

# Research on Coordinated Development of Bengbu Port Logistics and Regional Economy based on Grey Relational Degree Analysis

Kangjia Li\*, Xue Jiang

School of International Economics and Trade, Anhui University of Finance and Economics, Bengbu, 233030, China

**Abstract:** The proposal of the "Belt and Road" strategy has made international trade increasingly prosperous, which has also brought good development opportunities to ports as freight centers. Ports are an important carrier and support for urban economic development. The rapid growth of the regional economy has also laid a material foundation for the development of port logistics. Based on the data of port cargo throughput and some economic indicators of Bengbu City, this paper uses the gray correlation analysis model to calculate and rank the correlation between port logistics and various regional economic indicators. Finally, measures and suggestions are proposed to optimize the industrial structure, improve infrastructure, strengthen port cooperation, clarify the positioning of the port area, and promote information management, which can promote the coordinated development of the two.

**Keywords:** Port logistics; Regional economy; Grey correlation; Suggestions

## 1. Introduction

Bengbu was once an important economic town in Anhui, but its economic development has been relatively backward since the reform and opening up. One of the reasons is that the port resources were not fully utilized. With the major strategic deployment of "Belt and Road" construction and the proposal of "Huaihe ecological development economy plan", it provides policy guarantee for the development of Bengbu port economy. In accordance with the requirements of the "13th Five-Year Plan", as a key area of the Yangtze River Economic Belt, Anhui should do a good job in port construction, expand import and export, and help the port industry gather development. In 2018, the State Council approved the "Huaihe Ecological Economic Belt Development Plan", which states that as the central city of the Huaihe River Basin, Bengbu must know how to use its location and transportation advantages to promote the further growth of the port economy.

From the current domestic research, most scholars have affirmed the coordinated development relationship between port logistics and regional economy, and think that port is an important carrier and support to promote the development of urban economy. For example [1], studied the relationship between Qinhuangdao port logistics and industry through a combination of qualitative and quantitative methods, and determined the causal relationship between the two by establishing a Granger causality test

model [2]; proved the high degree of correlation and coordination between port logistics and regional economy by using the grey correlation model and the coupling coordination model [3]; took Wuhu City as an example, analyzed and summarized the three effects of port logistics and regional industrial economy related mechanisms: multiplier effect, cluster effect and incentive effect, and finally got the port throughput and the tertiary industry added value the most significant conclusions between them [4]; used the gray correlation analysis model to calculate the degree of correlation between the port logistics of Suzhou Port and the regional economy from the perspective of the integration of the Yangtze River Delta and the necessity of adjusting and optimizing the industrial structure to promote port construction is put forward. However, there are few articles on the development of port logistics in Bengbu, and no scholars have studied the coordinated development of port logistics and regional economy in Bengbu. Therefore, based on the relevant statistical data of Bengbu City from 2009 to 2018, this paper studies the coordinated development relationship between the two through GRA model analysis.

## 2. Coordinated Development Status of Bengbu Port Logistics and Economy

### 2.1. Development status of Bengbu port logistics

As one of China's important regional comprehensive transportation hubs, Bengbu City has a relatively devel-

oped transportation network, connecting many railways and highways, and is adjacent to cities with rapid economic development such as Hefei and Nanjing. Bengbu Port is located at the intersection of the Huaihe River and the Beijing-Shanghai Railway, and has a total of four port areas. Among them, Bengbu New Port has been enabled for container transportation in 2014. As of 2018, Xingang has 47 production berths, including 21 1,000-ton berths, 9 500-ton berths and 2 container berths. At present, the port is mainly responsible for the import and export and transit of goods such as crops, building mate-

rials, photovoltaic glass and chemical industry [5]. The Bengbu-Taicang foreign trade route first opened by COSCO Shipping Port Shanghai Pan-Asian Port in June 2019 has truly realized the Huaihe River's transportation to the sea, and has also strengthened foreign trade and attracted foreign investment. It has promoted the outward-oriented economy of the Huaihe River Basin to develop to a higher quality. Figure 1 shows the change of cargo throughput and annual growth rate in Bengbu port in recent ten years.

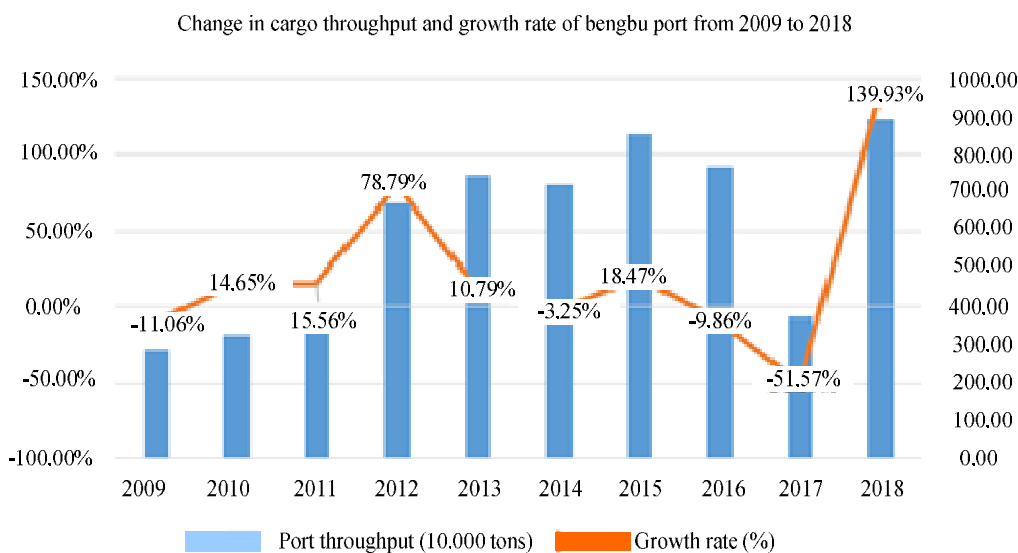


Figure 1. Changes in throughput and growth rate of Bengbu port from 2009 to 2018

### 2.2. Economic development of Bengbu

In recent years, Bengbu City has continuously implemented various policies to vigorously support the development and progress of regional industries, while paying attention to the optimization of the industrial structure, so that it can adjust or reform at any time with the development of the society and maintain social and economic stability and coordinated development [6]. In 2018, Bengbu City's GDP reached 171.46 billion yuan, up 8.5 percent, a high provincial level of 0.5 percentage points, and the growth rate of some major economic indicators, such as: industrial added value above the scale, total investment in fixed assets, etc. are also higher than the province. In addition, Bengbu City focuses on industrial coordination, seizes its own advantages, promotes the development of emerging industries mainly based on glass and silicon-based materials, and improves the level of science and technology innovation.

Overall, the port logistics and regional economy of Bengbu City are booming. Economic growth is insepara-

ble from industry. As a landlocked city, Bengbu City basically transports products such as industrial products and building materials through the port. The development of various industries has brought more business and benefits to the port. Therefore, it can be preliminarily judged that the two interact.

### 3. Correlation Analysis of Bengbu Poort Logistics and Coordinated Development of Regional Economy

#### 3.1. Index system construction

In accordance with the principles of comprehensive science, readily available data, and indicators that are directly independent of each other, in order to further clarify the relationship between port logistics and regional economy, and combine with the actual situation of economic development in Bengbu City, the article summarizes the port throughput of Bengbu City( $Y$ ) as a port logistics indicator, Gross Regional Product( $X_1$ ), Total

fixed asset investment( $X_2$ ),Agriculture, forestry, animal husbandry and fishery( $X_3$ ),industry( $X_4$ ),Construction industry( $X_5$ ),The total retail sales of social consumer

goods( $X_6$ ),Total imports and exports( $X_7$ )as indicators to measure the regional economic development of Bengbu City. Relevant data are shown in Table 1:

**Table 1. Main indicators of port logistics and economic development in Bengbu from 2009 to 2018**

	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$	Y
2009	532.09	355.71	104.39	202.35	34.10	226.98	3.84	283.69
2010	638.05	528.73	121.16	260.95	40.05	269.87	5.44	325.24
2011	780.24	650.92	144.38	337.58	47.30	319.28	7.70	375.85
2012	890.22	872.79	158.86	391.38	53.70	371.51	12.28	671.99
2013	1046.65	1060.89	172.36	456.65	59.03	424.82	15.80	744.50
2014	1151.19	1244.18	178.35	520.03	77.47	506.56	17.10	720.28
2015	1253.05	1457.97	192.49	560.64	81.31	570.65	23.41	853.33
2016	1385.82	1666.43	205.48	523.06	86.06	643.99	17.60	769.19
2017	1550.66	1912.55	211.39	581.87	99.43	725.13	17.71	372.50
2018	1714.66	2180.31	213.94	650.95	111.34	823.46	14.80	893.75

Note: Data source Bengbu City 2009-2018 statistical bulletin and Anhui Statistical Yearbook, Among them, the unit of  $x_1 - x_6$  is 100 million yuan, the unit of  $x_7$  is 100 million dollars, the unit of Y is ten thousand tons.

**3.2. Establishment of grey model**

Grey correlation analysis is a method to predict its correlation degree by using the similarity of the curve shape of each variable, mainly through the following steps: the determination of the analysis sequence, the dimensionless processing of the data, the calculation of the correlation coefficient, the calculation of the grey correlation degree, and the evaluation after ranking.

**3.2.1. Analysis of the construction of the sequence**

Determine the reference sequence that reflects the behavior of the system and the comparison sequence that affects the behavior of the system. Specific as the following two formulas:

$$Y = \{y(k) \mid k = 1, 2, \dots, n\} \tag{1}$$

$$X = \{x_i(k) \mid k = 1, 2, \dots, n\}, \quad i = 1, 2, \dots, m \tag{2}$$

**3.2.2. Dimensionless data**

**Table 2. Correlation coefficients between comparison sequences and reference sequences**

	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$
2009	0.9859	0.7494	0.7883	0.9731	0.9703	1.0000	0.7328
2010	0.9347	0.8459	0.7533	0.9370	0.9390	0.9910	0.7894
2011	0.8609	0.8729	0.6983	0.8058	0.9035	0.9586	0.9077
2012	0.6264	0.5680	0.7369	0.6766	0.6000	0.5876	0.7078
2013	0.6445	0.5930	0.6945	0.7002	0.5703	0.5798	0.8814
2014	0.7817	0.7706	0.7761	0.9398	0.8797	0.7644	0.9010
2015	0.6508	0.7235	0.6386	0.7539	0.6807	0.6716	0.6256
2016	0.9876	0.8194	0.8832	0.8240	0.9522	0.9394	0.9798
2017	0.3869	0.3381	0.4480	0.4266	0.3798	0.3675	0.4237
2018	0.8726	0.5994	0.6905	0.9456	0.8061	0.7215	0.5617

**3.2.4. Calculate the correlation degree**

In general, there are dimensional differences in the initial sequence data of each variable, and direct comparison will affect the conclusion of the accurate conclusion, so the data should be processed first in principle. There are two types of processing methods: initializing and averaging. This article uses the averaging method, and then calculates the absolute difference between all comparison series and reference series in the same year. The result is that  $\Delta_{\min} = 0.0071$ ,  $\Delta_{\max} = 0.9833$ .

$$\Delta = |y(k) - x_i(k)| \tag{3}$$

**3.2.3. Calculate the correlation coefficient**

In the formula, the magnitude of the resolution is negatively correlated with the value of  $\rho$ , which is usually between 0 and 1 and generally 0.5. The final result  $z_i(k)$  is also a positive number less than 1. The specific formula is as follows:

$$z_i(k) = \frac{\min_k \min_i |y(k) - x_i(k)| + r \max_k \max_i |y(k) - x_i(k)|}{|y(k) - x_i(k)| + r \max_k \max_i |y(k) - x_i(k)|} \tag{4}$$

Based on the data in Table 2, average them to get the final result representing the degree of correlation between each comparison sequence. The formula is as follows:

$$r_i = \frac{1}{M} \sum_{k=1}^M z_i(k) \tag{5}$$

where M is the length of the sequence and  $r_i$  is the degree of correlation sought.

The final results are shown in table 3:

**Table 3. The correlation between each index and Y**

$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$X_7$
0.7732	0.6880	0.7108	0.7983	0.7682	0.7581	0.7511

### 3.3. Conclusions

After sorting the degree of correlation  $X_2 < X_3 < X_7 < X_6 < X_5 < X_1 < X_4$ , it can be seen that among the indicators related to port logistics, the industry is the highest, and the GDP is the second. Generally speaking, when the degree of correlation is greater than 0.6, it is judged that there is a relatively high correlation between these two variables. The specific values are shown in Table 3. It can be clearly seen that the port throughput and the selected representative Bengbu city area Among the seven economic indicators, the smallest is 0.6880, and the rest exceed 0.7. Therefore, it can be judged as a whole that the economic prosperity of Bengbu City is closely related to the construction of the port. The two interact and develop together.

### 4. Countermeasures and Suggestions

At present, although the economy and ports of Bengbu City are developing steadily, as an inland city, there is a large gap with coastal ports. There are still some shortcomings that need to be resolved, such as: low level of industry; unclear positioning of port areas; The timeliness and cost of logistics need to be improved; there are many constraints on water transport. So in the next step, Bengbu City should seize the opportunities brought by the "Belt and Road" strategy, use its own favorable conditions to promote economic prosperity and port construction, and build a comprehensive port with reasonable layout, clear positioning and various functions in a certain period of time.

#### 4.1. Optimize industrial structure and accelerate economic development

Anhui Province is a large agricultural province. At present, the transportation of goods in Bengbu Port is mostly agricultural products, followed by building materials. As a supplier of high-end glass, the next step is to stabilize the existing enterprise foundation, and continue to expand and strengthen the production and export of high-end glass, silicon-based materials and other industrial products. At the same time use technology to upgrade the traditional industries, forming a relatively complete industrial chain of strategic emerging industries,

and promoting the development of the three major industries to a higher level.

#### 4.2. Improve infrastructure and strengthen port cooperation

Due to the comparative advantages of resource conservation, pollution reduction and low cost, the development of port transportation is very good. With the support of policies and its own transportation advantages, the cargo throughput of the port will inevitably increase greatly in the future. However, the current transportation capacity is limited, and the first foreign trade route between Taicang and Bengbu was opened in 2019. Therefore, the next step is to invest more to improve the infrastructure of the port, so as to improve its competitiveness. In addition, we need to develop more cooperative relationships with other ports, open more routes, and truly reach the river and the sea.

#### 4.3. Clear port positioning and promote information management

As the first port of the Huaihe River, it is necessary to give play to the role of the port, build more container berths, expand container business, and give full play to the advantages of low cost and large volume of container transportation. It should also learn from the experience of other local bonded logistics centers and ports to realize the port's leading role in surrounding industries. Of course, most customers are currently troubled by the long time of water transportation, so the port can rely on the Internet information system to monitor regional cargo, grasp the shipping status of the cargo, arrival time and so on, can reduce manual operations in the middle. It is not only reduce the cost of the company's operation to a certain extent, but also effectively improve the efficiency of port logistics.

### 5. Acknowledgment

Anhui University of Finance and Economics' 2020 Scientific Research and Innovation Fund Project, Project Number: XSKY2074, Instructor: Guicai Dong.

### References

- 
- [1] Li Peipei. Study on the relationship between Qinhuangdao port logistics and urban industrial structure. Yanshan University. 2013.
- [2] Zhang Baoqing, Sheng Jinlu. Research on the coordinated development of port logistics and regional economy based on multi-model - taking Chongqing as an example. Journal of Ningbo University (Science and Technology Edition). 2018, 31(02), 94-100.
- [3] Wu Jinghong, Lu Nengfang. Empirical research on the correlation between wuhu port logistics and regional industrial economy. Financial Theory and Teaching. 2018, (03), 53-57.
- [4] Chen Kang. Study on the coordinated development of Suzhou port logistics and regional economy from the perspective of Yangtze River Delta integration. Logistics Science and Technology. 2019, 42(11), 91-94+128.
- [5] Luo Yonghua. Port logistics and regional industrial structure optimization - based on the empirical study of Zhanjiang city. Journal of Beijing Jiaotong University (Social Science Edition). 2016, 15(02), 97-102.
- [6] Luo Yonghua, Peng Biyu. Coordinated development of port logistics and regional economy: measurement of correlation and spatial difference - empirical research based on guangdong province. Journal of Chongqing Jiaotong University (Social Science Edition). 2016, 16(02), 43-49.