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Evaluation of Logistics Competitiveness of Node Cities along the New Land-Sea Corridor in Western China—Based on Factor Analysis and Cluster Analysis

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Abstract: *This paper takes 18 nodal cities along the new land-sea Corridor in western China as examples to construct a comprehensive evaluation index system of urban logistics industry competitiveness. Based on the panel data of 2019, this paper uses factor analysis method to comprehensively evaluate the logistics competitiveness of the above 18 cities. The evaluation results show that: Chongqing and Chengdu occupy the leading position of logistics industry development along the corridor, Xi 'an, Kunming, Nanning, Guiyang and other cities have strong competitiveness, while Liuzhou, Zunyi, Luzhou, Yinchuan, Yibin, Xining and Lanzhou have general competitiveness. Yulin, Zigong, Urumqi, Baise and Qinzhou are limited by geographical location, infrastructure and other factors, and their overall competitiveness is weak. Finally, the paper puts forward relevant suggestions based on the conclusions drawn from the analysis.*

Keywords: *New land-sea corridor in the west; urban logistics competitiveness; principal component analysis; sustainable development*

1. Introduction

The Western land-sea New Corridor is located in the hinterland of China's western region. It connects with the "Silk Road" Economic Belt in the north and the 21st Century Maritime Silk Road in the south, and connects with the Yangtze River Economic Belt. It has an important strategic position in the pattern of coordinated regional development. Up to now, the passageway has basically formed a spatial layout composed of main passageway, important hub, core coverage area and radiation extension belt. This paper intends to analyze the characteristics and differences of the logistics competitiveness of 18 cities (prefectures) in the core coverage area of the channel, so as to make a scientific comprehensive evaluation of the level of logistics competitiveness of each city. The analysis of the logistics competition level and characteristics of each city and state has important theoretical and practical significance for optimizing the logistics layout of cities along the channel and improving the overall logistics competitiveness of cities along the channel.

2. Literature Review

According to the existing literature, the academic circles at home and abroad mainly evaluate and analyze the regional and urban logistics competitiveness by constructing the evaluation index system of logistics competitiveness.

In terms of research methods, Li Ming (2021) evaluated the regional logistics competitiveness of provincial level in China based on the AHP method [1]. Li Nan (2022) proposed a deep auto encoder momentum updating algorithm based on Widrow function, and conducted cluster analysis and empirical research on logistics competitiveness of 13 major cities in five provinces and regions in northwest China [2]. Jin Fangfang (2013) comprehensively evaluated the logistics competitiveness of 16 cities in the Yangtze River Delta using factor analysis method and cluster analysis method [3]. Liang Wen (2019) used co-integration theory to build VAR model and clarified the relationship among new-type urbanization, rural logistics and farmers' income [4]. Li Li Hua (2020) analyzed the functional mechanism of the competitiveness of provincial logistics clusters by using GEM model, and further empirically studied the evolution law and development characteristics of the competitiveness of provincial logistics clusters by combining GIS method [5]. Wang Lian et al. (2016) analyzed logistics competitiveness by constructing index system and principal component analysis method [6-8].

From the perspective of research objects, Song Er xing (2020) takes China's eastern, central and western regions as research objects and draws the conclusion that China's logistics industry as a whole is in the primary stage of coordinated development, and the coupling coordination degree of regional logistics is high in the east, followed by the central and lowest in the west[9].Dai Xiao ting (2020)and Guo Xue Song (2020) both took provinces as the research objects to construct the evaluation index system of logistics competitiveness[10-11].Hu Ting Ting and Huang Yan Xia (2021) took 13 provinces along the New land-Sea Corridor in the west as the research object to construct the coupled and coordinated development level of logistics industry and foreign trade index system respectively for empirical analysis [12-13]. Zhou Ping et al. (2018) took provinces, cities and states within the region as research objects, and used different research methods to evaluate and analyze the competitiveness of urban logistics[14-16].

To sum up, although some progress has been made in empirical research and theoretical research in the field of logistics competitiveness evaluation, there are still some shortcomings: There are many studies on the regional logistics competitiveness at the provincial level and the regional level composed of some provinces, but few studies on the evaluation of the logistics competitiveness of prefecture-level cities along the economic belt or the corridor, and the comprehensive evaluation of the logistics competitiveness of cities and states in the core area covered by the new land-sea corridor in the west is even rare. In addition, although there are a variety of evaluation methods on logistics competitiveness, it is still mainly to analyze the competitive strength, and few studies focus on the competitive potential and low-carbon development factors of logistics industry. In view of the above deficiencies and combined with the purpose of this study, this paper takes the logistics node cities along the western land-sea New Corridor as the research object, adopts the factor analysis method to study, and scientifically evaluates the level of urban logistics core competitiveness in the core coverage area of the western land-Sea New Corridor.

3. Data description and model setting

3.1 Data Description

The essence of the analysis of urban logistics competitiveness lies in the integration of all kinds of related index data and comprehensive evaluation of the overall competitiveness of regional logistics. Therefore, after fully considering the factors affecting the development of urban logistics, such as human resources, innovation drive, policy conditions, enterprise conditions and market demand, and combining with the research background of the new land-sea corridor in the west, this paper preliminarily establishes the evaluation index system of urban logistics competitiveness, as shown in Table 1.

Table 1: Evaluation index system

First-level index	Secondary indicators	Units	Code
Industry human resources Reserve	Number of employees in the logistics industry	person	X1
	General college enrollment	Ten thousand person	X2
Innovation competitiveness	R&D expenditure	Ten thousand yuan	X3
	Number of patents granted	unit	X4
Level of market demand	Total social consumption	Ten thousand yuan	X5
	Wholesale sales above limit	Ten thousand Yuan	X6
	Balance of all RMB deposits in financial institutions at the end of the year	Ten thousand yuan	X7
	Total import and export trade	Ten thousand yuan	X8
Business situation	Number of industrial enterprises above designated size	unit	X9
	Status of assets of industrial enterprises above designated size	Ten thousand Yuan	X10
	Number of foreign-invested enterprises	unit	X11
Policy Conditions	Government finance transportation expenditure	Ten thousand yuan	X12
Size of logistics industry	Revenue from postal services	Ten thousand yuan	X13
	Total area freight	Tons	X14

Data source: China Urban Statistical Yearbook

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4. Empirical analysis

4.1 KMO test and Bartlett sphericity test

SPSS software was used to conduct KMO test and Bartlett sphericity test on the standardized data, and the test results were shown in Table 2. As can be seen from Table 2, the obtained KMO measure value is 0.804, indicating the significance level Sig of Bartlett's sphericity test. Is 0.000, less than 1% significance level, indicating that there is a strong correlation between the variables selected in this study, that is, the index evaluation system established in this paper is suitable for factor analysis.

Table 2: Results of KMO test and Bartlett sphericity test of the evaluation index of urban logistics competitiveness

KMO and Bartlett's test		
Kaiser-Meyer-Olkin measure of sampling adequacy		804.
Bartlett's sphericity test	Approximate chi-square	588.423
	df	91
	Sig.	000.

4.2 Common factor extraction

The common factor variance of variables was extracted by the principal component analysis method. The results showed that (Table 3) only one index had a low extraction degree (0.748), and the loss of the common factor information extraction of the remaining 13 indexes were all lower than 10%. This result indicated that the extracted common factor had a strong representation of all indexes in the index system, that is, the factor analysis effect was good.

Table 3: Common factor variance of evaluation index of urban logistics competitiveness

Indicators	Extraction	Indicators	Initial	Extraction
Total freight (tons)	912.	Total social consumption (ten thousand Yuan)	1.000	994.
Balance of all RMB deposits in financial institutions at the end of the year (ten thousand Yuan)	980.	Total import and export trade (ten thousand yuan)	1.000	970.
Wholesale sales above limit (ten thousand Yuan)	748.	Number of industrial enterprises above designated size (number)	1.000	989.
Number of people employed in logistics industry (persons)	961.	Assets of industrial enterprises above designated size (ten thousand Yuan)	1.000	959.
General college enrollment (10,000)	916.	Government expenditure on transportation (ten thousand Yuan)	1.000	954.
R&D expenditure (ten thousand Yuan)	963.	Postal business income (ten thousand Yuan)	1.000	986.
Number of patents granted (pieces)	973.	Number of foreign-invested enterprises	1.000	968.

Table 4: Total variance explained by the evaluation index of urban logistics competitiveness

Components	Initial eigenvalue			Extract the sum of squares to load			Rotate the sum of squares to load		
	Total	% of the variance	Cumulative %	Total	% of the variance	Cumulative %	Total	% of the variance	Cumulative %
1	12.044	86.032	86.032	12.044	86.032	86.032	6.791	48.510	48.510
2	1.229	8.776	94.808	1.229	8.776	94.808	6.482	46.298	94.808
3	389.	2.777	97.585						
4	171.	1.223	98.808						

In this paper, common factors are extracted according to the principle that the eigenvalue is greater than 1, and the total variance interpretation obtained after extraction is shown in Table 4. According to the table, it is not difficult to see that two common factors were extracted this time, and their variance contribution rates were 86.032% and 8.776% respectively. In addition, the cumulative variance

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contribution rate of the extracted common factors reached 94.808%, which means that the index system data constructed in this paper has high structural validity.

At the same time, this paper also further combined the factor analysis lithotripsy diagram (see Figure 1) for analysis. It can be clearly seen from Figure 1 that the eigenvalue is obviously very small after the second factor, so the selection of the results of extracting the two factors in this paper is more reliable and scientific.

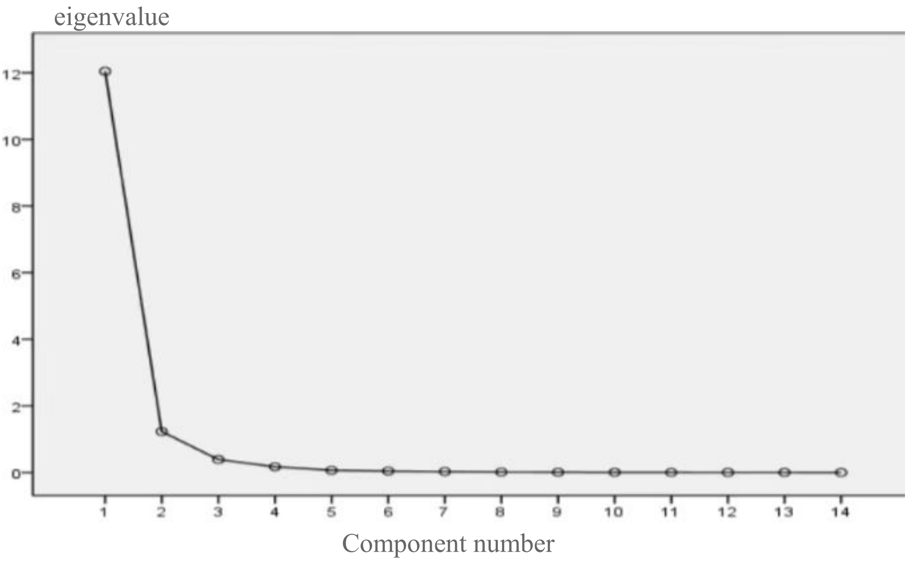

Figure 1: Lithotripsy diagram

By rotating the factor load matrix, the factor load matrix after rotation can be obtained (Table 5). Through observation, it can be found that the load distribution of each common factor after rotation is more reasonable and clear. The first common factor has a higher load on the number of logistics employees, total social consumption, the number of industrial enterprises above designated size, the asset status of industrial enterprises above designated size, government financial expenditure on transportation, postal business income, and the number of foreign-invested enterprises, which mainly reflects the urban economic and social development level, the scale of logistics industry and infrastructure conditions.

The second common factor has a higher load on the variables such as the balance of RMB deposits in financial institutions at the end of the year, the sales of wholesale industry above quota, the total amount of import and export trade, the number of college students, R&D expenditure, and the number of patents authorized, which mainly reflects the scale of the upstream industry of regional logistics and the level of regional economic and social development.

Table 5: Rotating load matrix of evaluation index of urban logistics competitiveness

	Components			**Ingredients**	
	1	2		1	2
Total freight (tons)	- 265.	366.	Total social consumption (ten thousand Yuan)	126.	- 011.
Balance of all RMB deposits in financial institutions at year-end (ten thousand Yuan)	- 001.	118.	Total import and export trade (ten thousand Yuan)	055.	061.
Wholesale sales above limit (ten thousand Yuan)	- 153.	252.	Number of industrial enterprises above designated size (number)	262.	- 160.
Number of people working in logistics industry (persons)	137.	- 026.	Assets status of Industrial enterprises above designated size (ten thousand Yuan)	065.	049.
General college enrollment (10,000)	- 138.	249.	Government expenditure on transportation (ten thousand Yuan)	346.	- 258.
R&D expenditure (ten thousand Yuan)	- 070.	186.	Postal business income (ten thousand Yuan)	274.	- 174.
Number of patents granted (pieces)	- 033.	150.	Number of foreign-invested enterprises	116.	- 003.

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4.3 Factor scores and total factor scores

In this paper, the regression method is used to calculate the factor score coefficient of the two extracted public factors, and the scores of the two main factors of each city along the passage are obtained. Finally, the comprehensive score is calculated as the weight according to the ratio of the variance contribution rate of each factor to the cumulative variance contribution rate of the two factors. The calculation method is shown as follows:

$$W = \frac{0.48510 \times f_1 + 0.46298 \times f_2}{0.94808} \quad (1)$$

By substituting the data into equation (2), the score of main factor, comprehensive score and ranking of logistics competitiveness of each node city are shown in Table 6.

Table 6: Comprehensive score ranking of logistics competitiveness of cities

Region	**F1**	**Ranking**	**F2**	**Ranking**	**Overall score**	**Overall ranking**
Chongqing	2.70845	1	2.73842	1	2.71	1
Chengdu	2.14466	2	-1.35404	17	1.82	2
Xi 'an	1.28326	3	-2.05838	18	.97	3
Kunming	.26397	4	-1.35123	16	.11	4
Nanning	-.10863	5	-.04874	12	-.10	5
Guiyang	-.16200	6	-.39655	15	-.18	6
Urumqi	-.23660	7	-.26210	13	-.24	7
Lanzhou	-.32250	8	-.37631	14	-.33	8
Liuzhou	-.44243	9	.26749	8	-.38	9
Zunyi	-.48627	10	.21214	9	-.42	10
Luzhou	-.52889	12	.59021	2	-.43	11
Yinchuan	-.49806	11	.07493	10	-.44	12
Yibin	-.54186	14	.45749	3	-.45	13
Xining	-.54008	13	.03061	11	-.49	14
Yulin	-.62070	16	.43161	4	-.52	15
Zigong	-.62044	15	.40139	5	-.53	16
Baise	-.63498	17	.32299	6	-.55	17
Qinzhou	-.65691	18	.32010	7	-.57	18

4.4 Cluster analysis

In order to comprehensively classify the logistics competitiveness of node cities along the new land-sea corridor in western China, Cluster Analysis is carried out according to the comprehensive factor score. K-Means cluster analysis is used, the number of clusters is set as 3, and the 18 cities under study are divided into 3 categories. The clustering results are shown in Table 7:

Table 7: Cluster analysis results

Category	**City**
strong	Chengdu, Chongqing
Stronger	Xi 'an, Kunming, Nanning, Guiyang,
General	Liuzhou, Zunyi, Luzhou, Yinchuan, Yibin, Urumqi, Lanzhou
Weaker	Yulin, Zigong, Baise, Qinzhou, Xining

The first category is the two cities with the strongest logistics competitiveness along the corridor -- Chongqing and Chengdu. The combined scores of the two cities were 2.71 and 1.82. From Table 6, it is not difficult to see that Chongqing and Chengdu have strong economic strength and perfect infrastructure, with large scale logistics industry and strong development potential.

The second type of cities have strong logistics competitiveness -- Xi 'an, Kunming, Nanning and Guiyang have relatively large comparative advantages in terms of high talent pool, consumption power of urban residents and market capacity, etc., and the local government's infrastructure investment in logistics industry is growing rapidly and has great development potential.

The competitiveness level of the third type of cities is general -- Liuzhou, Zunyi, Luzhou, Yinchuan, Yibin, Urumqi, Lanzhou and other cities need to be further explored in various aspects of the index level, logistics industry development level is general, with certain development potential in the future.

The fourth category is the cities with weak competitiveness level -- Yulin, Zigong, Baise, Qinzhou and Xining. In terms of geographical location and traffic location, the transport infrastructure of these cities is not perfect, and there are many problems, which need to be solved, such as a late start in urban development, weak industrial base and low overall consumption level.

To sum up, there is a big gap in the development level of the nodal cities along the passage, and the development of the comprehensive competitiveness of all kinds of cities is restricted by factors, showing a spatial development pattern of "two centers -- four poles -- multiple points". Chengdu and Chongqing are in the central position with high development level, radiating to the cities along the corridor; Xi 'an, Kunming, Nanning and Guiyang have certain advantages in human resources, consumer market and infrastructure construction. Together they form the four growth poles in the passage, and form the whole development pattern with Liuzhou, Zunyi, Bai and other multi-point cities.

5. Conclusions and suggestions

5.1 Conclusions

The scientific evaluation of the logistics competitiveness of a city is a comprehensive problem. The establishment of the index system needs to reflect the influence factors of all aspects related to logistics of a city, and consider the hard and soft power of logistics competition at the same time. After factor analysis and sequencing of the data of the established index system, this paper draws the following conclusions:

(1) The comprehensive score and ranking results of logistics competitiveness of cities along the corridor are in line with the current actual development situation.

(2) Chengdu and Chongqing are positioned as the core points in the logistics industry along the route, with strong comprehensive competitiveness; The whole channel presents a development pattern of "two centers - four poles - multiple points".

(3) According to the results of data analysis, the paper cluster 18 cities, and the results are as follows: the first type -- Chengdu, Chongqing; The second category -- Xi 'an, Kunming, Nanning, Guiyang; The third category -- Liuzhou, Zunyi, Luzhou, Yinchuan, Yibin, Urumqi, Lanzhou; And the fourth category -- Yulin, Zigong, Baise, Qinzhou and Xining.

In addition, the completeness of the index system constructed in this paper is limited due to the few data source channels. Therefore, the subsequent research can further increase the quantity and quality of the indicators of factors influencing logistics competitiveness, and improve the credibility and scientific nature of the research.

5.2 Suggestions

Through the evaluation of the logistics competitiveness of node cities along the corridor, it is found that the layout of node cities along the corridor presents the development characteristics of "two centers - four poles - multiple points". Therefore, in such a development pattern, the core city should clearly give full play to its own competitive advantages, play a leading role, and drive the joint development of node cities along the channel; On the other hand, cities with insufficient competitiveness need to adapt to local conditions, fully tap their own potential, explore the inter-city logistics linkage development, and jointly promote the overall logistics competitiveness of the western region.

Transport infrastructure such as railways and roads should be further strengthened to improve the intercity transport capacity among cities along the corridor.

(1) Speed up the construction of railway network within the corridor to achieve. Yulin, Zigong, Baise, Qinzhou, Xining and other cities, the railway construction progress is slow at present, still at the level of planning and design, need to further accelerate the construction progress; In addition, a relatively complete railway transport network has not been formed between the cities within the passage, so it is necessary to speed up the incorporation of the cities along the route into the passage railway network as soon as possible to improve the overall transport level.

(2) Improve the intra-city and inter-city highway transportation network within the passage, and expand the radiation range of the highway network. Local governments should put themselves into the

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macro-level of passageway nodes to make reasonable planning for the urban road network and speed up the connection of intercity routes. Chengdu-chongqing region should play a core leading role, accelerate the cooperation and development with cities along the routes, and jointly plan and construct.

Each node city in the channel should make clear its own positioning, develop characteristic logistics industry according to local conditions, and improve its own logistics competitiveness. For example, Chongqing, with its unique geographical advantages and well-connected transportation infrastructure, should develop into an international transportation hub city and further build itself into a smart logistics organization center. Take Chengdu as an example.

It has developed transportation and a number of state-level trade cities, with a large turnover of commodities. Chengdu can be positioned as an international trade and logistics center, which plays a good radiating and driving role for the cities in the channel. In addition, Nanning, Qinzhou, Yulin and other cities belong to the Beibu Gulf Economic Zone, which is the only outlet to the sea within the channel. They can vigorously develop the container cargo business, improve the sea and land combined transport, rail and sea combined transport and other multimodal transport, and improve the overall logistics competitiveness of the channel.

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