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The dynamic evolution of high-quality development of regional logistics industry

Rong Ma

School of Management, Xi'an University of Engineering, Xi'an 716300, China

Abstract: Order to clarify the current situation and changing trend of high-quality development of logistics industry, this paper explores the level and dynamic evolution of high-quality development of regional logistics industry with a Chinese sample. It is found that: The level of high-quality development of logistics industry in China as a whole and in all regions is on an upward trend, and the overall pattern shows that the eastern region is higher than the central and western regions, and the western region is the lowest, but the variability of the level of high-quality development of logistics industry in China first expands and then narrows, and there is a polarization phenomenon. Sub-regional observation: the difference in the level of high-quality development of logistics industry in the eastern and western regions is expanding, but the development of different provinces in the region is relatively coordinated, and the phenomenon of polarization does not appear. And the differences in the central region are also expanding, and the phenomenon of polarization has appeared.

Keywords: High-quality development of logistics industry; Dynamic evolution; Kernel density estimation.

1. Introduction

As an important part of the development of the real economy in different countries around the world, achieving high-quality development of the logistics industry can help inject new momentum into the economic development of different countries around the world. China is a large logistics country, but the traditional crude growth mode relying on factor scale expansion has led to the development of logistics industry with the characteristics of "large but not strong", and this low-quality development model is not sustainable, and its role in promoting industrial structure upgrading and optimization is increasingly weak. Therefore, in 2019, China's National Development and Reform Commission proposed the "Opinions on Promoting the High-Quality Development of the Logistics Industry to Promote the Formation of a Strong Domestic Market", pointing out that "accelerating the solution of the problem of unbalanced and insufficient development of China's regional logistics industry, promoting the high-quality development of the logistics industry is the way to promote the transformation of the development mode of the logistics industry, structural optimization and power transformation, and realize the transformation and upgrading of the logistics industry itself. The necessary path".

Regarding the research on high-quality development, the existing studies focus on three levels, including three aspects, such as the measurement of high-quality development level, the influencing factors of high-quality development, and the relationship between logistics industry and industrial structure upgrading. Among them, in the measurement of high-quality development in logistics industry, Gan et al. [1] constructed green logistics efficiency evaluation indicators based on the five development concepts of economy and society advocated by the Chinese government, namely "innovation, coordination, green, openness, and sharing", and analyzed the evolutionary characteristics of the high-quality development of green logistics efficiency in Jiangxi Province, China. Yan et al. [2] By establishing a high-quality economic development and logistics indicator system, using the coupled coordination model to measure the level of economic development and logistics high-quality development, and analyzing their coupled coordination degree, the study found that there are large regional differences in China in terms of economic high-quality development and logistics high-quality development and their coupled coordination degree. A. S Muradov and Z. S Atadzhanova [3] consider the level of quality of transport services, which depends to a large extent on the state of logistics infrastructure, as a very urgent issue. Caiming Zhang [4] established a panel data regression model based on the Cobb-Douglas production function model to analyze the relationship between logistics development and economic growth in each region of China. Futou Li [5] mainly derived the demand for regional logistics through a theoretical analysis of the relationship between regional logistics and regional economic development. Yan B. [6] and Guo Z. X. [7] sees logistics quality development Large regional differences exist.

In terms of research on the influencing factors of high-quality development, Niebel [8] studied the impact brought by ICT on the quality of economic development. Jahanger [9] studied the impact of FDI quality on the economic development of 30 inland provinces in China, and the findings showed that FDI quality has a significant impact on the quality development of China's economy. Liu et al. [10] used a dynamic spatial Durbin model to analyze the direct and indirect effects of environmental regulation on high-quality economic development and regional heterogeneity in China, and the study found that high-quality economic development in China is spatially correlated among different provinces. Amit Ghosh [11] explored the impact of globalization in the banking sector on the quality of economic development. Guo [12] and Xiao [13] measured and analyzed the trend of total factor productivity, regional differences and convergence characteristics from the microscopic perspective of enterprises, taking manufacturing and service industries as research objects respectively.

In view of this, this study draws on the five major development concepts of economy and society advocated by the Chinese government, and combines the connotation of high-quality development and the derivative characteristics of

logistics industry development, introduces the indicators related to regional economic development level to comprehensively construct a comprehensive evaluation index system for high-quality development of regional logistics industry, and measures the level change and dynamic evolution process of high-quality development of regional logistics industry in China.

2. Measurement of the level of high-quality development of China's regional logistics industry

2.1. Measurement index construction

This paper combines the connotation of high-quality development, and draws on the high-quality development of the economy and the evaluation index system of high-quality development of logistics industry, constructs the level of innovation and development of logistics industry, the level of coordinated development of logistics industry, the level of green development of logistics industry, the level of shared development of logistics industry, the level of open development of logistics industry, and further takes into account the derivative characteristics of logistics industry to introduce the level of regional economic development, a total of six primary indicators and 17 secondary indicators. The evaluation index system of high-quality development of logistics industry is based on six primary indicators and 17 secondary indicators. The comprehensive evaluation index system constructed in this study is shown in Table 1.

Table 1. Regional logistics industry high-quality development level evaluation index system

Tier 1 Indicators	Secondary indicators	Unit of measurement	Properties
Logistics industry innovation development level	R&D funding (X_1)	Billion	Positive
	Number of employees in the logistics industry (X_2)	10,000 people	Positive
	Number of patent inventions granted (X_3)	item	Positive
The level of coordinated development of the logistics industry	Value added of logistics industry as a percentage of GDP (X_4)	%	Positive
	The proportion of the output value of the logistics industry industry in the tertiary sector (X_5)	%	Positive
Logistics industry green development level	Logistics industry energy consumption (X_6)	million tons	Negative
	Urban greening coverage (X_7)	%	Positive
Logistics industry shared development level	Postal mileage (X_8)	10,000 km	Positive
	Fixed Internet users (X_9)	10,000 households	Positive
	Road car ownership (X_{10})	million units	Positive
	Railroad and road mileage (X_{11})	Kilometers	Positive
Logistics industry open development level	Import and export investment (X_{12})	Billions of dollars	Positive
	Amount of foreign direct investment (X_{13})	Billions of dollars	Positive
Regional economic development level	Regional GDP (X_{14})	Billion	Positive
	The level of consumption of the population (X_{15})	Yuan	Positive
	GDP growth rate (X_{16})	%	Positive
	Retail sales of social consumer goods (X_{17})	Billion	Positive

2.2. Measurements

The existing measurement and evaluation methods mainly include factor analysis, principal component analysis, AHP method, and TOPSIS method. The TOPSIS method combined with entropy weighting can objectively reflect the actual problem and the operational aspect can be efficiently processed even for panel data. Therefore, this paper uses the entropy-weighted TOPSIS method for evaluation, which is calculated as follows:

The indicator is dimensionless and the matrix is obtained U

For positive indicators: $u_{ij} = \dfrac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)}$

For negative indicators: $u_{ij} = \dfrac{\max(x_j) - x_{ij}}{\max(x_j) - \min(x_j)}$

The matrix u_{ij} is normalized to obtain the matrix P

Z for each element in: $p_{ij} = x_{ij} / \sqrt{\sum_{i=1}^{n} X_{ij}^2}$

Calculate indicator weights w_{ij}

First calculate each indicator x_j information entropy

$$e_j = -k\sum_{i=1}^{m} p_{ij} \ln p_{ij} \quad , \quad k = \frac{1}{\ln n}$$

Then calculate the redundancy measure of the variance of each indicator $d_j = 1 - e_j$ Calculate the weights of each indicator x_j based on $w_j = d_{ij} / \sum_{i=1}^{n} d_{ij}$ w_j .

Weighted canonical decision matrix transformation using normalized matrices

$$Z = (z_{ij}) = w_i p_{ij}$$

Calculate the positive and negative ideal solutions

For matrix $Z = \begin{bmatrix} z_{11} & \cdots & z_{1h} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{nh} \end{bmatrix}$

Since each indicator is normalized, the positive ideal value of Z_j^+ and the negative ideal value of Z_j^- for each indicator correspond to the maximum and minimum values of the corresponding indicator, respectively.

Define maximum value:

$$Z_j^+ = (z_1^+, z_2^+, ..., z_n^+) = \{\max(z_{11}, z_{21}, ...z_{n1}), \max(z_{12}, z_{22}, ..., z_{n2}), ..., \max(z_{1h}, z_{2h}, ...z_{nh})\}$$

Define minimum value:

$$Z_j^- = (z_1^-, z_2^-, ..., z_n^-) = \{\min(z_{11}, z_{21}, ...z_{n1}), \min(z_{12}, z_{22}, ..., z_{n2}), ..., \min(z_{1h}, z_{2h}, ...z_{nh})\}$$

Calculate the distance of each sample to the positive ideal solution and negative ideal solution

$D_j^+ = \sqrt{\sum_{j=1}^{h}(z_{ij} - Z_j^+)^2}$, $i \in [1,n]$ and $D_j^- = \sqrt{\sum_{j=1}^{h}(z_{ij} - Z_j^-)^2}$. $i \in [1,n]$

The score of the i evaluation object is calculated: $C_i = \frac{D_i^-}{D_i^- + D_i^+}$ and obviously $0 \le C_i \le 1$ and the larger the C_i the better.

2.3. Analysis of measurement results

This paper measures the high-quality development level of the logistics industry in different provinces (autonomous regions and municipalities directly under the Central Government) in China from 2013 to 2018 by applying the entropy power TOPSIS method and using MATLAB software for numerical analysis. To visualize the measurement results, this paper divides the high quality development level of the logistics industry in 31 provinces (autonomous regions and municipalities directly under the Central Government) in China into three categories, with the development level between the values of 0.1 and The provinces with development levels between 0.1 and 0.2 are classified as weak, the provinces with development levels between 0.2 and 0.3 are classified as potential, and the provinces with development levels above 0.3 are classified as strong, and the results are shown in Figure 1 below.

From Figure 1, we can see that the provinces in the strong category are Beijing, Shanghai, Jiangsu, Shandong, Henan, Sichuan, Guangdong, and Zhejiang, the provinces in the potential category are Tianjin, Chongqing, Liaoning, Anhui, Hebei, Hunan, Hubei, Jiangxi, Shaanxi, Fujian, and Inner Mongolia, and the provinces in the weak category are Heilongjiang, Jilin, Shanxi, Qinghai, Hainan, Guizhou, Gansu, Yunnan, Ningxia, Tibet, Xinjiang, and Guangxi. By examining the distribution of each province, it can be seen that the provinces in the strong category basically belong to the eastern region of China, mainly because the eastern region of China is in a very developed level because of the coast and the early opening to the outside world, and the investment in transportation facilities is also very large, and has the advantage of shipping, so the logistics industry in the eastern region has the highest level of quality development; the provinces in the potential category basically belong to the central region, and the central The scale of demand for logistics industry in the central region is gradually increasing, the level of demand is constantly improving and the construction of transportation infrastructure is continuously accelerating, but it is not enough to meet the development needs and still needs more investment, so the logistics industry in the central region has the middle level of quality development; the provinces in the weak category basically belong to the western region of China, because the western region has a weak economic foundation, backward transportation infrastructure and poor location advantages leading to Due to the weak economic foundation, backward transportation infrastructure and poor location advantage, the logistics industry has a relatively low level of quality development.

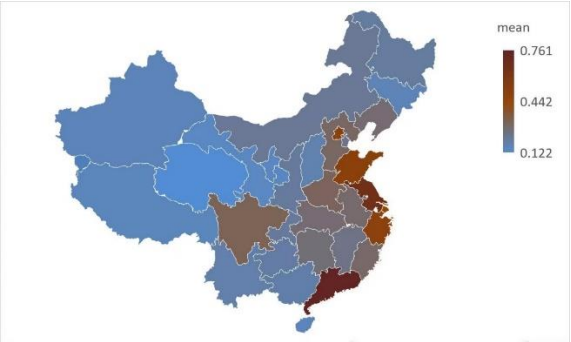

Figure 1. Average value of high-quality development of the logistics industry, 2013-2018

3. Dynamic evolution of high-quality development of China's regional logistics industry

3.1. Research Methodology

Based on the results measured by the above study, in order to further explore the dynamic trend of the level of high-quality development of China's regional logistics industry. This paper applies the kernel density estimation method for analysis, the advantage of this method is that it can reflect the situation of the probability distribution of the unknown variables contained in the density function in the graph, which can reduce the measurement error and truly reflect the actual value. Among them, the degree of similarity can be observed from the central peak, if the degree of similarity decreases, the central peak shifts to the left, and vice versa, it shifts to the right; while the degree of difference between regions can be observed by the degree of smoothing, if the greater the difference between regions, the smoother it is, and vice versa, the steeper it is. The basic model is.

$$f(x) = \frac{1}{Nn}\sum_{i=1}^{n} k(\frac{x_i - x}{h}) \quad (1)$$

In equation (1), the broadband is denoted by h , the number of observations is denoted by N , and the Kernel density function is denoted by. The independent identically distributed observations are denoted by and the mean value is denoted by x . The accuracy of the kernel density estimation and the smoothness of the Kernel density plot are affected by the broadband h , therefore, the bandwidth should be chosen to satisfy the following equation:

$$\lim_{N\to\infty} h(N) = 0 \quad (2)$$

$$\lim_{N\to\infty} h(N) = N \to \infty \quad (3)$$

The kernel function is a weighting function or smoothing function, and in this paper, we choose the Gaussian kernel function, which is expressed as follows:

$$K(x) = \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{x^2}{2}\right] \quad (4)$$

3.2. Dynamic evolution of the level of high-quality development of China's regional logistics industry

Based on the above kernel density method, this paper analyzes the dynamic evolutionary process of the high-quality development of China's regional logistics industry. As shown

in Figure 2-5. As can be seen from Figure 2, the position of the main peak of the distribution curve of the high quality development level of China's logistics industry shifts to the right over time, indicating that the high quality development level of China's logistics industry is continuously improving; the height of the main peak first decreases and then increases, and the width basically remains the same, indicating that the regional differences first increase and then decrease; and there are small peaks, showing the pattern of "one main and one small "This indicates that there is a polarization phenomenon in the level of high-quality development of China's logistics industry during the sample observation period.

From Fig. 3, we can see that the main peak of the distribution curve of the high quality development level of the logistics industry in the eastern region of China has shifted to the right, indicating that the overall high quality development level of the logistics industry in the eastern region has increased; however, the width of the peak has increased, indicating that the differences within the eastern region have been increasing; and there is only one peak, indicating that although the differences in the high quality development of the logistics industry in the provinces under the jurisdiction of the eastern region have been increasing, the sample observation period There is no polarization phenomenon. As can be seen from Figure 4, from the evolution of the wave peaks, the position of the main peak of the distribution curve of the level of high-quality development of the logistics industry in the central region of China keeps moving to the right, indicating that the level of high-quality development of the logistics industry in the central region is generally increasing; while in 2015, there are two main peaks, and the height of the wave peak first decreases, then increases, then decreases, and then increases again, and the width becomes wider, indicating that the differences within the central region are increasing and the phenomenon of polarization exists. From Fig. 5, it can be seen that the distribution curve of the logistics industry in western China has been shifting to the right from the evolution of the peaks, indicating that the logistics industry in western China has been increasing in terms of quality development; the height of the peaks shows a trend of rising, then falling and then rising again, and the width has increased, indicating that the differences in the western region have increased; there is only one main peak, indicating that the phenomenon of polarization has not occurred.

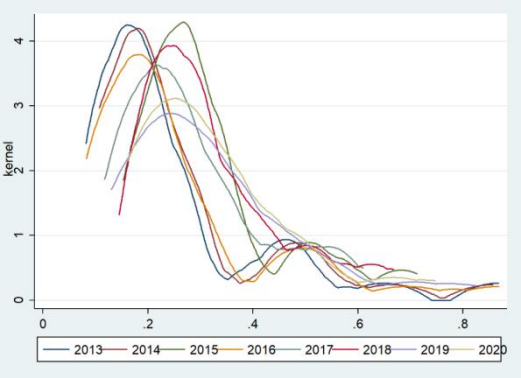

Figure 2. Dynamic distribution of high-quality development of China's logistics industry

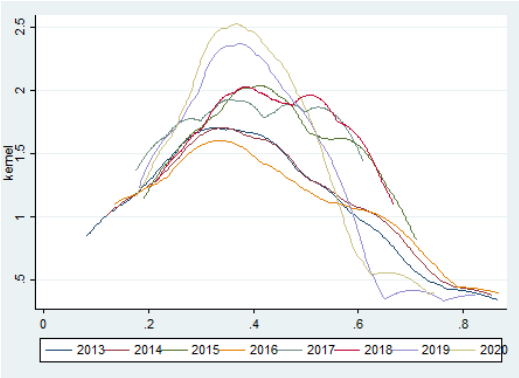

Figure 3. Dynamic distribution of high-quality development of logistics industry in eastern China

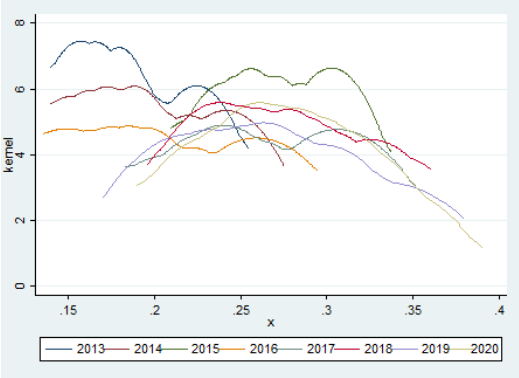

Figure 4. Dynamic distribution of high-quality development of logistics industry in central China

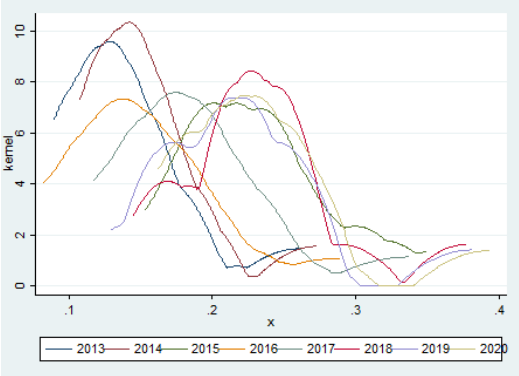

Figure 5. Dynamic distribution of high-quality development of logistics industry in western China

4. Research findings and limitations

4.1. Research findings

A system of indicators for the high-quality development of China's regional logistics industry was constructed to measure the dynamic evolution of the high-quality development of China's regional logistics industry. The main findings show that most of the Chinese provinces have effectively improved the level of high-quality development of logistics industry during the sample observation period, and most of the provinces with relatively high level of high-quality development of logistics industry belong to the eastern region of China, and most of the provinces with relatively low level of development belong to the western region of China. From the dynamic evolution of the high-quality development level of logistics industry: the difference of the high-quality development level of logistics industry in China increases and then decreases, and the polarization phenomenon of the high-

quality development level of logistics industry in China appears during the sample observation period. By region: the difference of logistics industry quality development level in the eastern region is increasing, but the development of different provinces in the region is relatively coordinated, and no polarization phenomenon occurs. The difference in the central region is also increasing, and the phenomenon of polarization has appeared. The level of high-quality development of logistics industry in the western region is rising, and the differences within the western region are increasing, but the phenomenon of polarization does not appear as in the eastern region.

4.2. Research limitations

This paper constructs a regional logistics industry quality development evaluation index system, measures the level of China's regional logistics industry quality development and analyzes the regional heterogeneity. Due to time constraints and difficulties in obtaining some data, this paper fails to further explore whether there is convergence or divergence in the variability of the quality development level of logistics industry in China as a whole and among different regions, and what factors lead to the convergence or divergence of the quality development level of logistics industry among regions, which is subject to breakthrough and expansion in this part in subsequent studies.

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