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Study on the Spatial Pattern and Driving Factors of China A-Class Logistics Enterprises

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ABSTRACT

In this paper, exploratory spatial data analysis (ESDA) and spatial econometric model are used to study the distribution characteristics and driving factors of A-class logistics enterprises. The results show that A-class logistics enterprises in the provincial and urban scale show a "strong East and weak west" situation, and each driving common factor has a significant positive effect on the development of local A-class enterprises. The regional comprehensive economic strength has the greatest direct impact on the development of local A-class logistics enterprises, while the demand of logistics itself and the status of infrastructure have a relatively small impact. However, they all show no significant negative spillover effect. According to the analysis results, this paper also puts forward corresponding countermeasures and suggestions.

KEYWORDS: *A-class logistics enterprises; ESDA; Spatial Durbin Model; Spillover Effects*

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1. INTRODUCTION AND LITERATURE REVIEW

Logistics industry is an indispensable service supporting industry in the development of modern social economy. It plays an increasingly important role in promoting economic development. In order to guide the development of logistics enterprises and standardize the development of logistics industry, the General Administration of Quality Supervision and Inspection and the State Standards Committee issued the Standard of Classification and Evaluation Indicators for Logistics Enterprises in 2005, and the China Logistics and Procurement Federation carried out the comprehensive evaluation of A-level logistics enterprises. By February 2018, 25 batches of A-level logistics enterprises had been issued. Logistics enterprises. The influence of A-level logistics enterprises is also gradually expanding. Now A-level logistics enterprises have become the backbone of leading the development of logistics industry. Therefore, it is necessary to analyze the spatial layout characteristics and influencing factors of A-level logistics enterprises.

At present, scholars at home and abroad have done a lot of research on the spatial layout of logistics enterprises and its driving factors. From the research scale, the related research mainly focuses on the national, regional and urban scales. From the research point of view, Han Zenglin and Wang Guanxian studied the layout and location factors of logistics enterprises from the macro perspective.

However, only two papers about the spatial pattern of A-level logistics enterprises were retrieved at present: Jiang Tianying et al. analyzed the spatial pattern characteristics and formation mechanism of A-level logistics enterprises in Zhejiang Province; Wang Chengjin et al. studied the spatial layout characteristics of A-level logistics enterprises in China at different scales and discussed the formation mechanism of the differences in enterprise layout. The two papers mainly focus on descriptive analysis, but do not study the relationship between the number of A-level enterprises and their influencing factors from the perspective of model. In addition, the research data of Wang Chengjin et al. were updated to July 2012, totaling 1855 A-level enterprises. In the past five years, with the rapid development of economy and logistics industry, there are more than 4000 A-level logistics enterprises in China. Therefore, it is necessary to further study their spatial layout characteristics.

This paper mainly uses the exploratory spatial data (ESDA) method to analyze the spatial layout characteristics of China's A-level logistics enterprises from the provincial administrative and urban unit scales, and then uses the spatial econometric model to further measure the relationship between the number of A-level logistics enterprises and their driving factors. The research results of this paper can further enrich the literature on the spatial layout of A-level logistics enterprises, fill in the blank of quantitative analysis, and provide some reference for the layout and location selection of logistics enterprises.

2. Data and method description

2.1. Data Sources

The Chinese Federation of Logistics and Purchasing regularly updates the list of Class A logistics enterprises on its official website, which includes only the names of enterprises and cross-sectional data of all provinces and cities but does not involve time information. In this paper, the network crawler technology is used to obtain the A-level enterprise catalogue from the official website, which will be acquired on February 1, 2018. The data of driving factors influencing the layout of A-level logistics enterprises are obtained through statistical yearbooks at all levels, and the index values of 2016 are selected to reflect the development level of relevant provinces and municipalities.

2.2. Exploratory Spatial Data Analysis

ESDA is a set of spatial descriptive analysis methods. Its main purpose is to study spatial autocorrelation or spatial dependence of spatial data, including global and local spatial autocorrelation. Using ESDA method to study the spatial pattern of logistics industry development, refer to Weng Gangmin et al.

Since global Moran's I statistics can not reflect the degree of local spatial correlation and difference between specific regions, Moran scatter plot should be introduced to compensate for this shortcoming. Moran scatter plot shows the standardized variable value Xi and the weighted average value of its surrounding area in the form of scatter plot. The scatter plot can be divided into four quadrants. The local agglomeration can be judged according to the quadrant of the point. The relevant literature can refer to Zeng Zhaofa et al..

2.3. spatial econometric model

According to the spatial cross-section data, the commonly used econometric models can be divided into spatial lag model, spatial error model and spatial Durbin model. The spatial lag model mainly involves the spatial lag of dependent variables, while the spatial error model mainly involves the lag of error items. Tang Jianrong et al. pointed out that the spatial Durbin model (SDM) involves both the intrinsic and the spillover effects of intraregional and extraregional independent variables. Therefore, this paper uses SDM model to measure the spatial mechanism between the A-level logistics enterprises and the driving factors.

3. Spatial pattern characteristics of A-level logistics enterprises

In this paper, the idea of studying the spatial pattern characteristics of A-level logistics enterprises is to describe the spatial distribution of A-level logistics enterprises from provincial administrative areas and urban units respectively, and then analyze the spatial agglomeration characteristics of A-level logistics enterprises by ESDA method.

3.1. Description and Analysis of Enterprise Spatial Pattern

The number of A-level logistics enterprises is summarized by provincial administrative districts, and the spatial distribution map is shown in Figure 1. From Figure 1, we can see that the spatial distribution of A-level logistics enterprises has certain spatial agglomeration. Except for Taiwan Province, every provincial administrative district in China has logistics enterprises with A-level certification, but the distribution of A-level logistics enterprises in the whole country is obviously "strong in the east, weak in the west" and there are significant differences. There are more than 100 A-level enterprises in 12 provincial regions in China, mainly concentrated in eastern China, Guangdong Province and Lianghu area, of which 10 logistics-developed provinces are geographically clustered into a continuous area; Sichuan Province, as an important junction of Northwest, Southwest and Central China, and as a sea passage of the three northeastern provinces. Liaoning Province also gathers more than 100 A-level logistics enterprises; however, in China's border provinces, such as Heilongjiang, Hainan, Guangxi, Tibet and other regions, the distribution of A-level enterprises is relatively sparse, especially in Tibet, there is only one A-level logistics enterprises. Overall, provinces with a large number of A-level logistics enterprises have relatively high level of economic development.

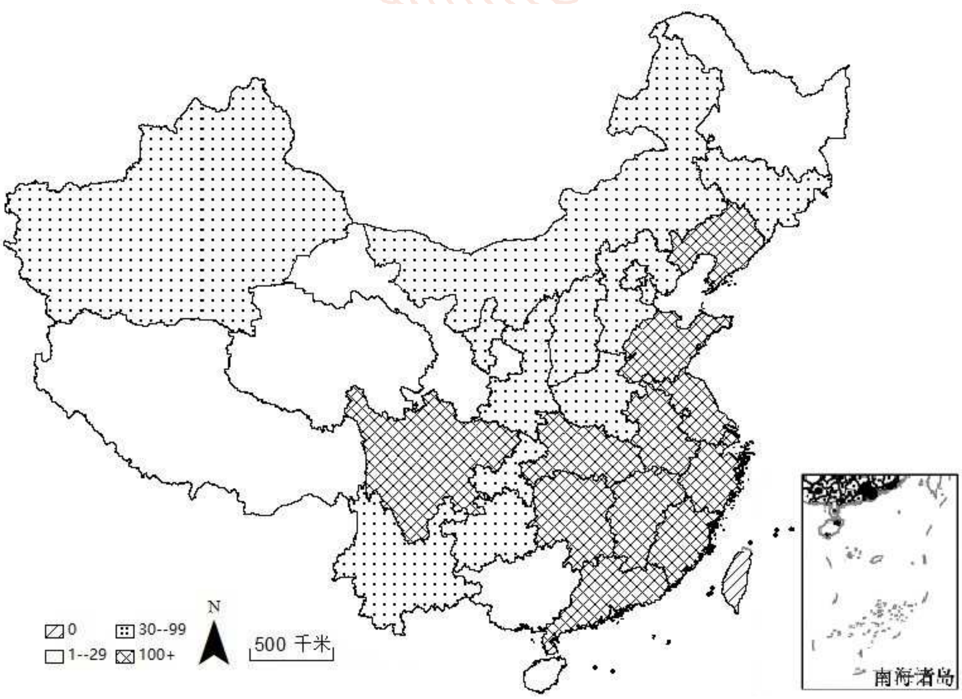

Fig.1 Spatial Distribution Map of Provincial Scale of A-level Logistics Enterprises in China

Through a simple summary of the list data of A-level logistics enterprises, a total of 4002 enterprises are distributed in 253 cities above the level. These developed logistics cities are all central cities or freight transit cities, their economies are often more developed and have a larger freight volume. The distribution of A-level logistics enterprises on the urban scale also shows great differences, and on the whole, it also shows the trend of "strong in the East and weak in the west", mainly forming six agglomeration areas: the northeast area led by Changchun, the Beijing Tianjin Hebei area led by Beijing, the Yangtze River Delta area led by Shanghai, the central China area led by Wuhan. Sichuan-Chongqing region headed by Chengdu and Pearl River Delta region headed by Guangzhou-Shenzhen. The Yangtze River Delta region has the largest number of A-level enterprises, accounting for 31% of the whole country. Among them, Suzhou, Ningbo and Shanghai have more than 180 A-level enterprises, even exceeding the number of enterprises in most provinces and regions of the country (Figure 1). The sparse areas of A-level logistics enterprises in urban scale are also mainly concentrated in China's border areas, such as Tibet, Qinghai, Inner Mongolia, Heilongjiang and other provinces where there are large number of prefecture-level cities without A-level logistics enterprises.

3.2. Spatial pattern analysis based on ESDA

The Moran's I index and P value of A-level logistics enterprises at provincial and urban scales are 0.382 (< 0.001) and 0.33 (< 0.001), respectively. From this, it can be seen that A-level logistics enterprises show significant positive spatial correlation at provincial and urban scales. According to the quadrants in Moran scatter plot of provinces and cities, their spatial agglomeration forms can be determined. At provincial scale, 26% and 55% of provincial areas fall in the first and third quadrants, 10% and 6% in the second and fourth quadrants, respectively. It shows that the spatial correlation model of A-level logistics enterprises at provincial scale is mainly positive correlation H-H and L-L, and the spatial unit values show little homogeneity. Some provinces and regions show negative correlation L-H and H-L models, and spatial unit values show heterogeneity. On the urban scale, 13% and 60% of cities fall in the first and third quadrants, 18% and 9% in the second and fourth quadrants, respectively. The spatial correlation patterns of A-level logistics enterprises on the urban scale are mainly positive correlation H-H and L-L. Therefore, A-level logistics enterprises are not independent at provincial and urban scales, and there is a certain spatial correlation.

4. Driving factors and spillover effects

Through the study of the spatial pattern characteristics of A-level logistics enterprises in China, we can see that A-level logistics enterprises show significant positive spatial correlation at provincial and urban scales. The development of economy and logistics industry in the central area often promotes the development of its adjacent areas. However, the central area has greater attraction to the resources of the surrounding areas and then inhibits the development of the adjacent areas. The specific comprehensive effect can be measured by the spatial econometric model. Because there are still about 110 prefecture-level cities that haven't been certified as A-level logistics enterprises, and there is a certain degree of lack of driving factors variable value at the city scale, this paper only establishes a spatial econometric model at the provincial and regional scale to study the driving factors affecting the development of A-level enterprises, and measures the space of driving factors.

In the process of spatial Durbin model building, the number of provincial A-level logistics enterprises is taken as dependent variable, and the driving factors are taken as independent variable. Dependent variables are integers. Log logarithmic transformation is done to meet the distribution requirements of model dependent variables. Because the values of each variable are quite different, standardized transformation is made for the convenience of reflecting the importance of each variable through model coefficients. In the process of modeling, the forward and backward stepwise regression methods are used to select the driving variables. In seven SDM models with only one driving factor index, each driving factor and its lagging term WX can only have a significant level of 0.05. In seven SAR models with only one driving factor and no lag term, all driving factors are extremely significant (p-value < 0.0026). The calculation shows that the driving factors and their lag terms have strong negative correlation, and the absolute values of the coefficients are all above 0.6. When more than two driving factors and their lag terms are put into SDM model, there are few more independent variables that are significant at 0.05 significant level and lag terms are significant at 0.05 significant level in many models. Similar cases are also found in SAR models with only two or more driving variables. After calculation, there is a strong positive correlation among the seven driving factors, and the coefficients are concentrated between 0.6 and 0.97. To sum up, it is difficult to build SDM and SAR models with more information about driving factors effectively because of the multiple collinearity among independent variables, independent variables and their lag terms.

In order to avoid the influence of multiple collinearity of independent variables, this paper makes factor analysis of the seven driving factors with high correlation, and establishes SDM or SAR models for the extracted common factors. Since there are only seven variables and the contribution rate of the first three independent variables' cumulative variance has reached 93%, only three common factors are extracted in this paper, and the maximum variance method is used to rotate the factor load matrix orthogonally so that the factor can be named and interpreted. The corresponding factor load matrix is shown in Table 3. Table 3 shows that the first factor has a higher load on economic strength, service industry development level, industrial development level and science and technology development level, which explains that it mainly explains the four driving factors, so it can be called comprehensive economic strength factor; the second factor has a higher load on the development level of logistics industry and the level of opening to the outside world. This factor mainly reflects the factors of goods circulation, so it can be called the level factor of logistics demand; the third factor only has a higher load at the level of infrastructure, which shows that this factor mainly reflects the factors of infrastructure, so it can be named as the level factor of infrastructure.

In SDM model and SAR model, this paper tries to establish SDM model with three common factors extracted as independent variables, and put the spatial lag term WX of factor independent variables into the model. The results show that only the comprehensive strength factor is significant at the level of 0.01, while the other factors and three lag terms are not significant. In the SAR model with lag term, all three factors were significant ($p < 0.05$). After calculation, there is a high positive correlation between the three factors lag ($r > 0.73$), and there is a certain negative correlation between the three factors and their respective lag items, as well as between the three factors and other factors lag items. In order to avoid the multiple collinearity and find the real influential factors, this paper finally establishes the SAR model.

Unlike linear regression model, in SDM and SAR models, the coefficient of independent variable does not represent its marginal elasticity. This is due to the lag term of dependent variable, which leads to the feedback effect of independent variable on dependent variable. In Table 4, the direct effect reflects the influence of local driving factors on the development of A-level logistics enterprises, which includes the effect after direct impact and feedback adjustment; the indirect effect reflects the influence of local driving factors on the development of A-level logistics enterprises in the surrounding areas, and the total effect is the sum of direct effect and indirect effect.

The following conclusions can be drawn:

1. Regional comprehensive economic strength is the main driving force affecting the number of regional A-level logistics enterprises. Firstly, the coefficient of comprehensive strength factor in the model is positive and has passed the 1% significance test, which shows that the development of comprehensive economic strength has a significant role in promoting the number of A-level logistics enterprises. Secondly, the direct impact coefficient of this factor is 0.65, and through 10% significance test, it shows that the improvement of comprehensive economic strength can directly and effectively promote the development of local A-level logistics enterprises; the indirect effect of this factor is - 0.33, which has not passed the significance test, indicating that the development of regional comprehensive economic strength will inhibit the development of peripheral A-level logistics enterprises. The development of logistics enterprises, but this role is not obvious. This is mainly because the comprehensive economic advantage areas tend to have more logistics business volume, which will attract the entry of various resources in the neighboring areas, thus restricting the development of logistics enterprises in the surrounding areas.

2. The level of logistics demand is an important driving force for the development of A-level logistics enterprises. Firstly, the factor of logistics demand level is positive and passes 5% significance test, which shows that the growth of logistics demand is helpful to promote the development of A-level logistics enterprises. Secondly, the direct effect of this factor is 0.26. Through 10% significance test, it shows that logistics demand will directly promote the development of local A-level logistics enterprises; the indirect effect coefficient of this factor is -0.13, which fails to pass the significance test, indicating that the growth of regional logistics demand will inhibit the development of peripheral A-level logistics enterprises, but this kind of factor can inhibit the development of peripheral A-level logistics enterprises. The effect is not obvious. This is because the demand of regional logistics business will bring about the growth of the number of logistics enterprises, and also promote the local A-level logistics enterprises to continuously improve the level of software and hardware and the operational efficiency of enterprises, and to be in a favorable position in the market competition with the logistics enterprises in the surrounding areas.

3. The level of infrastructure is an important guarantee for the development of A-level logistics enterprises. Firstly, the factor of infrastructure level is positive and passes 5% significance test. In addition, the direct effect of this factor is 0.34. The significance test of 10% indicates that the level of local logistics infrastructure construction will directly and effectively promote the development of local A-level logistics enterprises, but the indirect effect of this factor is - 0.17 but not significant. The reason is that regional logistics infrastructure helps logistics enterprises to carry out business and reduce logistics transportation costs. It has more advantages than the surrounding areas in attracting logistics enterprises' layout and investment. This also confirms the conclusion drawn by Tang Jianrong et al. [19] spatial modeling: the level of infrastructure in this region has a significant negative spillover effect on the development of logistics industry in the surrounding areas.

4. The direct effect of comprehensive economic strength is the main cause of the spatial pattern of A-level logistics enterprises. Firstly, in the model, the indirect effects of each factor are not significant, reflecting that the development of A-level logistics enterprises is mainly influenced by local driving factors. Secondly, the direct effect value of the comprehensive economic strength factor is far greater than the other two factors, which shows that the spatial pattern of A-level logistics enterprises is mainly affected by the local comprehensive economic development level, while the logistics demand itself and its infrastructure level have less influence. This result is consistent with the result of description and analysis in the third part of this paper, that is, provinces and cities with more A-level logistics enterprises tend to have a higher level of economic development, and it is difficult for underdeveloped regions to form a phenomenon of high concentration of logistics enterprises.

5. conclusions and suggestions

This paper uses ESDA method to analyze the spatial pattern of A-level logistics enterprises, and on this basis, uses spatial econometric model to study the relationship between the spatial layout of A-level logistics enterprises and their driving factors. To solve the problem of multiple collinearity among the seven driving factors, this paper extracts three common factors by factor analysis method and finally establishes a spatial lag model based on the common factors. The research finds that: (1) The distribution of A-level logistics enterprises in provincial and urban scales shows the trend of "strong in the East and weak in the west", forming the concentrated areas in coastal, central and Eastern inland areas and the sparse areas in border areas; A-level logistics enterprises are mostly concentrated in economically developed provinces, and cities with more A-level logistics enterprises tend to be economic or cross-border. Tong is relatively developed. (2) China's A-level logistics enterprises show significant positive spatial correlation at provincial and urban scales, and the agglomeration form of A-level logistics enterprises at provincial and urban scales is mainly positive correlation of high-level agglomeration and low-level agglomeration. (3) In the model analysis of driving factors, the three common factors of regional comprehensive economic strength, logistics demand level and infrastructure level have significant positive effects on the development of A-level logistics enterprises, but they have no significant negative effects on the development of logistics enterprises in the surrounding areas; from the model results, regional integration Economic strength has the greatest direct impact on the development of local A-level logistics enterprises, while the demand of logistics itself and the status of infrastructure have relatively small impact.

According to the conclusions of the study, four suggestions are put forward as follows:

1. Pay attention to spatial relevance and promote the linkage development of logistics enterprises.

   We should give full play to the advantages of regional central cities and economically developed cities in terms of economic strength, openness, logistics demand and policy, radiate and drive the linkage development of logistics enterprises in surrounding regions, and promote the logistics enterprises in their regions by means of the connectivity in geographical space and the activity in economic and trade exchanges of logistics developed provinces. Optimizing the organizational structure, improving the company's operational efficiency and enhancing the competitiveness of enterprises in the market, so as to realize the efficient and orderly development of logistics industry; relying on the leading position of the Yangtze River Delta urban agglomeration in the development of logistics enterprises, promoting the cooperation of logistics enterprises and the development of logistics industry clusters in its region, and also drawing lessons from logistics enterprises in the Yangtze River Delta region Developing experience to promote the coordinated development of logistics enterprises in the Pearl River Delta, Beijing, Tianjin and Hebei regions.

2. Pay attention to the direct effect of space and enhance the competitiveness of logistics enterprises in the market.

   Regional comprehensive economic strength, logistics demand level and infrastructure level all play an active role in promoting the development of logistics enterprises. Therefore, we should make full use of the development of China's economy and science and technology, constantly explore new growth points of logistics demand, constantly promote the innovation of logistics related technologies, and constantly improve the level of logistics services. To achieve rapid and sound development of logistics enterprises, we should promote the construction of transportation infrastructure such as highways and railways, constantly optimize the road network layout, and fully guarantee the high-speed development of logistics industry and logistics enterprises in China.

3. Pay attention to the spatial spillover effect and promote the coordinated development of regional logistics enterprises.

   Common factor indicators of driving factors have negative spillover effects on the development of logistics enterprises in surrounding areas. Therefore, it is necessary to break through the restrictions of administrative boundaries, actively promote the unified planning of interregional logistics development, accelerate the optimization of regional road network structure and the construction of logistics infrastructure, and actively organize logistics enterprises to participate in various exchanges. Actively, promote enterprises to build logistics information sharing platform, promote collaboration and cooperation among regional logistics enterprises to achieve complementary advantages; increase investment in scientific and technological research and development of logistics industry, promote technical cooperation exchanges among regional logistics enterprises, find more space spillover channels, and actively promote the formation of driving factors for the development of logistics enterprises in surrounding areas. Positive spillover effect, and then realize the coordinated development of regional logistics enterprises.

4. Pay attention to the direct effect of comprehensive economic strength and optimize the spatial distribution of logistics enterprises.

   Regional comprehensive economic strength has the greatest direct impact on the development of local A-level logistics enterprises, while the demand of logistics itself and the status of infrastructure have relatively small impact. When planning the regional layout of logistics enterprises, the government and enterprises should pay full attention to and give full play to the pulling effect of the comprehensive development level of local economy on the development of logistics enterprises, and use the momentum of local economic development to enhance the business capability of logistics enterprises. At the same time, they should be fully aware of the passive dependence on the surrounding regional economy and logistics. The development of the industry is not conducive to the local logistics enterprises to achieve a forward-looking grasp of the market and promote the process of enterprise specialization independently.

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