Research on the Evaluation of the Logistics Capability of Jinhua City under the Background of the Digital Economy

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Abstract. In the context of the global digital economy exceeding $ 45 trillion, the digital transformation of the logistics industry has become a key path to reducing the cost of social logistics. This paper takes Jinhua City, a typical city of the Yangtze River Delta land port hub, as the research object. Based on the theory of industrial synergy and dynamic capability, this paper uses the entropy weight method and TOPSIS method to construct an evaluation system of regional logistics capability, which includes 25 indicators in five aspects: economic support, infrastructure, operational efficiency, information service, and innovation kinetic energy and evaluates from two dimensions of time and space. The quantitative evaluation shows that the comprehensive index of logistics capacity in Jinhua is on the rise as a whole, but the economic and information service capacity lags behind the logistics operation capacity, and the development of logistics capacity in each city (county) is not balanced. Finally, according to the evaluation results of regional logistics capacity, relevant countermeasures are put forward.

1 INTRODUCTION

At present, the digital economy has developed in all aspects of society. As a key service industry in China, the logistics industry plays an important role in the growth and development of the national economy. In the " 14th Five-Year Plan " of the country, it is proposed to " create new advantages of the digital economy and promote the digital transformation of the industry.

In recent years, many scholars have carried out research on the evaluation of regional logistics capacity. Liu Y comprehensively considers the current situation of the integration of the digital economy and logistics industry, analyzes the evaluation results of logistics capacity in the era of digital economy from the horizontal and vertical dimensions, and uses the random forest model to analyze the important factors and their influence of digital economy on logistics capacity[1]. Based on the background of high-quality development, Li Q et al. selected the data from 2009 to 2017 as the evaluation object and used the grey correlation analysis method to find out the factors affecting the high-quality development of the logistics industry in Henan Province[2]. Peng H evaluates the actual situation of digital transformation of logistics enterprises more comprehensively and objectively from the four levels of digital operation level, digital foundation, digital management, and digital benefits[3]. Rao S uses the entropy weight-TOPSIS method to evaluate the logistics capacity of Fujian Province. The research shows that logistics informatization, logistics innovation driving ability, and economic foundation are the key factors affecting the improvement of logistics capacity[4]. Given the current situation of unbalanced development of regional logistics capacity in China, Zhang G. et al. evaluated the regional logistics capacity from three aspects: logistics demand capacity, logistics facilities and economic capacity, and logistics development potential, taking Beijing-Tianjin-Hebei, Yangtze River Delta, Guangdong-Hong Kong-Macao and Chengdu-Chongqing urban agglomerations as the research objects[5].

In summary, although the current research on the evaluation of regional logistics capabilities has achieved more results, there are few studies on the integration and development of the logistics industry and scientific and technological innovation capabilities, and there is no detailed study on the logistics capabilities of Jinhua City. Therefore, based on the background of the digital economy, this paper draws on the research results of scholars, combines the current situation of logistics development in Jinhua City, and uses the entropy weight-TOPSIS method to study the logistics capacity of Jinhua City, to better promote the digital development of logistics.

2 CONSTRUCTION OF LOGISTICS CAPABILITY EVALUATION INDEX SYSTEM

Jinhua City is an important node for East-West mutual assistance, North-South communication, and sea-land linkage. It is a veritable logistics hub center. 'Land and sea coordination, two-way opening ' has become a distinctive feature and strong advantage of Jinhua's modern logistics hub. The " *3-year Action Plan for the*

Development of Modern Logistics in Jinhua City (2021-2023) " issued in May 2021 clearly states that it is necessary to build a logistics hub economy, build a Jinhua logistics big data center, and accelerate the research and application of advanced logistics technology.

By sorting out the relevant literature, combined with the current situation of the development of logistics capacity in Jinhua City and the availability of data, the index system is mainly designed from five aspects. Among them, the economic support capacity[6] is the decisive factor in supporting the development of local logistics. Logistics infrastructure support capability[7] is a prerequisite for supporting the development of the digital economy, digital government, digital culture, and other fields. Logistics operation capability[8] is the key to ensuring the smooth and efficient operation of logistics activities from production, and circulation to consumption. Logistics information service capability[9] reflects the application of digital and information levels. Logistics innovation capability is the main feature of the digital economy[2]. The evaluation indicators are shown in Table 1.

TABLE 1 Summary of weight results calculated by entropy weight method

Goal Layer	First Index	Weight Coefficient	Second Index	Weight Coefficient
The logistics capacity of Jinhua City under the background of the digital economy	Economy Support Ability X_1	0.1373	Per Capita GDP X_{11}	0.362
			Total Retail Sales of Consumer Goods X_{12}	0.275
			The Added Value of the Tertiary Industry X_{13}	0.341
			Import and Export Sales X_{14}	0.395
	Logistics Infrastructure Support Capacity X_2	0.2087	Highway Mileage X_{21}	0.255
			Total Length of Postal Route X_{22}	0.393
			Logistics Fixed Assets Investment Completion Rate X_{23}	0.346
			Investment in Fixed Assets of Information Industry X_{24}	0.528
			Optical Cable Length X_{25}	0.257
			Number of Mobile Phone Base Stations X_{26}	0.308
	Logistics operational Capability X_3	0.2861	Freight Turnover X_{31}	0.491
			Cargo Carrying Capacity X_{32}	0.527
			Total Express Business X_{33}	0.518
			Industrial Added Value of Logistics X_{34}	0.887
			Post and Telecommunications Business Income X_{35}	0.438
	Logistics Information Service Capability X_4	0.157	Digital Inclusive Financial Index X_{41}	0.447
			Software Business Income X_{42}	0.236
			E-Commerce TransactionsX_{43}	0.277
			Number of Internet Access Users X_{44}	0.388
			Information Technology Population X_{45}	0.222
	Logistics Innovation Capability X_5	0.2109	Number of Higher EducationX_{51}	0.358
			Number of Logistics PractitionersX_{52}	0.407
			Number of R & D X_{53}	0.386
			intensity of R&D Expenditure Input X_{54}	0.389
			Patent Number X_{55}	0.569

3 EVALUATION MODEL OF REGIONAL LOGISTICS CAPABILITY

The entropy weight TOPSIS method belongs to the combination evaluation method in the comprehensive evaluation method. Firstly, the weight of each index is calculated by the entropy weight method, and then the weight value is multiplied by the original data to obtain new data. Finally, the TOPSIS method is used to quantify the comprehensive score of each index, and the advantages and disadvantages of each index are measured. The main steps are as follows.

3.1 Establish Evaluation Matrix

1. The evaluation index and evaluation object constitute the original matrix. Suppose that the matrix of the study contains m evaluation objects and n indexes, which can form a matrix $X=(X_{ij})_{m*n}$, $i=1,2,...,n; j=1,2,...,m$.

$$X=\begin{Bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{Bmatrix}_{m*n} \tag{1}$$

2. The original data are standardized, and the attributes of the selected indicators are positive. Let n positive index data are $Y_1, Y_2, Y_3, ..., Y_n$. After standardization, the matrix is obtained Y_{ij}.

$$Y_{ij}=\frac{X_{ij}-\min(X_i)}{\max(X_i)-\min(X_i)} \tag{2}$$

3. Due to the different dimensions of the original data, to facilitate the calculation and comparison of the data and eliminate the data dimensions of different evaluation indexes, the original data are normalized.

$$P_{ij}=\frac{Y_{ij}}{\sum_{i=1}^{n} Y_{ij}}, i=1,...,n, j=1,...,m \tag{3}$$

3.2 Calculating Weight by Entropy Method

1. The entropy value E_i of each index is calculated, and the utility value G_j formula is as follows.

$$E_j=k\cdot\sum_{i=1}^{n} p_{ij}\cdot\ln p_{ij}=\frac{1}{\ln(n)}\cdot\sum_{i=1}^{n} p_{ij}\cdot\ln(\frac{1}{p_{ij}}) \tag{4}$$

$$G_j=1-E_j \tag{5}$$

2. Determine the weight of each index, the formula is as follows.

$$w_j=\frac{1-E_j}{k-\sum_{j=1}^{m} E_j}(j=1,2,...,m) \tag{6}$$

3.3 TOPSIS Method is Used to Calculate The Logistics Capability Value

1. Determine the weighted normalized matrix Z.

$$Z=(z_{ij})_{n\times m}=(p_{ij}*w_j) \tag{7}$$

2. The distance between positive and negative ideal solutions of each sample is calculated.

The positive ideal solution D_i^+ refers to each index reaching the optimal value in the sample, and the negative ideal solution D_i^- refers to each index reaching the worst value in the sample.

$$D_i^+=\sqrt{\sum_{j=1}^{m}(z_{ij}-z_j^+)^2}, D_i^-=\sqrt{\sum_{j=1}^{m}(z_{ij}-z_j^-)^2}, (i=1,..,n) \tag{8}$$

3. Calculate the proximity of each evaluation object to the optimal solution and sort it.

$$C_i=\frac{D_i^-}{D_i^+ + D_i^-} \tag{9}$$

If the calculation result of relative proximity is larger, the logistics capacity is higher. On the contrary, it means that the lower the logistics capacity. The value range of C_i is [0,1], and the closer to 1, the higher the sample score.

4 AUTHENTIC PROOF ANALYSIS

4.1 Data Sources

This paper selects the data of Jinhua City, Zhejiang Province from 2014 to 2023 for research. The original data are from the Zhejiang Statistical Yearbook, the Jinhua Statistical Yearbook, and the Jinhua Statistical Bulletin of National Economic and Social Development. Because individual values are percentages, they need to be converted into specific numbers by formulas.

4.2 Evaluation of Regional Logistics Capability

As far as the data is concerned, the weight value only represents the process value. The key to the entropy weight-TOPSIS analysis is to calculate the logistics capacity value. The TOPSIS evaluation results are shown in Fig 1.

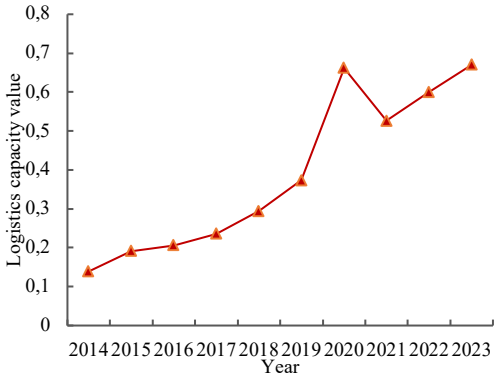

FIGURE 1 The changing trend of logistics capacity value in Jinhua City from 2014 to 2023

To more clearly consider the influencing factors of Jinhua's logistics capacity, this paper uses the same calculation method as above to calculate the logistics capacity value of the first-level indicators. The specific results are shown in Table 2.

TABLE 2 Jinhua City 2014-2023 Different first-level indicators of logistics capacity value ranking

Item	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
X_1	0	0.109	0.21	0.278	0.349	0.439	0.56	0.636	0.881	1
Ranking	10	9	8	7	6	5	4	3	2	1
X_2	0.084	0.156	0.291	0.271	0.351	0.616	0.592	0.707	0.628	0.637
Ranking	10	9	7	8	6	4	5	1	3	2
X_3	0	0.051	0.076	0.118	0.139	0.228	0.717	0.44	0.579	0.619
Ranking	10	9	8	7	6	5	1	4	3	2
X_4	0.27	0.347	0.289	0.299	0.605	0.538	0.666	0.657	0.351	0.783
Ranking	10	7	9	8	4	5	2	3	6	1
X_5	0.23	0.308	0.301	0.357	0.371	0.368	0.594	0.546	0.657	0.694
Ranking	10	8	9	7	5	6	3	4	2	1

From Table 2 and Fig 1, it can be seen that the logistics capacity of Jinhua City continued to rise from 2014 to 2020. The main reason is the improvement of logistics operation ability, logistics information serviceability, and logistics innovation ability, which provides a strong driving force for the development of logistics capacity in Jinhua City. From 2020 to 2021, the value of logistics capacity has decreased. The main reason is that due to the impact of the new coronavirus epidemic, the logistics operation capacity has been hit hard, resulting in the development of logistics capacity in Jinhua City in 2021 being greatly limited. From 2021 to 2023, the logistics capacity will rise at a steady speed. The main reason is that the new coronavirus epidemic has been controlled. The rapid economic growth, the continuous improvement of logistics infrastructure, and the recovery of logistics operation capacity have injected strong impetus into the recovery of logistics capacity. Therefore, under the background of the digital economy in 2023, Jinhua's logistics capacity is close to optimal.

To more intuitively and specifically understand the development trend of regional logistics capacity in Jinhua City, seven cities (counties) in Jinhua City were selected as evaluation objects, and an evaluation index system was established based on relevant data in 2023. According to the calculation formula of the entropy weight method, the weight of each index is calculated, as shown in Table 3.

TABLE 3 Weights of regional logistics capacity indicators of 7 cities (counties) in Jinhua City in 2023

Index	Weight	Index	Weight	Index	Weight	Index	Weight	Index	Weight
		X_{21}	0.049						
X_{11}	0.039	X_{22}	0.073	X_{31}	0.034	X_{41}	0.025	X_{51}	0.010
X_{12}	0.037	X_{23}	0.013	X_{32}	0.028	X_{42}	0.068	X_{52}	0.069
X_{13}	0.040	X_{24}	0.017	X_{33}	0.083	X_{43}	0.064	X_{53}	0.042
X_{14}	0.073	X_{25}	0.019	X_{34}	0.012	X_{44}	0.028	X_{54}	0.033
		X_{26}	0.020	X_{35}	0.034	X_{45}	0.063	X_{55}	0.029

According to the index weight, the evaluation results of the regional logistics capacity of 7 cities (counties) in Jinhua City in 2023 are calculated, as shown in Fig 2.

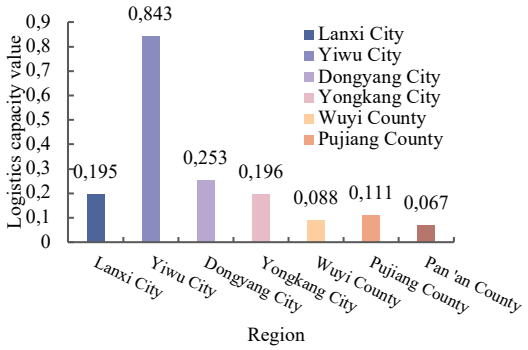

FIGURE 2 Evaluation results of regional logistics capacity in Jinhua City in 2023

It can be seen from Fig 2 that the development of logistics capacity in 7 cities (counties) of Jinhua is not balanced, among which the logistics capacity of Yiwu is as high as 0.843, ranking first. As the world's largest commodity trade center, Yiwu has higher advantages in economic support, logistics operation, infrastructure construction, and other aspects. In particular, the ' Yixin European ' train runs through many countries and regions, making Yiwu's regional logistics capacity far superior to other cities (counties). The logistics capacity of Wuyi County is 0.088, ranking last. Although Wuyi County is located in the south of Jinhua, the geographical location is relatively good, Wuyi's economy is underdeveloped, and the initial and last kilometer problems of logistics in some townships are difficult to solve, which greatly hinders the logistics development of Wuyi County, so the logistics capacity is inferior to other cities (counties).

5 CONCLUSION

Through the analysis of Jinhua's logistics capacity from 2014 to 2023, it is found that under the background of the digital economy, Jinhua's regional logistics capacity is generally on the rise. Logistics operation ability is the most critical factor in the development of logistics ability in Jinhua, followed by logistics infrastructure support ability and logistics innovation ability, which have a significant contribution to the promotion of logistics ability. Additionally, the development of regional logistics capacity in 7 cities (counties) of Jinhua is not balanced, and there is a big gap between Yiwu and other cities (counties).

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