

Tianjin's Logistics Industry Linkage based on Grey Relational Analysis

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Abstract. Logistics is a composite industry whose formation is based on logistics resource industrialization and it has very strong industry association. The linkage development between Chinese logistics industry and other industries, however, is not optimistic: high cost, low efficiency and bad linkage ability. The research selects Tianjin's economic data in recent years, uses the grey relational analysis method on data processing, studies the linkage between logistics industry and three industries' economic indicators and finally obtains the correlation ranking between economic indicators and the logistics industry. Then the research puts forward reasonable suggestions on the adjustment of industrial layout. It points out that the government should attach more importance on the linkage of logistics industry and regional economic.

Keywords: Logistics engineering, Logistics industry, Industry linkage, Grey relational analysis

1. Introduction

Modern logistics has a strong industrial correlation and driving effect. It plays an important role in promoting the development of regional economy and national economy. Research on the linkage of logistics industry and regional economic is conducive to the improvement of overall service level of the logistics industry, the integration of social logistics resources and the optimization and upgrade of regional industrial structure. It is also a key to the transformation of economic development mode. Furthermore, it has vital value to the reasonable adjustment of industrial layout. Tianjin is an important international port. However, there is a lack of study on Tianjin's logistics industry linkage.

Some scholars research the logistics industry with the combination of regional economic characteristics. Li Weiguo etc. make a quantitative research on the effect factors to the Pearl River Delta logistics economic and sort them [1]. Chen Yunping considers the concept and rationality of the logistics industry cluster. She puts forward that one can form market-oriented advantage, resources integration advantage, cooperation and competition advantage and quickly-meet advantage [2]. Shao yang etc. use transportation and warehousing to characterize logistics industry. They analyze the association of logistics industry and other three industries and obtain the result that logistics industry play a positive role in promoting the national economy and that is only second to manufacturing industry. The national economy, however, make a small drive to logistics industry [3]. In addition, the association of manufacturing and logistics industry also attracts a lot of attention. Wang Zhenzhen etc. consider the linkage pattern of manufacturing industry and logistics based on C-C Model [4]; Tan Renzhi and Zhang Hongxing consider the problems of supply chain management with the linkage of manufacturing industry and logistics. Then they put forward the strategy of supply chain management [5]. Dong Dengzhen and Chu Maoguang consider that Wuhan should attach great importance to the modern logistics industry in the construction of the modern manufacturing bases [6]. Liu Xueni etc. give an example of

Yangtze River Delta region manufacturing industry cluster to analyze the coupling relationship between industry clusters and logistics industry in the process of evolution [7].

Logistics economy occupies an important position in Tianjin's economic development. At present related researches are very little and mainly focus on input-output analysis. They construct a theoretical framework about logistics industry association effect by direct consumption coefficient, complete consumption coefficient, distribution coefficient, influence coefficient and other indexes [8]. Tianjin's logistics industry development is obviously insufficient in infrastructure construction and the relevant regulations [9]. In addition, existing researches are not perfect on index selection and research methods; they are mainly concentrated in the linkage of logistics industry and manufacturing industry and mainly use input-output analysis as the quantitative analysis tool.

2. Train of research

Research method

Grey theory is created in 1982 by Professor Deng Julong and it has extensive application in various fields and makes a series of achievements. As an important component of grey system theory, GRA (Grey Relational Analysis) not only analyses the affection degree of each factors in the system, but also determines the contribution degree of factors to main behavior of the system. Analytical procedures includes determining the reference sequence, making variables dimensionless, seeking difference sequence, maximum difference and minimum difference, then achieving the grey correlation coefficient and finally sorting them according to the correlation degree [10, 11].

Set reference sequence $x_0 = (x_0(1), x_0(2), \dots, x_0(n))$, comparative sequence $x_i = (x_i(1), x_i(2), \dots, x_i(n))$ ($i = 1, 2, \dots, m$). Define

$$\xi_i(k) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \rho \max_{1 \leq i \leq m} \max_{1 \leq k \leq n} |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max_{1 \leq i \leq m} \max_{1 \leq k \leq n} |x_0(k) - x_i(k)|} \quad (1)$$

$\xi_i(k)$ is the correlation coefficient, ρ is the discriminating coefficient ($0 < \rho \leq 1$). Obviously, $0 \leq \xi_i \leq 1$. We average the values for ξ_i is too disperse. Define

$$r_{0i} = r(x_0, x_i) = \frac{1}{n} \sum_{k=1}^n \xi_i \quad (2)$$

$r(x_0, x_i)$ is the correlation degree. Then make a sequence according to the correlation degree. The more it is close to 1, the more association.

In view of the difficulty of data collection, we can hardly use statistical model while grey relational analysis is suitable for it picks "small sample", "poor information" uncertain system as the research object. The research chooses grey relational analysis as the quantitative research tool, selects reasonable economic indicators and the data and sets up the research framework.

Indexes selection

(1) Indexes selection of the logistics industry: At present China has not set independent accounting indexes for logistics industry. We can use Freight volume and Freight turnover to stand for logistics demand. Although the two indexes are only a part of logistics demand, they penetrate the entire process of the logistics. The Freight volume determines the volume of other logistics activities.

(2) Indexes selection of comparative sequence: The research chooses 7 key factors and analyses their association with freight volume and freight turnover. They are GDP, primary industry output value, secondary industry output value, tertiary industry output value, total retail sales, foreign total import and export volume of foreign trade volume and capita disposable income of per urban resident. The GDP and capita disposable income of per urban resident reflect the social and economic development of Tianjin. The primary industry output value, secondary industry output value, tertiary industry output value reflect the industrial structure,

The total retail sales and total import and export volume of foreign trade reflect the consumption and circulation.

Variables setting

(1) Reference sequence: y'_0 is the initial value of freight volume (million tons), its normalization is y'_0 ; z'_0 is the initial value of Freight turnover (million tons km), its normalization is z'_0 .

(2) Comparative sequence: x'_1 is the initial value of GDP (Yuan), its normalization is x'_1 ; x'_2 is the initial value of primary industry output value (million tons), its normalization is x'_2 ; x'_3 is the initial value of secondary industry output value(billion Yuan), its normalization is x'_3 ; x'_4 is the initial value of tertiary industry output value(billion Yuan), its normalization is x'_4 ; x'_5 is the initial value of total retail sales(billion Yuan), its normalization is x'_5 ; x'_6 is the initial value of the total import and export volume of foreign trade (million Yuan), its normalization is x'_6 ; x'_7 is the initial value of capita disposable income of per urban residents (Yuan), its normalization is x'_7 .

3. Empirical researches

Object of empirical research

Tianjin has extremely advantageous geographical location and traffic position and it connects the northeast and north China. As one of the four municipalities and an important transportation hub, Tianjin has gradually formed a three-dimensional transportation network with seaport, airport, railway, highway and pipeline. Currently, Tianjin’s government treats logistics as its pillar industry.

Tianjin’s logistics industry has good prospect and development trend. However, the development of logistics industry can’t keep a good linkage with regional economy. Its core advantage has not got a full play. Many of Chinese coastal industrial cities have similar situations, so choosing Tianjin as the empirical research object has a relatively broad representation.

Data selection

The research selects Tianjin’s statistical data in 2001-2009, including GDP, primary industry output value, secondary industry output value, tertiary industry output value, total retail sales, total import and export volume of foreign trade and capita disposable income of per urban residents. As shown in Table 1 (Tianjin’s economic statistics in 2001-2009).

Table 1 Tianjin’s economic statistical data in 2001-2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009
y'_0	27988	30052	32014	36237	39219	41939	50261	34114	43554
z'_0	5158.2	6302.0	6521.1	11223.3	12593.0	12241.0	15289.0	2703.4	10102.3
x'_1	1840.1	2051.2	2447.7	2931.9	3697.6	4359.2	5050.4	6354.4	7500.0
x'_2	78.55	84.00	89.66	102.29	112.38	118.23	110.19	122.58	131.01
x'_3	904.64	1001.90	1245.29	1560.16	2051.17	2488.30	2892.50	3821.07	4110.54
x'_4	856.91	965.26	1112.71	1269.43	1534.07	1752.60	2047.70	2410.73	3259.25
x'_5	832.7	941.4	922.3	1052.7	1190.1	1356.8	1603.7	2000.3	2430.8
x'_6	1817209	2281140	2934244	4202861	5327680	6446194	7144973	8040084	6394400
x'_7	8958.7	9338.0	10312.9	11467.1	12638.6	14283.0	16357.0	19422.5	21430.0

Data processing

The research chooses GRA to build a model, makes the initial value non-dimensional, establishes a seeking difference matrix and calculates the correlation coefficient. Finally we get the correlation degree of freight volume and its influential factors (see Table 2).

Table 2 the correlation degree of freight volume and its influential factors

	2001-2005	2002-2006	2003-2007	2004-2008	2005-2009	Average
x_1	0.805980	0.738932	0.687424	0.715372	0.681920	0.725925
x_2	0.988899	0.984072	0.893267	0.886265	0.838542	0.918209
x_3	0.766790	0.671776	0.612121	0.669585	0.655354	0.675125
x_4	0.846872	0.820789	0.794021	0.767578	0.706349	0.787122
x_5	0.962434	0.933999	0.861699	0.815658	0.699895	0.854737
x_6	0.637957	0.607195	0.539432	0.722631	0.793959	0.660235
x_7	0.983998	0.939361	0.955232	0.864073	0.752941	0.899121

Similarly, we get the correlation degree of freight turnover and its influential factors (see Table 3).

Table 3 the correlation degree of freight turnover and its influential factors

	2001-2005	2002-2006	2003-2007	2004-2008	2005-2009	Average
x_1	0.745590	0.738633	0.720794	0.748465	0.679957	0.726688
x_2	0.657615	0.644793	0.554928	0.850781	0.773850	0.696393
x_3	0.784065	0.738610	0.798080	0.71262	0.664316	0.739538
x_4	0.729854	0.714478	0.633296	0.78680	0.692534	0.711392
x_5	0.662990	0.626702	0.602778	0.822473	0.690058	0.681000
x_6	0.767278	0.683062	0.796698	0.752115	0.741151	0.748061
x_7	0.652066	0.646291	0.574905	0.847226	0.722842	0.688666

Then we average the correlation degree of freight volume, freight turnover and their influential factors respectively, results are shown in Table 4.

Table 4 the average correlation degree of freight volume, freight turnover and their influential factors

	Freight volume	Freight turnover	Average	Sequence
GDP	0.725925	0.726688	0.726307	5
Primary industry output value	0.918209	0.696393	0.807301	1
Secondary industry output value	0.675125	0.739538	0.707332	6
Tertiary industry output value	0.787122	0.711392	0.749257	4
Total retail sales	0.854737	0.681000	0.767869	3
Total import and export volume of foreign trade	0.660235	0.748061	0.704148	7
Capita disposable income of per urban resident	0.899121	0.688666	0.793894	2

The sequence of the correlation degree is: primary industry output value > capita disposable income of per urban residents > total retail sales > tertiary industry output value > GDP > secondary industry output value > total import and export volume of foreign trade.

4. Results discussion and suggestions for development

Results discussion

Combining the sequence of the correlation degree and Tianjin's specific economic development situation, we get that:

The correlation degree of primary industry and freight volume, 0.918209, is the largest. It means primary industry promotes a greater demand for logistics. The development of the agricultural logistics is comparatively good. But the correlation degree of primary industry and freight turnover, 0.69639342, is not so high. Freight turnover is equal to actual shipping tonnage of freight multiply by average haul distance. That indicates that the transportation quantity is large while the haul distance is small. The range of agricultural products circulation is limited.

The correlation degree of capita disposable income of per urban resident, total retail sales and logistics is relatively high. This is due to the improvement of living standards and the increase of capita income and purchasing power. The correlation degree of tertiary industry output value and logistics industry is fourth. It is higher than the secondary industry. The large volatility indicates that the productivity service industry account for high proportions while its development is not steady.

The correlation degree of GDP and logistics industry is relatively stable, but it has a small concussion in 2005-2009. On the one hand, it illustrates that with the impact of financial crisis, Tianjin's economy had a small slowdown; on the other hand, it is generally remained stable and the logistics industry keep in harmony with GDP. All in all, the quality and efficiency of logistics industry should have a further improvement.

The correlation degree of secondary industry and logistics industry, 0.707332098, is lower than those of primary industry and tertiary industry. It indicates that there is a big distance for logistics industry to be in full harmony with second industry. Along with Tianjin's industrialization, the correlation degree drops ceaselessly. It is because of Tianjin's vigorously implementing in industrial upgrading and promoting the development of high-tech industry; on the other hand, with the rapid development of the logistics industry, invalid logistics activities gradually reduced. How to coordinate with logistics industry is still a big problem urgently to be solved in the process of industrialization.

The correlation degree of total import and export of foreign trade and logistics industry is 0.704147714. It is the lowest. That shows its low open degree to the outside world. It is necessary to optimize its trade structure and continue to stabilize and expand export volume.

Suggestions for development

From the view of industrial structure, Tianjin's manufacturing industry and foreign trade need to be improved to catch up with the development of primary industry and tertiary industry. As the industry structure of whole social logistics is not reasonable. Establishment of a resource optimal allocation system of logistics industry and agriculture is essential. Tianjin's agriculture logistics should focus on the construction of agricultural logistics system. It includes agricultural products wholesale market and circulation and agricultural products distribution center.

It is of great value to build further coordination of manufacturing industry and logistics industry. To develop Tianjin's industrial logistics, they should improve the level of logistics management, reduce the costs and enhance the core competence of enterprises, optimize and integrate enterprises 'procurement, inventory, production, sale, distribution and strengthen the management innovation.

They need overall optimization on trade industry based on the development of logistics development. It is of great importance to make the best use of Tianjin's ports and industrial advantages to accelerate the commodity logistics and distribution. With the integration of the existing logistics resources, they should establish specialized logistics distribution center and finally form the modern logistics service system.

5. Conclusions

In the post-financial crisis era, as a modern production service industry, the logistics has been placed into the key ten planning industries for adjusting and invigorating by the Chinese government. It provides an opportunity for logistics industry. The research carries out an empirical research on the linkage of Tianjin's logistics industry and other industries, analyses the situation and result of data processing and suggests that the government should take measures respectively. We can infer that all provinces and regions should take a further promotion on the linkage of logistics industry and regional economic from many aspects.

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