productivity, that is, it can generate reverse technology spillovers. (2) Human capital level, R&D intensity, infrastructure level and economic openness can promote China's technical progress, but the impact of R&D intensity is relatively small.

1. INTRODUCTION

Promoting domestic technological progress and industrial upgrading is one of the important expectations for the Chinese government to implement the strategy of "going out". It is of great significance to obtain reverse technology spillovers through OFDI (Outward Foreign Direct Investment) to make up for the objective limitations in the process of improving China's technology level. IFDI can bring technology spillover and lead to technological progress of the host country. OFDI, especially in developed countries, can bring technological advantages and competitive strength to the home country. These two views have been generally recognized by the academic community. Therefore, it is important to study whether direct investment in "the Belt and Road" countries will have a positive impact on China's reverse technological spillover effect and whether will affect the absorption of reverse spillovers.

1.1. Literature Review

Whether OFDI has the reverse spillover effect has not been determined. Most literatures think that OFDI has a significant reverse spillover effect. Grossman and Helpman [1] first analyzed technology spillover theoretically. Since the 21st century, research on developing countries has become increasingly rich. Whether from the national level [2] or the industrial level [3], the results show that OFDI in developing countries can also significantly affect the TFP and promote technological progress in the home countries. Yi Changjun et al. [4] took China as an example, studied emerging economies, and established a nonlinear threshold regression model using provincial panel data of China. It is concluded that OFDI can promote the technological progress of emerging economies, and for China, there is a positive and significant reverse spillover effect in the relatively developed eastern region. Further, China's reverse spillover from the developing countries along "the Belt and Road" has a positive impact on total factor productivity [5]. In addition, there are also some studies shown that OFDI has no significant reverse spillover effect [6].

1.2. Contribution

From the current research, first, there are few literatures study the OFDI reverse spillover effect in "the Belt and Road", and no comprehensive theoretical framework has been formed. Second, the vast majority of literature ignores the ways in which China's reverse technology can be achieved and thus, there are no effective recommendations. Based on the analysis of the countries along "the Belt and Road" and the transmission mechanism of reverse spillovers, we obtained the objective and comprehensive conclusions. By comparing the impact of various factors on TFP, we put forward the corresponding countermeasures and suggestions to make up for the defects.

2. Theoretical Mechanism

For developed countries, OFDI mainly through three channels to realizes reverse technology spillover: regional agglomeration, industry imitation and personnel flow. Most of the investment locations of multinational companies in developed countries will be in the high-tech industry cluster area, which can not only share the cost of cooperation, but also promote the accelerated development of the whole industry. Therefore, the larger the industrial agglomeration, the more obvious the reverse spillover effect will be. Industry imitation spillover refers to the spillover of technology from multinational companies to the whole industry, mainly through two channels: demonstration effect and competition effect. Demonstration effect refers to the huge demonstration effect of enterprises obtaining advanced technology through OFDI on other enterprises in the same industry, leading to the imitation and learning of the company's advanced technology [7]; the competitive effect is that the competition in the industry will eliminate enterprises without comparative advantage, promote other enterprises to learn advanced technology and maintain competitive advantage. The channel of personnel flow refers to that multinational parent companies and subsidiaries actively promote the exchange and communication of relevant technical information resources through the regular flow of researchers between them [7].

For developing countries, OFDI mainly improves the technology of home country through R&D cost sharing, R&D achievement feedback and marginal industry transfer. By sharing R&D costs in the host country, more resources are set aside for the R&D of core projects to enhance the innovation and technology capacity of the home country [8].By investing in the host country, MNC subsidiaries actively study local consumer preferences, utilize local resource endowments, develop localized products, and gain greater competitive advantage and higher profits in the host country .Some labor-intensive marginal industries in the home country that do not have competitive advantages recover their comparative advantages by using the cheap labor and energy resources of developing countries through OFDI to obtain more benefits. Some of these profits are returned to the parent company for R&D and innovation [9], promotion of industrial upgrading, release of previously occupied labor force and other production factors, and inject vitality into the development of new industries in the home country.

Therefore, through the OFDI along "the Belt and Road", China can promote technological progress and achieve technological spillovers.

3. Variable Selection and Model Setting

3.1. Variable Selection

Total factor productivity (TFP): According to the C-D production function, $Y_t = A_t K_t^{\alpha} L_t^{\beta}$, we get the expression of TFP: $\ln TFP_t = \ln Y_t - \alpha \ln K_t - \beta \ln L_t + \delta_t$.

By regression, α =0.46, β =0.31. Then we can get the time series data, TFP. Among this, L expressed by the total number of employees at the end of each year. Fixed capital stock K is determined according to the perpetual inventory method: $K_t = I_t / P_t + (1-\delta)K_{t-1}$, δ =5%, $K_0 = I_0 /(g+\delta)$, g is the average growth rate of China's fixed asset investment in the sample range, which is 17.9%.

Foreign R&D capital stock obtained from imports: estimated by the calculation method of L-P: $S_t^{imp} = \sum_{i=1}^{n} \frac{IMP_{it}}{Y_{it}} S_{it}^d$, IMP_{it} means import volume of China from country i in period t, Y_{it} means GDP of country i in phase t, S_{it}^d means domestic R&D capital stock of country i in phase t.

Foreign R&D capital stock obtained by OFDI: estimated by the calculation method of L-P: $S_t^{ofdi} = \sum_{i=1}^{n} \frac{OFDI_{it}}{Y_{it}} S_{it}^d$, $OFDI_{it}$ means China's stock of OFDI in country i during period t.

Reverse spillover of attracting FDI of countries along "the Belt and Road": $S_t^{fdi} = \sum_{i=1}^{n} (FDI_{it} / Y_{it}) \times S_{it}^d$, FDI_{it} means the amount of FDI absorbed by China in country i during period t.

Based on the current literature, it can be found that there are at least four factors: human capital level promotes China's absorption of reverse spillover effect through three aspects; R&D intensity reflects a country's attention and efforts in scientific and technological innovation, and also promotes the absorption of reverse spillover effect [5]; perfect infrastructure level and high economic openness can both effect the absorption of the reverse spillover effect. Therefore, this paper selects four influencing factors: China's human capital level, R&D intensity, infrastructure level and economic openness for analysis. Among them, human capital level is calculated by Barro et al. [10], infrastructure level is determined by the ratio of China's railway and road operation mileage to geographical area, and economic openness is expressed by trade openness.

Relevant data are from China Statistical Yearbook, China Science and Technology Statistical Yearbook, China Labor Statistical Yearbook, China Foreign Investment Statistical Bulletin, World Bank Database and OECD database.

Taking the time and data availability into account, this paper selects 2007-2017, 24 countries and regions along "the Belt and Road".

3.2. Model Setting

Coe and Helpman [11] established the C-H model, which first proved that there was technology spillover in import trade and it could promote the technological progress of importing countries (expressed in terms of TFP). Lichtenberg and Pottelsberghe [12] further modified the C-H model to obtain the L-P model, which is simplified as $F = f(S^d, S^m, S^{fdi}, S^{ofdi})$, S^m, S^{fdi}, S^{ofdi} are technology spillovers obtained through import, technology spillovers obtained by foreign direct investment and reverse spillovers obtained by foreign direct investment respectively. Build the basic model according to the above ideas, which is shown as formula (1).

$$\ln TFP_t = \alpha + \beta_1 \ln S_t^{imp} + \theta_0 \ln S_t^{ofdi} + \beta_3 \ln S_t^{fdi} + \varepsilon_t \quad (1)$$

t is the period, TFP represents China's total factor productivity, S^{imp}, S^{ofdi} and S^{fdi} respectively indicate China's technological spillover through the import of the countries along "the Belt and Road", the reverse technology spillover from OFDI along "the Belt and Road" and the technology spillover obtained through attracting direct investment from the countries along "the Belt and Road". α is a constant term, ε is the error term.

On the basis of model (1), the effect of each influencing factor on OFDI reverse spillover effect is verified by adding interaction terms, as shown in equation (2).

$$\ln TFP_t = \alpha + \beta_1 \ln S_t^{imp} + \theta_i X_i \ln S_t^{ofdi} + \beta_3 \ln S_t^{fdi} + \varepsilon_t \quad (2)$$

i=1,2,3,4, X_1, X_2, X_3, X_4 represent human capital level, R&D intensity, infrastructure level and economic openness respectively.

4. Empirical Analysis

This paper selects 24 countries and regions, 11 years of sample interval data and uses the least square method for regression to make empirical analysis. The regression results are shown in Table 1.

Table 1 The existence of reverse spillover effect and the influence of various factors.

Variables	Model（1）	Model（2）	Model（3）	Model（4）	Model（5）
$\ln S_t^{imp}$	0.0885* (1.1224)	0.0299 (0.3518)	0.0735* (1.1987)	0.0391 (0.4859)	0.7382*** (12.8833)
$\ln S_t^{ofdi}$	0.3202*** (8.1259)	—	—	—	—
$\ln S_t^{fdi}$	0.0371 (0.4111)	0.0306 (0.3674)	0.0238 (0.3468)	0.0665 (0.9264)	-0.1151 (-0.8578)
$X_1 \ln S_t^{ofdi}$	—	0.3823*** (8.7044)	—	—	—
$X_2 \ln S_t^{ofdi}$	—	—	0.1118*** (10.6858)	—	—
$X_3 \ln S_t^{ofdi}$	—	—	—	0.5949*** (10.5778)	—
$X_4 \ln S_t^{ofdi}$	—	—	—	—	-0.7261** (-4.6291)
Constant	0.6346** (1.8235)	1.9209*** (4.8369)	1.6858*** (5.3495)	1.5997*** (5.0107)	-0.0203 (-0.0375)
Adjusted R^2	0.9896	0.9910	0.9938	0.9937	0.9720
F	158.0969	183.5388	266.4157	261.2484	52.7789
DW	1.3712	1.5403	1.6638	1.5496	1.7730

Note: *, * *, * * * are significance at 90%, 95% and 99% levels.

It can be known from the model (1) that the total factor productivity of China can be improved by importing and investing directly along “the Belt and Road". Among them, the international R&D capital stock obtained by outward direct investment has the largest effect, which proves that China has a reverse spillover effect on OFDI along “the Belt and Road". The stock of international R&D capital obtained by attracting FDI has little effect on TFP in China, and the result is not significant.

From the model (2), we can see that China's human capital plays a significant role in the absorption of reverse spillover effect, and it is possible to absorb the reverse spillover obtained by OFDI in developed countries through China's human capital. Model (3) shows that when there is R&D inputting, the improvement effect of China's technological progress is relatively small. The reasons may be that although there are many R&D investments, its’ efficiency is low and the technological progress cannot be significantly promoted due to the backward management system and the incorrect allocation of funds. From the model (4), it can be seen that the improvement of infrastructure construction level can promote the absorption of reverse spillover effect from OFDI in countries along “the Belt and Road”, thus greatly promoting technological progress. The reasons may be that the complete infrastructure construction can promote foreign exchange and personnel flow, greatly improve the speed of technology transfer, and provide a good material basis for absorbing the reverse spillover effect. This also explains why our country should attach importance to the construction of infrastructure. It can be seen from the model (5) that when there is economic openness, the stock of international R&D capital obtained by attracting foreign direct investment and foreign direct investment have a negative effect on China's total factor productivity, which is inconsistent with the expectation. It may be due to incomplete data, or it may be due to a period of time from the promulgation to implementation of economic opening policies, but this paper does not consider the lag term, so we get the result which is not consistent with the expectation.

5. Conclusion

This paper selects 24 countries and regions along “the Belt and Road" during 2007-2017 to explore the existence and possible influencing factors of OFDI reverse spillover effect in China. The research shows that China has a significant reverse spillover effect on the OFDI along “the Belt and Road. The reverse spillover obtained by OFDI in developed countries is likely to be absorbed by

human capital in China; the improvement of R&D intensity can have a positive effect on China's technological progress, but this effect is not significant; the improvement of infrastructure construction can significantly promote the absorption of the reverse spillover effect, thus greatly promoting technological progress; when there is economic openness, it can directly promote the technological progress of countries along “the Belt and Road”. The stock of international R&D capital obtained by investment has a negative effect on China's technological progress, which may be caused by the lack of data or the lack of consideration of lagging items. Therefore, we should promote the development of OFDI in China along the lines, train high-quality talents and make rational allocation, strengthen the construction of transportation infrastructure and match the investment structure and location in order to better play the reverse spillover effect of OFDI along “the Belt and Road".

References

[1] Gene M. Grossman, Elhanan Helpman. Innovation and Growth in the Global Economy. The MIT Press, (1991).237- 257.

[2] Dierk Herzer. The long-run relationship between outward foreign direct investment and total factor productivity: Evidence for developing countries. The Journal of Development Studies. 47(5) (2011) 767-785.

[3] Pradhan J P,Singh N. Outward FDI and knowledge flows: A study of the Indian automotive sector. International Journal of Institutions and Economies. 1(1) (2009) 156-187.

[4] C. Yi, S. Li, J. Zhang. Institutional environment, absorptive capacity and OFDI reverse technology spillover effect in emerging economies - threshold test based on China's inter provincial panel data. Financial research. (11) (2015) 4-19. DOI: 10.16538/j.cnki.jfe.2015.11.004

[5] Z. Wu, Y. Fan, Y. Chen, Y. Huang. Reverse knowledge spillover effect of foreign direct investment in emerging economies: An Empirical Test of China's OFDI in the "one belt and one way" country. Chinese management science, (11) (2015) 690-695.

[6] H. Ye, Q. Yang. Empirical Study on the spillover effect of reverse technology of Chinese enterprises under the global value chain. Research and development management, (4) (2013) 61-68. DOI: 10.13581/j.cnki.rdm.2013.04.007

[7] D. Yin, J. Zhang. Research on reverse technology spillover effect of China's Foreign Direct Investment: An Empirical Analysis from the perspective of absorptive capacity. International trade issues, (1) (2016) 109-120. DOI: 10.13510/j.cnki.jit.2016.01.010

[8] W. Zhao, Y. He, G. Gu. Outward FDI and China's technological progress: mechanism analysis and tentative demonstration. Management world, (7) (2006) 53-60.DOI: 10.19744/j.cnki.11-1235/f.2006.07.007

[9] H. Chen, W. Wu. China's OFDI country differences and home country technological progress. Scientific research, 34(1) (2016) 49-56. DOI: 10.16192/j.cnki.1003-2053.2016.01.007

[10] Barro R J, Lee J. W International Comparisons of Educational Attainment. Journal of Monetary Economics. (1993). DOI: 10.1016/0304-3932(93)90023-9

[11] David T. Coe, Elhanan Helpman. International R&D spillovers. European Economic Review, 39(5) (1995).

[12] Frank R Lichtenberg, Bruno van Pottelsberghe de la Potterie. International R&D spillovers: A comment. European Economic Review,42(8) (1998). DOI: 10.1016/S0014-2921(97)00089-5