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Study on Economic Spillover Effect and Spatial Differentiation of Logistics Industry Agglomeration in Xinjiang

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***Abstract*—Based on the location entropy index and exploratory data analysis method, this paper studies the economic spillover effect and spatial differentiation of Xinjiang logistics industry agglomeration, and empirically studies the panel data of 14 prefectures in Xinjiang from 2007 to 2016, drawing the following conclusions: first, the agglomeration of the whole logistics industry in Xinjiang has no significant spillover effect on economic growth, and there are great differences among regions. Second, most of the regional logistics industry has a certain spatial agglomeration and spatial correlation, but the economic overflow effect of the logistics industry agglomeration is small, that is the driving effect of high-value area on low-value area is not prominent.**

Keywords—logistics industry cluster; economic spillover effect; Cobb Douglas production function; spatial auto-correlation

I. INTRODUCTION

Industrial agglomeration refers to a centralized state in geographical position composed of leading industries and related pillar industries, including upriver and downriver enterprises of leading industries and some institutions within a certain space [1]. Because of its extensive technology diffusion and knowledge spillover effect, industrial agglomeration has become an important way to promote regional economic growth and has attracted extensive research from many scholars. Logistics industry started late in our country, but with its important strategic position in the global supply chain, logistics has gradually become an important driving force of economic growth. Therefore, it is of practical significance to study the influence of logistics industry agglomeration on regional economic growth.

A number of researchers [2] found that industrial agglomeration is common in developing countries. Trends Business Research Ltd [3] demonstrated the effect of logistics industrial agglomeration on economic growth. Chinese scholars mainly use the theory of industrial agglomeration abroad for reference to study the phenomenon of industrial agglomeration in China. Liu. D and Zhang. S,Y [4] based on the empirical analysis of the panel data of 15 prefectures in Xinjiang to the regional economic growth of logistics industry agglomeration, founded that the logistics industry cluster has no significant effect on the regional economic growth, and that it is necessary to seize the good opportunity of reform, accelerate the transformation of logistics industry cluster to regional economic growth and promote the agglomeration of Logistics Industry. There is a lot of literature about using location entropy index to measure the degree of agglomeration. Fan. X, F and Kang. X, Q [5] use location entropy and spatial Gini coefficient to measure the industrial agglomeration and find out the influencing factors at the same time. Gong. X, S [6] based on the location entropy make a study on the provinces of the Silk Road Economic Belt, concluded that the logistics industry agglomeration has a significant economic spillover effect on the regional economic growth of the Silk Road Economic Belt, there is a great regional difference in the economic spillover effect of the logistics industry agglomeration. Dong. Y [7] introduces five spillover effects measurement models: cost function model, macro-economic model, input-output model etc. The research methods of logistics spatial layout are mostly quantitative methods, such as exploratory spatial data analysis, principal component analysis, and so on [8] [9]. In addition to the four-dimensional analysis framework of influencing factors of logistics agglomeration, Zhong. C, Z [10] constructs a spatial econometric model of influencing factors of logistic industry agglomeration by introducing spatial correlation. The result shows that there is a strong spatial auto-correlation and spatial heterogeneity in the agglomeration degree of regional logistics industry.

Since Marshall put forward industrial agglomeration in the 19th century, many scholars have studied industrial agglomeration from different angles and the research has reached the mature stage. However, the research on logistics industry agglomeration is still in the initial stage, most of them are the measurement of the degree of aggregation, which is not combined with the spatial analysis. There is little research on the agglomeration of logistics industry in Xinjiang. Therefore this paper, taking 14 prefectural cities of Xinjiang as the research object, studies the spillover effect of Xinjiang logistics industry agglomeration on the economy and the spatial differentiation of the economic spillover of the logistics industry cluster in Xinjiang during the past ten

years, providing theoretical basis and policy inspiration for Xinjiang logistics industry development policy formulation during the 13th five-year Plan period.

II. THEORETICAL BACKGROUND

A. The Degree of Concentration of Logistics Industry

Considering the characteristics of logistics industry and the availability of data in Xinjiang, this paper chooses the location entropy index to measure the agglomeration level of each region. It is the ratio of the gross product of logistics industry to the gross product of the whole industry of the region and the ratio of the gross product of the logistics industry of the whole country to the gross product of the whole country, expressed by formula:

$$LQ_i = \frac{\frac{e_i}{e}}{\frac{E_i}{E}} \quad (1)$$

Where LQ_i stands for the degree of concentration of logistics industry in i-th region, e_i represents the GDP of logistics industry in a certain region, e represents the total production of each industry in a region; E_i represents the total production of China's logistics industry, E represents the total domestic production of each industry. If LQ_i>1, It means that the logistics industry in this area has a high degree of concentration and a large scale of logistics industry, If LQ_i <1, it means that the degree of concentration of logistics industry in this area is lower and the scale of logistics industry is relatively small [11].

B. The Spillover Effect of Logistics Industry Agglomeration on Economic Growth

In the 21st century, the logistics industry is called the "third profit source" after the material and human resources, all three played a great role in economic growth. The Cobb Douglas production function is a description of economic output determined by capital, labor, and knowledge technology [10]. The existing research points out that the agglomeration of logistics industry is an important motive force of economic growth and is one of the input factors. Therefore, the calculated degree of concentration of logistics industry is introduced into the Cobb Douglas production function, taking this function as the theoretical foundation model for the empirical analysis of the economic spillover effect of logistics industry agglomeration [12].

$$Y = AK^{\alpha}L^{\beta} \quad (2)$$

Here, Y is the interpreted variable, representing the regional economic output value, K is the physical input variable, L is the labor input variable, and A is the technological progress rate, α, β are the output coefficients of capital and labor force. In this paper, it is assumed that the index of logistics industry concentration is in the form of power function, and the degree of concentration of logistics industry is introduced into Cobb Douglas function. LQ is logistics industry agglomeration level, e^{ε} is random interference term.

$$Y = AK^{\alpha}L^{\beta}LQ^{\gamma}e^{\varepsilon} \quad (3)$$

In this case, it is assumed that the rate of progress of A technology will not change over a period of time, taking logarithms on both side of a function and converting the following model A:

$$InY_{it} = InA + \alpha InK_{it} + \beta InL_{it} + \gamma InLQ_{it} + \varepsilon_{it} \quad (4)$$

In order to better investigate the impact of logistics industry agglomeration level on economic growth in various regions, the coefficient to be estimated and the variables related to economy are introduced. The choice of variable is related to author's study [12] and some variables that affect economic development in the new economic growth theory and improve the reality of Xinjiang, model B:

$$InY_{it} = \beta_o + \beta_1 InL_{it} + \beta_2 InK_{it} + \beta_3 InLQ_{it} + \beta_4 NX_{it} + \beta_5 Ge_{it} + \beta_6 INS_{it} + \varepsilon_{it} \quad (5)$$

T is the time parameter; I is the Xinjiang 14 prefectural index; Y represents the gross national product (GDP); L as the input of labor force, expressed in terms of the number of employees in all regions and states; K is the capital input, expressed by the fixed capital investment amount of each state; LQ is the level of logistics industry agglomeration, expressed by the location entropy index obtained above; NX represents the degree of opening up to the outside world in a region and is represented by the proportion of total imports and exports to GDP; Ge is a government function variable, expressed as the proportion of fiscal expenditure to GDP and INS is the three major industrial structures, expressed as the ratio of the primary industry to the second and third industries.

C. Exploratory Spatial Data

The most commonly used metrics for global spatial autocorrelation are $Moran'sI$ Index [13]:

$$I = \frac{n\sum_{i}^{n}\sum_{j}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i}^{n}\sum_{j}^{n} w_{ij}(x_i - \bar{x})^2} \quad (\forall j \neq i) \quad (6)$$

Here n is the total number of counties and cities in Xinjiang: 85, w_{ij} is spatial weight matrix standardized for Row, x_i and x_j is the attribute value of the cell, $\bar{x}$ is average of all attribute value Moran'$_{Moran'sI}$ have values in the interval [-1,+1]. If $_{Moran'sI}$ >0, it indicates that there is a positive correlation between the economic activities of the studied regions; if $_{Moran'sI}$ <0, it shows that here is a negative correlation. In the selection of spatial weight, this paper chooses Euclidean distance method, $k-nearest$ weight matrix. At the same time, it is available to use the standard normal distribution Z statistics according to the size of Z to

determine whether there is a spatial correlation between the areas. In particular, when the Z value is positive and significant, there is a positive space self-correlation, that is similar observation values tend to gather in space; when Z value is negative and significant, it indicates that there is a negative spatial autocorrelation, that is similar observations tend to be dispersed; when Z value is 0, the observed value is distributed independently and randomly [13].

$$Z = (I - \frac{-1}{(N-1)}) / \sqrt{\frac{N^2 \sum_i^n \sum_j^n W_{ij}^2 - N \sum_i^n (\sum_j^n W_{ij})^2 + 3(\sum_i^n \sum_j^n W_{ij})^2}{(N^2-1)(\sum_i^n \sum_j^n W_{ij})^2}} \quad (7)$$

Global spatial autocorrelation is a description of the spatial characteristics of the whole regional logistics development, local spatial autocorrelation through Local Indicator of Spatial Association (LISA) index [12] to test whether there are similar or different observations between parts of the region. The local Moran index is used to measure the degree of association between a region and a neighboring region, the method of calculation is as follows:

$$I_i = \frac{\left(x_i - \bar{x}\right)}{s^2} \sum_{j \neq i} w_{ij} \left(x_j - \bar{x}\right) \quad (8)$$

When I_i >0, indicates that a high value is overridden by a high value (High-High), or a low value is overridden by a low value (Low-Low); when I_i <0, indicates that a low value is overridden by a high value (High-low), or a high value is overridden by a low value (Low-high).

The data used in this paper are from the Statistical Yearbook, where the raw data of the region are derived from the Statistical Yearbook of Xinjiang and the raw data of the whole country are derived from the National Statistical Yearbook. The study period is set to 2007-2016 and objects are Xinjiang 14 states. The eastern part of Xinjiang: Turpan, Hami; northern Xinjiang: Urumqi, Karamayi, Changji Hui Autonomous Prefecture, Yili County, Tacheng area, Altay area; southern Xinjiang: Bortala Mongolian Autonomous Prefecture, Bayinggol Mongolian Autonomous Prefecture, Aksu region, Kizilesu Kirgiz Autonomous Prefecture, Kashgar region and Hetian region.

III. EMPIRICAL ANALYSIS

A. Measurement of Concentration Degree of Logistics Industry

Based on the statistics of transportation, warehousing and postal industry's gross product of logistics industry 2007-2016, (1) is used to measure the level of logistics agglomeration in 14 prefectures of Xinjiang in the past 10 years. The results are shown in "Table I":

TABLE I. AGGREGATION DEGREE

LQ	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Ave.
Urumqi	1.62	1.56	1.89	2.21	2.33	2.85	2.96	3.20	2.89	3.15	2.47
Karamayi	0.38	0.32	0.50	0.37	0.37	0.41	0.42	0.41	0.45	0.43	0.41
Turpan	1.14	1.09	1.60	1.60	1.54	1.51	1.50	1.53	1.54	1.10	1.42
Hami	3.34	2.56	3.14	2.63	2.20	2.21	2.33	1.95	2.07	2.00	2.44
Changji	1.12	1.11	1.01	0.92	0.87	0.88	0.87	0.86	0.90	0.80	0.93
Yili County	1.23	1.17	0.97	0.89	0.90	0.94	0.92	0.92	0.89	0.83	0.97
Tacheng	0.79	0.89	0.75	0.67	0.64	0.64	0.67	0.43	0.49	0.47	0.64
Altay	0.59	0.51	1.01	0.99	0.93	0.97	1.01	0.94	1.10	0.97	0.90
Bortala	1.94	1.93	2.02	1.78	1.76	1.63	1.58	1.98	1.69	1.45	1.78
Bayinggol	0.48	0.49	0.72	0.65	0.59	0.58	0.55	0.75	0.82	0.74	0.64
Aksu	0.62	0.63	1.05	0.94	0.91	0.88	0.85	0.86	0.71	0.68	0.81
Kizilesu Kirgiz	0.95	1.02	1.14	1.08	1.02	0.95	0.82	0.77	0.70	0.59	0.90
Kashgar	0.78	0.75	0.77	0.77	0.69	0.70	0.67	0.68	0.62	0.57	0.70
Hetian	0.26	0.24	0.51	0.50	0.47	0.48	0.45	0.31	0.29	0.26	0.38

TABLE II. AGGREGATION DEGREE

LQ	Whole	East	North	South
2007	0.93	1.90	1.12	0.57
2008	0.90	1.66	1.08	0.57
2009	1.04	2.30	1.27	0.81
2010	0.91	2.09	1.30	0.75
2011	0.87	1.87	1.35	0.70
2012	1.09	1.88	1.60	0.69
2013	1.05	1.97	1.64	0.66
2014	1.18	1.79	1.74	0.73
2015	1.30	1.90	1.69	0.69
2016	1.31	1.68	1.73	0.63

As shown in "Table I": in the period 2007-2016, the concentration of the logistics industry increased, such as Urumqi, Turpan, et al; there are Changji Hui Autonomous Prefecture, Hami area et al, in the state where the concentration of the logistics industry is reduced. The concentration degree of logistics in Urumqi not only shows an increasing trend, but also is above 1, which belongs to a higher concentration of logistics industry. This also matches its economic status and industrial development. It is Xinjiang's industrial development and distribution of the leader.

Overall, the degree of concentration of the logistics industry is generally a growth trend, but there are obvious differences among regions. The overall logistics concentration in Xinjiang increased from 0.93 to 1.31. Eastern Xinjiang was above 1, which depended on the contribution made by Hami region. North Xinjiang has been on the increase all the time. Southern Xinjiang has increased, but the degree of concentration of logistics industry is less than 1. This is because during the period from 2011 to 2016, the construction of the infrastructure such as the railway and the highway , the construction of the port, the establishment of the special economic zone, the "One Belt and One Road" strategy put forward in 2013 and the increase of the concentration of the logistics industry. But at the same time, some typical resource development-dependent cities, such as Karamay, Turpan, and Guanyin Mongolia Autonomous Prefecture have been depleted in recent years and the concentration of logistics industry has been growing, but the economic growth and power of the logistics industry in the region have been reduced. So in 2015, 2016 the concentration of logistics industry decreased.

B. Empirical Analysis and Result

The unit root test of panel data is the first step of model estimation. The ADF test method suitable for heterogeneous panel data is selected to carry out the first-order difference for non-stationary series. By means of unit root test, it has been proved that both GDP and variables are single integrals of the same order, which accords with the condition of co-integration test. This paper selects Johansen Test and the results show that the final ADF test P<0.05, through Co-integration test.

According to the model form and the result of Co-integration test, considering the possible cross-section heteroscedasticity of the model, the inverse variance weight is used to estimate the parameters of the panel data. Four samples of Xinjiang as a whole, Eastern Xinjiang, Northern Xinjiang and Southern Xinjiang are selected to regression the model and the following empirical results are obtained:

TABLE III. REGRESSION RESULTS

Variables	**Whole**		**East**		**North**		**South**	
Model	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
C	3.578	-3.419	-10.898	-4.708	4.465	24.320	16.703	1.699
LNK	0.622	0.424	0.205	0.282	0.235	0.801	0.655	0.192
LNL	0.238	1.065	1.961	1.293	0.623	-1.776	-0.784	0.802
LNLQ	-0.732	-0.279	-0.546	-0.821	0.690	0.169	-0.023	0.193
LNNX		0.305		-0.265		-0.206		-0.042
LNGE		0.421		0.125		-0.323		0.342
LNINS		-0.569		0.000		1.237		1.132
R2	1.000	1.000	0.994	0.998	0.976	0.996	1.000	0.999
Adjusted R2	1.000	1.000	0.990	0.994	0.965	0.989	1.000	0.998
F	18656.380	23513.480	306.977	236.810	82.540	142.065	36842.420	926.182
P	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000

Compared with model A and model B, most of the variables are significant at different statistical levels, which is consistent with the initial assumption in this paper. From the result of the overall regression of Xinjiang, the marginal benefit of the agglomeration of the logistics industry to the economic growth is -0.279. The reason is that most of the land states in Xinjiang are resource-based cities and the industrial structure is not very reasonable, which has the high concentration of the logistics industry. The regression coefficient of the proportion of industrial structure is negative, which indicates that the ratio of the output value of the whole primary industry to the secondary and tertiary industries in Xinjiang has no significant effect on the economic growth.

From a regional perspective, because of the different level of development in each region, the estimation coefficients of the explanatory variables are also different. First of all, logistics industry agglomeration, the regression coefficient of North Xinjiang and South Xinjiang is positive, the regression coefficient of East Xinjiang is negative value. It shows that the logistics industry agglomeration has a significant impact on the economic development of North Xinjiang and South Xinjiang region. The marginal elastic coefficients are 0.169% and 0.193%. Logistics industry agglomeration has no significant effect on the economic development of eastern Xinjiang and the marginal elasticity coefficient is -0.821%. This shows that there are regional differences in the spillover effect of logistics industry agglomeration on economy. Through the analysis of the results and the review of the literature, it has been learnt that the agglomeration of logistics industry has little effect on the economic spillover effect, because there are abundant resources in the lower part of the Xinjiang region, and its industrial development depends on its resource-based industry. Although it can be seen that some regions are very high in terms of location entropy, their structure is unbalanced. With the depletion of resources and the development of economy, the spillover effect of logistics industry agglomeration on economic development has been weakened.

C. Exploratory Data Analysis

This article chooses the total value of the logistics industry of 85 counties and cities in Xinjiang for 10 years as

the attribute value, of which X_i needs to be adjusted to eliminate price index factors based 2006 data. Spatial weight matrix selects $K-nearest$, k=1. Put X_i in (6, 7) and calculate the value of $Moran'sI$、Z、P.

TABLE IV. MORAN'S I AND INSPECTION VALUE

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
I	0.243	0.259	0.294	0.294	0.289	0.309	0.308	0.306	0.337	0.283
Z Value	1.884	2.001	2.261	2.263	2.229	2.381	2.375	2.361	2.594	2.191
P Value	0.060	0.045	0.024	0.024	0.026	0.017	0.018	0.018	0.010	0.028

"Table IV" shows the Moran's I value of Xinjiang logistics industry as a whole is positive from 2007 to 2016 and the test results are significant. This indicates that Xinjiang regional logistics industry does exists this significant spatial autocorrelation and the spatial distribution of logistics industry among different regions doesn't show randomness, but a positive correlation relationship, which is a spatial agglomeration of similar values. In 2009, 2010 there was no obvious change in output value, so the Moran index had a small difference. From the overall change trend, after 2011, there was a trend of growth and there was a decline in 2016.

In order to further compare the spatial change characteristics of logistics industry in Xinjiang, three time points of 2007, 2010, and 2016 were selected to compare and analyze.

Figures indicate that the spatial autocorrelation of regional logistics development in Xinjiang. In 2007, Karamay, Hutubi, Changji, Urumqi, Shanshan, Hami and Yiwu were significant at 0.01 level. Karamay, Hutubi County, Changji City, Urumqi City and Shanshan County are located in the High-High concentration area. That is the high value surrounded by the high value and indicates that the logistics development level in these areas is higher, which well drives the economic development of the surrounding areas. Hami is in the High-Low region, which the high value is surrounded by the low value. On the contrary, Yiwu County is in the Low-High region, which is the low value is surrounded by the high value. This indicates that the level of logistics industry agglomeration in Hami City is high, which is different from the economic development level of the surrounding areas and has little driving effect on the surrounding areas. In 2010 only Karamay and Urumqi are significant. They are in the High-High region and all the other counties and cities have no significance. In 2016 only Urumqi is significant.

Through the above analysis, it is found that the economic growth of each region is influenced not only by its own economic level, but also by the economic development of the surrounding areas, showing different agglomeration patterns at different stages. On the other hand, the spatial spillover effect of economic growth among cities in Xinjiang is not significant, which mainly depends on the driving effect of the cities with good economic development on the backward surrounding cities. But the effect of logistics industry agglomeration in Xinjiang shows a trend of gradual weakening. This kind of drive has little effect.

IV. CONCLUSION

There are spatial agglomeration phenomena and differences in the development of logistics industry in Xinjiang. The whole logistics industry in Xinjiang has no significant economic spillover effect on economy, but there are obvious spatial differences among different regions. From the regional point of view, the logistics industry in North Xinjiang and South Xinjiang has a significant spillover effect on economic growth. The regional logistics industry in Xinjiang has agglomeration effect and positive autocorrelation, which shows a weakening trend. The spillover effect of inter-regional agglomeration is not very obvious, and the high-value region has little driving effect on the surrounding area.

There is great economic demand in the construction of the Silk Road Economic Belt. Xinjiang's existing economic zone should play its economic advantages, cooperate extensively with the logistics industry and other industries in the surrounding region or surrounding countries, and gradually realize the development of the regional economy. According to the exploratory data analysis, it can be seen that the driving effect of high-value area to low-value area in Xinjiang is not reflected yet, so it is necessary to exert the spillover effect of cities. With the capital Urumqi as the core, Kulla, Hami, Horgos and Kashgar as the center, a fast logistics channel connected internally and externally is formed. With existing logistics facilities such as warehousing, distribution, packaging, processing and trans-shipment distribution, it is attached to road freight hub and railway logistics center in important logistics node cities and ports such as Urumqi, Horgos, Kashgar, etc. freight transit airport. Then build a batch of cargo pivot type, port service type and comprehensive logistics park, enhance the professional of logistics gathering.

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