

Research On The Grey Correlation Between Dalian Port Logistics And Urban Economy

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Abstract

The paper summarizes the relevant indicators of the interactive development between port logistics and urban economy by consulting the Dalian Statistical Yearbook from 2015 to 2021. The grey correlation method model is used to study the correlation between port logistics and urban economy in Dalian. Suggestions are proposed to strengthen the construction of logistics infrastructure in Dalian Port, enhance the level of informationization development in port logistics, strengthen cooperation with surrounding ports, and optimize regional economic structure to promote the interactive development of port logistics and urban economy.

Keywords – port logistics, regional economy, grey correlation

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I. Introduction

Since the reform and opening up, the level of China's economic opening up to the outside world has continuously improved, and the development of the logistics industry in the tertiary sector has become a top priority for economic development. Port logistics plays a crucial role in trade development. As an important node in the global logistics network, ports provide various services such as cargo loading and unloading and transfer, warehousing and distribution, shipping, and maritime transportation. They not only connect different modes of transportation and trade gateways, but also drive economic development and create a large number of job opportunities. Ports not only provide basic logistics needs for cities, but their location advantages also facilitate cities to fully leverage their resource advantages, form highly integrated industrial chains, ensure efficient logistics activities, achieve low-cost operations, and bring more trade opportunities.

II. Theories Related To Port Logistics And Economic Development

Concept of port logistics

Port logistics mainly refers to the development of logistics activities around ports in central cities located near ports, utilizing their unique location advantages and relying on their own software and hardware conditions to promote economic development in the hinterland and related areas. The purpose is to integrate the port and surrounding resources into a comprehensive logistics service system, which includes all links of the port supply chain and develops together with other industries.

The interaction between port logistics and economy

Ports have special characteristics in their location, which have formed certain features in the development

process of port logistics, such as close connection with urban economy, integration effect, distribution effect, susceptibility to environmental impact, and facing fierce competition. There are many factors that can constrain the development of port logistics, among which the urban economy has the most direct impact. The transportation system, industrial scale, population density, and economic development level of the city significantly affect port logistics.

Urban economy and port logistics are complex systems. The higher the degree of cooperation between the two, the greater the correlation, synergy, and linkage. The mutual cooperation between urban economy and port logistics has played an important role in the good development of both parties.

There is a correlation effect between urban economy and port logistics. Port logistics provides logistics services and value-added services related to urban economy, and cities offer more investment opportunities for logistics. The rapid development of port logistics relies on urban policies, and the development of cities cannot be separated from port logistics. Therefore, urban and port logistics are interconnected and mutually reinforcing.

III. Current Situation Of Logistics At Dalian Port

As the most important comprehensive port in Northeast China, Dalian Port's development is of great significance to the regional economy and logistics industry. Dalian Port has a superior geographical location, connecting the maritime trade routes between Northeast China and various countries around the world. As the largest comprehensive port in Northeast China, Dalian Port not only plays the role of an import and export hub for goods in the region, but also serves as a bridge and link between the region and international trade. Dalian Port was founded in 1899 and is located at the southern end of the Liaodong Peninsula. It is the largest port group in Northeast China, the center of international shipping in Northeast Asia, and the maritime gateway to the world in Northeast China. Dalian Port Group has developed rapidly due to its superior natural and geographical conditions. As of 2020, Dalian Port has 111 berths with a capacity of 10000 tons, closely cooperating with more than 300 ports around the world. Its cargo throughput and container throughput have reached 334.17 million tons and 5.1 million TEUs, respectively. While the port is developing rapidly, its urban economy is also greatly improving. In 2020, the per capita regional GDP of Dalian reached 100000 yuan, which is about three times that of 2004; The industrial structure of Dalian city is also constantly adjusting, with investments in the secondary and tertiary industries reaching 44.029 billion yuan and 101.114 billion yuan respectively. Although there was a certain decline in 2015, the overall trend is gradually increasing.

IV. Grey Correlation Analysis Of Logistics And Economy In Dalian Port

Dalian port logistics and urban economy correlation index system

There have been many studies on the correlation between port logistics and regional economy, and many scholars have proposed representative evaluation indicators. Based on previous research conclusions and the specific situation of Dalian city, the evaluation index system selected in this article is shown in Table 1.

Table 1 evaluation index system for the correlation between port logistics and urban economy

system	specific indicators	symbol
Port Logistics X	port berths (number)	X1
	10000-ton berth (number)	X2
	container throughput (10000 TEUs)	X3
	passenger throughput (10000 person times)	X4

	cargo throughput (10000 tons)	X5
	foreign trade cargo throughput (10000 tons)	X6
Regional Economy Y	regional GDP (100 million yuan)	Y1
	fixed assets investment (100 million yuan)	Y2
	retail sales of consumer goods (100 million yuan)	Y3
	fiscal revenue (100 million yuan)	Y4
	total import and export volume (100 million yuan)	Y5
	the proportion of the tertiary industry in the regional GDP (%)	Y6

Grey correlation analysis method

Standardization of indicators

Due to the lack of unified units of measurement for various indicators, they need to be standardized before calculating comprehensive indicators, that is, the absolute values of the indicators need to be converted into relative values, in order to solve the problem of homogenization of different indicator values.

The indicators in the paper are all positive indicators, and the standardized method is:

$$x_{ij}^* = \frac{x_{ij} - x_{\min}}{x_{\max} - x_{\min}} \quad (\text{Formula 1})$$

Calculation of grey correlation coefficient between indicators

After dimensionless processing, calculate the correlation between each factor, and the correlation coefficient is as follows:

$$\xi_{ij} = \frac{\min_i \min_j |\Delta_{ij}| + \alpha \max_i \max_j |\Delta_{ij}|}{|\Delta_{ij}| + \alpha \max_i \max_j |\Delta_{ij}|} \quad (\text{Formula 2})$$

Among them: $i=1,2,\dots, 6$ represents port logistics indicators, $j=1,2,\dots, 6$ represents regional economic indicators, k represents each year, α with a value of 0.5. $|\Delta_{ij}|$ indicate the deviation between logistics indicators and various economic indicators.

Due to the fact that ξ_{ij} can only reflect the correlation between points, the information is relatively scattered and may have adverse effects on analyzing the correlation between data. Therefore, when ξ_{ij} integrated, the correlation degree is represented by r :

$$r_i = \frac{1}{n} \sum_k \xi_i(k) \quad (\text{Formula 3})$$

Empirical study

The data on port logistics and economic indicators in Dalian city in this article is sourced from the "China Urban Statistical Yearbook" from 2015 to 2021. As shown in Table 2.

Table 2 raw data of Dalian Port Logistics and Urban Economic Indicators

indicators	2015	2016	2017	2018	2019	2020	2021
X1 (number)	247	247	248	248	223	231	237
X2 (number)	102	102	104	104	104	111	118
X3 (10000 TEUs)	930	944	971	977	876	511	367
X4 (10000 person times)	379	438	624	646	688	749	789
X5 (10000 tons)	41526	43648	45136	46784	36641	33428	31553
X6 (10000 tons)	13395	14372	15672	15586	16511	15968	13861
Y1 (100 million yuan)	7364	8234	7364	7669	7002	7030	7826
Y2 (100 million yuan)	4550	3654	1883	1551	1403	1404	1815
Y3 (100 million yuan)	3054	3397	3724	3880	4195	3467	1828
Y4 (100 million yuan)	655	650	653	704	701	660	734
Y5 (100 million yuan)	5501	4691	4533	5224	5330	4352	4360
Y6 (%)	51.4	53.2	54.0	56.6	58.0	60.0	62.1

According to the grey correlation analysis method mentioned above, the grey correlation degree between Dalian Port logistics and economy is calculated, and the average correlation degree is further calculated as shown in Table 3.

Table 3 grey correlation between logistics and economy in Dalian Port

	X1	X2	X3	X4	X5	X6	Average correlation degree r_y
Y1	0.7978	0.5898	0.6614	0.5815	0.7199	0.6827	0.6722
Y2	0.9334	0.5409	0.7626	0.7022	0.8205	0.7671	0.7545
Y3	0.9492	0.5821	0.7665	0.7881	0.8473	0.8022	0.7892
Y4	0.8599	0.7005	0.8119	0.7612	0.8088	0.8491	0.7986
Y5	0.5628	0.5972	0.6221	0.5634	0.6077	0.6095	0.5938
Y6	0.6529	0.6547	0.7552	0.8367	0.6987	0.7866	0.7308
Average correlation degree r_x	0.7927	0.6109	0.7300	0.7055	0.7505	0.7495	-

The higher the correlation value, the stronger the correlation. From the average correlation value r_x , it can be seen that the correlation between various indicators of port logistics and regional economy is in the order of port berths (X1)>cargo throughput (X5)>container throughput (X6)>foreign trade cargo throughput (X3)>passenger throughput (X4)>10000-ton berths (X2). From the above results, it can be seen that port berths play an important role in promoting economic development, and it is necessary to strengthen the construction of port berths, such as infrastructure construction, information technology construction, and strengthening cooperation with surrounding areas.

From the average correlation r_y value, we can see the correlation between the indicators of regional economy and port logistics, which is in the order of fiscal revenue (Y4)>retail sales of consumer goods (Y3)>fixed assets investment (Y2)>the proportion of the tertiary industry in the regional GDP (Y6)>regional GDP (Y1)>total import and export volume (Y5). From the above results, it can be seen that there is a high correlation between fiscal revenue and port logistics, which is consistent with reality because port logistics generates taxes and can increase government fiscal revenue. Conversely, an increase in government fiscal revenue will increase support for the development of port logistics, enabling further development of port logistics.

V. Suggestions For Dalian Port Logistics And Economic Promotion Development

Strengthening the construction of logistics infrastructure in Dalian Port

In order to develop port logistics and promote regional economic development, the government can appropriately invest in fixed assets in Dalian Port based on the investment environment and economic development pattern, improve the port's work efficiency, increase the port's cargo throughput and port facility utilization, and expand the economic radiation of the port. The increase of fixed assets investment can greatly guarantee the construction of port logistics infrastructure. In addition, in order to leverage the role of port logistics infrastructure, Dalian city also needs to strengthen investment in scientific research, build research bases with local characteristics, actively implement technological and institutional innovations, and promote the modernization of port logistics development.

Enhance the level of logistics informatization development in Dalian Port

To improve the development level of logistics informatization in Dalian Port, we can start from two aspects: strengthening the application of big data and information sharing technology, and enhancing the intelligent construction of port facilities.

To strengthen the application of big data and information sharing technology, firstly, we need to accelerate the deployment and application of basic information networks and equipment such as 5G base stations, provide support for further strengthening the application of big data and information sharing technology, and establish a sound data information collection and analysis system. Secondly, to enhance the ability of data integration and sharing, as the logistics system of Dalian Port involves multiple parties, including shipping companies, logistics enterprises, customs, border inspection, transportation, etc., it is necessary to establish an efficient data sharing mechanism, vertically and horizontally integrate data, and coordinate the sharing of data and information among various departments. Highlight the roles of supervisory and regulatory departments, promote coordination and integration among various departments, and form an efficient and rapid information exchange platform. Furthermore, in addition to productive processes, other service-oriented and auxiliary production processes also need to accelerate the layout and application of big data and information sharing technology, in order to improve and enhance the efficiency of ship navigation, material supply, production machinery and facility maintenance and other businesses.

Intelligent construction is the main measure to improve the operational efficiency and ensure safety of port logistics systems nowadays. By using intelligent technology, the port logistics system can automatically complete tasks such as loading and unloading, transportation, storage, scheduling, cleaning, and maintenance, achieving fast, accurate, and reliable operation of the entire logistics process. Strengthening the intelligent construction of port facilities, firstly, from the perspective of improving the overall operational efficiency of the port logistics system, adopting a modular and process oriented overall optimization approach, analyzing the bottleneck links of the production line for different types of goods and processes, and then improving the existing port logistics system facilities and equipment to reduce human interference and shorten the production cycle; Secondly, it is necessary to establish an intelligent monitoring system to monitor the production process and equipment status, in order to promptly and quickly identify and solve problems, thereby reducing production failures and downtime and improving the operational efficiency of the port logistics system.

Strengthen cooperation with surrounding ports

In recent years, regional port integration and port resource integration have been key measures for China to promote coordinated development of regional ports and promote port transformation and upgrading. By integrating the logistics system resources of surrounding ports and optimizing port layout, ports can have more

complete facilities and broader service capabilities, enhance their comprehensive competitiveness, and maintain their image and service quality. At present, the logistics system of Dalian Port has been merged and restructured with other ports in Liaoning, completing the integration of provincial-level ports. Strengthening cooperation with the logistics systems of surrounding ports can help improve the ability of Dalian Port's logistics system to respond to external risk disturbances, while avoiding vicious competition, further optimizing the industrial layout of each port area, and improving the quality and operational efficiency of freight services.

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