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A Spatial Statistic and Spatial Econometric Analysis for Co-agglomeration of FDI in Producer Services and FDI in Manufacturing Industry

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Abstract: This study employs spatial statistics and spatial econometrics to analyze the co-agglomeration of (FDI) Foreign Direct Investment in producer services and FDI in manufacturing industry of 24 provinces in China during 2004-2011. The results indicate that the distribution of both FDIs presents the feature of spatial co-agglomeration, with a high level co-agglomeration in 5 eastern provinces and a low level co-agglomeration in 7 middle and western provinces. There is collaborative interaction between the agglomeration of FDI in producer services and that of FDI in manufacturing industry, FDI in manufacturing industry in the lagged one period will significantly promote the agglomeration of FDI in producer services in current period while FDI in producer services in the lagged one period will significantly promote the agglomeration of FDI in manufacturing industry in current period. The FDI in manufacturing industry prefers areas with large scale of economy, high level of manufacturing industry and lower labor cost while FDI in producer services prefers areas with large scale of service industry, high level development of manufacturing industry and human capital.

Key words: Producer services, manufacturing industry, FDI, co-agglomeration, spatial statistics, spatial econometrics

INTRODUCTION

Producer services and manufacturing industry are in a close relationship on the levels of industry and space and there is a more and more obvious trend of co-investment in both industries. For example, A.P. Moller-Maersk, the largest logistics service provider in the world has followed IKEA, Nike, Michelin, Adidas and other multinational manufacturers to invest into China and United Parcel Service has followed IBM, Dell, Nike, 3COM, Cisco, GE, Volkswagen, HP and other multinational manufacturers to enter China market. According to the actual situation in China, the agglomeration of Foreign Direct Investment (FDI) in manufacturing industry occurs before that of FDI in producer services which is the same as the situations in USA, Western Europe and other developed countries. There have raised some questions about whether the agglomeration of FDI in manufacturing industry in advance is promoting FDI in producer services, whether the later agglomeration of FDI in producer services is promoting the further agglomeration of FDI in manufacturing industry and how is their spatial co-agglomeration, an in-depth study on this subject will drive the collaborative development of producer services and manufacturing industry in China.

The literatures referred in this study mainly focus on two subjects: Co-agglomeration of producer services and manufacturing industry and the relationship between FDI in producer services and FDI in manufacturing industry. On the first subject, Klaesson (2001) believed that the agglomeration of producer services was the only factor to explain the agglomeration of manufacturing industry and the typical reason was that greater spatial distance would result in higher cost of services provided by the service providers, in terms of the frequency of meetings and contacts, as well as the time needed during such processes. As a result, in order to cut down the cost the manufacturers need to make good use of the input from producer services within the nearer spatial distance. Macpherson (2008) pointed out that if producer services and manufacturing industry were geographically close to each other, the service providers would benefit by the shorter distance from the manufacturer clients while the manufacturers would benefit by the service providers in a shorter distance. Accordingly, the time-based "Accessibility" is the important factor to explain such spatial co-agglomeration. Chen and Chen (2011) proposed that the influence of producer services location on the agglomeration of manufacturing industry as well as the influence of such agglomeration on producer services

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location, depended on the scale of the city and the transaction cost played an important role in the collaborative location of producer services and manufacturing industry. Cao *et al.* (2014) carried out an analysis based on Systematic Synergy Theory and the result shows that the high-end service industry in Shanghai and the advanced manufacturing industry in Yangtze Delta are enjoying co-development, with a more obvious trend after 2006. On the second subject, many scholars believed that in their own countries, FDI in producer services tended to pursue FDI in manufacturing industry, resulting in their spatial agglomeration (Guerrieri and Meliciani, 2005; Francois and Woerz, 2008; Liu, 2009). Kolstad and Villanger (2008) study showed that producer services could connect the different sections in the specialization value chain and FDI in manufacturing industry was positively related to FDI in producer services, especially for financial industry and transportation sector. Tang (2009) found that it was obvious that FDI in China's service industry from the USA pursues FDI in manufacturing industry from the United States. Zhang (2012) used the panel data of 19 provinces in China during 2000-2009 to analyze the factors influencing the location determinants of FDI in producer services and FDI in manufacturing industry and found that they are pursuing each other.

To sum up, there is few literature on the co-agglomeration of producer services and manufacturing industry, especially, there is no literature on this subject from a more micro view of foreign direct investment. Although it has been realized that there is correlation effect between FDI in producer services and FDI in manufacturing industry, most literatures are focusing on the subject that FDI in service industry or producer services pursues FDI in manufacturing industry. Few literatures have raised the point that there is co-agglomeration of FDI in producer services and FDI in manufacturing industry while they just observed and described such co-agglomeration, with no empirical test, basically ignoring spatial correlation effect, resulting in a lack of a sound empirical support for their conclusions.

Based upon the reality background mentioned above and the potential expansion of related studies, this study puts spatial correlation effect into the analytical framework, introduces the interrelationship between regions into the model and employs global Moran's I index and Moran's I plot in spatial statistics as well as spatial error model and spatial autoregressive model in spatial economics, to analyze the co-agglomeration of FDI in producer services and FDI in manufacturing industry of 24 provinces in China during 2004-2011 in order to provide theoretical guide and decision basis for the flow of foreign investment and promoting the co-development of the secondary and tertiary industries.

MATERIALS AND METHODS

Description of data: With regard to the definition of producer services, the input-output table of the year of 2010 is used to calculate the intermediate demand rate of the service industries and five service sectors with intermediate demand rates higher than 60% are identified as producer services. These five service sectors include: (1) Transportation, warehousing and postal services, (2) Leasing and business services, (3) Financial services, (4) Information technology, computer services and software and (5) Scientific research, technical services and geological survey. The FDI in producer services is represented as the actual amount of FDI in the five sectors mentioned above and priced in RMB based on the median exchange rates in each year.

As there is no sound statistical system in many cities and a few provinces in China, these citie's data of FDI in producer services and some province's data are not available. Furthermore, for most provinces in China, only the statistical data of FDI in producer services since 2004 are opened. Therefore, the spatial regions analyzed in this study are 24 provinces of China including Beijing, Tianjin, Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hebei, Henan, Heilongjiang, Hubei, Hunan, Jiangsu, Jiangxi, Liaoning, Inner Mongolia, Shandong, Shanxi, Shaanxi, Xinjiang, Yunnan, Zhejiang, Chongqing and Gansu, with a sample period defined as 2004-2011. The data of FDI in producer services and FDI in manufacturing industry come from the statistical yearbooks of each province, China Statistical Yearbooks and China Commerce Yearbooks.

According to spatial econometrics, it is required to employ some indexes of spatial statistics, such as Moran's I Geary's G and Getis, to perform spatial correlation test before constructing the spatial econometrics model. If the spatial correlation is proved it means that the spatial econometrics method is applicable to this study; otherwise, general econometric method applies.

Spatial statistic method: Global Moran's I index in spatial statistics is used to test the spatial correlation of FDI in producer services and FDI in manufacturing industry respectively.

The global Moran's I index is calculated using Eq. 1 in the following:

$$\text{Moran's I} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(Y_i - \bar{Y})(Y_j - \bar{Y})}{S^2 \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \quad (1)$$

where, Y_i represents the total FDI of the i-th region, n is the total number of regions, i.e., the 24 provinces in this study:

$$S^2 = \frac{1}{n}\sum_{i=1}^{n}(Y - \overline{Y}) \text{ and } \overline{Y} = \frac{1}{n}\sum_{i=1}^{n} Y_i w_{ij}$$

where, w_{ij} is the n×n weight matrix, that means the spatial adjacent relation matrix of the n spatial units. The most common ways to construct this spatial weight matrix are distance and adjacency methods. Since there are common boundaries between the 24 provinces, therefore, using information provided by (GIS) Geographic Information System spatial analysis, the K-nearest neighbour spatial weight matrix is employed in the analysis and ArcGIS10.1 software is used to construct the spatial distance matrix based on the distances between the gravity centres of the maps of these 24 provinces.

The range of Moran's I is [-1, 1]. When Moran's I>0, there is a positive correlation and spatial agglomeration between the similar regions; when Moran's I = 0, there is no spatial correlation; when Moran's I<0, there is a negative correlation and spatial discrete between the different regions.

By plotting Moran's I scatter plot, this study divides FDI inflows in producer services and manufacturing industry of 24 provinces into four quadrants, in order to more accurately identify the co-agglomeration regions of both FDIs. The horizontal axis of Moran's I scatter plot represents the regional standardized values of FDI in producer services after treatment, the ordinate is the average value of FDI in producer services of adjacent units which is determined by the spatial weight matrix. Four quadrants means four different types of spatial correlation between a region and its adjacent area. There is an aggregated distribution of high FDI in producer services in the first quadrants. This aggregated distribution means the regions with high FDI are surrounded by other regions with high FDI, showing a High-High (HH) positive spatial correlation. There is an aggregated distribution of low FDI in producer services in the third quadrant, showing a Low-Low (LL) positive spatial correlation. The first and third quadrant is spatial agglomeration area which indicates the existence of the positive spatial correlation between similar regions. The regions in the second quadrant have low FDI but are surrounded by regions with high FDI, showing a Low-High (LH) negative spatial correlation. The regions in the fourth quadrant have high FDI but are surrounded by regions with low FDI, showing a High-Low (HL) negative spatial correlation. The second and fourth quadrant is spatial discrete areas which indicates the existence of spatial negative correlation between different regions. If FDI is unevenly distributed among the four quadrants which suggests the existence of spatial correlation between the regions; conversely if FDI is evenly distributed in four quadrants which means that the spatial correlation does not exist.

Spatial econometric method: According to the spatial correlation effect in spatial econometrics, the representation of spatial correlation has two basic forms, i.e., the Spatial Autoregressive Model (SAM) and the Spatial Error Model (SEM).

In the SAR, the spatial correlation between variables is expressed as the spatial lag of the dependent variable and is used to examine the influence of the behaviors of adjacent regions on those of other regions in the entire system. The SAR can be expressed as:

$$Y = \rho WY + X\beta + \varepsilon \quad (2)$$

where, Y is the dependent variable, X is the n×k matrix parameter of exogenous explanatory variables and ρ is the spatial regression coefficient, representing the influence of independent variable WY to the dependent variable Y. W is an n×n spatial weight matrix, WY is the spatially lagged dependent variable, ε is the random error vector and β is the spatial regression coefficient, representing the influence of the independent variable X to the dependent variable.

The SEM is a SAR included in the error term, used to represent the influence of error impulses caused by the neighbours to the dependent variable on local observations. The SEM can be expressed as:

$$Y = X\beta + \varepsilon,\ \varepsilon = \lambda W\varepsilon + \mu \quad (3)$$

where, ε is the random error vector and λ is the spatial error coefficient of n×1 sectional dependent vector.

The spatial relationship between the both FDIs is just the extension of the relationship between producer services and manufacturing industry from the home market to the international market, that is to say that producer services on international market calls for the support from the manufacturing industry of the motherland while manufacturing industry calls for high-quality intermediate services provided by the producer services of the motherland, the essence of this relationship is the location coordination of both FDIs. Generally speaking, the level of agglomeration of FDI in an industry in a period might be influenced by the lagging effect from the level of agglomeration of FDI in another industry related. Therefore, this study takes the actual investment of both FDIs as the independent variable and dependent variable to describe the agglomeration of foreign investment, introduces the independent and dependent variables of the lagged one period into the

model and takes the other factors influencing the location determinants of FDI as the control variables, to study the co-agglomeration of both FDIs based on the data of 24 provinces during 2004-2011. Based upon the analysis above, this study establishes the simultaneous equations for the SAR and those for the SEM, where Ln represents the variable after logarithm process:

$$LnPSFDI_{it} = \rho WLnPSFDI_{it} + \beta_0 + \beta_1 LnPSFDI_{i,t-1} + \beta_2 LnMFDI_{it} + \beta_3 LnMFDI_{it-1} + \sum \beta_i LnX_{it} + \varepsilon \quad (4)$$

$$LnMSFDI_{it} = \rho WLnMFDI_{it} + \beta_0 + \beta_1 LnMFDI_{i,t-1} + \beta_2 LnPSFDI_{it} + \beta_3 LnPSFDI_{i,t-1} + \sum \beta LnX_{it} + \varepsilon \quad (5)$$

$$LnPSFDI_{it} = \beta_0 + \beta_1 LnPSFDI_{i,t-1} + \beta_2 LnMFDI_{it} + \beta_3 LnMFDI_{i,t-1} + \sum \beta_i LnX_{it} + \varepsilon \quad (6)$$

$$LnMSFDI_{it} = \beta_0 + \beta_1 LnMFDI_{i,t-1} + \beta_2 LnPSFDI_{it} + \beta_3 LnPSFDI_{i,t-1} + \sum \beta LnX_{it} + \varepsilon \quad (7)$$

where, $LnPSFDI_{it}$ is the level of agglomeration of FDI in producer services of the i-th region in period t, $LnPSFDI_{i,t-1}$ is the level of agglomeration of FDI in producer services of the i-th region in the lagged one period, $LnMFDI_{it}$ is the level of agglomeration of FDI in manufacturing industry of the i-th region in period t and $LnMFDI_{i,t-1}$ is the level of agglomeration of FDI in manufacturing industry of the i-th region in the lagged one period. The $\Sigma\beta_i LnX_{it}$ is a series of control variables, representing the other factors influencing the location choice of FDI which include: (1) Scale of economic development (PERGDP). A region w greater scale of economic development is more attractive to foreign investment. This study uses GDP per capital to represent the scale of economy of each province which is predicted to have positive influence on the agglomeration of foreign investment: (2) Scale of services development (SEMPLOY). For a specific region, a greater scale of service industry allows more potential of growth of FDI in producer services and FDI in manufacturing industry (Xu, 2013). This study uses the ratio of the employment in the tertiary industry to the total employment to represent the scale of service industry which is predicted to have positive influence: (3) Degree of opening-up (OPEN). A higher degree of opening-up indicates a higher degree of marketization of a country or region, better attitude of the government to foreign investment and more flexible policy, therefore, the investment of multinational corporations can expect higher expected returns. This study uses the ratio of total export of goods trade to the GDP of the same year to represent the degree of opening-up which is expected to have positive influence: (4) Condition of human capital (EDU). Compared to FDI in manufacturing industry, FDI in producer services has higher requirement for the level of human capital, that the availability of high-quality human capital in a specific region will influence the agglomeration of FDI in producer services. This study uses the number of students in colleges and universities to be the proxy variable for the level of human capital which is expected to have positive influence: (5) Development level of manufacturing industry (MD). According to the relationship between supply and demand, higher development level of manufacturing industry would have higher demand for producer services and multinational corporations will choose to invest directly in those areas w great demand for producer services (Kang and Yang, 2013). This study uses output per capital of the secondary industry to represent the development level of manufacturing industry which is expected to have positive influence: (6) Labor cost (WAGE). Labor cost is an important factor to consider when multinational corporations make their decisions on investment and the lower the labor cost is, the greater the scale of foreign capital in flow is Shihai and Fen (2014). This study uses the average wage of the employee in service industry and manufacturing industry to represent the labor cost which is predicted to have negative influence: (7) Infrastructure (INFRA). Sound infrastructure will create a good environment for the growth of foreign capital, in order to better reflect the development level of the whole infrastructure of any region (Lian and Ma, 2014). This study uses a single infrastructure index which is sourced from the number of landline telephones, the length of highways and the length of railways per ten thousand people, to represent the condition of infrastructure which is predicted to have positive influence. All the data above are sourced from the statistical yearbooks of each provinces, China Statistical Yearbooks and China Commerce Yearbooks during 2005-2012.

RESULTS AND DISCUSSION

Spatial statistic analysis: Using the method discussed above, a spatial distance matrix is constructed. Then, Geoda 1.4.6 software is used to calculate the global Moran's I index of FDI in producer services and FDI in manufacturing industry of the 24 provinces in the years of 2004-2011 and to perform the test (Table 1). The Moran's I index of FDI in producer services passes the test at the 10% significance level except the years of 2005 and 2006, with a value larger than 0 and a trend to increase year by year. The result indicates that the distribution of FDI in producer services of China is positively spatially

correlated. Except the years of 2005, the Moran's I index of FDI in manufacturing industry also passes the test at the 10% significance level, with a value larger than 0 and a trend to increase year by year. The result indicates that the distribution of FDI in manufacturing industry of China is positively spatially correlated. Both distributions are positively spatially correlated which means that they are not totally random but appear the feature of spatial agglomeration and that spatial econometrics model is applicable to the study of their co-agglomeration. The value of Moran's I of FDI in manufacturing industry is greater than that of FDI in producer services, indicating that the former is more spatial related than the latter which seems to back up the current situation in China that the agglomeration level of FDI in producer services is lower than that of FDI in manufacturing industry.

According to Fig. 1a, FDI in producer services is not distributed evenly across the 4 quadrants and there are 13 provinces in the first and third quadrant in total, indicating positive spatial correlation for 54.2% out of the 24 provinces; according to Fig. 1b, FDI in manufacturing industry is not distributed evenly across the 4 quadrants and there are 18 provinces in the first and third quadrant in total, indicating positive spatial correlation for 75% out of the 24 provinces which further indicates the significant spatial correlation of the distribution of both FDIs.

Table 1: Test results of spatial correlation

	FDI in producer services		FDI in manufacturing industry	
Year	Moran's I	p-value	Moran's I	p-value
2004	0.014	0.046	0.101	0.057
2005	-0.235	0.121	-0.023	0.183
2006	-0.335	0.123	0.254	0.014
2007	0.019	0.031	0.251	0.015
2008	0.023	0.034	0.182	0.076
2009	0.041	0.037	0.209	0.047
2010	0.046	0.029	0.211	0.046
2011	0.075	0.035	0.160	0.093

Based on Fig. 1, this study lists the spatial correlation models of the agglomeration of both FDIs (Table 2). As shown in Table 2, there are 5 provinces with high agglomeration of FDI in producer services, namely Zhejiang, Jiangsu, Liaoning, Shandong and Tianjin and 6 provinces with high agglomeration of FDI in manufacturing industry, namely Zhejiang, Jiangsu, Liaoning, Shandong, Tianjin and Fujian. There are same 5 provinces for the distribution of FDI in producer services and FDI in manufacturing industry, namely Zhejiang, Jiangsu, Liaoning, Shandong and Tianjin which means a higher level of co-agglomeration of both FDIs in these provinces. There are 8 provinces with low agglomeration of FDI in manufacturing industry, namely Gansu, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Xinjiang and 12 provinces with low agglomeration of FDI in manufacturing industry, namely Beijing, Gansu, Guizhou, Henan, Hunan, Inner Mongolia, Shandong, Shaanxi, Xinjiang, Yunnan, Chongqing and Jiangxi. There are same 7 provinces for the distribution of FDI in

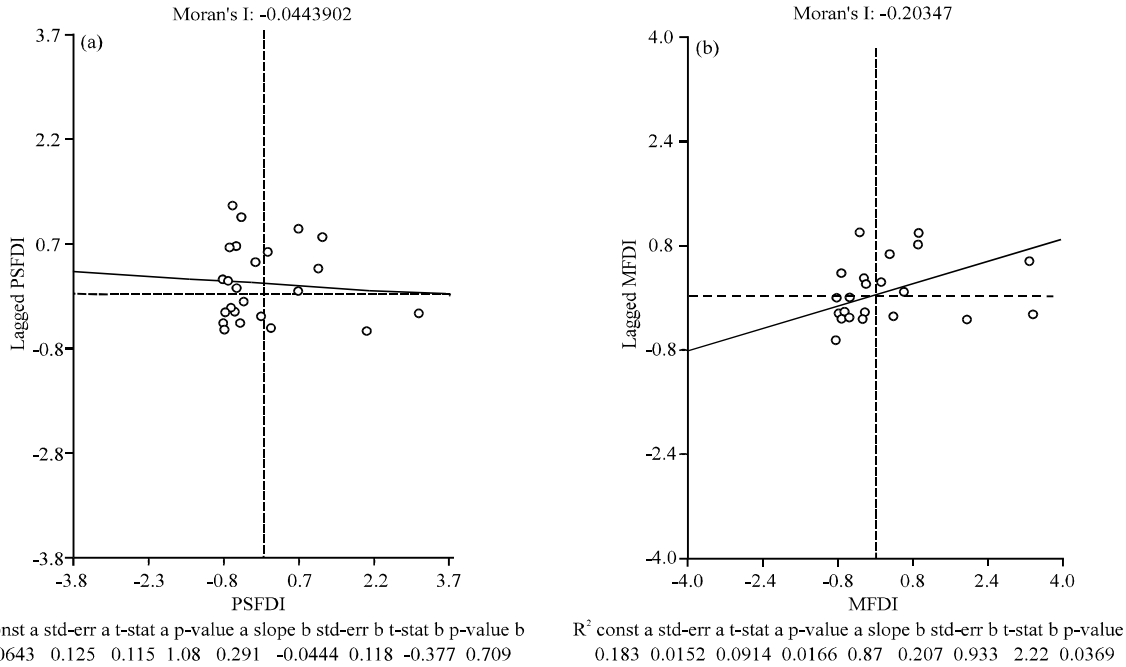

Fig. 1(a-b): Moran's I scatter plot of FDI in (a) Producer services and (b) Manufacturing industry

Table 2: Spatial correlation pattern

Quadrant	Spatial correlation pattern	Distribution provinces of FDI in producer services	Distribution provinces of FDI in manufacturing industry
First	HH	Zhejiang, Jiangsu, Liaoning, Shandong, Tianjin	Zhejiang, Jiangsu, Liaoning, Shandong, Tianjin, Fujian
Second	LH	Anhui, Fujian, Guangxi, Hebei, Heilongjiang, Inner Mongolia, Shanxi, Yunnan	Anhui, Guangxi, Hebei, Heilongjiang
Third	LL	Gansu, Guizhou, Henan, Hubei, Hunan, Jiangxi, Shaanxi, Xinjiang	Beijing, Gansu, Guizhou, Henan, Hunan, Inner Mongolia, Shanxi, Shaanxi, Xinjiang, Yunnan Chongqing, Jiangxi
Fourth	HL	Beijing, Guangdong, Chongqing	Guangdong, Hubei

Table 3: Results of spatial econometric regression

	Agglomeration of FDI in producer services		Agglomeration of FDI in manufacturing industry	
Explanatory variable	SAR	SEM	SAR	SEM
Constant	0.0494***	0.0378***	0.0257**	0.0125**
$LnPSFDI_{it}$	-	-	0.54**	0.57**
$LnPSFDI_{i, t-1}$	0.23***	0.51***	0.58**	0.6***
$LnMFDI_{it}$	0.48**	0.27***	-	-
$LnMFDI_{i, t-1}$	0.52**	0.44**	0.29***	0.3***
LnPERGDP	0.3706*	0.6777*	0.652*	0.4645**
LnSEMPLOY	0.561**	0.237**	0.282*	0.245**
LnOPEN	0.225**	0.227**	0.247**	0.238*
LnEDU	0.3791	0.3737	0.2782	0.1745
LnMD	1.0206**	1. 0457*	1.1283*	1.1603*
LnWAGE	-0.212**	-0.412**	-0.362**	-0.421**
LnINFRA	0.0812***	0.0834***	0.0793***	0.0838***
ρ/λ	0.1455	-0.0669	0.0680	0.4212
R^2	0.8916	0.8759	0.8478	0.8589
Log L	105.234	102.450	91.211	93.234
AIC	-190.012	-188.291	-170.716	-172.395
SC	-180.124	-178.786	-158.678	-162.120

***,**and* Represent the result passes the significance test at 1, 5 and 10% level respectively

producer services and FDI in manufacturing industry, namely Gansu, Guizhou, Henan, Hunan, Shaanxi and Xinjiang, which neans a level of co-agglomeration in these provinces. To sum up, there are more provinces with high or low agglomeration of FDI in manufacturing industry in China and 12 provinces with the same distribution of FDI in producer services and FDI in manufacturing industry which proves their co-agglomeration in spatial development.

In comparison to previously published studies (Guerrieri and Meliciani, 2005; Francois and Woerz, 2008; Liu, 2009), spatial statistic analysis can identify the co-agglomeration of FDI in producer services and FDI in manufacturing industry in specific regions and can recognize this kind of co-agglomeration belongs to high agglomeration or low agglomeration.

Spatial econometric analysis: Due to the endogeneity of the independent variables of the SAR and the SEM, there might be bias or invalid value for the estimate of regression coefficient if we still use Ordinary Least Square (OLS) method. Therefore, it is necessary to make a more scientific estimation by generalized least square method, maximum likelihood method, generalized matrix or other methods. This study employs maximum likelihood method to estimate the regression coefficients of the SAR and the SEM. Table 3 shown the result.

In order to further decide which model is more applicable, it is feasible to apply the criteria as follows: When it is found in spatial correlation test that the statistic of LMLAG is more significant than that of LMERR and the statistic of R-LMLAG is more significant than that of R-LMERR, the SAR shall be used to estimate; otherwise, the SEM shall be used. The greater R^2 and LogL and the smaller AIC and SC are, the better imitative effect the model. According to the estimates of Table 3, for the agglomeration of FDI in producer services, R^2 and LogL of the SAR are greater than those of the SEM which are 0.8916 and 105.234, respectively; meanwhile, AIC and SC of the SAR are lower than those of the SEM which are -190.012 and -180.124. As a result, the SAR is the optimal one. Similarly, for the agglomeration of FDI in manufacturing industry the SEM is the optimal one.

It can be concluded from the regression results of Table 3 that the agglomeration of FDI in manufacturing industry can promote the agglomeration of FDI in producer services and the agglomeration of FDI in producer services can promote the agglomeration of FDI in manufacturing industry effectively, that there is collaborative interaction between them. According to the test results of the SAR for the agglomeration of FDI in producer services, the contribution rate of the agglomeration of FDI in manufacturing industry in the lagged one period to the agglomeration of FDI in producer

services in current period is 52% and the contribution rate of the agglomeration of FDI in manufacturing industry in current period to the agglomeration of FDI in producer services in current period is 48%; meanwhile, according to the test results of the SEM for the agglomeration of FDI in manufacturing industry, the contribution rate of the agglomeration of FDI in producer services in the lagged one period to the agglomeration of FDI in manufacturing industry in current period is 60% and the contribution rate of the agglomeration of FDI in producer services in current period to the agglomeration of FDI in manufacturing industry in current period is 57%. The results above indicate that, compared to the agglomeration of FDI in manufacturing industry in current period, the agglomeration of FDI in manufacturing industry in the lagged one period has greater contribution to the agglomeration of FDI in producer services in current period; meanwhile, compared to the agglomeration of FDI in producer services in current period, the agglomeration of FDI in producer services in the lagged one period has greater contribution to the agglomeration of FDI in manufacturing industry in current period.

The empirical results for the other factors influencing the location choice of FDI meet the theoretical expectation. Both FDIs agglomerations are positively related to the scale of economic development, the scale of services development, the degree of opening-up, the condition of human capital, the development level of manufacturing industry and infrastructure while negatively related to labor cost. Generally, FDI in manufacturing industry focuses on a region's scale of overall economy and the level of manufacturing industry while FDI in producer services focuses on a region's development scale of service industry and the development level of manufacturing industry. The FDI in manufacturing industry prefers areas with lower labor cost, with little attention to the availability of high-level human capital within the region while FDI in producer services prefers areas with high-level human capital. From a regional perspective, the areas with greater scale of economy, higher development level of service industry and manufacturing industry, lower labor cost and higher quality of human capital are mainly in the east of China which soundly proves the conclusion of the spatial statistical analysis above that there is a high level of co-agglomeration in the east of China.

Both FDIs agglomerations have spatial correlation effect which is in line with the conclusion of the spatial statistical analysis above. The spatial correlation effect of FDI in manufacturing industry is 0.4212, more significant than that of FDI in producer services which is 0.1455. The reason may be that FDI in producer services is still in its early stage, with no good cooperative interaction among adjacent area yet, so that the spatial correlation effect of FDI in producer services is not so significant.

In comparison to previous study (Kolstad and Villanger, 2008; Tang, 2009; Zhang, 2012), spatial econometric analysis considers the both influences of spatial correlation factors and traditional factors on the co-agglomerations of both FDIs, solving the problem that the existing study ignores the influences of spatial correlation factors on the co-agglomerations of both FDIs.

CONCLUSION AND RECOMMENDATIONS

This study employs Moran's I index and Moran's I plot in spatial statistics, as well as the SAR and the SEM in spatial economics, to analyze the spatial co-agglomeration of FDI in producer services and FDI in manufacturing industry of 24 provinces in China during 2004-2011. The conclusions are as follows: (1) The distribution of FDI in producer services and that of FDI in manufacturing industry presents the feature of spatial correlation and spatial agglomeration while the agglomeration level of FDI in producer services is lower than that of FDI in manufacturing industry. There lies spatial co-agglomeration for the distribution of both FDIs, with a high level for 5 eastern provinces, namely Zhejiang, Jiangsu, Liaoning, Shandong and Tianjin and a low level for 7 middle and western provinces, namely Gansu, Guizhou, Henan, Hunan, Jiangxi, Shaanxi and Xinjiang: (2) There is collaborative interaction between the agglomeration of both FDIs. The agglomeration of FDI in manufacturing industry can promote the agglomeration of FDI in producer services and compared to the agglomeration of FDI in manufacturing industry in current period, the agglomeration of FDI in manufacturing industry in the lagged one period has greater contribution to the agglomeration of FDI in producer services in current period. Meanwhile, the agglomeration of FDI in producer services can promote the agglomeration of FDI in manufacturing industry effectively and compared to the agglomeration of FDI in producer services in current period, the agglomeration of FDI in producer services in the lagged one period has greater contribution to the agglomeration of FDI in manufacturing industry in current period: (3) Both FDIs agglomerations are positively related to the scale of economic development, the scale of service development, the degree of opening-up, the condition of human capital, the development level of manufacturing industry and infrastructure while negatively related to labor cost; FDI in manufacturing industry prefers areas with large scale of economy, highlevel of manufacturing industry and lower labor cost

while FDI in producer services prefers areas with large scale development of service industry, high level of manufacturing industry and human capital.

Considering the spatial co-agglomeration and collaborative interaction of the both FDIs each province shall carefully analyze its environment and give full attention to such inter-regional spatial connection to formulate a special policy accordingly so as to attract foreign capital. For provinces with high-level co-agglomeration, they shall make good use of the agglomeration of FDI in manufacturing industry, to attract the inflow of FDI in producer services, after its self-accumulation for a period, FDI in producer services can create a better investment environment for FDI in manufacturing industry and improve the production efficiency of manufacturing industry, then further attract the inflow of high-quality FDI in manufacturing industry. With such mutual promotion between the both FDIs agglomerations, it is achievable to realize self-cycling and self-improvement in an upward spiral manner. The co-agglomeration of the both FDIs in the middle and western provinces is in a relatively low level, because FDI in manufacturing industry is mainly on resource industries so, that FDI in producer services does not follow the customers apparently and it is not necessarily that lower labor cost and abundant natural resources in the middle and the west of China can be the advantage to attract FDI in producer services. FDI in producer services pays more attention to the development scale of service industry and the development level of manufacturing industry in the middle and the west provinces, therefore, the government shall accelerate the transformation and upgrading of manufacturing industry to attract the inflow of technology-intensive FDI and capital-intensive FDI, meanwhile expand the development scale of service industry to attract FDI in producer services, so as to raise the co-agglomeration of the both FDIs in middle and western provinces, for a win-win prospect to attract foreign capital.

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