Study on the Coupling and Coordination Relationship between Logistics Industry and Regional Economic Development in Qinghai Province

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Abstract. Logistics industry and economic development are inseparable, and the evaluation system of development indicators for both is constructed in Qinghai Province as an example. The results show that from 2000 to 2021, the comprehensive evaluation level of the logistics industry and the level of economic development in Qinghai Province have maintained a good development trend, and at the same time, the coupling and coordination degree between the logistics industry and the regional economy in Qinghai Province has significantly improved, evolving from a serious dissonance to primary coordination.

Keywords: logistics industry; regional economy; Qinghai Province

1 Introduction

Logistics industry generally refers to the physical flow of goods from the place of supply to the destination, because it involves many and wide range of industries, basic, not only is an important driving force for the development of the national economy, but also the level of its development has become an important measure of the strength and vitality of the regional economy[1].

About the relationship of logistics and economic development, the academic community has three views: ① logistics industry promotes economic development: such as Li Jian [2], Maciulis [3] and other research, The logistics development to enhance the trade in favour of the incoming and outgoing, to promote the overall decline in social costs, pulling the economic growth. ② The economy tend to good and advance the development of logistics: such as Xu Jie[4], Liu Mingfei[5]and other studies. ③ Between logistics and economic development, co-development: such as Li Baoku[6], Peter J and Catherine L [7], etc., that there is a cointegration relationship between logistics and the economy as mutual cause and effect, and mutual promotion.

In terms of research methods, the entropy value method and the coupling coordination degree model[8-9] are mainly used for the assignment of indicator weights and the division of the coupling coordination degree, while some other scholars use geographic concentration[10-11], spatial autocorrelation and local autocorrelation method[12-13], and express the spatio-temporal coupling evolution law of those with the help of Arcgis.

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In the study area, Chinese scholars for the logistics industry and regional economic development of the relationship between the study area is mainly concerned in China's Pearl River Delta[14-15], the Yangtze River Economic Belt[16-17]and the Middle East [18] and other developed areas, the northwest region is not much attention. According to the statistics show that only in 2021, the gross regional product of Qinghai Province and the logistics industry added value of 334.663 billion yuan, 14.082 billion yuan, only that year, the added value of the logistics industry accounted for about 4.2% of the gross regional product, which shows the rapid development of the logistics industry, but Qinghai Province is located in the Tibetan Plateau, living in the north-western part of the country, and its unique location makes it far away from the developed areas in the central and eastern parts of the country, and thus the level of development of the logistics industry is still a big gap compared with the There is still a big gap between the development level of the logistics industry and that of the developed regions in the east and the centre.

Based on this, this paper takes the "semi-agricultural and semi-pastoral" Qinghai Province as the study area and constructs the evaluation index system,thus exploring the reasons for the coordinated relationship between the two.

2 Research methodology

2.1 Selection of evaluation indicators

This paper follows the principles of scientific, systematic, representative and availability of indicator selection, as well as drawing on Zhou Yanchun [19]and Guo Qiongqiong[20] research results. The construction of the indicator system is as follows: Table 1and Table 2.

Table 1 Logistics system indicator system

norm	Indicator properties	Indicator system weights per cent
Railway freight volume*X1*/million t	greater than zero	8.57
Road freight volume*X2*/million t	greater than zero	11.88
Railway freight turnover*X3* /(million t/km)	greater than zero	6.17
Road freight turnover*X4* /(million /.km)	greater than zero	13.61
Ownership of freight vehicles*X5* /10,000 vehicles	greater than zero	14.37
Total post and telecommunications business*X6* /Billions of dollars	greater than zero	11.26
Transport, storage and postal workers*X7* /person	greater than zero	10.85

Road mileage*X8* /km	greater than zero	13.76
Railway mileage*X9* /km	greater than zero	9.53

Table 2 Indicator system of regional economic systems

norm	Indicator properties	Indicator system weights per cent
GDP*Y1*/billion	greater than zero	12.39
GDP*Y2*/$ per capita	greater than zero	12.11
Value added of primary sector *Y3*/billion	greater than zero	12.32
Value added of secondary sector *Y4*/billion	greater than zero	10.11
Value added of tertiary sector *Y5*/billion	greater than zero	14.03
Total retail sales of consumer goods *Y6*/billion yuan	greater than zero	13.20
Total investment in fixed assets *Y7*/billion yuan	greater than zero	15.31
Total exports and imports *Y8*/$ billion	greater than zero	10.53

2.2 Research methodology

2.1.1 entropy method

The entropy method is an objective method of assigning values.Qinghai Province from 2000 to 2021 is selected as the research object, and a total of 17 evaluation indexes of logistics system and economic system are assigned. The steps of entropy value method are as follows:

① Assuming that there are a total of m research objects and n evaluation indicators, construct the original data matrix, notated as $X=(X_{ij})m\times n$. Since the selected indicators are all positively oriented indicators, the polar deviation standardisation method is used to standardise them.

$$Y_{ij} = \frac{x_{ij} - minx_{ij}}{max_{xij} - min_{xij}} \tag{1}$$

Get the normalisation matrix $Y = (Y_{ij})_{m\times n}$

② Calculate the ith evaluation object underthe jth indicator Yijin the Yjthe proportion of the ith evaluation object in thePij

$$P_{ij} = \frac{Y_{ij}}{\sum_{i=1}^{m} Y_{ij}} \tag{2}$$

③Calculate the information entropy of the jth indicatorEj and coefficient of variationDj

$$E_j = -\frac{1}{lnm}\sum_{i=1}^{m} P_{ij} \times lnp_{ij} \quad (3)$$

$$D_j = 1 - E_j \quad (4)$$

④ Calculate the weight of the jth indicatorWj

$$W_j = \frac{D_j}{\sum_{j=1}^{n} D_j} \quad (5)$$

⑤Calculate the composite value for each sampleUi

$$U_i = \sum_{i=1}^{n} W_j \times P_{ij} \quad (6)$$

In equation (6):Ui denotes the comprehensive evaluation score of each sample, n represents the number of indicators, the larger the U-value, the higher the comprehensive score, the more favourable to the evaluation results, and the results of the weights calculated for each indicator have been listed in Table 1 and Table 2.

2.2.2 Coupling

In this paper, we believe that there is an interaction between logistics elements and regional economic elements, so we use the coupling and coordination model to calculate, where $U_i$is a subsystem..

$$\left\{C = \frac{U_1 \times U_2 \times U_3 \times \cdots \times U_N}{\Pi(U_i + U_j)}\right\} \quad (7)$$

whereU_i is the integrated work of each subsystem n = 2; coupling degree C ∈ [0, 1]. When C = 0, it indicates that there is no coupling degree, and the subsystems are irrelevant and develop alone; when C = 1, it indicates that the coupling degree reaches the maximum, and the subsystems develop well with each other.

2.2.3 Coupled Coordination Degree Model

The coupling coordination degree reflect the overall synergistic effect of the logistics industry and the regional economy ,the formula is as follows:

$$T = \sqrt{\alpha U_1 \times \beta U_2} \quad (8)$$

$$D = \sqrt{C \times T} \quad (9)$$

Where T is the coupling and coordination index; α and β are coefficients to be determined, this paper considers that the coupling logistics industry and regional economy in Qinghai Province are important, so take α = β = 0.5;U_1 and U_2 represent the integrated value of the logistics industry subsystem and the integrated value of the regional economic subsystem, respectively, C represents the degree of coupling, and D represents the degree of coupling coordination.In reference to Guo Hu Bin[21]research, the coupling coordination degree of this article is divided into the following categories as Table 3.

Table 3 Classification of the coupling and coordination degree of logistics industry and regional economic system

degree of coupling coordination	Type of coupled coordination	degree of coupling coordination	Type of coupled coordination
0-0.1	extreme disorder	0.5001-0.6	sue for coordination
0.1001-0.2	severe disorder	0.6001-0.7	Primary coordination
0.2001-0.3	moderate disorder	0.7001-0.8	Intermediate level coordination
0.3001-0.4	mild disorder	0.8001-0.9	good coordination
0.4001-0.5	on the verge of becoming dysfunctional	0.9001-1.0	Quality coordination

3 Analysis of results

3.1 Entropy method of analysis

The weights of the indicators in the logistics industry and the regional economic evaluation system were calculated respectively. As can be seen from Table 1, the weights of road cargo turnover, the number of freight vehicles owned and the number of road journeys are larger, which are 13.61%, 14.37% and 13.77% respectively. Because Qinghai Province is located in the inland area of northwest China, in the development of modern logistics industry, it mainly relies on roads for transport, and the facilities related to it are crucial. As shown in Table 2, the proportion of total investment in fixed assets, added value of the tertiary industry and total retail sales of consumer goods is larger, respectively 15.31%, 14.03% and 13.20%, which indicates that these indicators play an important role in evaluating the level of regional economic development.

The same entropy value method is used to calculate the annual comprehensive value of logistics and regional economy in Qinghai Province, and the coupling coordination degree of the system is obtained through the constructed coupling model (Table 4).

Table 4 Score and Type of Coupling and Coordination between Logistics Industry and Regional Economic System in Qinghai Province, 2000-2021

vintages	U_1	U_2	C	D	Type of coupled coordination
2000	0.0360	0.0001	0.0472	0.0292	severe disorder
2001	0.0379	0.0111	0.4188	0.1013	severe disorder
2002	0.0530	0.0188	0.4395	0.1256	severe disorder
2003	0.0565	0.0359	0.4874	0.1501	severe disorder
2004	0.0924	0.0654	0.4926	0.1971	severe disorder
2005	0.1089	0.0678	0.4863	0.2072	moderate disorder

2006	0.1561	0.1005	0.4881	0.2503	moderate disorder
2007	0.1896	0.1232	0.4886	0.2765	moderate disorder
2008	0.2939	0.1647	0.4797	0.3317	mild disorder
2009	0.3592	0.2009	0.4796	0.3665	mild disorder
2010	0.4390	0.2621	0.4838	0.4118	on the verge of becoming dysfunctional
2011	0.5206	0.3220	0.4859	0.4525	on the verge of becoming dysfunctional
2012	0.5630	0.3877	0.4914	0.4833	on the verge of becoming dysfunctional
2013	0.5838	0.4502	0.4958	0.5063	sue for coordination
2014	0.6390	0.5061	0.4966	0.5332	sue for coordination
2015	0.6611	0.5602	0.4983	0.5516	sue for coordination
2016	0.7109	0.5725	0.4971	0.5648	sue for coordination
2017	0.7695	0.5664	0.4942	0.5745	sue for coordination
2018	0.8181	0.6281	0.4951	0.5963	sue for coordination
2019	0.8699	0.6391	0.4941	0.6106	Primary coordination
2020	0.7922	0.6336	0.4969	0.5952	sue for coordination
2021	0.9072	0.693 6	0.4955	0.6298	Primary coordination

3.2 Analysis of coupling and coordination models

As table 4 shown as, we can see that the value of the level of the logistics industry in Qinghai Province and the value of the level of the regional economy from 2000 to 2021 are both on an upward trend, and the level of the logistics industry has been higher than the level of the regional economy.The regional economic development speed from 2007 to 2015 Faster, gradually catch up with the development level of logistics industry, the two began to appear synergistic effect, 2016-2021 logistics industry development level and regional economic development level are fluctuating trend. Also from Table 4, it can be seen that the value of the coupled and coordinated development level of the logistics industry and the regional economy in Qinghai Province has been rising. Among them, 2000-2012 is the level of dysfunction, and 2013-2021 is the level of coordination, but the coordination relationship between the two systems is only primary coordination, far from reaching a better state of coordination.

4 Conclusions and recommendations

(1) From 2000 to 2021, both the level of the comprehensive development index of the logistics industry and the level of the comprehensive development index of the regional economy in Qinghai Province continue to rise. As far as the logistics development index is concerned, the level of the comprehensive development index of the logistics industry was only 0.0360 in 2000, and it rises to 0.9072 in 2021, which is a large increase. In terms of the economic development index, it rises from 0.0001 in 2000 to 0.6936 in 2021, which is similar to the achievements of economic development planning in Qinghai Province in recent years. However, from a national perspective, there is a big gap between the logistics industry and

regional economy of Qinghai Province and the Middle East, and the level of development is lagging behind. Therefore, Qinghai Province should improve the construction of basic transport facilities to promote the improvement of the logistics system, and at the same time, relying on the location advantages, actively promote the construction of related logistics parks in Haidong, Golmud, Delingha, etc., to drive the synergistic development of the region, and to strengthen the multimodal transport.

(2) The overall fluctuating upward trend of the logistics industry and the regional economic development level in Qinghai Province from 2000 to 2021, evolving from a lagging level of regional economic development to a synergistic development of the two. From 2000 to 2007, the logistics industry and regional economic development showed different upward trends, and the development of the logistics industry rose steadily due to the fact that the development and structure of the bottom-end industries in Qinghai Province lagged behind the pace of the modern logistics industry, thus failing to satisfy its needs. 2008-2015, the period of rapid development of the regional economy, the two evolved into a synergistic development situation. As Qinghai Province takes advantage of its resources during this period, the regional economic development catches up with the pace of the logistics industry. 2016-2019, the level of development of the logistics industry is always higher than the level of development of the regional economy, because at this time, Qinghai Province, in response to the national strategy of ecological protection, adjusted some irrational industries, and the regional economy has been affected, but the overall economy is still in the 2020-2021, affected by the new Crown Pneumonia epidemic, the development of logistics industry and regional economic development both decline. But after 2021, it resumed the upward trend. In the future development, Qinghai Province should continue to adhere to the national strategic layout, based on the need to protect the ecological priority. Strengthen the associated development of the logistics industry with plateau organic animal husbandry and speciality tourism, so as to promote the benign interaction between the logistics industry and the regional economy.

(3) From 2000-2021, the degree of coupling and coordination between the logistics industry and the regional economy in Qinghai Province has been increasing, which is shown as a state of dissonance from serious dissonance to primary coordination.From 2000-2012, the value of coupling is always higher than the value of coupling coordination, and despite the gradual increase in the degree of coupling coordination, the two are still in a state of dissonance. Although the local government continuously introduces policies to optimise the relationship between the two during this period, the degree of coupling coordination (dysfunction) of the two has not improved. 2013-2021, the value of coupling coordination is gradually higher than the value of coupling, and the overall development relationship between the two has improved, reaching the level of preliminary coordination. During this period, the development of logistics industry and regional economic development are interdependent and mutually accomplished. Qinghai Province should actively integrate into the industrial economic development circle, based on the needs of the province, vigorously develop product differentiation, and achieve a large hub channel for "urban commodities in the Middle East" in the east and "agricultural and animal husbandry products" in the west.

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