*Advances in Economics, Business and Management Research, volume 110*
**5th International Conference on Economics, Management, Law and Education (EMLE 2019)**

# The Spatial Effects of Trade and OFDI of China in "the Belt and Road" Regions*

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***Abstract*—The authors use the Moran's I index to test the univariate spatial correlation of trade and investment from china in "the Belt and Road" areas and construct spatial lag panel models for export, import and investment in two weighted matrices: geo-distance and economic disparities to analyze the spatial spillover effects and find that the area that close to china in trade and economic affect have more significant spatial correlation, the spatial spillover effects of Europe of export and import from china are significant, which in Africa and Latin are poor, the southeast Asia regions have positive import spillover effects, yet the export and investment spatial lags are negative of south Asia, and only the export spatial model is significant both in the middle and west Asia.**

***Keywords—"the Belt and Road"; trade and investment; spatial correlation; spatial spillover effect***

## I. INTRODUCTION

With the active promotion of the strategy of "the Belt and Road" in the past five years, trade and economic cooperation between China and the participating countries has been continuously deepened. From the data point of view, the trade and investment of the One Belt and One Way country has been expanding, and its position in China's foreign trade and economic cooperation has steadily increased. The investment from China, with the support of related countries along the line, and the strong demand and supply capacity of developing economies is the key to the agreement. Chaisse (2018) argued that China's large-scale investment in infrastructure in these countries will accelerate industrial development in the region and reshape its bilateral economic and trade pattern. The goal of the One Belt and One Way strategy is to actively promote investment and trade with other countries, to increase transnational industrial cooperation and market opening.

Many scholars have extensively studied the economic and trade cooperation between China and the countries along the belt and road. Baltagi et al. (2007) agreed that trade and investment play a leading role from the view of spillover effect. According to the study of bilateral trade by Li and Xu (2017), the different free trade situations analysis shows that the GDP growth and the total import and export volume of these countries will be increased by varying degrees, the capital demand and investment space will be enormously increase at the same time. Boubacar (2016) constructed the dynamic bilateral trade linkage matrix GVAR model to study the transmission mechanism of economic spillover between China and "the Belt and Road" country. Zhang (2016) used the mean principal component analysis to measure the level of investment facilitation in various countries and the gravitational model of transnational panel data to analyze its impact on China's OFDI in these areas. Sun et al. (2017) found that the proposed agreement significantly promoted the growth of China's export to the countries along the line, and the impact on export growth of heterogeneous products is greater. Du and Zhang (2018) analyzed the investment role of state-owned and non-state-owned enterprises. Zhang (2017) found the growth mechanism of export trade of differentiated products is the key to trade structure and mutual complementarity of "the Belt and Road" country.

Most of the studies analyze the determinants of China's trade and investment in the countries along the line as a whole. However, there is no comparative study of regional differentiation and the coordination of trade and investment in these areas. Because of geographic and economic factors, Baltagi et al. (2008) found the spatial effects of trade and investment in various regions are greatly different. Meanwhile, there is a problem of coupling and synergy between import and export and foreign investment from china. Both of them have exerted a great influence on the promotion of China's economic and trade strategy in all regions along the line. Based on the test of univariate spatial correlation of trade and investment from china in different regions, this paper constructs two spatial lag panel models with different weight matrixes to study the spatial spillover effect and coordination of China's import, export and investment in various regions.

## II. METHODOLOGY

### A. Spatial Maxtrices

Based on the theory of New Economic Geography, the economic variables are not only affected by their own factors, but also by the changes of the adjacent regional variables in the same spatial dimension. This paper chooses Spatial Lag Panel Data Model for empirical study and established

*Fund: This study was supported by the National Social Science Fund (14BJY174) and Sichuan Province Training Project Fund of Academic and Technological Leaders (Y02028023601044).

 

distance and economic difference weight matrix respectively. Based on the first law of geography, the spatial effects of economic variables such as trade and investment in a region are also affected by distance. Therefore, the reciprocal square between the capitals along the line is used as the weight matrix element, and the diagonal element are assigned to 0. The weight matrix of economic disparity reflects the spatial relationship between countries by their economic strength. The economic interaction between countries with similar economic strength is great. A spatial matrix is set up to reflect the economic strength by the per capita GDP of each country, which is the weighted average sum of the per capita disposable income of each country from 2012 to 2016:

$$w_{ij} = \begin{cases} 0, i = j \\ \frac{1}{|y_i - y_j|}, i \neq j \end{cases} \quad (1)$$

### B. Data and Variables Selection

Based on the geographic location and economic relations of each country, we divided them into different regions. This paper collected the data of Trade and investment variables of China from 2012 to 2016 and calculated the spatial correlation of the single variable in each region. We also used panel data of the past five years for the spatial lag model empirical study, which the dependent variables are China's total exports, imports and total investment (OFDI) to these countries in each year.

## III. Research Design and Empirical Analysis

### A. Univariate Spatial Correlation Test

The authors used the Moran's I index to test the spatial correlation of trade and investment from china single variables of each region. At the same time, two different spatial weight matrices, distance and economy, were used for calculating the global Moran 's I value of the total import/export volume and total foreign direct investment from china in 75 countries of 9 areas along the line.

Moran's I:

$$I = \frac{n\sum_{i=1}^{n}\sum_{i\neq j}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{S^2 \sum_{i=1}^{n}\sum_{i\neq j}^{n} w_{ij}} \quad (2)$$

$x_i$ is the observation value of variables and $w_{ij}$ is the element of spatial matrix, $S^2 = \frac{1}{2}\sum_i (x_i - \bar{x})^2$.

TABLE I. Moran's I Test

| | Year | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| | | **Southeast Europe** | | | | |
| **Export** | $W_d$ | 0.074** | 0.091*** | 0.048** | 0.045* | 0.039* |
| | $W_e$ | 0.245* | 0.259** | 0.198* | 0.201** | 0.187* |
| **Import** | $W_d$ | 0.026** | 0.020 | 0.022** | 0.031** | 0.019* |
| | $W_e$ | 0.103 | 0.100 | 0.115** | 0.099 | 0.109** |
| **Invest** | $W_d$ | -0.034 | -0.092 | 0.033** | 0.025* | -0.124 |
| | $W_e$ | 0.039 | -0.139 | 0.056 | 0.092 | -0.195 |
| | | **Middle Europe** | | | | |
| **Export** | $W_d$ | 0.181** | 0.175*** | 0.184* | 0.178* | 0.173** |
| | $W_e$ | -0.195 | -0.219 | -0.291 | -0.349 | -0.321 |
| **Import** | $W_d$ | 0.071 | -0.076 | -0.373 | -0.728* | -0.672** |
| | $W_e$ | 0.061 | 0.103*** | 0.103** | 0.126** | 0.009 |
| **Invest** | $W_d$ | -0.675** | 0.077 | -0.073 | -0.575 | -0.494 |
| | $W_e$ | -0.266 | -0.114 | -0.302 | 0.092 | 0.022 |
| | | **Southeast Asia** | | | | |
| **Export** | $W_d$ | -0.146 | -0.147 | -0.138 | -0.147 | -0.139 |
| | $W_e$ | 0.066 | 0.001 | -0.065 | -0.062 | -0.073 |
| **Import** | $W_d$ | -0.046 | -0.043 | -0.04 | -0.043 | -0.048 |
| | $W_e$ | 0.147 | 0.143 | 0.131 | 0.111 | 0.092 |
| **Invest** | $W_d$ | 0.088 | 0.119 | -0.157** | -0.230** | -0.233* |
| | $W_e$ | 0.052 | -0.086 | -0.037 | 0.069 | 0.064 |
| | | **South Asia** | | | | |
| **Export** | $W_d$ | -0.156 | -0.151 | -0.148 | -0.141 | -0.137 |
| | $W_e$ | -0.064** | -0.057* | -0.051* | -0.037** | -0.032** |
| **Import** | $W_d$ | -0.14 | -0.133 | -0.143 | -0.139 | -0.151 |
| | $W_e$ | -0.086 | -0.093 | -0.081 | -0.085 | -0.073 |
| **Invest** | $W_d$ | -0.095 | 0.068 | -0.012 | -0.028 | -0.089 |
| | $W_e$ | -0.191 | -0.24** | -0.213* | -0.211** | -0.194* |
| | | **Middle Asia** | | | | |
| **Export** | $W_d$ | -0.013 | -0.018 | -0.027 | -0.022 | -0.029** |
| | $W_e$ | 0.001 | 0.01 | -0.018 | -0.041 | -0.134 |
| **Import** | $W_d$ | -0.007* | -0.014** | -0.015* | -0.025* | -0.042** |
| | $W_e$ | 0.408* | 0.395** | 0.460*** | 0.438** | 0.438* |
| **Invest** | $W_d$ | -0.047 | -0.033 | -0.134 | -0.024 | -0.13 |
| | $W_e$ | 0.082* | 0.002 | -0.136 | 0.208** | -0.237 |

[a.] Note: ***、**、* denote the 0.01, 0.05and 0.1 significance levels.

The "Table I" compares the spatial correlation of investment and trade from China between different regions. Different weight matrix indicates that considering distance and economic disparity. With the deepening of the agreement, the spatial correlation of the relevant variables in some regions has also changed. China's trade and investment have positively significant spatial correlated in the dimension of distance and economic difference in the Southeast Europe. This means the spatial correlation in the region increased with the distance between countries and the economic level.

In Central Europe, China's export is positively correlated in the distance dimension, while import trade has negatively spatial correlation in the distance dimension and positive value in the economic disparity dimension. In addition, the investment variables are less significant, which shows that the coordination among China's import, export and investment is comparatively poor. Yet in Eastern Europe the Moran index is negative, only the export variable has certain significance in the last two years, and the annual value are relatively stable and does not change with time. The spatial correlation of total FDI in Asia from China is significant. The spatial distance effect is stronger in East Asia and Southeast Asia than other areas, because the spatial difference is the most prominent. In terms of import and export trade, there is a strong negative spatial correlation and the value decreases year by year.

### *B. Empirical Results*

The authors used spatial econometric models to construct SLPM of export, import and investment in different regions for empirically study. The dependent variables in the formula (3) are China's total export, import and investment to ""the Belt and Road"" countries. W is the distance and economic spatial weight matrix. The core independent variable is the dependent variable space lag term and other control variables are the economic strength (GDP), the level of human resources (Labour) and the tax level (Tax).

$$LnExport_{it} = \rho W * LnX_{it} + \beta LnGDP_{it} + \gamma LnLabour_{it} + \theta LnTax_{it} + \alpha_i + \nu_t + \varepsilon_{it} \quad (3)$$

TABLE II. ESTIMATION RESULTS OF SLPM

| **Southeast Europe** | **Export** | | **Import** | | **Invest** | |
|---|---|---|---|---|---|---|
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | 0.359*** (0.000) | 0.274*** (0.003) | 0.474*** (0.000) | 0.457*** (0.000) | -0.016 (0.937) | 0.083 (0.642) |
| Log-L | 57.051 | 70.179 | 70.611 | 77.371 | 62.792 | 62.722 |
| **Middle Europe** | **Export** | | **Import** | | **Invest** | |
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | 0.528*** (0.000) | -0.236 (0.136) | -0.306 (0.161) | -0.236 (0.238) | 0.173 (0.440) | -0.236 (0.357) |
| Log-L | 42.128 | 37.781 | 38.568 | 35.465 | 35.431 | 33.121 |
| **East Europe** | **Export** | | **Import** | | **Invest** | |
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | -0.236 (0.131) | 0.188*** (0.002) | -0.236** (0.025) | 0.051 (0.318) | -0.236 (0.331) | 0.133 (0.381) |
| Log-L | 17.448 | 13.909 | 18.391 | 13.985 | 45.733 | 54.366 |
| **Southeast Asia** | **Export** | | **Import** | | **Invest** | |
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | 0.294*** (0.000) | 0.065 (0.336) | 0.344*** (0.000) | 0.077 (0.337) | 0.395*** (0.006) | 0.075 (0.597) |
| Log-L | 13.747 | 22.097 | 61.266 | 70.450 | 113.687 | 117.174 |
| **South Asia** | **Export** | | **Import** | | **Invest** | |
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | -0.201*** (0.003) | -0.151** (0.013) | -0.059 (0.382) | -0.048 (0.422) | -0.382* (0.063) | -0.549*** (0.000) |
| Log-L | 17.123 | 14.799 | 15.875 | 15.929 | 75.334 | 70.565 |
| **West Asia** | **Export** | | **Import** | | **Invest** | |
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | 0.301*** (0.000) | 0.330*** (0.000) | -0.004 (0.975) | 0.077 (0.450) | -0.068 (0.725) | 0.056 (0.707) |
| Log-L | 11.110 | 16.783 | 72.732 | 72.455 | 20.493 | 20.492 |
| **Middle Asia** | **Export** | | **Import** | | **Invest** | |
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | 0.638*** (0.000) | 0.484*** (0.000) | 0.144 (0.158) | 0.135 (0.121) | -0.221 (0.465) | -0.028 (0.895) |
| Log-L | 19.725 | 12.977 | 14.145 | 13.912 | 19.721 | 19.932 |
| **Africa** | **Export** | | **Import** | | **Invest** | |
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | -0.123 (0.499) | -0.172 (0.255) | 0.052 (0.354) | 0.031 (0.655) | 0.145 (0.267) | -0.101 (0.427) |
| Log-L | 22.439 | 59.845 | 52.339 | 49.118 | 15.501 | 15.767 |

| Latin America | Export | | Import | | Invest | |
|---|---|---|---|---|---|---|
| | $W_d$ | $W_e$ | $W_d$ | $W_e$ | $W_d$ | $W_e$ |
| ρ | 0.178<br>(0.227) | 0.068<br>(0.646) | -0.133<br>(0.183) | -0.138<br>(0.102) | 0.052<br>(0.833) | -0.167<br>(0.445) |
| Log-L | 6.447 | 6.996 | 13.152 | 12.887 | 23.867 | 23.685 |

[a] Note: ***、**、* denote the 0.01, 0.05and 0.1 significance levels.

The "Table II" shows that the spatial lag coefficient of SLPM model estimates of trade and investment in Africa is not significant, which indicates that the spatial effect of China's import, export and investment to these countries in the region is not prominent. The spatial effects of the Latin America are not significant either, which indicates that the economic and trade relationship between China and this region is not strong. Its import and investment are far less than that of exports from China. The spatial effects of the export and import model on the two weighting matrices in Southeast Europe are significantly positive, and the coefficients of the import model are larger than that of the export model. China has obvious positive spatial spillover effect on its imports and exports to this region. Increased trade exchanges with China and Southeast European countries can promote trade exchanges with countries adjacent to its space. In Central Europe only the export model of distance weight matrix has a significant positive value in each model, which indicates that China has a positive spillover effect on the export in latitude and distance dimension. The closer the country gets, the stronger the spillover effect. In Eastern Europe, the spatial effect of China's export dependent variables is significantly positive in the spatial dimension of economic disparity. Export growth to one country can promote exports to the whole region. However, the spatial effect of the import dependent variables is significantly negative, which means that there is homogeneity of export products and certainly competitive effect between countries in this region. Compared with import and export trade, the spatial effect of China's investment in Europe is less significant and the coordination between them is not strong.

## IV. CONCLUSION

China's import and export trade and investment in all countries of the "one belt and one way" have great differences in space. There are also obvious differences in spatial correlation among these variables in different regions. These areas have more significant in spatial effects, such as central Europe, Southeast Europe, Central Asia, South Asia and East Asia and Southeast Asia, due to better economic development and stronger relation with China.

As for the spatial effects of China's export, import and investment in "the Belt and Road" regions, it is much weaker in Africa and Latin America, while in Europe is significantly positive. Three empirical models of Southeast Asia are all positive in the dimension of distance, and the spatial spillover effect of investment is stronger than that of import and export. The spatial lag of dependent variables of export and investment models of South Asia is significantly negative. And we can find the results of West and Central Asia are similar, only the spatial lag coefficient in export model is significantly positive, while the spatial effect of import model is not obvious.

Because of the differences in economic and cultural factors in different regions, trade and investment in these regions should be promoted in accordance with the actual situation. In order to further to deepen the "the Belt and Road" cooperation, it is necessary to maintain good coordination between China and Europe in terms of economic and trade exchanges, steadily increase the degree of trade and investment coupling in South Asia and Central Asia, and improve the poor synergy between imports and exports and investment in Southeast Asia and Western Asia.

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