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ABSTRACT

China's Yangtze River has become the navigable river with the largest volume in the world, and its development is very important for China. In this context, this paper first focuses on its water transport volume from two perspectives of the time series and the influencing factors; it forecasts the water transport volume in 2015 and 2020 with Regression Analysis, Elastic Coefficient Method, Time Series Analysis and the weighted combination of those methods. On this basis, this paper analyzes and redefines the transport efficiency of ships, and then it calculates the water transport capacity in the future. From above analysis, this paper draws the conclusion that the problem of oversupply of Yangtze River shipping is more and more serious in the future. Finally this paper puts forward two suggestions to solve the problem, such as paying much attention to the building of arterial channel and optimizing the structure of freight capacity, which will play an active role in the development of Yangtze River shipping.

Keywords: Yangtze River Shipping, Water Transport Volume, Water Transport Capacity, Forecast, Freight Rate

INTRODUCTION

Yangtze River shipping is an important part of China's integrated transport network, and it is irreplaceable especially in the bulk cargo transportation. On the one hand, the development of Yangtze River shipping is consistent with the transportation requirements of national sustainable development, which can facilitate the dredging and improvement of the channel to achieve comprehensive benefits of shipping, flood prevention, electricity generation and irrigation, and can also promote the development of the basin's economy. On the other hand, its development is vital to national politics, military and security, and it plays a special role in disaster relief in emergencies. China's Yangtze River has become the largest volume of the navigable rivers in the world, in this context, this paper studies on the water transport volume and capacity of Yangtze River shipping.

1. THE CURRENT SITUATION OF THE INLAND WATER TRANSPORTATION OF YANGTZE RIVER

The Yangtze River's channel is 2838 kilometers long totally, of which the upstream part is 1074 kilometers long from Shuifu to Yichang, the midstream part is 900 kilometers long from Yichang to Hukou, and the downstream part is 864 kilometers long from Hukou to Liuhekou. At present, the 12.5-meter-deep water channel of the downstream part is extended to Taicang, and the channel from Nanjing to Taicang is 10.5 meters deep which is accessible for the 30,000-ton ship's perennial navigation to Nanjing, and the 50,000-ton ship's perennial navigation to Taicang. The channel from Wuhu to Nanjing is 9.0 meters deep which is accessible for the 10,000-ton ship's perennial navigation to Wuhu. The minimum maintenance depth of the channel of Jingjiang River in midstream part is officially increased from 2.9 meters to 3.5 meters. The minimum depth of the channel in the upstream part from Chongqing to Yibin is increased from 1.8 meters to 2.7 meters, which is up to the standard of the third-class channel.

The specialization and formalization of the ports along Yangtze River have been accelerated in 2011, and there are 4036 productive berths, including 389 berths of more than 10,000 tons, and nine ports of 100 million tons such as Nantong, Taicang, Zhangjiagang and Jiangyin, Taizhou, Zhenjiang, Nanjing, Wuhan, Chongqing.

In 2011, the number of various ships of the seven provinces and two cities along Yangtze River is 11.49 thousands, with an increase of 229 ships compared with 2010. The net dead weight is 116 million tons, with an increase of 20 million tons compared with 2010.

The cargo throughput of Yangtze River in 2011 is 1.66 billion tons, which is increased by 10.5%. The cargo throughput of large-scale ports is 1.58 billion tons, which is increased by 14.0%. The cargo throughput of foreign trade is 195 million tons, which is increased by 15.3%. The container throughput is 11.19 million TEUs, which is increased by 23.2%.

In 2011, the construction of support and guarantee system of the inland water transportation of Yangtze River has been strengthened, at the same time, the capabilities of the navigable protection, safety supervision, emergency rescue, water crime prevention and fire control have been improved, which provides strong support and protection for the scientific development of the transportation of Yangtze River and the goal of safety development. The Electronic Channel Chart of Yangtze River (Version 2.0) has been officially put into use, which runs through Yangtze River channel of 2687.8 kilometers.

2. THE COMBINATION FORECASTING OF WATER TRANSPORT VOLUME OF YANGTZE RIVER

The shipping development of Yangtze River is in order to meet the water transport volume of socioeconomic development. On the one hand, the level of socioeconomic development forms new water transport volumes or constraints, on the other hand, the rapid development of shipping promotes the rapid development of the social economy, obviously, there is a very close relationship between them. Therefore, for forecasting the water transport volume, Jiang (2004) has proposed that it must firstly analyze and forecast the level of socioeconomic development, based on the characteristics and trends of which, this paper makes scientific

and reasonable forecast of the development level of the water transport volume through the application of a variety of qualitative and quantitative methods.

This paper selects relevant mathematical models to forecast the water transport volume with a combination of qualitative method and quantitative method, which analyzes the water transport volume from two perspectives of the time series and the influencing factors. Firstly, it is necessary to make analysis and judgment of historical trends of all kinds of predictors, and consult with the planning of relevant planning department and transport sectors. Secondly, it analyzes a number of constraints, chooses important constraints, and adjusts forecasting results obtained by the application of several kinds of methods. Finally, it is important to invite experts of rich experience in forecasting and planning aspects to analyze the forecasting results, make sure of the credibility, and adjust the results if it is necessary.

2.1 Analysis of Major Types of Cargoes of Yangtze River Shipping

According to the statistics of water transport volume completed by registered ships by the Transportation Department of seven provinces and two cities along the river, in 2011, the overall water transport of major goods is steady, and the growth slows down. Compared with 2010, the types, of which the growth relatively slows down, are mainly coal and metal ores, with an increase of 3.5% and 3.6%, and the growth decreased by 14 and 30 percentage point. The types, of which the growth is faster, are chemical fertilizers, pesticides and grain, with an increase of 18.5% and 42.7%, and the growth increased by 16 and 50 percentage point. The top four in the proportion of the total transport volume are building materials, coal, oil and gas and related products, and metal ores, of which the transport volume completed respectively are 561.28 million tons, 302.06 million tons, 202.07 million tons and 179.61 million tons, respectively accounting for 27.8%, 15.0%, 10.0% and 8.9% of the total volume, which are together accounting for 61.7% of the total volume, the proportion is 2 percentage point lower than 2010. The water transport volume statistics of major types of cargoes between 2003 and 2011 of provinces and cities along the river is shown in the table 1 and figure 1, the composition of the water transport volume in 2011 is shown in the following figure 2.

Table 1 - The Statistics Table of Water Transport Volume of Major Types of Cargoes of Provinces and Cities along Yangtze River between 2003 and 2011 Unit：Million Tons

Year	Dry Bulk Cargo							Oil, Gas and Products	Container Cargo	Total
	Building Materials	Coal	Metal Ores	Cement	Steel	Non-metallic Ore	Others			
	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8	Y_9	
2003	196.94	163.46	44.04	30.46	18.65	13.70	151.24	91.40	16.97	726.86
2004	169.58	515.95	87.06	99.59	35.46	15.75	203.70	407.33	20.87	1555.29
2005	174.37	168.30	88.06	18.26	30.55	25.62	273.24	123.67	29.14	931.21
2006	196.94	185.58	107.00	33.44	35.74	22.41	292.59	138.75	42.95	1055.41
2007	251.28	234.69	89.45	39.70	36.82	25.25	342.07	127.89	58.37	1205.52
2008	480.33	248.57	91.18	44.88	81.03	29.59	307.71	122.80	70.48	1476.57
2009	403.60	249.34	129.57	61.34	42.92	29.83	349.59	147.07	86.00	1499.25
2010	489.04	291.76	173.31	67.71	53.76	45.08	389.33	182.36	109.00	1801.34
2011	562.74	302.98	179.67	81.03	67.79	57.97	430.81	202.07	136.06	2021.12

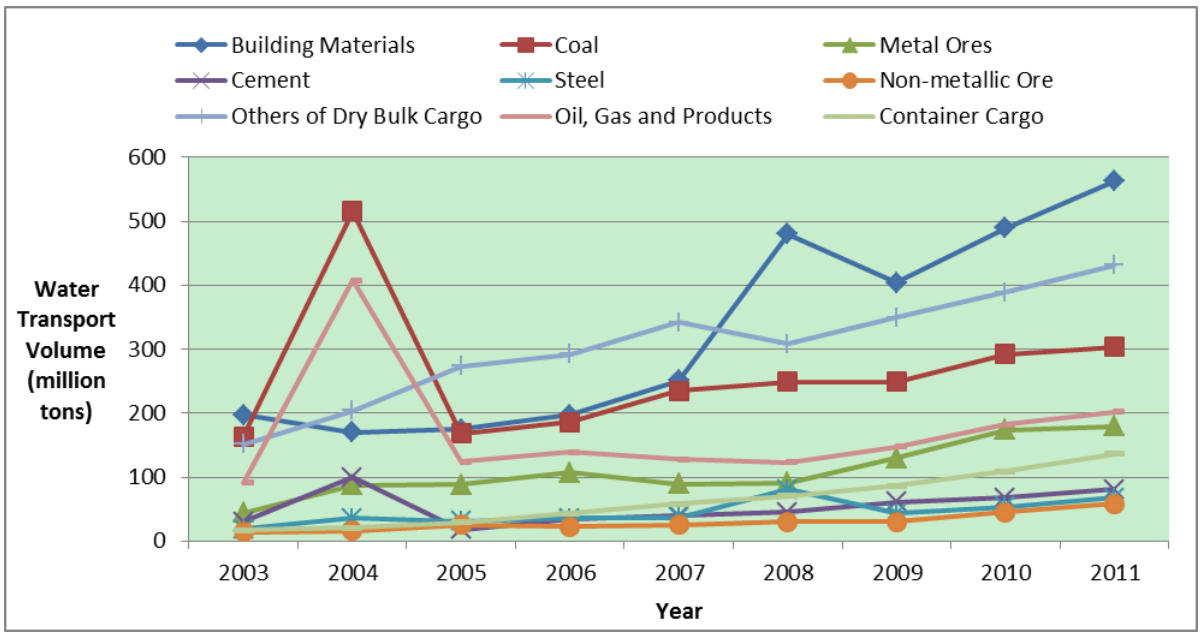

Figure 1- The Trend Figure of the Water Transport Volume of Major Types of Cargoes

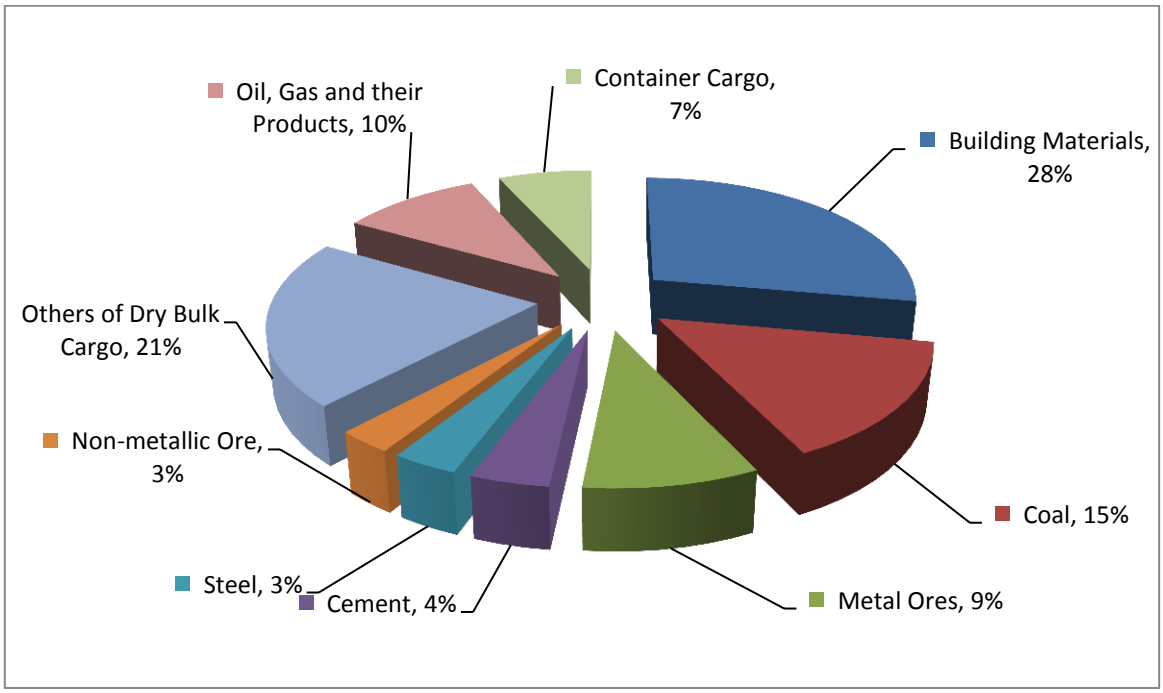

Figure 2- The Composition of the Water Transport Volume of Provinces and Cities along Yangtze River in 2011

This major types of cargoes studied on this paper include dry bulk cargo which includes building materials, coal, metal ores, cement, steel, non-metallic ore), liquid bulk cargo which includes oil and gas and their products, and container cargo.

2.2 The Forecast of Water Transport Volume of Yangtze River Shipping from the Perspective of the Influencing Factors

2.2.1 The Selection of Influencing Factors

Cao (2010) points out that the development of water transport is restricted by geographic conditions, and other factors also have a direct impact on the development space of water transport, such as the regional economic structure, resource endowments, level of economic growth and comprehensive traffic conditions, which shows that the water transport is of strong economic sensitivity. Based on relevant studies, this paper chooses representative factors as hypothetical factors of the structural equation model of Yangtze River's water transport volume. As shown in Table 2, there are two main factors such as the macro economy and industrialization, which are latent variables of the structural equation model. And then a number of observed variables are set according to every latent variable as indicators, such as GDP per capita, investment in fixed assets, import and export volume of foreign trade, electric energy production and steel production. In addition, it defines a corresponding observable variable according to the dependent variable of water transport volume. Finally, three latent variables and six observable variables are represented in character form, and the factorization table of structural equation model is formed.

Table 2 – The Factorization Table of Structural Equation Model

Latent Variables	Observable Variables in Character Form	Description of the Observable Variables
Macro Economy	X_1	GDP per capita
	X_2	Investment in Fixed Assets
	X_3	Import and Export Volume of Foreign Trade
Industrialization	X_4	Electric Energy Production
	X_5	Steel Production
Water transport volume	Y	Water Transport Volume

Table 3 – The Factorization Table of Structural Equation Model

Observable Variables	X_1	X_2	X_3	X_4	X_5
Unit	RMB	Million RMB	Million Dollars	Billion KWH	Million Tons
2003	9351.36	183.52	25417266	574.89	91.70
2004	11202.42	228.14	36827238	651.44	110.19
2005	13533.64	289.79	45943668	770.70	132.56
2006	15890.27	357.34	57177237	876.36	157.58
2007	19052.43	450.90	71287093	1095.57	186.25
2008	22608.61	573.40	82261384	1049.64	189.35
2009	25045.58	763.10	71223908	1180.77	209.18
2010	29836.82	938.69	97978166	1327.69	248.00
2011	35661.02	108759.12	118566200	1431.20	275.29

2.2.2 Water Transport Volume Forecast with the Method of Regression Model

Through the original data collection of those observable variables between 2002 and 2011 shown in table 1 and table 3, it calculates correlation coefficient of every indicator before the evaluation and correction of the original model with the calculation formula (Xu, 1998) as following:

$$\rho_{x,y} = \frac{Cov(x,y)}{\sigma_x \cdot \sigma_y} \quad (1)$$

Based on the coefficients of Y (it includes Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7, Y_8 and Y_9 as shown in table 1) and X_1, X_2, X_3, X_4, X_5 calculated by using the above formula, we can obtain the original covariance matrix as shown in following table 4 as an example.

Table 4-The Covariance Matrix of Y_6 and X

	X_1	X_2	X_3	X_4	X_5	Y_6
X_1	1					
X_2	0.993	1				
X_3	0.978	0.948	1			
X_4	0.977	0.962	0.970	1		
X_5	0.989	0.975	0.982	0.995	1	
Y_6	0.957	0.948	0.947	0.908	0.938	1

According to the correlation of water transport volume and main economic indicators, it builds the multivariate regression model. Then, with the prediction software, it calculates parametric estimation of each indicator and water transport volume, and deletes the indicators which are not significantly related to or in conflict with the water transport volume with the test of significance level from a mathematical perspective. This paper uses the method of multivariate regression model to forecast the water transport volume of container cargo and some types of bulk cargoes such as building materials, metal ores, non-metallic ores and others.

Take the forecast of non-metallic ore as an example, through the analysis of the relationship between water transport volume of non-metallic ore and main economic indicators of Yangtze River, it firstly puts the above five independent variables into the prediction model, and deletes those variables which are not significant until there are no independent variables without significance to calculate by the F-test significance level used as criteria. After optimization, we can draw the regression model of the water transport volume of non-metallic ore with those five factors as following:

$$Y_6=1570.769-0.054X_1+0.028X_2+0.00003X_3-0.877X_4+0.443X_5$$

In the analysis process of the regression model, the correlation coefficient is 0.976, the decisive coefficient is 0.953, and the adjustment coefficient is 0.873, which indicates that the equation is of a good fitting degree. The significance test of the regression equation is F (3, 5) =12.040 and p=0.000<0.001, which illustrates that the regression effect is remarkable. The result of this regression model is that the water transport volumes of Yangtze River in the year of 2015 and 2020 are respectively 112.50 million tons and 123.74 million tons.

Through the multivariate regression model, the forecast results of water transport volume of some major types of cargoes are obtained as shown in the following table 5.

Table 5-The Forecast Results of Multivariate Regression Model Unit: million tons

Year	Dry Bulk Cargo				Container
	Building Materials	Metal Ores	Non-metallic Ore	Others	
2015	74677	22572	11250	55021	18092
2020	101039	29810	12374	70379	25442

2.2.3 Water Transport Volume Forecast with the Method of the Coefficient of Elasticity

The coefficient of elasticity refers to the ratio of the change rate of a variable to another variable; accordingly, the coefficient of elasticity of water transport volume is defined as the ratio of change of water transport volume to relevant economic quantity (1994). Figure 3 is the change trend of coefficient of elasticity of water transport volume of building materials, which indicates that the volume growth of the provinces and cities along Yangtze River is of strong economic sensitivity in the "Eleventh Five-Year" period. With the change of the factors related to economic development, such as the industrial structure, the distribution of productive forces and the scale of foreign trade imports, in addition, the experience of developed countries suggests that the coefficient of elasticity of the cargo transportation and the total economy will generally present the decreasing trend.

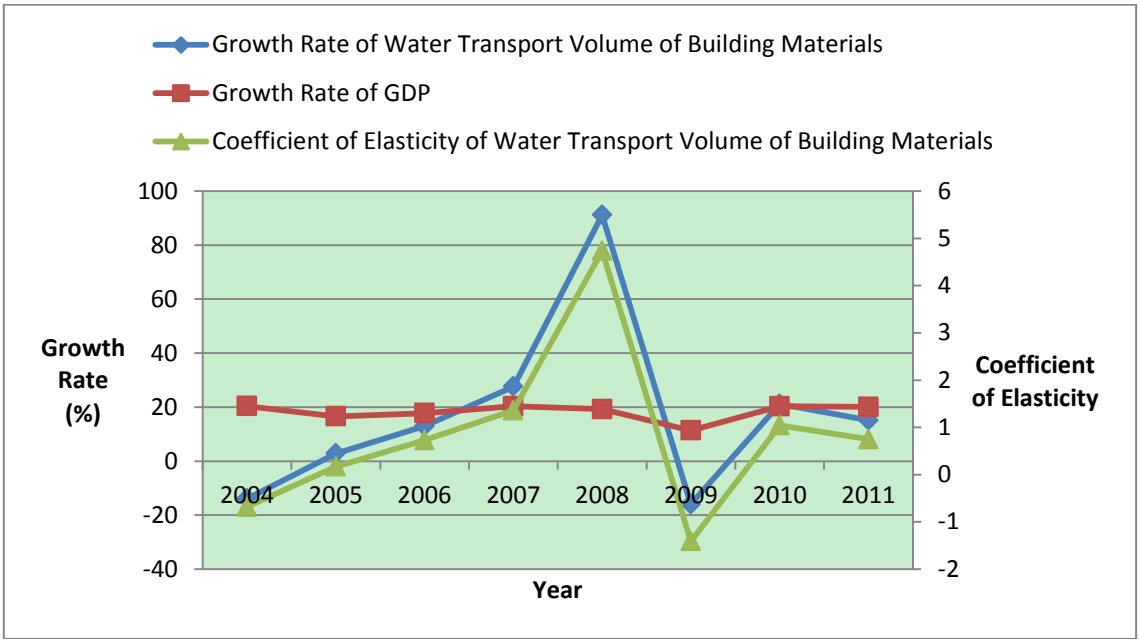

Figure 3- The Change Trend of Coefficient of Elasticity of Water transport volume

Take the forecast of water transport volume of building materials as an example. First, it comprehensively analyzes the effect of the product structure, regional structure, investment structure, transportation structure, and change relationship of physical assets production, supply and marketing on the water transport coefficient of building materials. Then, it forecasts that the coefficients of elasticity of the water transport volume of Yangtze River in the year of 2015 and 2020 are respectively 0.82 and 0.53, and the growth rates of water transport volume are respectively 13.12% and 6.36%. Finally, based on the data of 2011 and with the method of the coefficient of elasticity, it forecasts that the water transport volume of

building materials of Yangtze River in the year of 2015 and 2020 are respectively 921.44 million tons and 1254.17 million tons.

Through the method of the coefficient of elasticity, the forecast results of water transport volume of major types of cargoes are obtained as shown in the following table 6.

Table 6-The Forecast Results of Method of Coefficient of Elasticity Unit: million tons

Year	Dry Bulk Cargo							Oil, Gas and Products	Container Cargo	Total
	Building Materials	Coal	Metal Ores	Cement	Steel	Non-metallic Ore	Others			
2015	819.12	441.02	294.19	132.68	111.00	94.92	705.41	294.13	198.05	3309.40
2020	1008.14	542.79	400.43	180.59	151.08	129.20	960.14	362.01	243.75	4504.45

2.3 The Forecast of Water Transport Volume of Yangtze River Shipping from the Perspective of the Time Series

The above forecasts of water transport volume of major types of cargoes of Yangtze River shipping are calculated mainly on the basis of the fitting equation of the relationship between water transport volume and economic development. There is a close relationship between them; however, those forecasts must be on the basis of economic development forecast with the premise that the economic growth must achieve the projected figures. Canning (1993b) proposed that due to the certain laws of the historical data of freight volume, these laws actually include the impact of external factors, and there is a continuity of the development law followed by the economic variables, at the same time, a number of changes of water transport volume of Yangtze River present a strong trend. Therefore, it can forecast the water transport volume with the method of the time series, which means that it speculates the water transport volume on its law of movement variation from the past to the present.

Take the forecast of water transport volume of container as an example. In the analysis process of the time series model, the correlation coefficient is 0.993, the decisive coefficient is 0.986, and the adjustment coefficient is 0.983, which indicates that the equation is of a good fitting degree. The significance test of the regression equation is $F(1, 7) = 592.975$ and $p = 0.000 < 0.001$, which illustrates that the regression effect is remarkable. The result of the time series model is that the water transport volumes of container cargo of Yangtze River in the year of 2015 and 2020 are respectively 318.14 million tons and 407.34 million tons.

Based on the comprehensive analysis of water transport volume factors, it builds mathematical models and forecasts the water transport volume of Yangtze River from different perspectives. The forecast results are shown in table 7.

Table 7-The Forecast Results of Method of Coefficient of Elasticity Unit: million tons

Year	Dry Bulk Cargo							Oil, Gas and Products	Container Cargo	Total
	Building Materials	Coal	Metal Ores	Cement	Steel	Non-metallic Ore	Others			
2015	1099.51	406.90	331.52	97.43	118.08	142.36	787.62	177.82	318.14	3765.56
2020	1297.77	507.27	397.02	106.74	134.71	180.90	901.64	180.77	407.34	4500.68

2.4 The Combination Forecasting of Water Transport Volume of Yangtze River Shipping

As a cyclical industry, the shipping industry is closely related to the economic development and trade, and the rapid development of China's economic and trade has brought the previous prosperity of the shipping industry. At present, the shipping industry of China is at an alarming scale expansion, and it is expected that China will achieve the modernization of the shipping industry by 2020, by that time, China would achieve the transformation from a big shipping country to a great shipping country. Water transportation accounts for a considerable proportion of the transportation industry in China, and the transportation of China's foreign trade and important materials is mainly completed by water transportation. Among it, 93% of the cargo transportation of foreign trade is completed by sea, 95% of the crude oil and 99% of the iron ore also rely on the water transportation. In 2000, the throughput of China's ports was only 1.4 billion tons, however, in 2011, the cargo throughput of national ports has exceeded 10 billion tons for the first time, and the throughput of container has reached 0.164 billion TEU. At the same time, the total scale of China's water transportation has exceed 0.2 billion dead weight tonnages for the first time which is fourth in the world, including the shipping fleet of 0.115 billion dwt. It can be seen that the development of China's shipping industry is very rapid. Although there might be a small cycle fluctuation, it will continue to be relatively high stage of the shipping industry cycle in the coming decades.

In the next period of time, the water transport of the golden channel of Yangtze River will continue to develop rapidly. On the one hand, with the development of the economic trend of globalization, the development of high-tech industry and modern service industry will further speed up, in addition, the transnational investment will further increase, then the area along Yangtze River will continue to be one of the main directions of industrial transnational transformation and foreign investment, and the development of international situation is conducive to the development of water transportation industry on the whole. On the other hand, the regional economy will continue to maintain a healthy and stable development trend, in addition, Yangtze River Delta area and other area along the river will become one of the fastest growing areas of China in the next several years, and rapid and coordinated development of the area along the river will further promote the sustained and rapid growth of water transport volume.

On the basis of comprehensive analysis of influencing factors of water transport volume, this paper forecasts water transport volume of Yangtze River Shipping from different perspectives, according to the accuracy and applicability of different forecasting methods, it gives different weights to each group of forecasting results, then it obtains the final quantitative analysis and forecasting results with the method of combination forecasting method. Then, with the qualitative analysis of the views of experts, this paper makes the overall balance and gets the final result of water transport volume of Yangtze River as shown in table 8, the water transportation of Yangtze River will continue to maintain a rapid growth in the near future, therefore, the sustained and stable development of the national economy and foreign trade will further promote the faster growth of iron ore, coal and crude oil energy, raw materials and containers, so the water transport volume of Yangtze River in 2015 is 3165.17 million tons. After 2015, as the change of China's economic development pattern

and industrial structure will result in the profound change of cargo structure, the throughput of coal, oil and ore will grow slowly, therefore, the freight volume and throughput of port will continue to maintain a moderate growth, at the same time, the growth rate will gradually fall, so the water transport volume of Yangtze River Shipping in the year of 2020 is 3799.21 million tons.

Table 8-The Combination Forecasting Results of Water Transport Volume of Yangtze River Shipping

Unit: million tons

Year	Dry Bulk Cargo							Oil, Gas and Products	Container Cargo	Total
	Building Materials	Coal	Metal Ores	Cement	Steel	Non-metallic Ore	Others			
2015	979.95	441.41	256.58	110.20	99.87	100.91	723.26	213.76	239.23	3165.17
2020	1142.28	526.05	318.82	139.26	121.80	122.52	873.71	241.32	313.45	3799.21

3 THE FORECASTING ANALYSIS OF WATER TRANSPORT CAPACITY OF YANGTZE RIVER SHIPPING

3.1 The Current Situation of Water Transport Capacity of Yangtze River Shipping

3.1.1 Total Water Transport Capacity of Yangtze River Shipping

In recent years, the water transport capacity of Yangtze River has increased quickly as shown in Table 9 and Figure 4. The cargo capacity in 2011 continues to keep a trend of rapid growth, but the growth rate has slowed. In 2011, the net dead weight is 63.73 million tons, the contain volume is 87.4 thousand TEUs, and the total power is 19.82 million kilowatts, which respectively increase by 10.50 million tons, 13.8 thousand TEUs and 2.85 million kilowatts, and the growth rate of which respectively reduce by 11.6%, 1.0% and 3.9% compared with 2010.

Table 9- The Statistical Table of the Water Transport Capacity of Yangtze River between 2005 and 2011

	Number of Ship(vessels)			Net Dead Weight (tons)	Container (TEUs)	Total Power (kilowatts)
		Motor Vessel (vessels)	Barge (vessels)			
2005	123746	98367	25379	52257408	668485	19530836
2006	114169	92253	21916	54596902	758685	21118276
2007	114019	93109	20910	61209714	818880	22270002
2008	109529	89669	19860	62969271	930786	25343225
2009	109236	89917	19319	73451568	945703	26437038
2010	114714	99207	15507	95606568	1026658	30834224
2011	114943	100444	14499	116063723	1134569	35135776

Data Sources: Report on the Shipping Development of Yangtze River

The average net dead weight in 2011 is 570.4 tons per vessel, which increases by 94.5 tons per vessel compared to the end of 2010. The maximization trend of ship is obvious, such as

the average tonnage of ships in the area along Yangtze River has reached 1130 tons per vessel with an increase of 20.6%, in which the average tonnage of inland water transportation is 640 tons per vessel with an increase of 19.3%. At the same time, the average tonnage of Three Gorges Reservoir Area has reached 1600tons, and the average tonnage of inland water transportation of the city of Chongqing and the province of Hubei are more than 1000 tons.

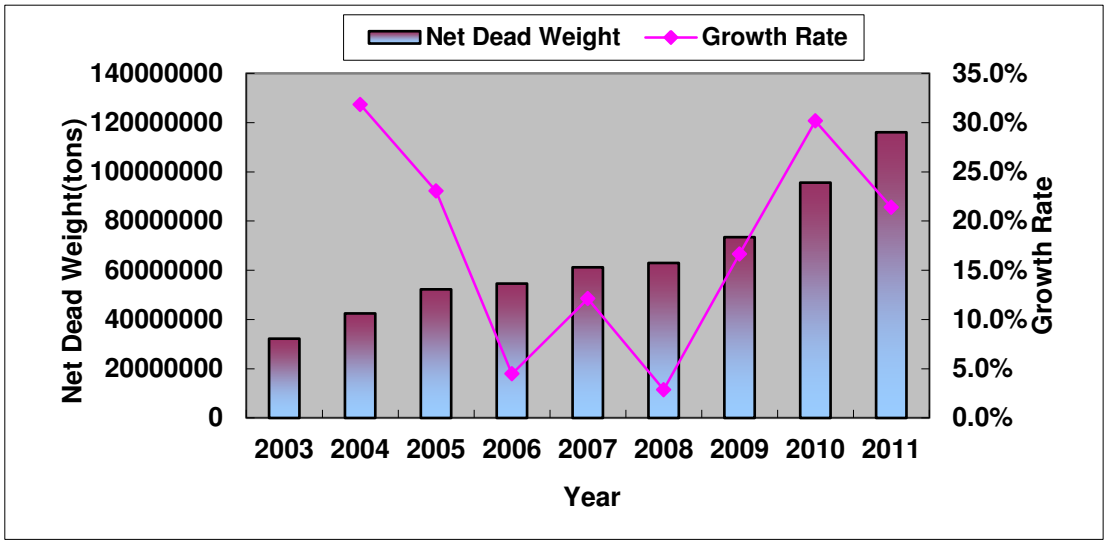

Figure 4- The Average Tonnage of Ships in Yangtze River and its Growth

3.1.2 Water Transport Capacity of Upper, Middle and Lower of Yangtze River Shipping

In the year of 2011, the water transport capacity of the upper of Yangtze River accounts for 83.7% of the total capacity of Yangtze River, which includes Anhui Province, Jiangsu Province and City of Shanghai; the water transport capacity of the middle of Yangtze River accounts for 11.4%, which includes Hubei Province, Hunan Province and Jiangxi Province.

Table 10- The Statistical Table of the Water Transport Capacity of Upper, Middle and Lower of Yangtze River in 2011 Units: thousand tons; %

	Year of 2011		Compare with Year of 2010	
	Net Dead Weight	NDWT of Inland Water	Net Dead Weight	NDWT of Inland Water
Upper of Yangtze River				
Yunan Province	90	90	51.5%	51.5%
Sichuan Province	950	950	20.0%	20.0%
City of Chongqing	4602	4579	9.6%	10.2%
Middle of Yangtze River				
Hubei Province	8028	5064	18.0%	16.0%
Hunan Province	3068	3068	26.3%	26.3%
Jiangxi Province	2086	1893	6.6%	5.1%
Lower of Yangtze River				
Anhui Province	25988	24610	25.2%	25.2%
Jiangsu Province	37191	22726	29.1%	18.0%
City of Shanghai	33825	527	14.1%	-6.5%

With the continuous improvement of the channel depth and accelerated construction of the channel of the Yangtze River, the capacity in every region along the river has maintained a rapid growth as show in the table 10, compared with 2010, the growth rate of Yunan Province is 51.5%, the growth rates of inland water capacity of Sichuan Province, Hunan Province and Anhui Province are all more than 20%.

3.2 Water Transport Capacity Forecasting of Yangtze River Shipping

3.2.1 Analysis of Transport Efficiency of Ships of Yangtze River Shipping

Nowadays, there is no clear formula about the transport efficiency of ships, this paper defines it from two aspects, one of which is the water transport volume carried by ships per net deadweight ton, the other of which is the normal navigation speed and lockage-through time of ships. Take the two factors in consideration, this paper finally defines the transport efficiency of ships as cargo turnover volume produced per net deadweight ton, with the unit of ton-km/net-dwt.

As shown in table 11, the transport efficiency of ships takes on ascend trend in recent six years, which is increase from 29590.51 ton-km/net-dwt in 2005 to 26212.51 ton-km/net-dwt in 2011, the annual growth rate is 2.04%.

Table 11- The Calculation Table of the Transport Efficiency of Ships of Yangtze River

	2005	2008	2011	Annual Growth Rate in recent three years	Annual Growth Rate in recent six years
Water Transport Volume (million tons)	941.20	1476.57	2016.73	10.95%	13.54%
Cargo Turnover Volume (billion ton-kms)	1546.32	2193.90	3042.30	11.51%	11.94%
NDWT of Ships (million net-dwt)	52.26	62.97	116.06	22.61%	14.22%
(1)Average Transport Distance（km）	1642.93	1485.81	1508.53	0.51%	-1.41%
(2)Water Transport Volume per NDWT(ton/net-dwt)	18.01	23.45	17.38	-5.12%	-0.60%
(3)Transport Efficiency of Ships(ton-km/net-dwt)	29590.51	34840.84	26212.35	9.95%	2.04%

3.2.2 Forecast of Water Transport Capacity of Yangtze River Shipping

The forecast method of water transport capacity of Yangtze River shipping is as following:

$$t_m = v_m \cdot d_m \tag{2}$$

$$e_m = e_n \cdot (1 + g_{m-n})^{m-n} \tag{3}$$

$$c_m = t_m / e_m \tag{4}$$

With:

t_m-Cargo turnover volume in the year of m;

v_m-Water transport volume in the year of m;

d_m-Average transport distance in the year of m;
e_m-Transport efficiency of ships in the year of m;
e_n- Transport efficiency of ships in the year of n;
g_{m-n}-Annual growth rate between the year of m and n;
c_m-Water transport capacity in the year of m.

Based on the foregoing analysis, the water transport volume of 2015 is 3.2 billion tons. With the above analysis, it defines the annual growth rate between 2011 and 2015 is 8%, so it can calculate that the water transport capacity of 2015 is 161.52 million net-dwts. It defines the annual growth rate between 2011 and 2020 is 6%, so the water transport capacity of 2020 is 171.62 million net-dwts.

4 ANALYSIS OF PROSPERITY AND FREIGHT RATE OF YANGTZE RIVER SHIPPING

4.1 Analysis of Prosperity of Yangtze River Shipping

In 2011, with the economic growth slowing down, the demand of bulk cargo has declined, the operating costs of port and shipping enterprises has maintained always high, as a result, there is a decline in the level of the prosperity of Yangtze River shipping, and the confidence of port and shipping enterprises has continued to decline. As shown in the figure 5, the Yangtze River Shipping Prosperity Indexes (YRSPI) of one to four quarter of 2011 are respectively 110.31 points, 111.95 points, 109.82 points and 102.96 points, the whole year is prosperous. The Yangtze River Shipping Confidence Indexes (YRSFI) of one to four quarter of 2011 are respectively 113.51 points, 110.59 points, 105.64 points and 93.23 points, the fourth quarter has fallen into recession. Compared to the beginning of 2011, the two indexes in the end of 2011 have respectively declined by 7.1 percentage points and 21.8 percentage points.

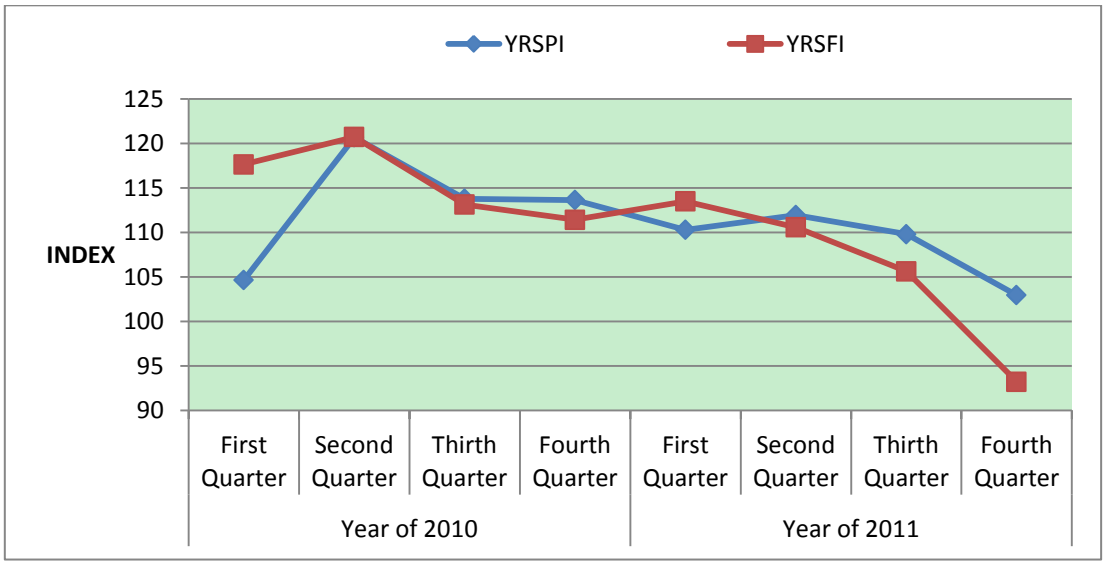

Figure 5- The YRSPI and YRSFI in 2010 and 2011

In the view of the type of enterprises, the prosperity index of port enterprises is higher than

the index of shipping enterprises; in the view of classified markets, the prosperity index of passenger shipping enterprises is higher than the index of freight enterprises; in the view of geographical distribution, the prosperity index of the enterprises of the lower is the highest, the index of the upper is the lowest; in the view of major types of transport cargoes, the prosperity index of container transport is higher than the index of liquid bulk cargo transport, which is higher than the index of dry bulk cargo transport.

4.2 Analysis of Freight Rate of Yangtze River Shipping

In 2011, the shipping market of dry bulk cargo of Yangtze River has been overall downturn, and the freight rate has continued to decline; the container market is generally stable, and there is a slight increase in freight rate. As shown in the figure 6, affected by the slowdown of shipping demand of coal and metal ores, the decreasing range of the freight index of dry bulk cargo of Yangtze River shipping is 14.8%, with the highest point of 806.82 points in January and all the way down to the lowest point of 687.59 points in December, which is also the lowest point since 2010. There are different degrees of decline of the freight indexes of coal, metal ores and building materials with the decreasing range of 27.3%, 10.4%, 10% and 1.4%. The container freight index has been basically stable at 1,000 points up and down, with the highest point of 1017.27 in August, which is also the highest point since 2010, and compared to the beginning of 2011, the container freight index in the end of 2011 has increased by 3.4%.

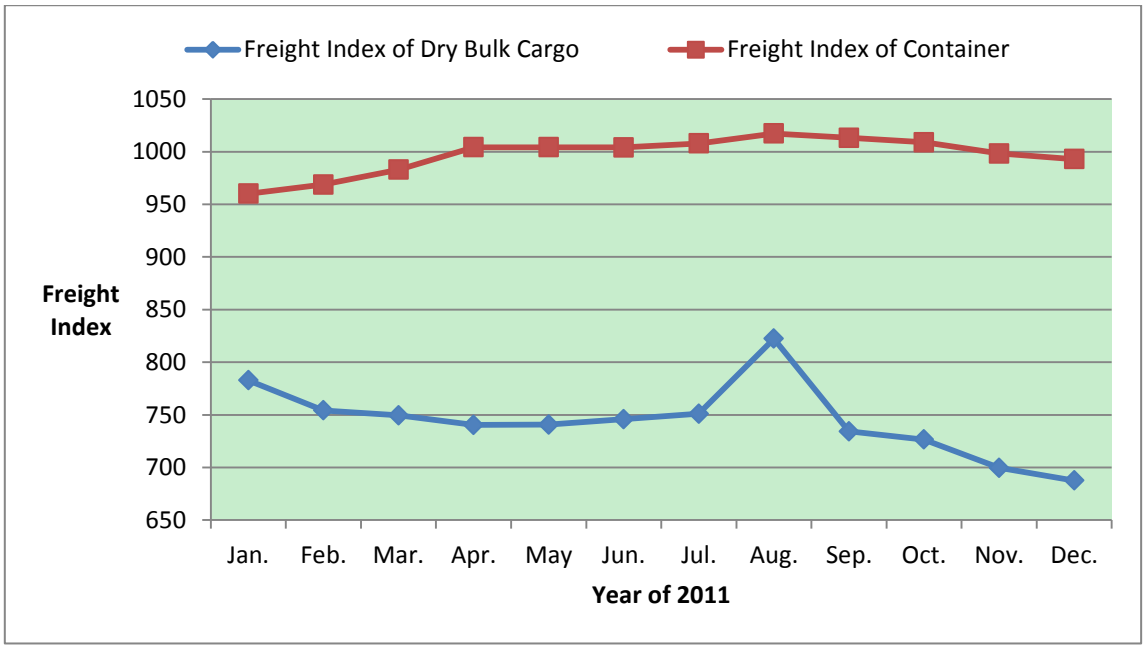

Figure 6- The Freight Index of Dry Bulk Cargo and Container in 2011

On the one hand, the freight index is a reflection of the economic downturn; on the other hand, it also is a reflection of the changes of relationship between supply and demand of shipping capacity. The rapid development of the shipping industry from 2000 to 2004 had hidden some dangers for the subsequent oversupply of Yangtze River shipping. Coupled with the financial crisis from 2008 to 2009, it had resulted in a rapid decline in shipping

demand, and the deterioration of the supply and demand imbalance, and the decline of freight rate of Yangtze River shipping. However, with the pulling function of domestic demand of China on the whole, it reduces the impact of the international financial turmoil on Yangtze River shipping, of which the domestic trade transportation is main, and the decreasing range of freight rate of Yangtze River shipping is far below the international shipping market.

5 THE DEVELOPMENT PROPOSALS OF THE INLAND WATER TRANSPORTATION OF YANGTZE RIVER

On the basis of the above analysis, on the one hand, the rapid economic development of the area along Yangtze River has generated a large number of transportation demand which is suitable to water transport, and the growth of water transport volume of Yangtze River proposes new and urgent requirement of improving the capacity of the channel; on the other hand, the type of ships is currently complex, there is a large number of old ships, and the standardized rate is slow, and the average tonnage of ships is also slow. Furthermore, various types of specialized ships are only on at the initial stage of which the scale is small, and it is to be further developed. This paper proposes some recommendations as following to solve these problems.

5.1 Paying Much Attention to the Building of Arterial Channel

Perfect waterway network is the key of laying shipping foundations and releasing developmental potential, and the shipping development of Yangtze River should be always around the needs of economic development and the construction of an integrated transportation system, so it is necessary to pay much attention to the building of the arterial channel and fight for fulfilling the building task one to two years ahead of schedule of the "12th Five-Year" period, which will leave more space for the development in future. Firstly, it is to make the most of the advantage in the 12.5-meter-deep channel construction of Nanjing. Secondly, in the channel construction of the midstream part, it should be based on the systemic control of Yangtze River's reaches, and resolutely implement the general idea of "Overall planning, system governance, full forward and step-by-step implementation", in order to solve the outstanding problem of passing through the channel hardly in the midstream part of the river as soon as possible. Thirdly, it is necessary for Three Gorges Reservoir Area to accelerate the study on the governance problems of the fluctuating backwater area. Finally, it is important for the channel over Chongqing to take measures to maintain the improvement of the capacity.

5.2 Optimizing the Structure of Freight Capacity and Promoting the Ship Standardization

It can take measures to optimize the structure of the freight capacity and promote the ship standardization from the following five aspects. Firstly, it is necessary to firmly eliminate the small-tonnage ships through the lockage and passenger ships, single-hull oil tankers and chemical tankers of the sewage discharges to meet the regulatory requirements, and it

should prohibit the lockage of merchant ships less than 600 gross tonnage (except for the standard ships, ships of heavy and big cargoes, the ships to transport fresh goods), and also prohibit the ingress of the shipping market of Three Gorges Reservoir Area of such ships as passenger ships (including roll-roll truck), single-hull oil tankers and chemical tankers of the sewage discharges to meet the regulatory requirements. Secondly, it can implement the construction of demonstration projects of ship standardization in the upstream part of Yangtze River and Three Gorges Reservoir Area, and amend "Main Scale Series of Standard Transportation Ships in the Upstream Part of Yangtze River and Three Gorges Reservoir Area", pay close attention to the research and development of the lockage type and lift type of ships in Three Gorges, and prohibit new-built and rebuilt substandard ships to enter the shipping market of Three Gorges Reservoir Area. Thirdly, it should continue to implement " Plan of Promoting the Standardization of Ships of Yangtze River", promote the implementation of the encouraging economic policies, make the best use of government subsidies and guide the ship owners to the elimination of old and backward ships, and strive actively for the understanding and support of leaders in order to get a higher level of central financial subsidies. Fourthly, it should improve the index system of ship standardization of Yangtze River, and pay much attention to push forward the research, development, comparison, selection, promotion and application of the standard type of ship. Finally, it is necessary to organize and carry out cross-checks and exchange of experiences of ship standardization, and release the work information of it in time.

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