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A Research on Competition and Cooperation Between Shanghai Port and Ningbo-Zhoushan Port

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Abstract

With the course of the integration of global economy accelerating, and the speedy growth of world trade, important nodes of global logistics and ports acquire more and more important status in the global economy. Ports with the development of Chinese economy and especially with the rapid growth of the foreign trade have made a great progress. This research mainly focuses on the study of the competition and cooperation between neighboring ports. Several models were developed in the research to analyze the relationship between Shanghai port and Ningbo-Zhoushan port. The research results show that the two ports enter into competition with each other. Ports are faced with competition not only from domestic ports but also from their counterparts in other countries. Therefore, Shanghai port and Ningbo-Zhoushan port should avoid competition and join hands in developing the resource reasonably in Zhoushan and achieving a regional scale economy, so that the entire ports in the region of the Yangtze River Delta can have a better competitive power.

Key words : Competition, Cooperation, Container port, Competitiveness, Linear Regression

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I. Introduction

The high-speed development of international trade is one of the most important signs of economic globalization. We can find that the growth rate of world trade is bigger than that of world economy. As a major way of global logistics and an important factor of economic globalization, ocean transport becomes more and more important. Modern seaports have become critical nodes in complex logistics chains. Seaports failing to establish themselves as key players in the optimization process unfolding within such logistics chains are in danger of 'missing the boat' and being disregarded as ports of call on international freight routes.

In an era of economic globalization, ports are evolving rapidly from being traditional land/sea interface to providers of complete logistics networks. This means ports have to face many challenges due to unpredictable environmental changes and trends in the shipping, port and logistics industries. It is estimated that 90% of the internationally traded goods are imported or exported by sea. And the container transportation has become the most important way in global trades.

Due to the rapid development of Asia-Pacific region's economy, the world economic center has been transferred into this area step by step. In terms of annual container throughputs, 9 Asian ports are ranked among the top 10 container ports in the world and 6 of them are Chinese ports which are ranked second, third, forth, seventh, eighth and tenth respectively. In Asian economies, the Chinese economy is regarded as the world's most fascinating one in the modern era. The proportion of container transport is getting higher and higher, and it is the future trend of ocean shipping development. So container transport is an important aspect in port competitiveness research.

In March 2001, the Fourth Session of the Ninth National People's Congress of the People's Republic of China approved "the Tenth Five-year Plan Outline of the Economic and Social Development in the People's Republic of China." It included the newly published plan (2001-2005) "to build Shanghai international shipping center".

The Central Committee of the Party indicated in 1994: the building of Shanghai as an international shipping center is the key to the development of Pudong into

an economic center in the Fareast and that of the whole Yangtze River Delta. The Shanghai international shipping center should take full advantage of the favorable situations in the economic, financial and trade center of Shanghai, the Beilun deepwater port in Zhejiang province, and the enormous container traffic in Shanghai and Jiangsu province to weave a system of ports with Shanghai as the center and with those in Zhejiang and Jiangsu provinces to coordinate.

However, there is also competition in this system of ports. Ningbo-Zhoushan port has developed rapidly in recent years. It has continued to expand at a very high average annual growth rate of approximately 31% over the period 1997-2007, and it has become the eighth largest container port in the world in 2007. As a nearby port with Shanghai port, the competition can't be avoided during the high-speed development. This paper will aim to the co-opetition between Shanghai port and Ningbo-Zhoushan port, using different methods to analyze the relationship between the two ports and puts forward the relative suggestions concerning their competition and cooperation.

II. Theoretical Background on Port Competition and Co-operation

1. Conceptual definition of port competition

A Conceptual Definition of 'Seaport Competition': Seaport competition refers to competition between port undertakings, or as the case may be terminal operators (the competing players involved in the organization of entire transport chains) in relation to specific transactions. Each operator is driven by the objective to achieve maximum growth in relation to goods handling, in terms of value added or otherwise. Port competition is influenced by (1) specific demand from consumers, (2) specific factors of production, (3) supporting industries connected with each operator, and (4) the specific competencies of each operator and their rivals. Finally, port competition is also affected by port authorities and other public bodies.[1)]

Port competition can be divided into 3 levels. Firstly, there is competition

1) Baird (1999), pp.141-173.

between operators. This type of competition may be summarized as 'intra-port competition at operator level'.[2] In recent years, operators within ports have increasingly tried to diversify their activities, offering services throughout the total logistics chain. As a result, operators are now often present in several ports, where they are involved in the handling of various traffic categories.

Secondly, there is competition between operators from different ports. This second level of port competition occurs mainly between operators within the same range serving more or less the same hinterland. However, Verhoeff and Goss both have asserted that competition may also involve port ranges as such. Competition in the Hamburg-Le Havre range is usually restricted to competition within that range. Only rarely are ports belonging to other ranges involved, as there is very little overlap between the hinterlands of ports from different ranges. Consequently, operators within a given range usually do not feel threatened by operators from other ranges, and there is no evidence whatsoever of competition as this level.

Thirdly, there is competition between port authorities- whether it is national, regional or local-which directly affects the determinants of port competition (particularly the infrastructure in and around a port). This is of course crucially important for the competitive position of operators. This is level 3: 'inter-port competition at port authority level'.

2. Port co-operation against competition and port co-operation modes

The philosophy of port development faced with competition changes from 'hardware' to 'software'.[3] Hardware of port development includes the construction of infrastructure and superstructure. Software of port development includes port management on behalf of port privatization for high efficiency, know-how, IT technology for supporting and network structure. Now, however, software of port development can be expected to be the factor of determining the importance in port competition.

The fourth generation of ports is introduced by UNCTAD and characterized by co-operation in combination with competition together with horizontal and vertical integration. Port co-operation can be considered as a strategy against

2) Slack (1985), pp.293-303.
3) Mi-Sun Yoon (2006), pp.749-752.

competition. Song said coopetition is a way of collaborating to compete.[4)]

Intra-port co-operation at operator level is the co-operation regarding terminal operations within a port. Inter-port co-operation at operator level, on the other hand, is a co-operation of terminal operators among different ports. According to the research by Song, the competition between the ports of Hong Kong and Shenzhen is increasing, so the Hong Kong decided to cooperate with the Shenzhen port, instead of continuously competing. This cooperative strategy has an objective to strengthen the position in times of high competition of South China, by a joint venture. In this Hong Kong-Shenzhen example, for the terminal operators there are elements of competition as well as co-operation, both within and among the ports. Usually the co-operation, within or among ports is accomplished by the same terminal operator. Terminal operators are used to expand their power sphere through investments, such as joint venture, because co-operation through joint venture enhances the competitiveness as well as the market power.

Inter-port co-operation at port authority level is the co-operation of port authorities among ports. For example, Copenhagen Malmo Port as a limited company was founded by Copenhagen port of Denmark and Malmo port of Sweden on 1 January 2005. Both ports had already cooperated before they founded Copenhagen Malmo Port and considered a closer co-operation. The aim of the co-operation is to realize economies of scale through the collaboration of marketing and operations, and finally to improve competitiveness.

According to UNCTAD, highly suggested areas for port co-operation are technical training, harmonization or exchange of tariffs, and information for common service. The other areas are harmonization of statistics and operational documents or procedures, relationships between port users and pooling of port services or equipment. Song states that co-operation leads to advantageous results: risk reduction, economies of scale, rationalization, technological exchanges co-opting or blocking competition and overcoming government mandated trade or investment barriers, both parties can be stronger by sharing techniques and information through co-operations.[5)] Finally, co-operation as a strategy of

4) Song (2003), pp.29-44.
5) Wang (1998), pp.187-200.

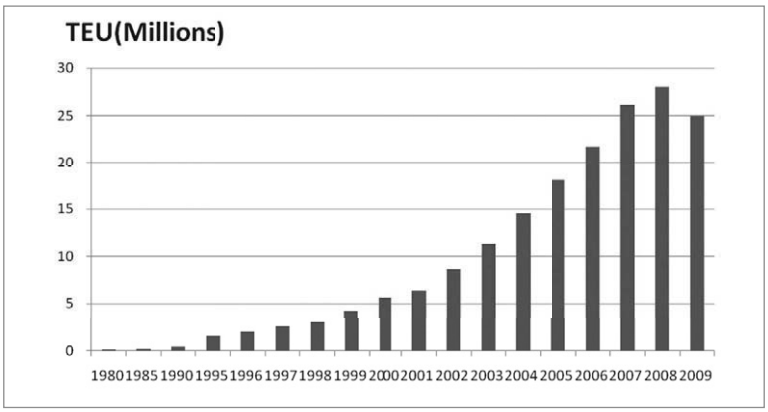
competition can be a competitiveness among parties. The parties, especially, are expected to be largely complementary. If they can cooperate through each party's core competence, they can have a unique competitiveness and achieve a more competitive position.

III. A Comparative Analysis of Ports in the Yangtze River

1.Overview of Shanghai port and Ningbo-Zhoushan port

As one of the mainland China's traditional industrial centers, Shanghai has drawn worldwide attention. As shown in figure1, the throughput of Shanghai container port has dramatically developed since the reform (or 'opening up') of the mainland China's economy began in 1978.

<Figure 1> Historic throughput at Shanghai Port



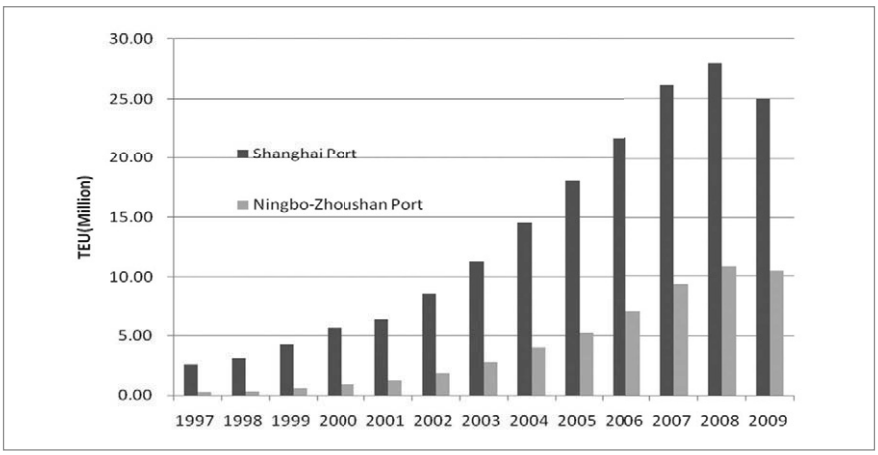
Source: Constructed by the authors using information from various sources

A more recent picture of container throughput at both Shanghai and Ningbo container ports (see figure2) reveals that the phenomenal growth of Shanghai's international container throughput has continued. It also shows, however, that the port of Ningbo now poses a significant threat to Shanghai's position as the leading container port on the central eastern seaboard of mainland China. As can be seen in the graph, the (largely international) container throughput to the hinterlands of the two ports has continued to expand at a very high average annual growth rate of

approximately 31% over the period 1997-2009. In addition, the graph reveals that Ningbo's market share of the two ports' total international container throughput has been consistently increasing over this period, at the expense of Shanghai.

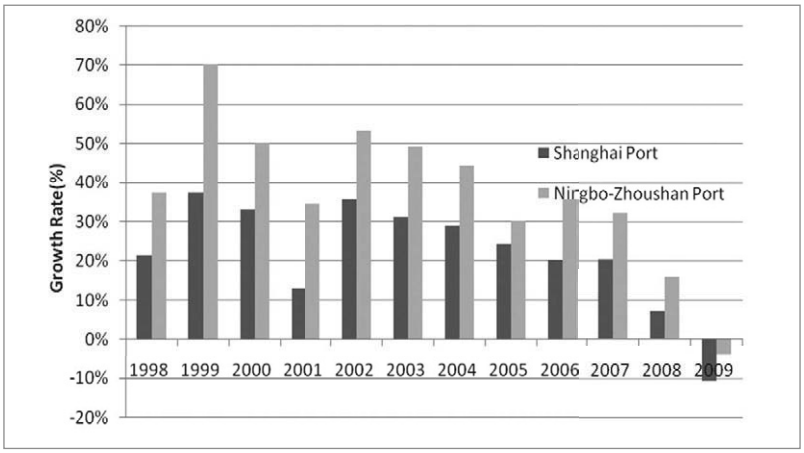
By inspection of the comparative annual growth rates in throughput at the two ports over the period 1998-2009, we are able to gain some insights as to why this has been the case. Figure 3 clearly shows the vastly superior growth at Ningbo compared to Shanghai over this period. Given its lower base in terms of the absolute level of throughput, however, this is not a wholly unexpected result.

<Figure 2> Recent container throughput for Shanghai port and Ningbo-Zhoushan port



Source: Constructed by the authors using information from various sources

<Figure 3> Recent annual growth rates in container throughput for Shanghai and Ningbo-Zhoushan port



Source: Constructed by the authors using information from various sources

In 2007, Ningbo achieved a great annual increase in container throughput. Spurred on by a tremendous expansion in the industrial output of its natural hinterland of Zhejiang province, as well as by the fact that it is one of just four credible transshipment hubs in the Chinese mainland, Ningbo handled just over 9 million TEU. In consequence, in terms of throughput handled, it moved from being ranked 23 to 11 in the world league of container ports.

Port of Suzhou is an important inland river transport hub. It is situated in Jiangsu province. It consists of three ports in Zhangjiagang, Changshu and Taicang on the lower reaches of the Yangtze River. The total cargo throughput is about 127 million tons in 2006. It is the largest inland river port in China. The majority of the port trade is in coal, steel, and construction materials such as cement.

Port of Nanjing is the largest inland port in China, yearly throughput reaching 121.43 million tons in 2009. The port area is 98 kilometers in length and has 64 berths including 16 berths for ships with the tonnage of more than 10,000. Nanjing is also the biggest container port along the Yangtze River; in March 2004, the one million container-capacity base, Longtan Containers Port Area opened, further consolidating Nanjing as the leading port in the region. In the 1960s the first Yangtze river bridge was completed, becoming almost the only solid connection between North and South in eastern China at the time. The bridge became a source of pride and an important symbol of modern China, having been built and designed by the Chinese themselves following the failed surveys by other nations and the reliance on and then rejection of Soviet expertise.

Begun in 1960 and opened to traffic in 1968, the bridge is a two-tiered road and rail design spanning 4,600 meters on the upper deck, with approximately 1,580 meters spanning the river itself.

Wenzhou Port lies on the southeast coast of China with Ningbo Port to the north and Fuzhou Port to the south. In the southeast, Kaohsiung and Keelung of Taiwan are separated by the sea. It is located in the Economic Delta of Yangtze River which is led by Pudong, Shanghai. The port's coastline is 350-kilometre-long. With the superiority in geography, Wenzhou Port is one of the 25 main coastal ports of China and the center of offshore transportation and ocean shipping of southern Zhejiang Province, playing an important role in the integrated

transportation system of China.[6)]

2. The Competitiveness of Shanghai port and Ningbo-Zhoushan port

1) Natural condition

Ningbo Port is well situated in the middle of China's coastline, at the T-shaped joining point of China's coastline and the Yangtze River. It's a famous deep-water port of mainland China. With deep water and smooth current, the port area of Ningbo is free from strong winds and waves. The entry channel is normally over 18.2 meters deep. Large ships of 250,000 up to 300,000 tonnages can come and leave at tide. With an exploitable deep-water coastline of over 120 km, Ningbo Port owns broad developing and construction prospects. On the north of Beilun Port Area, Zhoushan Islands serve as its natural defense, so there is no need to build breakwaters when constructing berths at Beilun Port Area. Less investment can produce better benefits.

Ningbo-Zhoushan ports have obvious advantages in depth of water which was the most important factor in port nature factors. According to the index of International Shipping Center, the depth of water should be more than -14 meters.[7)] The average water depth is about -9 meters in Shanghai before the construction of Yangshan deep sea port, the container vessels are limited seriously by it. The deep water factor is one of the comparative advantages of Ningbo-Zhoushan port.

2) Price (direct cost to liner companies)

Port charges in mainland China are based very closely on a standard rate specified by China's Ministry of Communications. It includes separate charges for stevedoring, piloting and tugs. Currently Shanghai and Ningbo both adopt a more flexible pricing policy than sticking simply to the centrally set standard rates.[8)] Their approach is characterized by a differentiation between large and small customers, especially with respect to the stevedoring charge. Generally, large mainline operators receive a 10% discount compared with coastal liner operators. The stevedoring charges listed in Table1 and it shows that it is the same at the two ports.

6) Hu Liang De (2005), pp.28-42.
7) Liu, Hai Hu (1993), pp.239-247.
8) Liu Jun (2006).

<Table 1> Stevedoring charges in Shanghai and Ningbo-Zhoushan container terminals in RMB (2009)

	20GP (Full)	40GP (Full)	40HQ (Full)
Terminals in Shanghai	463	695	868
Terminals in Ningbo-Zhoushan	475	750	923

Source: Constructed by the authors using information from various sources

The piloting tariffs are all based on a standard rate by Ministry of Communications. For distances less than 10 nautical miles, the rate is 0.5 RMB per net ton. For any distance above 10 nautical miles, the rate for the rest of the voyage is 0.005 RMB per net ton per nautical mile. Since the piloting distance for Ningbo is relatively shorter than for the terminals in Shanghai, especially STC, so the piloting charges payable in Ningbo are generally less than those prevailing in Shanghai.

The tug tariffs for the ports of Shanghai and Ningbo are given in table 2 and table 3.

<Table 2> Shanghai port tug tariff in RMB (2009)

Length of vessel (meters)	>220	180-220	155-180	122-155	95-133	<95
Yangshan port	38900	32200	28800	22200	18000	16200
Waigaoqiao	39290	32500	29100	22400	18200	16300

Source: Constructed by the authors using information from various sources

<Table 3> Ningbo-Zhoushan port tug tariff in RMB (2009)

Length of vessel (meters)	>320	251-320	171-250	121-170	<120
Ningbo-Zhoushan port	32300	25800	21000	14700	9800

Source: Constructed by the authors using information from various sources

Stevedoring, piloting and tug charges are the three major port costs incurred in calling at a mainland Chinese port. Together, they account for about 90% of the total direct cost of a vessel's call at port. By broadly comparing the cost associated with the port calls of ships of similar size, it is self-evident that Ningbo possesses a definite price advantage.

3) Informationization level

Informationization level is also an important index of hub ports. The efficiency of port works could be increased by high informationization level. The informationization level depends on the implement condition of EDI.

Shanghai port has paid much attention to promote informationzation and advanced equipment. The service objects of EDI platform are wide, which include government, port authority, liner, ship agent, cargo agent, tally company, and so on. Especially in recent years, Shanghai has accelerated the construction of port infrastructure.

<Table 4> List of port facilities of Shanghai port (2009)

Company	Length of Berth	Number of berth	Quay Cranes	GTG	Forklifts and Reach Stackers	Truck
	(Meter)	(Unit)	(Unit)	(Unit)	(Unit)	(Unit)
Shanghai Pudong International Container Terminals Ltd	900	3	12	40	12	78
SIPG Zhendong Container Terminal Branch Ltd	1,634	6	27	78	20	82
Shanghai East Container Terminals Co., Ltd	1,250	4	14	52	14	72
Shanghai Mingdong Container Terminals Ltd	1,110	4	16	48	25	90
Shanghai Shengdong International Container Terminals Co., Ltd	3,000	9	35	110	26	228
Shanghai Container Terminals Ltd	2,281	10	19	60	22	92
Total	10,175	36	123	388	120	642

Source: Constructed by the authors using information from various sources

Comparatively speaking, although Ningbo-Zhoushan port has started the development of EDI system, the coverage rate is much lower than in Shanghai port because of the backward equipment and limitation of the further development of Ningbo-Zhoushan port.

4) Port service

The quality of port service in Shanghai is better than that of Ningbo-Zhoushan port. It is one of the most important factors of port competitiveness. The major reason of why Hong Kong Port and Port of Singapore could be huge ports of transshipment is its high level port service and the relative low price. Compared with Ningbo-Zhoushan port, the port service in Shanghai port is much better in piloting service as well as VTS, port facilities and port safety work. The list of major port facilities of the two ports are given in table 4 and table 5

<Table 5> List of port facilities of Ningbo-Zhoushan port (2009)

Company	Length of Berth	Number of berth	Quay Cranes	GTG	Forklifts and Reach Stackers	Truck
	(Meter)	(Unit)	(Unit)	(Unit)	(Unit)	(Unit)
Beilun Second Container Limited Company	1,238	5	14	42	12	110
Ningbo Beilun International Container Harbor Limited Company	900	3	13	38	9	31
Ningbo Port Ji Harbor Business Limited Company	1,400	4	6	51	8	115
Ningbo Far East Harbor Business Limited Company	385	1	8	12	10	50
Merchants International Terminals Co, Ltd. Daxie Ningbo Port	930	2	11	33	9	13
Zhenhai Harbour Limited Company	460	1	4	6	2	4
Total	5,313	16	56	182	50	323

Source: Constructed by the authors using information from various sources

According to the two tables, it is obvious that major facilities in Shanghai port are about twice as much as in Ningbo-Zhoushan port. It supports Shanghai port providing high level service reducing average loading time of vessels.

5) Hinterland

The major comparative advantage of Shanghai port is its huge hinterland—Yangtze River Delta area. Collecting and distributing system in this area is developed and it has advantage in industry, science, nature resource, skilled labor and demand of consumption. As the center of the economic development of western China, it would generate a lot of container cargoes from this area. Shanghai port could absorb these cargoes through multi-modal transport system and make western of China the direct economic hinterland of Shanghai port.

The hinterland of Ningbo-Zhoushan port is much smaller than Shanghai port. The main hinterland of Ningbo-Zhoushan port is south-east of Zhejiang province. Cargoes generated from Hangzhou, Jiaxing, and Huzhou are mostly exported or imported through Shanghai port. Because of the underdevelopment of railway transport in Ningbo, road transport is the main way for cargo collecting and distributing. In addition, the liners and sea routes in Shanghai port are much more than in Ningbo-Zhoushan port, so under the same condition, the shipper in other area would choose Shanghai port.

IV. Analysis of relationship between Shanghai port and Ningbo-Zhoushan port

1. HHI Index model

Several indicators may be used to measure concentration. A very direct way to measure concentration is simply to count the players in the market. Intuitively, a large number of competitors are more likely to be associated with a lower level of concentration. This approach has the advantage of simplicity. It suffers, however, from the serious drawback that the market share of each company is not reflected in the approach.

The HHI index accounts for the number of players in a market, as well as their concentration, by incorporating the relative size (measured by market share) of all firms in a market. It is calculated by squaring the market shares of all firms in a market and then summing the squares, as shown in (1):

$$D = \frac{\sum_{i=1}^{n} TEU_i^2}{\left(\sum_{i=1}^{n} TEUi\right)^2} \quad (1)$$

In equation (1),

D= the Concentration ratio of port system in Yangtze River Delta,

TEUi = the container throughput of port i.

n= the number of ports in the port system.

Consider the extreme case where one port has a market share of one hundred percent, then HHI index equals to 1. By contraries, if the container throughputs of the ports located in the port system are same, HHI index should be 1/n. Generally speaking, HHI index more than 0.1 represents that the port system is concentrated. It shows that the port system is highly concentrated when HHI index is more than 0.18.

In order to research the concentration ratio of container ports in Yangtze River Delta, the authors calculated the result by HHI index model using the recent 8 years throughputs of 8 main ports in this area. The authors also calculated the share of the Port of Shanghai, the share of the Port of Ningbo-Zhoushan and the share of the summation of the two ports. The result is shown as Table 6

In the recent 8 years, the market share of Shanghai port is floating between 60%--77%. It represents that as the hub port of Yangtze River Delta, Shanghai port has big advantage compared with other ports in this area. Because of the development of other small and medium ports located in Yangtze River Delta, the share of Shanghai port decreased from 76.4% to 60.7%, and it is estimated to be lower in the future but it still enjoys absolute advantage in this area.

<Table 6> Concentration Analysis of ports in Yangtze River Delta

	2000	2001	2002	2003	2004	2005	2006	2007
HHI index	0.623	0.597	0.589	0.566	0.549	0.533	0.512	0.487
ROSH	76.4%	75.9%	76.1%	72.3%	71.0%	68.6%	64.5%	60.7%
RONB	12.2%	14.5%	16.4%	17.8%	19.5%	19.8%	21.0%	21.7%
ROTP	88.6%	90.3%	92.6%	90.1%	90.6%	88.4%	85.5%	82.4%

Source: Constructed by author using information from various sources
ROSH represent the market share of Shanghai port.
RONB means the market share of Ningbo-Zhoushan port.
ROTP is the summation of ROSH and RONB.

The share of Ningbo-Zhoushan port keeps on rising during the last 8 years from 12.2% to 21.7%. The average annual increasing rate of Ningbo-Zhoushan port is 42.1%, which is much more than that of China mainland. Because of the increasing of Ningbo-Zhoushan port's share, ROTP increased from 81.2% to 90.7%, which represents the two ports have absolute advantage of container transport in the region and the concentration ratio is very high.

The HHI index of this port system is floating between 0.487-0.623. It is much more than 0.18 and we can prove the result again that the concentration of Yangtze River Delta is very high.

2.Correlation analysis

The initial purpose of this chapter is to investigate econometrically the current mechanism of Chinese port behavior. More concretely, special attention is given to the Port of Shanghai and the neighboring Port of Ningbo-Zhoushan. Both ports clearly form a competitive relationship and are managed by completely independent port bureaus under the control of the City of Shanghai and the City of Ningbo respectively. Their competitive relationship can be confirmed by the correlation analysis as detailed in Table 7, where the Port of Shanghai has negative sign in relation to the correlation coefficient. This indicates that the higher the market share of the Port of Shanghai is, the lower the share of the Port of Ningbo-Zhoushan.

The 'unstable' condition of the Port of Ningbo-Zhoushan is also clearly indicated in Table 7. Five other ports (Zhangjiagang, Wenzhou, Changzhou, Nanjing, Nantong) are also clearly prime competitors to the Port of Ningbo-Zhoushan. In almost all cases, the correlation coefficient between Ningbo-Zhoushan port and the other five ports are significant and negative. In contrast, the Port of Shanghai has a complementary relationship with the five ports. On the other hand, as a sea port in north Jiangsu, the Port of Lianyungang is the second competitor to Shanghai port and it has a 'friendly' relationship with the Port of Ningbo-Zhoushan.

<Table 7> Result of Correlations

		Shanghai	Ningbo	Zhangjiagang	Wenzhou	Changzhou	Nanjing	Nantong	Lianyungang
Shanghai	Pearson Correlation	1	-0.887	0.837	0.830	0.914	0.325	0.884	-0.958
	Sig. (2-tailed)		0.003	0.009	0.011	0.002	0.432	0.004	0.000
	N	8	8	8	8	8	8	8	8
Ningbo	Pearson Correlation	-0.887	1	-0.621	-0.601	-0.718	-0.626	-0.992	0.847
	Sig. (2-tailed)	0.003		0.100	0.115	0.045	0.097	0.000	0.008
	N	8	8	8	8	8	8	8	8
Zhangjiagang	Pearson Correlation	0.837	-0.621	1	0.949	0.875	0.142	0.663	-0.850
	Sig. (2-tailed)	0.009	0.100		0.000	0.004	0.738	0.073	0.008
	N	8	8	8	8	8	8	8	8
Wenzhou	Pearson Correlation	0.830	-0.601	0.949	1	0.877	0.048	0.626	-0.852
	Sig. (2-tailed)	0.011	0.115	0.000		0.004	0.909	0.097	0.007
	N	8	8	8	8	8	8	8	8
Changzhou	Pearson Correlation	0.914	-0.718	0.875	0.877	1	0.235	0.707	-0.893
	Sig. (2-tailed)	0.002	0.045	0.004	0.004		0.575	0.050	0.003
	N	8	8	8	8	8	8	8	8
Nanjing	Pearson Correlation	0.325	-0.626	0.142	0.048	0.235	1	0.643	-0.418
	Sig. (2-tailed)	0.432	0.097	0.738	0.909	0.575		0.085	0.303
	N	8	8	8	8	8	8	8	8
Nantong	Pearson Correlation	0.884	-0.992	0.663	0.626	0.707	0.643	1	-0.864
	Sig. (2-tailed)	0.004	0.000	0.073	0.097	0.050	0.085		0.006
	N	8	8	8	8	8	8	8	8
Lianyungang	Pearson Correlation	-0.958	0.847	-0.850	-0.852	-0.893	-0.418	-0.864	1
	Sig. (2-tailed)	0.000	0.008	0.008	0.007	0.003	0.303	0.006	
	N	8	8	8	8	8	8	8	8

3. Linear regression model

1) Export logistics function

The export logistics volume through the Port of Shanghai and Port of Ningbo-Zhoushan is hypothesized to be determined by four factors. These include three basic economic factors (x_1-x_3) which are concerned with the port environment in China and one other factor (x_4) which represent the service level and the market power of the port. The function of the export logistics for the Port of Shanghai can be written as follow:

$$Y_{ei} = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + \varepsilon \qquad (2)$$

Where:

Y_{ei}: Export logistics volume for the Port i

x_1: Foreign direct investment in Yangtze River Delta by the six economies (Korea, Japan, Taiwan, Hong Kong, America and Europe). The sign of the coefficient of X1 will be in principle positive.

x_2: GDP (Gross Domestic Product) of the six countries and economies. The coefficient will be positive.

x_3: Ratio of the foreign exchange rate of China to the six countries and economies. The coefficient will be positive.

x_4: Ratio of export container cargo volume through the Port i to its total cargo volume, which can be referred to as the 'Export Ratio of Containerization for the Port i. Its coefficient will be positive because it is assumed that a high level of port infrastructure will attract export container cargo.

The fourth factor (x_4) is operational factors whose value depends on the type of port management system utilized. In general, the greater the influence of the one operational factor on export container volume, the stronger the competitive position of Port i.

Export-related variables selected as factors causing changes in volumes of cargo through the Port of Shanghai include four determinant factors (x_1-x_4). The percentage point change for each factor was determined by measuring the elasticity of the change in total seaborne trade in relation to each of the variables

under study. It is calculated by using econometric methods.

This study identified the following characteristics of export flows through the Port of Shanghai, which can be confirmed in Table 8. Initially, on the export side, GDP has the largest influence on export container volume flowing from Shanghai to the six countries and economies under study. Thus, GDP is the determinant variable with highest elasticity among the three main economic factors. The elasticity value of 1.526 indicates that a percentage point increase in the GDP growth rate in a nation or economy results in more than 1.5 percentage increase in seaborne trade for that economy.

A second point to emerge from the analytical results is that the elasticity of FDI is generally lower than the elasticity of the GDP variable. But it still affects export container volume in a positive way.

Thirdly, it should be noted that the containerization ratio for the Port of Shanghai has desirable effect of increasing export logistics volumes. Therefore, the Port of Shanghai's infrastructure is well suited to the technological progress apparent in container shipping.

It is abnormal that the coefficient of foreign exchange rate ratio is minus which should be plus according to the theory of international trade. In our opinion, there are three important reasons:

The exchange rate is deeply affected by Chinese government. It can not change freely according to the relation between market supply and demand.

The second reason is trade policy such as export rebate and export subsidies. The negative effect of CNY increasing in value can be offset by push these kinds of policies.

Half of the foreign trade in YRD is processing trade and this part of trade will not be influenced by exchange rate.

In the case of the Port of Ningbo-Zhoushan, Table 8 indicates that GDP is still the largest positive effect on the export container volume flowing from the Port of Ningbo-Zhoushan to the six countries and economies under study. The elasticity value of 0.815 indicates that a percentage point increase in the GDP growth rate in a nation or economy results in 0.815 percentage increase in seaborne trade for that economy.

Secondly, the containerization ratio of the Port of Ningbo-Zhoushan has a great effect on its export logistics.

<Table 8> Export Logistics function

Determinant Factors	Shanghai port	T Value	Sig.	Ningbo-Zhoushan port	T Value	Sig.
FDI of Yangtze River Delta	0.153	3.213	0.003	0.053	0.694	0.492
GDP of Six Countries and Economies	1.526	12.116	0.000	0.815	4.014	0.000
Foreign Exchange Rate Ratio	-0.717	-5.905	0.000	0.024	0.125	0.901
Ratio of Containerization	0.239	5.001	0.000	0.277	3.614	0.001
Constant	-88.408	-4.768	0.000	-26.699	-3.901	0.000
Statistical Result	RB^2=0.929 SE=16.10			RB^2=0.817 SE=12.512		

Source: Constructed by the authors using information from various sources

2) Import logistics function

The import logistics function can be developed utilizing the same logic as described above. Three basic economic factors concerned with the port environment as well as one other factor concerned with port service and market power determine the import logistics volumes through the Port of Shanghai.

Hence,

$$Y_{mi} = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + \varepsilon \qquad (2)$$

Where,

x_1-x_3 represent the three basic economic factors and x_4 represent port service. The four basic economic import factors concerned with port environment are as follow:

Ymi: Import logistics volume for the Port i

x_1: Foreign direct investment in Yangtze River Delta by the six economies (Korea, Japan, Taiwan, Hong Kong, America and Europe). The sign of the coefficient of x1 will be in principle positive.

x_2: GDP (Gross Domestic Product) of the six countries and economies. The coefficient will be positive.

x_3: Ratio of the foreign exchange rate of China to the six countries and economies. The coefficient will be positive.

The other one import factor concerned with port service is as follow:

x_4: Ratio of import container cargo volume through the Port i to its total cargo volume, which can be referred to as the 'Import Ratio of Containerization for the Port of Shanghai. Its coefficient will be positive because it is assumed that a high level of port infrastructure will attract import container cargoes.

The first noticeable characteristic on the import side of Shanghai port is the positive elasticity of the GDP. This indicates that imports into the Port of Shanghai will increase as the growth of the six nations or economies GDP.

Secondly, the foreign exchange rate ratio shows an anticipated negative value. The elasticity of exchange rates in relation to import volumes, in general, approaches the unit value of 1.

Thirdly, it should be noted that the containerization ratio for the Port of Shanghai has a weak positive effect on the import logistics volume for all of the six nations or economies under study. Thus, the containerization of the Port of Shanghai is contributing to import logistics or import logistics volumes.

In the case of the Ningbo-Zhoushan Port, the first noticeable characteristic on the import side is also the positive elasticity of the GDP. This indicates that imports into the Port of

<Table 9> Import Logistics function

Determinant Factors	Shanghai port	T Value	Sig.	Ningbo-Zhoushan port	T Value	Sig.
FDI of Yangtze River Delta	0.012	0.170	0.886	-0.104	-1.149	0.258
GDP of Six Countries and Economies	1.595	8.747	0.000	0.698	2.880	0.007
Foreign Exchange Rate Ratio	-0.893	-5.081	0.000	-0.051	-0.219	0.828
Ratio of Containerization	0.254	3.679	0.001	0.482	5.259	0.000
Constant	-77.137	-3.034	0.004	-28.067	-4.173	0.000
Statistical Result	RB^2=0.851 SE=21.632			RB^2=0.738 SE=12.337		

Source: Constructed by the authors using information from various sources

Ningbo-Zhoushan will increase as the growth of the six nations or economies' GDP.

Secondly, the containerization rate shows a great positive value. The elasticity value of 0.482 indicates that a percentage point increase in containerization rate will result in almost 0.5 percentage increase in seaborne trade for that economy.

V. Summary and Suggestion

This study analyzed the concentration ratio of Yangtze River Delta by HHI index model. The result shows that container transport is highly concentrated in this area. Based on the research of port behavior, we found that the two biggest ports in this port system (Shanghai port and Ningbo-Zhoushan port) have a fierce competitive relation. As the two biggest ports in China, Shanghai and Ningbo-Zhoushan have a great impact on the national port industry. However, the overall competition in container handling is very serious between Shanghai

port and Ningbo-Zhoushan port. After Yangshan port came into operation and with the combination of Ningbo port with Zhoushan port into a single entity, the competition had become more and more fierce.

Through the comparative analysis of the two ports, we get the result that each of them has its own comparative advantages which would make the cooperation of them impossible and reasonable. For example, Ningbo port has an advantage of nature deepwater berth and major bulk handling service. Shanghai port enjoys an advantage of management, finance, and container handling service. Therefore, the cooperation of Shanghai port and Ningbo-Zhoushan port is both necessary and emergent.

If Shanghai port and Ningbo port want to cooperate with each other, the first phase is to realize information and port resource sharing. Both ports should share the information, port resources and facilities, technique resources and the human resources. Then they should communicate in port engineering technique, container management, and cargo handling technique. Through resources sharing and port communication, both ports can reduce the cost and achieve the mutual benefits.

Two ports should establish an extensive platform for ports information sharing. The information sharing is incarnated in integration of the network including customs, inspection, shipping companies, cargo owners, shipping agencies and so on. This activity will build a solid basis for the future cooperation between these two ports. In addition, Shanghai and Ningbo-Zhoushan has basis for cooperation in information sharing aspects. These two ports signed an agreement on customs integration in 2005. In the future, the integration of EDI system, which has been implemented between Shanghai and Ningbo, can be adopted between these two ports.

Since these two ports can cooperate with the others in order to achieve the business benefits, they can also cooperate with each other. Especially, the development project of Zhoushan Island affords a good opportunity for the port enterprises of Shanghai and Ningbo to do the business cooperation. In the market economy the business cooperation between two port enterprises is the best mode for ports to achieve coordinated development.

There are some limitations of this study that need to be discussed. It is limited in the insufficient sample size used in the study. As the statistical information system in China is not so developed as in Japan or other developed countries, some data can only be found from 2001. Ningbo port has not developed for a long time, so it was hard to collect the related data before 2000. It could be researched more in the future to verify the model and predicated data, and to apply to other neighboring ports such as Port of Busan and Port of Gwangyang.*

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