# Spatial Autocorrelation Analysis of the Concentration Level of Logistics Industry in Beijing-Tianjin-Hebei urban Agglomeration

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**Abstract:** The "13th Five-Year Plan" outline once again proposes to improve the modern integrated transportation system and improve the overall efficiency of transportation and logistics. Promoting the agglomeration of the logistics industry is in line with the current economic development of the Beijing-Tianjin-Hebei urban agglomeration and the long-term development of the logistics industry. In this paper, the global spatial autocorrelation analysis method is used to calculate Global Moran's I of the logistics industry concentration level of Beijing-Tianjin-Hebei urban agglomeration. In addition, the Moran scatter plot is used to analyze the local spatial correlation of the logistics industry agglomeration level of the Beijing-Tianjin-Hebei urban agglomeration. The results show that the logistics industry agglomeration level of Beijing-Tianjin-Hebei cities presents a significant spatial positive correlation, and the areas with similar levels of logistics industry agglomeration are significantly concentrated in geography. From the whole research period (2009-2016), the spatial distribution pattern of regional economic development in Beijing-Tianjin-Hebei has undergone major changes. These changes were mainly completed in 2009-2012. Starting from 2012, the Beijing-Tianjin-Hebei urban agglomeration logistics industry began. The spatial distribution pattern has gradually stabilized.

## 1. Introduction

In recent decades, the state has implemented a series of policy and institutional reforms to promote social and economic development. This has provided a new management method, organizational structure and business philosophy for the stable development of the logistics industry. Industrial agglomeration is a common phenomenon in economic activities and an important force for promoting regional economic growth. It has become a hot topic at home and abroad. The accumulation of logistics industry is the result of the development of regional economy to a certain level. The development of economy has stimulated the demand for more logistics services, thus the development of the animal industry and the formation of agglomeration. Industrial agglomeration is generally positive for the entire industry and enterprises. It promotes the integration of multiple individual entities into the same regional specialized market to form industrial cluster development. At the same time, the accumulation of logistics industry in turn serves the development of regional economy. Marshall [1]analyzes the causes of agglomeration from the perspective of knowledge spillover, labor market development and input sharing; Krugman[2] analyzes the economies of scale brought about by the spatial clustering of economic activities to explain the agglomeration of the same industry; Krugman and Venables[3] view the input and output With the help of the vertical link model, the reasons for the spatial clustering of upstream and downstream industries are explained. Niebuhr[4] used Harris' market potential formula to analyze the concentration of European industries from 1995 to 2000; Ellision [5] analyzed the spatial agglomeration characteristics of the US manufacturing industry from 1972 to 1997 by constructing industry agglomeration indicators; The EG Index established a regional agglomeration indicator system to explore the regional concentration of China's manufacturing industry in 1998-2003. The Haaland [6] study is aimed at 35 manufacturing industries in 13 countries of the European Union. The research data is for a period of

6 years and the data is scientific and reliable. In this paper, the global Moran index and Moran scatter plot are used to analyze the spatial autocorrelation of logistics industry agglomeration level, and the current situation of logistics industry cluster space in Beijing-Tianjin-Hebei urban agglomeration is obtained.

## 2. Research Models and Methods

Global Moran's I am often used to analyze the spatial correlation of regional populations. The calculation formula is:

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

Moran scatter plots are often used to analyze the spatial correlation of local regions. The spatial relationship of the local area is divided into four types: HH, LH, LL, and HL through four quadrants. See Table 1 for details.

Table 1. Moran scatter plot spatial relationship

| Quadrant | City itself | Nearby Cities | Spatial association |
|---|---|---|---|
| First quadrant（HH） | High level of agglomeration | High level of agglomeration | Larger |
| Second quadrant（LH） | Low level of agglomeration | High level of agglomeration | Smaller |
| Third quadrant（LL） | Low level of agglomeration | Low level of agglomeration | Larger |
| Fourth quadrant（HL） | High level of agglomeration | Low level of agglomeration | Smaller |

## 3. Results and Analysis

### 3.1 Global Spatial Autocorrelation Analysis of Beijing-Tianjin-Hebei Logistics Industry Agglomeration Level

The global spatial autocorrelation analysis method was used to calculate Global Moran’s I of the logistics industry concentration level of the Beijing-Tianjin-Hebei urban agglomeration. The results are shown in Table 2. From 2007-2016, Global Moran's I am greater than 0, and the P value is less than 0.05. That is, the global Moran's I of the Beijing-Tianjin-Hebei urban agglomeration logistics industry is significantly positive, and the logistics of the cities in the Beijing-Tianjin-Hebei region. The level of industrial agglomeration presents a significant spatial positive correlation, and the areas with similar levels of logistics industry agglomeration are significantly concentrated in geospatial.

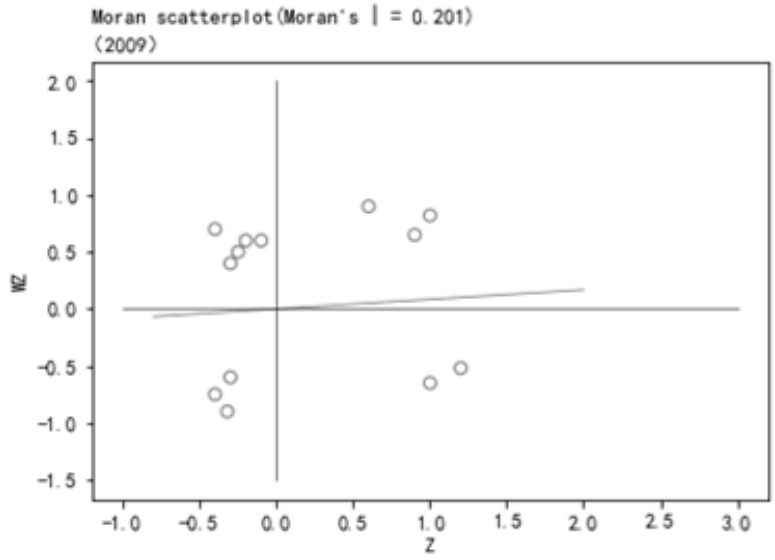
Table 2. Global Moran's I of the concentration of logistics industry in Beijing-Tianjin-Hebei urban agglomeration

| | I | E(I) | P-value |
|---|---|---|---|
| 2007 | 0.180 | -0.083 | 0.023 |
| 2008 | 0.174 | -0.083 | 0.005 |
| 2009 | 0.201 | -0.083 | 0.004 |
| 2010 | 0.195 | -0.083 | 0.003 |
| 2011 | 0.210 | -0.083 | 0.005 |
| 2012 | 0.218 | -0.083 | 0.017 |
| 2013 | 0.203 | -0.083 | 0.003 |
| 2014 | 0.225 | -0.083 | 0.006 |
| 2015 | 0.219 | -0.083 | 0.029 |
| 2016 | 0.246 | -0.083 | 0.024 |

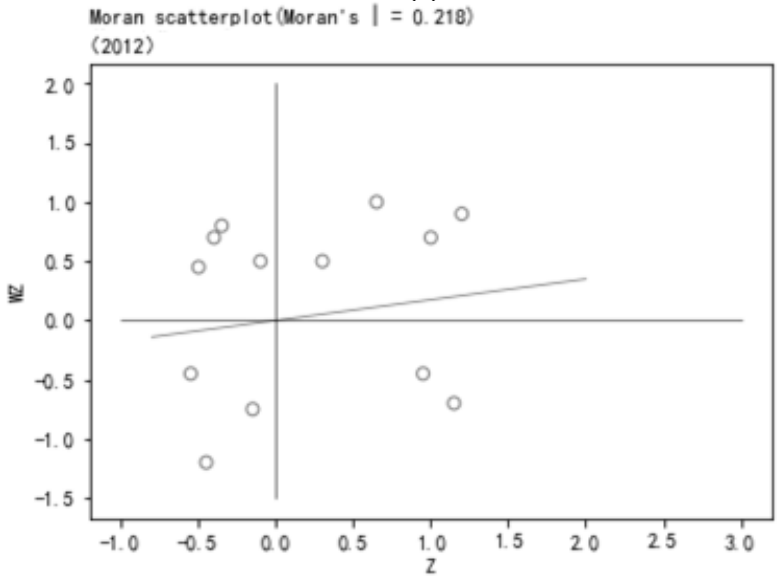
On the whole, the Global Moran's I value of the Beijing-Tianjin-Hebei urban agglomeration is generally showing a steady upward trend. During this period, the growth rate of traditional industries declined in 2013. Most of the urban industrial structure of Beijing-Tianjin-Hebei urban agglomeration except Beijing-Tianjin was mainly based on traditional manufacturing. The economic development frustrated led to the stagnation of the logistics industry; while the Beijing-Tianjin region took the lead in responding. Industrial transformation and upgrading, actively developing modern service industry, the logistics industry is developing steadily and rapidly, the intensification and scale effect of the logistics industry is enhanced, and the spatial heterogeneity of the degree of logistics industry aggregation among cities in the Beijing-Tianjin-Hebei region is gradually increasing. Moran's I reached the corresponding low point of 0.203. In 2010-2016, the value of Global Moran's I showed a relatively rapid increase. In 2012, China's economy entered a period of growth and shift, and the spatial heterogeneity of the level of logistics industry aggregation among cities in the Beijing-Tianjin-Hebei region is slowly narrowing. In recent years, under the background of the "new normal" of the economy, China's economic downward pressure has increased, the growth rate of logistics demand has slowed down, and the pressure on the transformation and upgrading of the logistics industry has increased. The value of Global Moran's I has shown a volatility.

### 3.2 Local Spatial Autocorrelation Analysis of Beijing-Tianjin-Hebei Logistics Industry Agglomeration Level

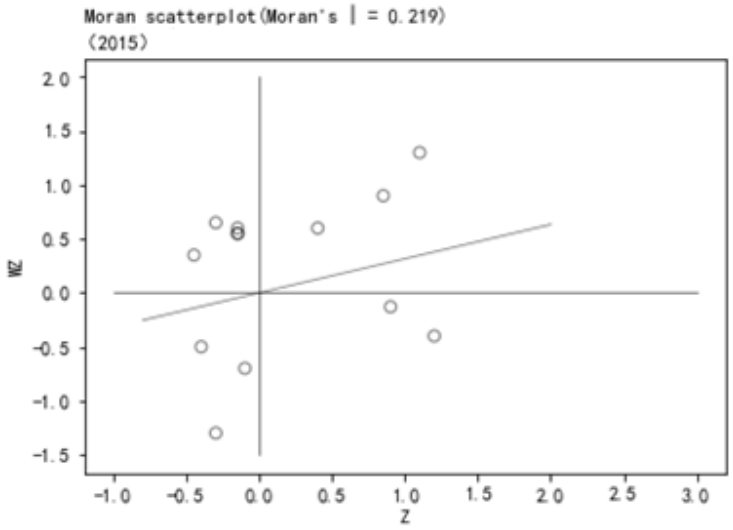
Although the analysis of the global autocorrelation has judged whether there is spatial correlation in the economic development of Beijing-Tianjin-Hebei, it cannot deeply resolve the specific location of spatial clustering, and it is very likely to hide the turbulence of certain regions. Local autocorrelation analysis can make up for this disadvantage of global spatial autocorrelation analysis. Therefore, this study uses Moran scatter plot method to comprehensively and thoroughly analyze the local spatial correlation of Beijing-Tianjin-Hebei urban agglomeration logistics industry agglomeration level analysis. In order to better compare the spatial correlation changes in 10 years, this study selects 2012 as the representative year for analysis, and uses the local spatial autocorrelation analysis method to calculate the Moran scattered of the 2012 Beijing-Tianjin-Hebei urban agglomeration. Point map, see Figure 1.




(a)




(b)




(c)

Figure 1 (a)(b)(c) Three years scatter plot of Beijing-Tianjin-Hebei logistics industry agglomeration

Table 3. Evolution of spatial pattern of logistics industry agglomeration level in Beijing-Tianjin-Hebei urban agglomeration from 2009 to 2016

| Year | H-H | L-H | L-L | H-L | Across two quadrants |
|---|---|---|---|---|---|
| 2009 | Beijing Tianjin Chengde | Langfang Xingtai Baoding Zhangjiakou Tangshan | Handan Cangzhou Hengshui | Qinhuangdao Shijiazhuang | |
| 2010 | Beijing Tianjin Chengde | Langfang Xingtai Baoding Zhangjiakou Tangshan | Handan Cangzhou Hengshui | Qinhuangdao Shijiazhuang | |
| 2011 | Beijing Tianjin Tangshan Chengde | Langfang Baoding Zhangjiakou | Handan Cangzhou Hengshui | Qinhuangdao Shijiazhuang | Xingtai |
| 2012 | Beijing Tianjin Tangshan Chengde | Langfang Xingtai Baoding Zhangjiakou | Handan Cangzhou Hengshui | Qinhuangdao Shijiazhuang | |
| 2013 | Beijing Tianjin Tangshan Chengde | Langfang Xingtai Baoding Zhangjiakou | Handan Cangzhou | Qinhuangdao ShijiazhuangHengshui | |
| 2014 | Beijing Tianjin Tangshan Chengde | Langfang Xingtai Baoding Zhangjiakou | Handan Hengshui | Qinhuangdao Shijiazhuang | Cangzhou |
| 2015 | Beijing Tianjin Tangshan Chengde | Langfang Xingtai Baoding Zhangjiakou | Handan Cangzhou Hengshui | Qinhuangdao Shijiazhuang | |
| 2016 | Beijing Tianjin Tangshan Chengde | Langfang Xingtai Baoding Zhangjiakou | Handan Cangzhou Hengshui | Qinhuangdao Shijiazhuang | |

According to Figure 1 and Table 3, the spatial aggregation characteristics of the horizontal distribution of logistics industry development in Beijing-Tianjin-Hebei urban agglomeration can be analysed.

(1) 2009: Beijing, Tianjin, and Chengde are located in the first quadrant, with the spatial characteristics of “high accumulation”. The spatial development of logistics industry between these cities is relatively large, and to some extent is a mutual Promote the development of the logistics industry. The city's own logistics industry has a high level of agglomeration and a high level of concentration of logistics industries around the city. This state of strong alliance will continuously promote the common progress and development of the logistics industry between the city itself and the surrounding areas, thus achieving a radiation effect and driving the development of surrounding cities. On the whole, about 46.2% of the cities are in the first and third quadrants, and the spatial homogeneity region is smaller than the spatial heterogeneity region, showing spatial positive correlation, which verifies the neighbouring regions in the global spatial correlation analysis. There is a spatially positive correlation analysis of economic development levels. 38.5% of the “HH” and “HL” types, and 61.5% of the “LL” and “LH” types, it is clear that the regions with higher economic development are less than those with low economic development. indicating that the overall spatial distribution is uneven.

(2) 2012: Beijing, Tianjin, Tangshan and Shijiazhuang are located in the first quadrant and are the core areas for economic development in the Beijing-Tianjin-Hebei region in 2010. On the surface, the areas in the first and third quadrants are comparable to those in the second and fourth quadrants, but Langfang spans the third and fourth quadrants and is more inclined to the third quadrant. What is still shown is the spatial positive correlation. 38.4% of the “HH” and “HL” types, and 53.8% of the “LL” and “LH” types, indicating that regions with higher levels of economic development are still less than those with low levels of economic development. The uneven distribution of spatial space did not improve in 2010.

(3) 2015: Beijing, Tianjin, Tangshan and Shijiazhuang are located in the first quadrant and are the core area for the economic development of the Beijing-Tianjin-Hebei region in 2015. On the whole, about 53.8% of the regions are in the first and third quadrants, while 30.76% are in the second and fourth quadrants, and the spatial homogeneity region is larger than the spatial heterogeneity region. The areas located in the “HH” and “HL” types accounted for 30.7%, while the “LL” and “LH” types accounted for 53.8%. It is thus known that areas with higher economic development levels are still lower than those with low economic development levels. Less, the uneven distribution of the overall space is still evident.

2009-2012: As can be seen from Table 3 and the above analysis, the situation of Beijing, Tianjin and Tangshan in the core area of Beijing-Tianjin-Hebei economic development did not change during 2009-2012, but the overall spatial pattern of the rest of the region has occurred relatively large. Adjustments and changes. The pattern of the development of the core area has not changed. To a certain extent, it shows that the radiation effect of the core area on the development of the surrounding areas is not obvious and has not been effectively exerted. In addition, it can be seen from the two-year scatter plot that the distribution of each region is increasingly discrete. This feature is particularly evident in the first quadrant, indicating the gap in economic development in some regions between regions with spatial positive correlations. As the situation continues to widen, the polarization phenomenon is gradually becoming serious. It is gratifying that although the regions with higher levels of economic development are still less than those with low levels of economic development, the gap between the two has narrowed, indicating that the imbalance in overall spatial distribution has slightly weakened. 2012-2015: From Table 3, the spatial distribution pattern of Beijing-Tianjin-Hebei regional economic development has not changed in 2010-2015. It is only fine-tuned in the original pattern, but the value of Moran's I index is relatively obvious. Upgrade. Comparing the 2010 scatter plot with that of 2015, it can be seen that the overall economic development level of Beijing-Tianjin-Hebei has a spatial distribution, but it is not the case in the first quadrant, but it is more discrete, indicating In the regions of the core regions, the gap in regional economic development has not narrowed, but has continued to expand. From the whole research period (2009-2016), the spatial distribution pattern of regional economic development in Beijing-Tianjin-Hebei has undergone major changes. Since 2012, the spatial distribution pattern has gradually stabilized, with only minor adjustments. It can be clearly seen from the Moran scatter plot

that the Moran's I value is not only relatively improved, but also spatially distributed from the original discrete state to the agglomerated state, and the spatial positive correlation of the entire Beijing-Tianjin-Hebei region is enhanced. In addition, the proportion of the regions with higher economic development levels in the entire Beijing-Tianjin-Hebei region continues to be lower than the regions with low economic development levels, and the overall spatial distribution imbalance continues to be significant.

## 4. The Conclusion

Through the analysis of this paper, the global spatial autocorrelation coefficient I shows a volatility trend in the period of 2009-2016, and the spatial heterogeneity of the logistics industry agglomeration level among cities in the Beijing-Tianjin-Hebei region is slowly shrinking. From the analysis of local spatial autocorrelation, it can be seen from the whole period of 2009-2016 that the spatial distribution pattern of the Beijing-Tianjin-Hebei urban agglomeration logistics industry has undergone major changes, especially in the previous period 2009-2012, the logistics industry. The spatial distribution pattern of agglomeration was improved in 2012, and there has been no significant fluctuation since then. It can be seen from the three-year Moran scatter chart that the logistics industry in each city has gradually gathered in the spatial distribution, and the logistics industry cluster in the whole region has been strengthened.

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