

Consistency Analysis of Port Industry Development and Chinese Economic Development

Jianping Sun, Zhenfu Li, Yunxiao Guan, Tongchao Liu

College of shipping economics and management, Dalian Maritime University, Dalian 116026, China

Abstract. As a function in organization and management, coordination is used to adjust the interrelation of the individuals in the organization in order to achieve the ultimate goal. Coordination can make individuals groups in a whole, reduce the contradiction and conflict between each other and promote the realization of the overall goal. The research on the coordination of relationship between the port industry of China and the growth of economy plays an important guiding role for the port industry and healthy development of national economy. According to the correlation model between port industry and economic growth, the correlation factor between port industry and economic growth is extracted, and the coordination indicator system of the relationship between the port industry and economic growth is established. Then, this article makes correlation analysis of the standardization of indicators, removes the bigger indicators of correlation coefficient and eliminates the impact of the duplication of information between indicators in order to simplify the indicator evaluation system. The actual results by data calculation show that there were six obvious changes in the coordination degree of the relationship between the port industry and economic growth in China during the period from 1990 to 2014.

1 Introduction

Coordination in the organization and management is a function to achieve the ultimate goal by regulating the relationship between the individual organizations, it can make these individuals in a whole, to reduce the contradiction between each other, to promote the realization of the overall goal [1]. The study of the coordination relationship between port industry and economic growth plays an important role in guiding the healthy development of port industry and national economy. In order to effectively measure the relationship between the two, this paper introduces the coordination index to assess the relationship between port industry and economic growth in China. In view of the lack of research on the relationship between port industry and economic growth, and taking into account the important role of the coordination relationship between port industry and economic growth on the development of national economy, this paper focuses on the coordination degree of the relationship between the two industries. Through the investigation of the correlation pattern between the two, the coordination degree evaluation model is established, and the coordination level of the two is quantitatively analyzed to explore the coordination degree between the port industry development and economic growth in China, and then guide the healthy development of China's port industry.

2 A Study on the Relevance Model of Port Industry and Economic Growth

As a demand industry which is derived from the process of national economic development, the port industry plays an important role in the development of national economy. It combines the production, distribution, exchange and consumption of domestic and foreign trade and economic activities organically. It plays an important pillar role in the development of the national economy. At the same time, shipping as a carrier of import and export trade, for the import and export trade in the world to provide the possibility of the port as an important interface to maritime transport development has a great role in promoting. Therefore, it is clear that the correlation between port industry and economic growth contributes to the further innovation of the port industry and can also serve as an important basis for the development of national development strategies.

2.1 Contribution of Port Industry to Economic Growth

The first one is the impact of a region's economy. Combined with the development of domestic and international port industry, can be found in the development of the port industry has a strong effect of aggregation, according to Hong Kong City, Hong Kong and cities linked to the economic development model more common. Port as the core of the development of the city, because it has close to the transport node, low transport costs, the advantages of a single volume, often become the best area to attract the relevant industries gathered to form a port industrial clusters, these industrial clusters Attracting talent, technology and other elements of a large number of inflows, the formation of a strong competitive industrial clusters, and thus promote the

development of the city, its direct performance is the region's GDP growth. And as a comprehensive reflection of the regional economic development indicators, GDP can clearly show the role of port industry in promoting economic growth. The second one is the promotion of labor and employment role [2]. Expressed as the performance of the port industry in promoting the employment, each additional unit of output value can directly use or mobilize the number of labor personnel situation in relevant industry. When the port industry participates in economic activities, it has a great correlation with other industries. The port industry, as a derivative industry, provides services such as loading and unloading and transit for the economic activities of other sectors. At the same time, the port industry needs to develop manufacturing, trade and other industries to provide services and products, and in the process of labor and employment generated by the relevant areas to meet the needs of the employment of workers in the region to promote the employment of workers in order to create more social production value and promote economic growth.

2.2 The Effect of Economic Growth on the Development of Port Industry

One is to provide direct financial support for the development and construction of the port industry. In the course of economic development in a country or region, the accumulation of capital can provide financial support for the development of the national economic sector. As the economy continues to grow, the region's capital stock will increase, in order to promote the port industry and related industries to

upgrade the allocation of resources for the port industry to provide a strong scale of protection. When the infrastructure construction of the port industry reaches a certain level, it can speed up the development of the port industry and enhance the service level of the port industry, so as to better serve the economic construction. Similarly, when the development of the financial system of an area's port industry is relatively complete, it can attract relevant industries such as industry, trade and logistics, and bring together the resources, talents, technology and other resources in the region to form a whole industrial chain, so as to enhance the quality of the development of the port industry in the region, the region's port industry to increase the core competitiveness.

The other one is to provide indirect trade logistics needs for the development of the port industry. The purpose of the port industry is to meet the logistics needs, so as to promote economic and social development. Economic growth, as the driving force behind the demand for logistics, can provide constant demand for the development of the port industry. When a region's economy continues to grow, it will stimulate the continuous development of various industrial sectors, resulting in a huge trade logistics needs, and shipping with large volume, low cost, low energy consumption advantages, in terms of foreign trade, Country or region of the main transport tasks. Port as a hub for maritime transport, in the realization of maritime missions play an important role, therefore, by the economic growth caused by the demand for trade logistics will be completed by means of the port industry, which indirectly contributed to the development of the port industry.

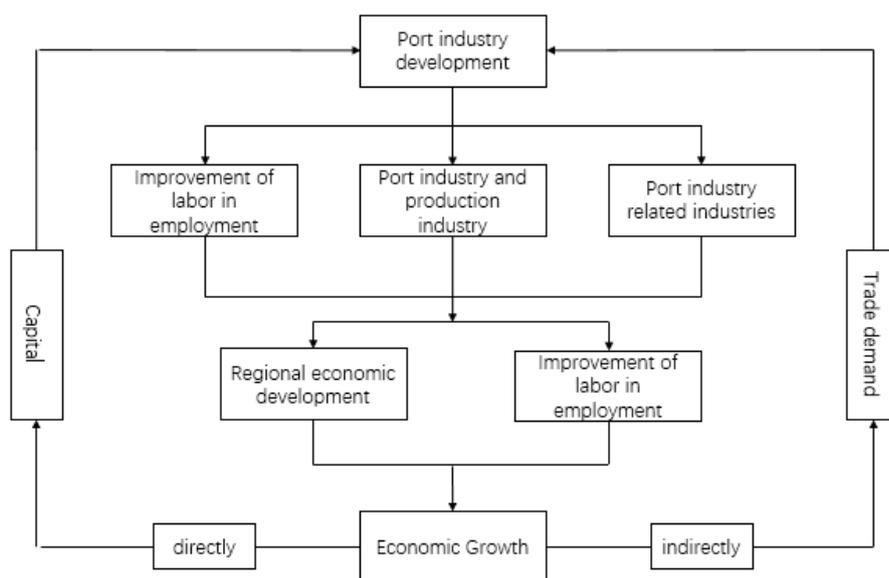


Fig 1. The correlation model between port industry and economic growth

3 Coordination Model of Port Industry and Economic Growth

The purpose of coordination is "harmony and consistency, with appropriate" [3]. From the system point of view, coordination refers to the system or between the various levels of the system, the various parameters of the system between the harmony, with the appropriate, structure and function of the relationship between the integration of coordination through the system can reduce the negative Effect, and improve the overall output function and synergistic effect of the system. The coordination degree of a system can be expressed as the degree of harmony between the elements of the system or the system, which can reflect the trend and degree of the system from disorderly to orderly development, and can effectively measure the internal factors of the system or system. The level of coordination between the level. Thus, coordination is a measure of the coordination of the system.

Port industry and economic growth belong to two systems. The development of port industry is affected by factors such as economic trade, shipbuilding industry and government's legal policy. Similarly, economic growth will be affected by the accumulation of capital, labor input, technological progress and other factors. The coordination between the port industry and economic growth is to deal with the interrelationship between these two parameters in order to improve the overall output function of the two systems and to promote the continuous development of the world economy. And coordination is used to measure the relationship between the two indicators, is a quantitative measure of this relationship.

3.1 Index System

In order to be able to measure the degree of coordination between the two industries, considering to reflect, monitor, compare, evaluate and predict the principle of the analysis of the object, the paper analyzes the relationship between the port industry and the economic growth, Port industry development and economic growth indicators to select the index system, in order to reflect the development of China's port industry and economic growth of the respective characteristics of the characteristics and factors. Due to the large number of factors influencing the port industry and economic growth, and there is a great correlation between the different indicators, through the analysis of the index system, the indicators that have significant influence on the evaluation results are selected as the analysis of the port industry and economic growth Indicators of covariance measurement.

To select indicators [4] influencing the development of the port industry, respectively, from the port-related industries development level, maritime fleet, economic and trade, talent and technology, ports, government investment in six aspects to measure. As shown in Table 1.

As for indicators [5] selected affecting the economic growth.

Specifically, from the following seven aspects such as the accumulation of capital, resource consumption, economic development system, labor costs, science and technology education level, urbanization rate and degree of industrialization to make judgments.

3.2 Coordination Model and Type

The relationship between port industry and economic growth is a dynamic process. There may be a big gap between the two stages. However, there is a reasonable interval between the port industry and the economic growth. As long as the coordination of the two in the threshold range, not enough to affect the overall relationship between the two, this development model can be recognized, of course, the overall development of the two to maintain the optimal state is the best. For this idea, we define the formula for the degree of coordination:

$$C_{XY} = 1 - \delta/\mu \quad (1)$$

$$\mu = \frac{X+Y}{2} \quad (2)$$

$$\delta = \sqrt{\frac{(X-\mu)^2+(Y-\mu)^2}{2}} \quad (3)$$

In the above formula, X is the comprehensive index of the development of port industry in China, Y is the comprehensive index of China's economic growth, C_{XY} is the coordination degree of port industry and economic growth, $C_{XY} \in [0, 1]$. C_{XY} is determined by the variables X and Y, and when X and Y are both positive and the values are equal, C_{XY} takes the maximum value and the value is 1. According to the value of X and Y, the coordination degree of the two will change, and the degree of coordination will be divided into the following categories according to the value of C_{XY} .

3.3 Calculation Method

3.3.1 Standardization of data

Due to the existence of different dimensions of the original data for the different indicators in the system, and the size of the order of magnitude is not the same. Data for different indicators could not be compared and calculated directly. In order to eliminate the impact of these factors, evaluation index of different dimensions need to be transformed into dimensionless standardized indicators, through an appropriate way. That is, the standardization of indicators. Considering that the covariance matrix of each index data processed by the mean method can reflect the difference in the degree of variation of each index in the original data and the information of the degree of mutual influence of each index, this paper adopts the mean method to carry out the index standardized processing.

Let \hat{x}_{ij} be the normalized value of the i-th-evaluation index at the j-th time point, \hat{x}_{ij} is the original value of the i-th evaluation index at the jth time point, and m is the total length

of the time series. Then
 Standardization formula for port industry development indicators:

$$\hat{x}_{ij} = \frac{x_{ij}}{\bar{x}_i} \quad (4)$$

$$\bar{x}_i = \frac{1}{m} \sum_{j=1}^m x_{ij} \quad (5)$$

Among them, \bar{x}_i is the average of the original indicators of

the development of the port industry;
 Standardization formula for economic growth indicators:

$$\hat{y}_{ij} = \frac{y_{ij}}{\bar{y}_i} \quad (6)$$

$$\bar{y}_i = \frac{1}{m} \sum_{j=1}^m y_{ij} \quad (7)$$

Among them, \bar{y}_i is the average of the original indicators of economic growth;

Table 1. The indicator system of the effects in the port industry's development

Target layer	Criteria layer	Index layer
The indicator system that affects the development of port industry	Port - related industry development level	Shipbuilding industry development level
		Maritime trade service industry development level
		Average return on capital of shipping enterprises
		Enterprise fleet market share
	Sea fleet	China's maritime fleet capacity scale (100t dwt)
		The proportion of domestic imports and exports of goods transported by their own ships
		Fleet structure
		Fleet age structure
		Route density
	Economic and Trade	China's import and export trade volume (ten thousand US dollars)
		Sea freight
		The degree of development of the financial industry
	Talent and Technology	Sailing senior personnel training
		Training of professional personnel in shipping enterprises
		Maritime information service platform
		Maritime research investment
	Port	The natural conditions of the port
		Port throughput
		Port infrastructure improvement
	Government investment	Port logistics service level
		The state of the domestic shipping industry policy force
		Government 's financial support for the development of maritime industry

3.3.2 Relevance analysis for indexing

The basic principle of correlation analysis is to calculate the correlation coefficient between the two evaluation indexes, and to remove the set of indexes with large correlation coefficient, so as to eliminate the influence of information repetition and simplify the index evaluation system [6].

Let r_{ij} be the correlation coefficient between the i -th index and the j -th index, Z_{ki} denote the value of the k -th time period of the i -th index, \bar{Z}_i denote the expected value of the time series of the i -th index, and n be the length of the time series.

According to the calculation of the correlation coefficient, then

$$r_{ij} = \frac{\sum_{k=1}^n (Z_{ki} - \bar{Z}_i)(Z_{kj} - \bar{Z}_j)}{\sqrt{\sum_{k=1}^n (Z_{ki} - \bar{Z}_i)^2 (Z_{kj} - \bar{Z}_j)^2}} \quad (8)$$

In order to be able to effectively select a representative evaluation index, we need to define the value of r_{ij} , specify the critical value M ($0 < M < 1$), if $|r_{ij}| > M$, you can delete one of the two evaluation Index, leave another, if $|r_{ij}| < M$, that is to say there is little correlation between the two

indicators ,and both are retained.

Through the relevance of the index screening, the impact of repeated information on the evaluation can be effectively removed, and the evaluation of the index system being simplified.

Table 2. The indicator system of the effects in the economic growth

Target layer	Criteria layer	Index layer
The indicator system that affects economic growth	Capital accumulation level	GDP
		Foreign investment level
		Foreign exchange reserves
	Economic development system	The proportion of public ownership economy
		Taxation accounts for the proportion of the national economy
	Labor input	Employment rate
		Per capita income of urban residents
		Per capita income of rural residents
	Urbanization level	Proportion of urban and rural population
		Urban land
		Urban population aggregation degree
	Level of science and technology education	Accept the number of higher education
		Per capita education level
		Education and Research Funds Proportion of National Economy
		Number of national patents
	Degree of industrialization	Three types of industrial structure than
		Industry coordination degree
		High - tech industrialization rate
	Resource utilization	Energy consumption elasticity coefficient
		Resource consumption
		Renewable energy utilization

3.3.3 Calculation of Comprehensive Evaluation Index Affecting Port Industry Development and Economic Growth

Because the factor influencing the development of the port industry and the economic growth is the comprehensive index composed of different indicators, it is a multi-index statistical analysis method. Therefore, this paper chooses the correlation-principal component analysis [7] to measure the indicators. The essence of the principal component analysis is the linear combination of the observed indicators. The calculation model of principal component analysis is:

$$x_i = \alpha_{i1}\hat{x}_{i1} + \alpha_{i2}\hat{x}_{i2} + \dots + \alpha_{in}\hat{x}_{in} \quad (9)$$

$$X = \sum \omega_i \hat{x}_i$$

$$y_j = \beta_{j1}\hat{y}_{j1} + \beta_{j2}\hat{y}_{j2} + \dots + \beta_{jn}\hat{y}_{jn} \quad (10)$$

$$Y = \sum v_j \hat{y}_j \quad (11)$$

In the formula, x_i and y_j are the sovereign factors after the standardization of port industry and economic growth, and ω_i

and v_j are the contribution rates of the sovereign factor eigenvalues of port industry and economic growth. \hat{x}_{ij} is the j -th index of the i -th sovereign factor which influence the port industry. \hat{y}_{ji} is the i -th index of the j -th sovereign factor which influence the economic growth. X and Y are the comprehensive indexes of port industry development and economic growth respectively, n is the number of indicators. The relevant steps [7] of the principal component analysis is, take the calculation method of x_i as an example:

- ① Standardize the index data processing, unified dimension;
- ② Calculate the normalization of the index data after the correlation coefficient, obtain the results of correlation coefficient matrix $R_{n \times n}$;
- ③ Calculate the eigenvalues $\lambda_i (i = 1, 2 \dots n)$ of the matrix $R_{n \times n}$, λ_i represents the total variance of the data of the original index explained by the i -th sovereign factor x_i ;
- ④ Determine the value of k , make the utilization rate

of information reaching 85% or more, k indicates the number of indicators that affect the sovereign factor after screening;

$$\frac{\sum_{i=1}^k \lambda_i}{\sum_{i=1}^n \lambda_i} \geq 0.85 \quad (12)$$

⑤ The contribution rate ω_i of the eigenvalue of the sovereign factor x_i is:

$$\omega_i = \frac{\lambda_i}{\sum_{i=2}^n \lambda_i} \quad (13)$$

⑥ The weight of the index α_{ij} is determined by the expert consultation method [8].

Through the correlation analysis and principal component analysis, we can eliminate some non-quantifiable and high correlation index with the known indicators, select the indicators that have higher impact on the evaluation object as the calculation factor of the coordination degree, so as to analyze The relationship between port industry development and economic growth.

4 The Empirical Analysis and Evaluation of Coordination Degree between Port Industry and Economic Growth

4.1 Selection of Samples and Data Sources

In view of the index system which affects China's economic growth and the development of China's port industry, this paper chooses the data from 1990 to 2014 as the time series to analyze the relationship between China's economic growth and port industry. The data for the indicators used for coordination are from the website of the National Bureau of Statistics of the People's Republic of China, the website of the Ministry of Transport, the China Yearbook of Transportation, and the website of the China Shipbuilding Industry Association.

Table 3. The classification of coordination degree between the port industry and economic growth

Coordination type	C_{XY}	Port industry and economic growth of the comprehensive indicators X, Y value	Coordination characteristics
Class I	$0.8 \leq C_{XY} \leq 1$	$X \geq 0, Y \geq 0$	Very coordinated, the port industry and economic growth are optimized development, the system was the best state
Class II	$0.6 \leq C_{XY} < 0.8$	$X \geq 0, Y \geq 0$	Coordination, the development of port industry and economic growth are relatively high level, the overall system to the good direction
Class III	$0.5 \leq C_{XY} < 0.6$	$X \geq 0, Y \geq 0$	Relatively coordinated, the port industry development and economic growth in one of the comprehensive level higher than the other, but the system as a whole is still relatively coordinated
Class IV	$0.4 \leq C_{XY} < 0.5$	$X \geq 0, Y \geq 0$	Not coordinated, economic growth and port industry, the level of imbalance, the development of the system instability
Class V	$0.2 \leq C_{XY} < 0.4$	$X \geq 0, Y \geq 0$	Uncoordinated, the development of the port industry and the level of economic growth are relatively low, and the development of the two is very uneven, the overall system of instability
Class VI	$0 \leq C_{XY} < 0.2$	$X \geq 0, Y \geq 0$	Very uncoordinated, port industry and economic growth in the development of a comprehensive level are in a low state, the overall system was in recession

Table 4. The coordination degree of the port industry’s development and economy growth in China (1990-2014)

Time	Port Industry Development Index	Economic growth index	Coordination degree	Coordination type
1990	0.2294	0.6786	0.3004	Class V
1991	0.2294	0.6863	0.2945	Class V
1992	0.2249	0.6489	0.3138	Class V
1993	0.2306	0.6739	0.3069	Class V
1994	0.2563	0.6745	0.3646	Class V
1995	0.2618	0.7148	0.3439	Class V
1996	0.2680	0.7246	0.3495	Class V
1997	0.2900	0.7336	0.3871	Class V
1998	0.3021	0.7273	0.4157	Class IV
1999	0.3426	0.7201	0.4976	Class IV
2000	0.4071	0.8109	0.5312	Class III
2001	0.4548	0.8750	0.5531	Class III
2002	0.5195	0.9557	0.5818	Class III
2003	0.6198	1.0871	0.6128	Class II
2004	0.7503	1.1281	0.7156	Class II
2005	0.8860	1.0872	0.8558	Class I
2006	1.0235	1.0595	0.9755	Class I
2007	1.1761	1.1001	0.9528	Class I
2008	1.3481	1.1056	0.8602	Class I
2009	1.4005	1.1813	0.8799	Class I
2010	1.7948	1.2881	0.7676	Class II
2011	2.0476	1.3941	0.7315	Class II
2012	1.9988	1.4209	0.7610	Class II
2013	1.9695	1.4652	0.7923	Class II
2014	1.9685	1.4838	0.8014	Class I

Source: 《China Statistical Yearbook》, 《China Transportation Yearbook》 and China Shipbuilding Industry Association website

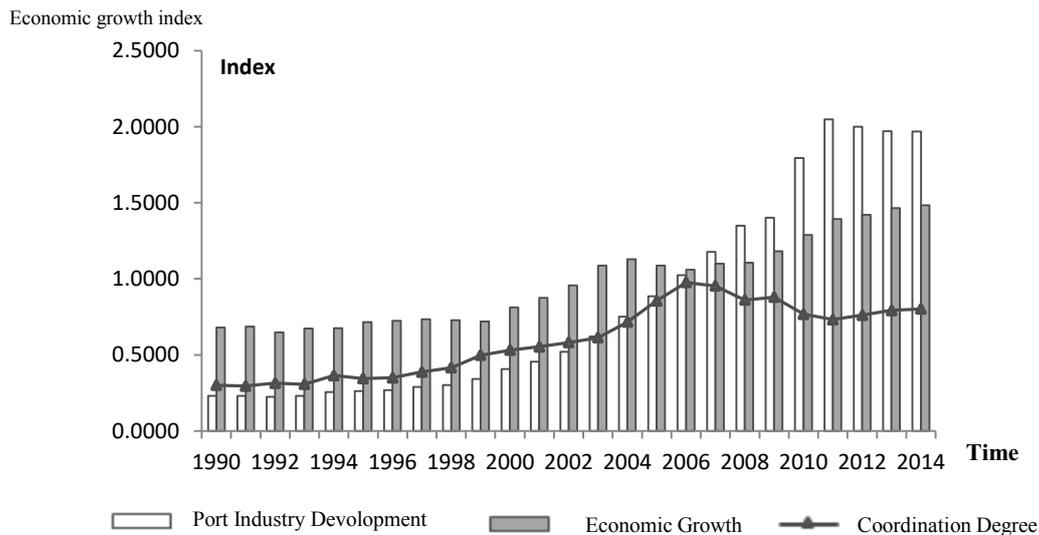


Fig 2. The changing curve of coordination degree between the port industry’s development and economic growth in China

4.2 Analysis of Results

After extracting the evaluation index by the correlation-principal component analysis, the index weight determined by the expert consultation method is brought into the calculation model of the coordination degree, and the coordination table between China's port industry and economic growth can be obtained. As shown in Table 4.

It can be seen from Table 4 and Figure 2, there have been six significant changes of the coordination of the relationship between China's port industry and economic growth. The first stage was in the early 1990s (1990-1991). Although China's reform and opening-up policy was effective, economic growth reached a certain scale, but because of the poor economic base in China, the structure of economic development is irrational and the economic growth is instability, resulting in a series of problems in China's economic growth, economic development, the level of comprehensive development in a low state. At the same time, the rapid development of economy and foreign trade brought by reform and opening-up policy has stimulated the huge demand for import and export goods for maritime transport. However, due to the limited ship capacity and relatively backward construction of port infrastructure, serious problem such as the pressure port phenomenon has been appeared in the development of the port industry.

The second stage is in 1992-1997, when China's port industry development and economic growth is in a state of incongruity. In 1992, Comrade Deng Xiaoping's "Southern Tour Speech" pointed out the direction of China's economic development. The upsurge of reform and opening up continued in our country. The foreign capital entered China's territory, and there was an investment boom in China. However, due to China's economic development system reform in the early stages, lacking effective policy guidance and macroeconomic regulation and control, which caused a lot of duplication of the project, a serious waste of resources, leading directly to China's economic growth reached a climax in 1992-1993, causing the phenomenon of overheating. Although economic growth maintained a high rate in this period, the economic development of the structural problems also highlighted. Therefore, the state in the 1993-1996 stage implemented the macro-control, which successfully controlled the momentum of economic growth and the level of economic growth has also been improved. Similarly, in this stage of development, the state has further expanded the scope of coastal openness, which greatly promoted the development of the coastal port industry. During that time, Ministry of Communications put fully effort to carry out the long-term planning of traffic infrastructure construction which named "three main one support" [9], made a series of planning and constructing achievements, not only in the supporting system, but the main water channel and the main port as well. At the same time, it brought the initial formation of the coal, oil, iron ore, grain-based bulk cargo terminals and container specialized terminals. However, due to the late development of China's port

industry, infrastructure is still weak, so a short period of time the level of development will not be qualitative improvement, the overall level of development is still in a low state.

The third stage is in 1998-1999, when China's port industry and economic growth is in a state of less coordinated. During this period, China's economic growth rate is lower than the 9.5% growth rate since the reform and opening up. Economic growth failed to maintain the momentum of development, partly from the Southeast Asian financial turmoil in the second half of 1997. Although the financial turmoil did not have a direct impact on the Chinese mainland economy, coincided with Hong Kong and Macao return to the motherland, Hong Kong has been greatly affected as a financial center in Asia in the face of this financial turmoil. At the same time, Southeast Asia as an important area of China's foreign trade, China has also encountered some problems in foreign trade and foreign investment, which also led to some limits of the development of China's port industry at this stage.

The fourth stage is in 2000-2004, when China's port industry development and economic growth transformed from a relatively coordinated state to a coordinated state. From this stage we can see that China's port industry development system and economic growth are in the rising stage, and the development model is maturing, one of the important turning point is China's successful accession to the World Trade Organization in November 2001, which has produced a great impact on the Chinese economy growth. A significant change is that China's economic growth rate being substantial rebound. At the same time, with the formation of China's all-round, multi-level and wide-ranging pattern, China has made certain achievements in economy, politics, science and technology, culture and security. The relationship between China's economy and the world economy has been strengthened, and further reform of China 's economic system has also been accelerated. China has begun to play an increasingly important role in the world stage. However, in the early years of China's accession to the WTO, China was still in a passive and one-way state in relations with various WTO members [10], especially developed countries. Therefore, China has always been at the disadvantage in the foreign trade, which brought certain restrictions in implementing the strategy of "going out". As an important carrier of foreign trade, the port industry also ushered in a new era of development after China's accession to the WTO. As an important manufacturing country in the world, a large number of product that made in China began to enter international markets, which promote further innovation in China's port industry.

The fifth stage is from 2005 to 2009, during which China's economic development as a whole showed a continuous wave of heat, China played an increasingly important role in international economic affairs. As the world's largest developing country, China's contribution rate to the world economy during this period of time reached 15%, which has made great contributions to the development of the world economy. At the same time, China successfully held the 2008 Beijing Summer

Olympics during this period, which not only shown the great achievements since China's reform and opening up to the world, but also enhance China's international status. The development of China's port industry has experienced a climax. China has grown as the world's maritime power. As 《2009 China's Shipping Development Report》 shows, which issued by the Ministry of Transport, the national port to complete the cargo throughput of 7.657 billion tons. In the top 10 ports of global cargo throughput, China has occupied eight seats and has become the world's largest country of port throughput. Therefore, at this stage, China's economic growth and the development of the port industry are in a period of rapid development of the golden period, the coordinated development of the relationship between the two are in good condition.

The sixth stage is from 2010 to 2014, the development between port industry and economic growth is in a coordinated state. However, suffering the 2008-2009 US "subprime mortgage crisis", the world economy declined at this stage as a whole, which directly reflected by the substantial reduction in global trade demand. World's economic development is in trouble. Similarly, China's economic development in the face of this crisis has not escaped the tragedy of decline, China's economic growth rate has declined for five consecutive years. The reason for this can be divided into two kinds. One reason is that the volume of China's economic increased gradually, which reduced the pace of development. The other reason is that China's foreign trade development has been facing the challenge of global economic downturn. For this situation, China's government has introduced a series of policies to slow down the impact of the financial crisis on China, optimize the industrial structure, promote the supply side of the reform, China's economy also grew in a high speed in face of this crisis. As for port industry, after a boom of economic development in the last stage, China's port industry booming, has made unprecedented achievements, the comprehensive level of China's port industry development has reached a new height. But the resulting shortcomings of the airport empty ship is also fully exposed at this stage, the development of China's port industry experienced a cliff-style decline. However, the crisis also contributed to China's port industry, making it continue to develop in a more reasonable direction.

5 Conclusion

Based on the systematic review of the co-ordination model, this paper analyzes the various factors related to the growth of the port industry and economic and economic factors. By using the correlation analysis and the principal component analysis, the indicators are screened and the indicators with large correlation coefficients are removed, the impact of information duplication was also reduced, which makes the indicators strong representative, independent of each other. Through the quantitative measurement of the coordination degree, we can accurately identify constraints restricting the development of the port

industry, in order to provide an important basis for formulating the strategy of the port industry developing in the future, and then guide the healthy development of the port industry.

The actual data calculation results show that there had been six significant changes in the relationship between the port industry and economic growth in China during the period from 1990 to 2014: ① in the early 1990s (1990-1991), the rapid development of economic and foreign trade caused by the reform and opening up policy brought about a series of pressure ship pressure port phenomenon; ② in 1992-1997, China's port industry development and economic growth were in a state of incongruity; ③ in 1998-1999, China's port industry and economic growth was in a state of less coordinated; ④ in 2000-2004, China's port industry development and economic growth were transforming from a coordinated state to a coordinated state; ⑤ in 2005-2009, the growth of China's economy and the development of the port industry were in a period of rapid development, and the coordinated development of the two was in a good state; ⑥ During the period from 2010 to 2014, the development of the port industry and economic growth is in a state of coordination. These changes are closely related to the background and policy environment of the time, in which the coordination degree of the two reached a high level in 2005-2009.

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References

1. Zhangjingjing,Chenzhengjiang,Yangdegang. Construction and Application of Evaluation Model of Urban and Rural Coordination Degree [J]. Journal of Arid Land Resources and Environment,2007,21 (2) :85-94
2. Liming. Water transport on the contribution of China's national economy [D]. Dalian Maritime University master's degree thesis,2004
3. Zhangxiaodong,Chitianhe. Analysis on the Coordination of Regional Economy and Environment in China in the 1990s [J]. Geography Research,2001,20 (4) :506-515
4. Sunyabo,Fanhouming,Liuyiying,Lizhenfu. Construction of Evaluation Index System of Shipping Power Based on Reliability and Validity Analysis [J]. Journal of Shanghai Maritime University, 2014,35(4):26-31
5. Wangjunlei,Wangzhaokai,Yangxiaoming. Economic Growth Quality Evaluation Model Based on Analytic Hierarchy Process [J]. Statistics and Decision,2007
6. Chiguoqin,Caotingting,Zhangkun. Based on the correlation-principal component analysis of human

- comprehensive development evaluation index system construction [J]. *Systems Engineering Theory & Practice*, 2012, 32 (1) :111-119
7. Lihongxi. Research on Port Logistics Evaluation Based on Correlation - Principal Component Analysis [D]. Dalian University of Technology Master of Engineering degree thesis, 2013
 8. Hanxiaohai, Zhangzhaihui, Sunfujun, Wangshaohua. Method of Determining Weight of Index Based on Principal Component Analysis [J]. *Journal of Sichuan Ordnance*, 2012, 33(10):124-126
 9. Tongxinchun. On the Development and Changes of the Maritime Industry in New China [J]. *Research on China 's Economic History*, 2012, 2:127-137
 10. Chentaifeng, Huangang. The Influence of China 's Entry into WTO on China: Post-evaluation based on international returns [J]. *National situation report*, 2009, 12:1-34
 11. Zhangxiaodong, Chitianhe. Analysis on the Coordination of Regional Economy and Environment in China in the 1990s [J]. *Geography Research*, 2001, 20 (4) :506-515
 12. Liuqiang, Chenyixian. A Summary of China 's Economic Growth since the 1990s [J]. *Journal of Zhengzhou Institute of Aeronautical Industry Management*, 2004, 22 (1) :8-11
 13. Panwenyan, Wangzongjun. Research on Evaluation Index System of Low Carbon Competitiveness Based on Coordination Model [J]. *Information magazine*, 2012, 31 (10) :76-82
 14. Liuyaobin, Songxuefeng. Analysis on the Coordination Degree between China 's Industrialization and Urbanization since the Reform and Opening - up [J]. *Science and Technology Herald*, 2005, 23 (2): 48-51
 15. Zhangxiaodong, Zhudehai. Forecast and Analysis of China 's Regional Economy and Environment Coordination [J]. *Resource science*, 2003, 25(2):1-6
 16. Ministry of Communications, Ministry of Commerce. Provisions on the Administration of Foreign Investment in International Maritime Industry. (2004) Order 1
 17. B Büttner. Effectiveness versus Efficiency: Growth Accelerating Policies in a Model of Growth without Scale Effect, *German Economic Review*, 2006, 7 (3), 297-316.
 18. GLASS, A. and X.WU. "Intellectual Property Rights and Quality Improvement". *Journal of Development Economics*, 2007, 82: 393-415
 19. Maddison A. Chinese economic performance in the long run[M]. *Organization for Economic*, 1998
 20. Jones, C.R&D-based Models of Economic Growth[J]. *Journal of Political Economy*, 1995, 6 (3) :286-297