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SHANGHAI MARITIME UNIVERSITY
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Shanghai, China

Port competition and cooperation in a shipping alliance era: A case study on the port of Shanghai and Ningbo

By
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A research paper submitted to the World Maritime University in partial fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE
In
INTERNATIOANL TRANSPORT AND LOGISTICS

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DECLARATION

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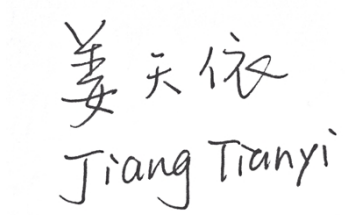

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ABSTRACT

Title of research paper: **Port competition and cooperation in a shipping alliance era: A case study on the port of Shanghai and Ningbo**

Degree: **Master of Science in International Transport and Logistics**

This dissertation's main topic is how ports compete and cooperate to face to the impacts of shipping alliances. It starts with the discussion of the shipping alliance situation，especially after economic crisis. In the face of the depressed current global economic situation and the trend of large contianer vessels, the shipping alliances have a rising trend. However, this trend's chain reaction impacts the port industry. The strong status of shipping alliance strikes ports in the world and affects the competition of ports. So the competition structure among ports have been changed, and the focus of port competition is gradually changing. This dissertation will analyze background of shipping alliance and its impact on ports. Then using comparison analysis method to analyze the changes of ports competition facing strong shipping alliances, necessity of cooperation among ports and how to maintain the balance between competition and cooperation.A case study about competition and cooperation on the port of Shanghai and Ningbo will also be use to specifically analyze how can port do to deal with shipping alliance's strike on ports. In this chapter, factor analysis method will be used to compare the competitiveness of these two ports. Through this method, readers can observed visualy the advantage and disadvantage in Shanghai port and Ningbo port by data analysis. It's helpful to provide advice to ports to cooperate and compete with each other. The application result illustrates the ports affected by shipping alliance more cannot get much business volume, so they should pay more attention to its distinctive business.

KEYWORDS: Shanghai, Ningbo, Container port, Shipping alliance, Competition, Cooperation.

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List of Abbreviations

Maersk	Maersk Line
MSC	Mediterranean Shipping CompanyS.A.
HMM	Hyundai Merchant Marine
VSA	Vessel Sharing Agreement
MOL	Mitsui O.S.K. Lines
APL	American President Lines
UASC	United Arab Shipping Company
NYK	Nippon Yusen Kabushiki Kaisha
OOCL	Orient Overseas Container Line
MISC	Malaysian International Shipping Corporation
YML	Yang Ming Marine Transport Corporation
NOL	Neptune Orient Lines
TEU	Twenty-foot Equivalent Unit
3E	Triple E Class
MPA	Maritime and Port Authority of Singapore
AGV	Automated Guided Vehicle
ESPO	European Sea Ports Organization
AHP	Analytic Hierarchy Process
FCE	Fuzzy Comprehensive Evaluation
ERA	Evdential Reasoning Approach
KMO	Kaiser- Meyer- Olkin
GDP	Gross Domestic Product

Chapter 1 Introduction

1.1 Background

As a significant module in shipping industry, liner shipping started developing rapidly from 50s last century. Experiencing the grope at first and then the rapid expansion, liner shipping seems to have faced a bottleneck problem now after about half a century. Also, the over-capacity that is resulted from unbalance between supply and demand has disturbed many liner companies for a long time. In order to deal with this problem, to get more profit, and to seek for sustainable development of container liner market in shipping industry, most liner companies strike for alliance in recent years under the background that the shipping industry situation is severe and liner shipping market is depressed recent years, especially after the economic crisis in the years between 2008 and 2010.

With the contabescence of Liner Conferences, strategy alliances gradually become a new form that increasingly more liner companies choose to improve their operation. It is a product of the expansion and deepening of the joint venture. For example, Maersk, the largest liner company in the world, cooperated with MSC to be 2M Alliance in 2015. Just before that, the top three shipping companies (i.e. Maersk, MSC and CMA-CGM) tried to unite to be P3 Alliance which is by size of operated fleets control over 40% of all vessels that are operated among the top 20. And after that, 2M absorbed HMM and they signed the VSA. Even top 3 liner companies joined in shipping alliances, others among the top 20 are nearly all be members of a certain shipping alliance. Container

shipping companies realized that they can share the shipping accommodation and port facilities through establishing shipping alliance. So there are approximately 80% fleet capacity have joined shipping alliance, that's a big number for ports which service for shipping company will berth in their quay. If the companies adjust their berth schedule and even change their ports of call because of their shipping alliance's common plan, they will be in a passive position when negotiating.

To deal with this crisis and problem, nowadays, the competition situation of shipping companies have been changed. It becomes more and more fierce. Large ports may be favored by shipping alliance because of large- scale vessel trend and its big digestive capacity. So nearby ports may sacrifice the interests of the port in exchange for the liner company. At this time, the competition pattern among ports has been changed. For all ports' benefits, they must cooperate with each other to enhance their utilization and survive together in this depressed background.

1.2 Purposes of the dissertation

The main goal of this dissertation is to give some advice to ports which is facing the situation that most liner shipping companies have joint together to be several shipping alliances to cooperate and compete with each other reasonably in this depressed shipping environment. In this dissertation the author will use Shanghai and Ningbo-Zhoushan[1] ports' competition and cooperation as a case study to explain the measures to coordinate competition and cooperation concretely. Even in this case, the author will make a model to compare the competitiveness of both Shanghai port and Ningbo port. That will be useful to know comparative advantage between Shanghai port and Ningbo port and to provide the suggestions for them then.

[1] For convenience, the following said Ningbo port all means Ningbo-Zhoushan port, which have used this name from 2006.

To achieve this purpose, this dissertation will first analyze the background about shipping alliance in the world to show their strong status in shipping industry. Second, uncover the necessity of cooperation by analyzing port completion before and now. Third, take the competition and cooperation on Shanghai port and Ningbo port as an example. Finally, give the author's recommendation for not only Shanghai and Ningbo ports to compete and cooperate with each other but also that of other similar ports in the world.

1.3Literature review

1.3.1Shipping alliance

Both scientists in China and abroad have done quite a lot of research on shipping alliance to analyze the shipping market environment and its impact on shipping industry.

There are some researches on evaluation of strategic alliances in liner shipping. In Renato Midoro& Alessandro Pitto's article (2010), we can see many force reasons pushing container carriers towards new forms of co-operation organizational (shipping alliance)like globalization and risk and investment sharing and the alliance now become more and more complex. Another article (2010) specially provides the suggestion of shipping alliance for Asian container carriers in globalization era and this tool (alliance) is flexible. It highlights the region function in alliance. Some other relative article mentions the relationship between shipping alliances and port, and concludes that the membership of alliance has given carriers opportunities to add ports of call as part of their overall activity would appear, such as Brian Slack, Claude Comtois & Robert McCalla's article (2010).

1.3.2 Port competition and cooperation

There are many literature are related with port competition or refer to cooperation. Most

of them use one or two specific port as a case to analyze their point. Wei Yim Yap a,1, Jasmine S.L. Lam b,'s article(2006)analyzes their extent and intensity and unveils the competitive dynamics between the major container ports in East Asia. And the study suggests that inter-port competition in the region would intensify in the future as the centre of gravity of cargo volume shifts to mainland China.

One (2006) analyzes the relative competitiveness of the neighboring container ports of Shanghai and Ningbo in China and to develop a view of the likely future outcome of the competition between them. And it concluded that Ningbo will continue to gain greater market share as the result of advantages in its natural endowments (particularly depth of water), price and quality of service improvements. It's nice to see that there is a literature (2007) which mentions the shipping alliance's impacts on ports. And ports authority will have new dynamics.

One approach about that is the network analysis method in Notteboom (2009), who investigates the number of calls of liners at major ports in Northern Europe and analyses the complementarity and substitutability of those ports.

Min JuBae , et al.(2013)'s paper developed the two-stage duopoly model of container port competition for transshipment cargos. It was shown that shipping lines may assign more port calls to the port that offers better services, like a cheaper price and a larger capacity. And the trend is increasing. That's ports' way to compete with each other. The conclusion is port expansion in either port will decrease the equilibrium port prices.

1.3.3 Port competitiveness evaluation

In this part, it's necessary to discriminate the definition and connotation. Some literatures specially distinguish competition and competitiveness. Such as Wang Jixian's article(2005) explains the misunderstanding of port competition and port competitiveness and connotation, like some port competition mainly in the terminal

competition.

Haezendonck and Notteboom (2002) provided a comprehensive appraisal to show that hinterland accessibility, productivity, quality, cargo generating effect, reputation and reliability are critical in enhancing a port's competitiveness.

Because of Asia's sharp increases in trade volume and severe internal competition for the status as hub ports in the 2000s, there are many literature about Asia port's competitiveness, like one by Tae Seung KIM(2015). This paper contributes to the literature by evaluating the performance of East Asian ports from a different perspective, focusing on container handling and revealing port competitiveness.

1.3.4 Existing problems

However, problem and weakness still exist.

- ✧ *Very few researches analyze the ports competition and cooperation issue considering the impacts of shipping alliances. When they analyze reasons of ports competition and cooperation, they only mention a little about shipping alliance, or even no mention. Or they only briefly introduce the shipping alliance's impacts on the shipping market, without detailed investigation on their effects to ports.*

These could be found in Chinese articles from Yan Xianghui (2012).Zhang Tingfa(2009).Chen Miao(2007) and so on. Some abroad and English research also aim to this area, such as articles from Xin Tian, Liming Liu & Shouyang Wang(2015).Min Ju Bae , Ek Peng Chew , Loo Hay Lee & Anming Zhang(2013).

- ✧ *Articles of shipping alliance development should be updated quickly.*

  Although many researches of shipping alliance are published, with the rapid development of shipping market and cooperation situation in liner companies, the

article about new alliance such as THE alliance is lack. There are just news reported the dynamic developing of shipping alliance.

- ✧ *Some research papers on port competition don't consider the difference cost structure and different location among the shipping line.*

  Many research papers use quantitative techniques to analyze port competition, like Wei Yim Yap & Theo Notteboom's article. However, shipping lines are likely to possess different cost structures given the variations in network structures adopted and strategies of vertical integration pursued with respect to the whole supply chain which includes the port-to-port component as well as logistics costs involved in serving the hinterland among other considerations.

In a word, port competition and cooperation in shipping alliance era still has a lot of areas waiting us to explore deeply inside. And research on both port competition and cooperation and shipping alliance is not that abundant or considered all shipping lines' different factor. Research of decision making on ports competition and cooperation still has a long way to go.

1.4 Structure and Methodology of the dissertation

The dissertation is organized as follows:

Chapter1, Introduction, intends to introduce the background, purpose ,Literature review（about shipping alliance, about port competition and cooperation, and about port competitiveness evaluation）structure of the dissertation and methodology.

Chapter 2, Shipping alliance in the world, intends to overview the development of shipping alliance in the word and its effects, especially on ports.

Chapter 3, Shipping alliance's impacts on ports——cooperation and competition. In this

chapter, this dissertation will analyze the changes of ports competition facing strong shipping alliances, necessity of cooperation among ports and how to maintain the balance between competition and cooperation.

Chapter 4, A case study on the port competition and cooperation of Shanghai and Ningbo in a shipping alliance era. Through compare the competitiveness between Shanghai and Ningbo ports by factor analysis method, conclude the developing direction of adjacent port and provide advice for them.

Chapter 5, Conclusions. The summary of findings, suggestions, implication and future extend of this study and practical recommendation will be presented.

This dissertation will mainly use the comparative studies, such as shipping alliance before and now, past port competition and recent port competition and the comparative advantage of Shanghai port and Ningbo port. Also, when analyze competition and cooperation of Shanghai and Ningbo ports, this dissertation will use factor analysis method to certain the advantage and disadvantage between Shanghai port and Ningbo port. Qualitative and quantitative analysis have been used on this dissertation in order to make a study comprehensively.

Chapter 2 Shipping alliance development

2.1Development of shipping alliance in the world

2.1.1 Historical shipping alliance in last century

Historically, the development of shipping alliances is usually accompanied by acquisitions and mergers. As the first major shipping joint venture in the world, the Global Alliance was established in 1994. Since then, several top shipping liner companies in the world has been competing and cooperating through the way of joint alliances. In order to reduce the cost, improve the service quality and enhance the competitiveness, different shipping companies chose to join different alliances with the breakup of the liner conference.

By the year of 2000, the container liner market had formed five major joint ventures: New World Alliance (HMM, MOL, APL);Unite Alliance (Hanjin, DSR-senator, UASC,CHOYANG); Grand Alliance (Hapag-Lloyd, NYK, OOCL, MISC， Royal P&O Nedlloyd) and CKY alliance (COSCO,K-LINE, YML).However, some of these shipping liner companies had experienced mergers and acquisitions, for example, PO Containers and Nedlloyd combined to be P&O Nedlloyd Container Line, and Maersk merged SEALAND, but they firstly just combined to be an alliance. So the

world alliance pattern was always changed until 1998. After year of 1998, the shipping alliance had entered a relative stability period.

2.1.2 Changes of shipping alliance in this century(before 2016)

After entering 21 century, some cooperation happened between shipping alliances, like CKY alliance and Unite Alliance. In 2001, CKY alliance and HanJin who owned DSR-senator's 80% share combined to be CKYH alliance. And then MISC quit Grand Alliance in 2009. The pattern of shipping alliances has changed dramatically, because of both the birth of new shipping alliances and mergers and acquisitions. Then Evergreen, who always work herself without any alliance suffered a lot of operation pressure, so it finally change its strategy and choose to join CKYH alliance. They finally constituted CKYHE alliance. Maersk and the MSC have formed the 2M alliance after the P3 alliance (Maersk, MSC, CMA-CGM) was not approved by the Chinese Ministry of Commerce for the reason of antimonopoly. While the rest of P3, CMA-CGM, established O3 Alliance with CSCL and UASC who was a member of Unite Alliance before. That these two alliances operated at the same time greatly changed the pattern of the liner industry. And at the end of 2011, 6 shipping companies of New World alliance and Grand alliance, which are APL, MOL, Hapag-Lloyd, NYK, OOCL and Hyundai, formed to be the G6 Alliance. In this century, many big liner companies merge or acquire other liner companies in pursuit of larger market share and more fleet capacity. For instance, Maersk merged P&O Nedlloyd Container Line, Hapag-Lloyd merged Canadian Pacific Steamship Line, CMA-CGM merged DELMAS. In 2015, Hapag-Lloyd merged other liner company again. This time her target is CSAV. While CMA-CGM's target is NOL. Also, two big shipping companies in China, COSCO and China Shipping, who had joined different shipping alliances combined together. In this case, the shipping alliance pattern has to be changed. In 2015, Hamburg Süd, a German oldest and largest privately owned Shipping company, took over the container business of CCIN who is the second biggest shipping company in Chile. Because of this acquisition,

Hamburg Süd joined the first ten liner companies at that time. With the alteration of shipping pattern, shipping alliance faced reshuffle.

In conclusion, there are 4 main shipping alliances in this century (before 2016). They are 2M Alliance (Maersk, MSC); O3 Alliance(CMA-CGM, CSCL, UASC); CKYHE Alliance(COSCO, K- LINE, Yang Ming, Hanjin, Evergreen) and G6 Alliance(APL, Hapag-Lloyd, HMM, MOL, NYK and OOCL).The top 16 container liner companies of the world which showed in Alphaliner at that time, 15 of which belong to the four largest shipping alliances, excluding Hamburg Süd.

2.2Current situation of shipping alliance in the world

2.2.1 Three big shipping alliances

After 2016, the pattern of liner shipping alliances has been reshuffled. Following by the bankruptcy of HanJin, the merger between Hapag- Lloyd and UASC, the combination of COSCO and China Shipping, the consolidation of four big Japanese shipping companies and so on, there are two new shipping alliance established in these years, while old alliance fall to pieces, except O3 Alliance.

Affected by the bankruptcy of HanJin, HMM who is also a Korean shipping company lost too much order and businesses. It have to cut freight rate in order to persuade its clients to continue choose it. But with deeper and deeper of the overlapping coalition of shipping companies in the world，shipping companies that have worked with Hanjin have the possibility to cancel South Korean routes. Fortunately, 2M Alliance have signed an 3-year cooperation agreement with HMM. So HMM can cooperate with the 2M Alliance as an "unofficial member". And 2M itself is very stable for its 10-year contract period.

Two new shipping alliances mentioned above are named OCEAN Alliance and THE

Alliance. The previous members of CKYHE Alliance, O3 Alliance and G6 Alliance formed these two new shipping alliances.

When OCEAN Alliance was set up initially, it planned to put into 41 routes in total as well as over 350 container ships, whose capacity up to 3.5 million. While 2M Alliance only has 2.1 million TEU capacity. So OCEAN Alliance might be the biggest container shipping alliance in the world so far. The scope of cooperation includes: Asia from/to Northwest-Europe, Asia from/to Mediterranean Sea, the Far East from/to the Red Sea, Far East from/to the Persian Gulf region, Asia from/to the east/west coast of the United States and the Atlantic routes.

THE Alliance is an alliance lead by Hapag-Lloyd. Except Hapag-Lloyd, others are all Asia shipping companies, including HanJin before it bankrupted. The scope of cooperation includes: The Far East - Nordic routes, far-east Mediterranean routes, the Far East - East / West Coast routes, routes across the Atlantic, the Far East Middle East (Persian Gulf / red sea route). Nowadays, Hapag-Lloyd has merged UASC. That means the new Hapag-Lloyd became the fifth biggest container shipping company, and the previous UASC's capacity will put into THE Alliance. This merger will enhance THE alliance stronger in this tough market condition.

So, the 2M Alliance's position in the container transportation market has changed because of the appearance of OCEAN Alliance and THE Alliance. Its strength has been weakened. What's more, OCEAN Alliance in the trans-Pacific routes market delivers goods by "one ship one dock", in order to improve the punctuality and enhance the customer satisfaction. No matter strength and competitive power, 2M Alliance's advantages are not obvious any more.

2.2.2 Reasons of the formation of the three big shipping alliances

Shipping alliance is a new style after shipping conference which was forbidden in 2008

by European Union. The alliance with the loose, flexible and simple legal procedure achieved considerable success. The practices like complementary route, slot chartering, wharf sharing within the members of alliances prove that there are some advantages of routes designation, resource optimization and cost control and so on in shipping alliance. However, some factors like relatively independent, act of one's own free will cause the complex of corporation and management. So these container shipping companies choose alliance for both cooperation and competition.

These three big shipping alliances appear after Maersk seeking for establishing P3 Alliance (later change to be 2M) and several shipping companies' merger and reorganization or even bankruptcy. That's because "big cooperation" and "big vessel" have become a tendency in the main routes of container line transportation market. With more and more over-size vessels joining the market, it become a large challenge that single container line company canvasse itself. So even the first biggest shipping line, Maersk Line seek for establish an alliance. And Maersk quickly discarded CMA-CGM in order to establish a less powerful alliance, 2M Alliance with MSC when China issued a prohibitory edict of P3 Alliance. The 2M Alliance which starts operating from 2015 affects the whole container shipping market. The main commercial reason for P3 Alliance is not only facing the depression of international trade, but also for more effectively arranging over-sized container vessels.

Another example which can explain why most big container liner shipping companies join in shipping alliances is that Evergreen who claimed never building over-sized vessel and won't join any alliance now changes its thoughts. That's because the market situation cannot afford its developing alone and only operating small vessels that less than 10000 TEU. If Evergreen insists its thought, in the long term, it may be difficult to continue its work. But after building big vessel, single operation cannot produce an advantage of big vessel. Then joining an alliance become necessary, not only Evergreen, but also other big container shipping companies.

Considering the market background, there are some reasons to explain this current situation: Firstly, the era of rapid economic growth has passed. So in the shipping market, it will mainly be low growth or restorative growth. That means the era that makes the capacity substantial and rapid rise has been over. Before a wave of capacity rose rapidly because of industrial migration which can bring some changes of a large amount of raw materials and finished product. The current global industrial migration has basically been stable, which resulted in a relatively stable pattern of maritime transport and there will be no great ups and downs. Secondly, lager-sized vessels due to the cost results in capacity growth faster than demand growth as well as re-layout of routes. As for liner company, the most important thing is stable supply in order to produce benefits, thus enhancing canvassion can become the biggest challenge for the liner company, and increasing the alliance cooperation, expansion of the customer pool is undoubtedly the best choice. Thirdly, the continuous development of information technology to facilitate the transport of cooperation, which makes a large-scale global cooperative operations possible.

In all, alliance reorganization can improve the stability of the entire shipping industry. So when some liner companies change their target and strategy or experience merger or acquisition, the entire liner industry can be re-shuffled. These liner companies have a long-term vision for economies of scale, so the form of several liner companies is becoming more common. But the more members of an alliance, the lower the efficiency. In a big team of liner companies, it is inevitable that some companies need to make concessions. So even the mode of shipping alliance is popular nowadays, one shipping alliance cannot constituted by too many shipping companies. There must several shipping alliance checks and balances in the world. So three big shipping alliances emerges one after another in these years.

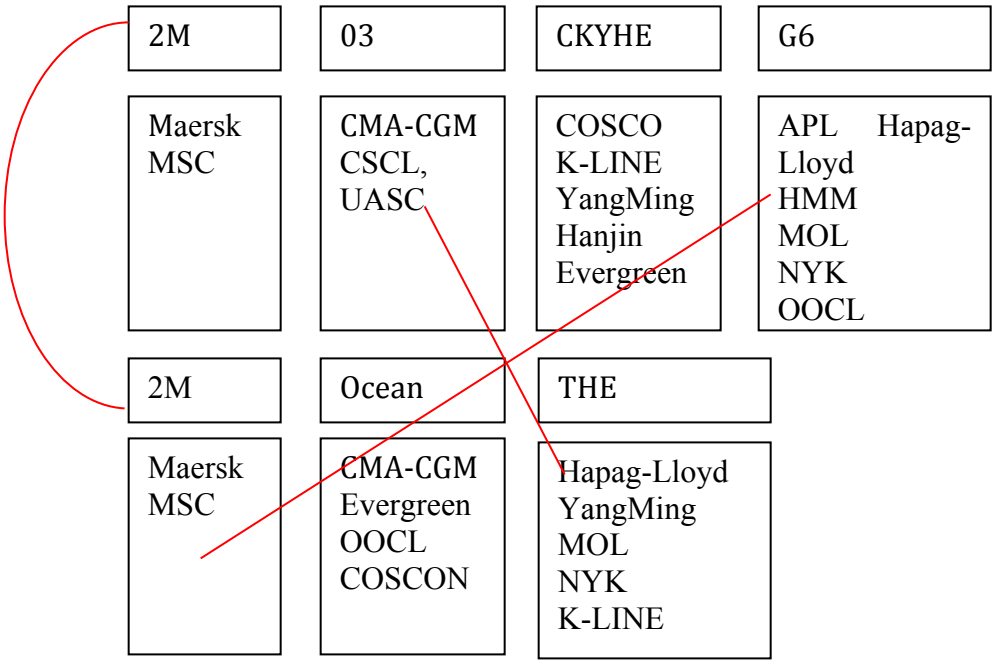

Figure 1- Changes of shipping alliance before/after 2016

2.3 Shipping alliance's impacts on the shipping industry

In the long term, shipping alliance makes a positive effect on the shipping industry. Primarily, monopoly can be excluded after the case of P3 alliance. And these three big shipping alliances all cannot reach monopoly. Also, the shipping alliance has improved the efficiency of shipping operations by increasing the utilization rate of space, which has, to a certain extent, exacerbated the over- capacity of the market, so in the short term, it can only make the overall tariff down. But in the long run, the alliance makes the shipowners less willing to build new vessels, which makes a positive effect the future freight rate. Although the three major shipping alliances occupy an absolute advantage in the market share and compressed the small shipping company's living space. On the other way, the shipping alliance is more focused on transport among hub ports. So small shipping companies can pay more attention on feeder transport. Compared with merger and acquisition, alliance is a quicker and lower-cost way to cooperate. It has some

flexibility which can relatively easier in and out. So it is a easier available way to achieve economies of scale.

In terms of the effect on the ports due to the growing of shipping alliances, on the one hand, the liner company is in a very strong position in contract negotiations with the ports; on the other hand, facing the growing shipping alliances, the competition and cooperation will be intensified. Along with the trend of larger-sized vessel, the development of shipping alliance will change the layout of hub and feeder ports and strengthen the trend of port concentration. With the utilization of space which affected by shipping alliance, the number of port of call will be reduced. There will be increased cooperation between major global port groups and adjacent container ports. Over the past few years, the plan of terminals new-built and expanded have been developed, resulting in a slight excess of terminal capacity. But that doesn't mean that all the hub can serve these huge shipping alliance. So besides facilities optimization for competition, some terminals can merge to serve big customers because these shipping companies are so large that it's impossible to let them spread to places to anchor. What's more, the changes of the pattern of shipping alliance will breaking the original operation of the terminal. Shanghai port congestion after April 2017 is an obvious instance.

Chapter 3 Shipping alliance's impacts on ports

——cooperation and competition

3.1 Current relationship between shipping alliance and ports

3.1.1 Threat of shipping alliance

With the appearance of shipping alliances, ports have suffered more pressures than ever. Shipping alliances consolidate the power of shipping liner companies, thus they gain more bargaining power over ports. As a consequence, ports have no choice but to meet the requirements from alliances in order to catering for their customers. For example, many ports are upgrading their facilities, taking in larger cranes and building more deep-water depth berths to serve 3E mega-container ships which have already been used by shipping alliance among trunk lines. What's more, to maintain competitiveness and improve effectiveness and efficiency, many ports also combine automation with traditional port operations, building up automatic ports. All above facts have shown how weak ports are when they face challenges from shipping alliance.

3.1.2 Impacts on ports

The impacts of shipping alliance on ports are various according to different roles ports

play.

For those ports which serve as hubs and their nearby competitors, they are going to be impacted heavily by shipping alliance. Port side may accept investment from liner shipping company to build up exclusive berth, it may also sacrifice part of its revenue, providing better service and charging less, so that it can maintain competitiveness and even become more attractive. However, shipping alliance will deliberately reduce operational risk by cooperating with hub ports and their competitor, thus enhance the fierce competitions among ports in the end.

For those ports which serve as spokes, shipping alliance does not have much influence on them. It is the hinterlands which spoke ports serve and feeder markets they have that matter.

3.2 Changes of competition structure among ports

The core issues of competition among ports never change with the times and competitions on the hinterlands, transshipment cargoes and investments are three critical aspects any port will focus on. A solid hinterland will ensure a steady demand for port daily operations and a strong need of transshipment of goods can increase the revenue and improve the reputation of ports, last but not least, investments from the outside enable port to maintain its facilities, even extent its business.

3.2.1 Port competition in the past decades

In order to compete over others in hinterlands, transshipment cargoes and investment, ports mainly take advantage of two factors.

First of all, natural location and conditions of port are of great importance, for example, Port of Hong Kong and Singapore fit in perfect geographical locations, at estuary of Pearl River and entrance of Malacca strait, with proper water depth. That's part of the

reasons why Port of Hong Kong and Singapore gain their reputations around the world.

The other factor is national policies on ports. Sponsorships and financial incentives awarded by local government can boost the development of a port and Port of Shanghai is a good instance, though it sits on a good location. Since the central government issues its 5 year plan, trying to build up Shanghai as an international shipping center in 2020s, Port of Shanghai has benefited a lot from the policies in comparison with other ports. With the assistance of Regulations of Shanghai Municipality of Promoting the Construction of International Shipping Centers[2], which was issued by Ministry of Transport of the People's Republic of China in 2016, Port of Shanghai is going to enjoy a systematic development in the coming 3 years.

3.2.2 Port competition in the 21century

After 21 century, with the popularity of economy of scale and automation applications, Mega-container ships and automatic ports become main-stream tendency as well as capacity of collecting and distributing cargoes. More and more ports are competing in above three directions.

For Mega-container ships, the bigger ship is, the wider and deeper water depth berth need to be. Besides that, to relieve congestion happen in the waiting-for-berth process, more new berths are going to be constructed. Although the construction of new berths and reconstruction of old berths cost lots of capitals, many reputable ports still keep adapting themselves to the bigger ships. In far East Asia, the YangShan deep water port 4 began its construction at the end of 2014, and it was planned to put into use in 2017[3].In Southeast Asia, MPA is going to build up Port of Tuas, which is going to be completed

[2] Regulations of Shanghai Municipality of Promoting the Construction of International Shipping Centers, section 2.
[3] http://www.guancha.cn/Project/2014_12_23_304244.shtml

in 6 years and providing 20 more deep water berths at south west of Singapore.[4] In Europe, Maasvlakte II, opened in 2013, was an extension of port of Rotterdam for the purpose of accommodating larger container ships.

For automation, many world leading ports are gradually transferring themselves into automatic ports. The application of automatic equipment, such as semi-automatic cranes and automated guided vehicle (AGV) have achieved positive outcomes. In terms of efficiency and safety, automatic facilities have an upper hands. Crane operators now cam stay in remote room to control the loading and discharging process. AGV can work along the routes for which they have already been programmed and avoid severe accident in the port yard. The automation is worthwhile, though the annual maintenance cost could be very expensive.

For collecting and distributing functions, because good collecting and distributing functions can ensure high throughput of cargoes, especially for containers, setting up a comprehensive distribution center within port area is essential. Cargoes can be transshipped by barges to feeder ports, by railway to inland cities and by truck to nearby urban, forming a new model split. A model split consists of various transportations can not only reflect diversification of port system, but also ensure the green awareness, which has already been a compulsory requirement in Europe.

3.3 Cooperation among ports

As mentioned in the subtitle, cooperation among ports can be classified into three different area: cooperation among different port groups, cooperation among ports within one port group and cooperation among operators within one port. In this subtitle, cooperation among ports within one port group will be discussed.

3.3.1 Necessity of cooperation

[4] China Shipping gazette ,http://news.hsdhw.com/169818

Cooperation among ports is essential in current port businesses. There was a time port need to develop individually, but now with the emerging of shipping alliance, cooperation and competition become a new trend.

Cooperation among ports can better allocate precise resources among ports. Resources such as available land resources, experienced labor and capital investment are all matters for port's development. With cooperation, ports can better achieve their 5 to 10 years master plan and avoid too much cost on fundamental resource arrangements.

Cooperation among ports can help ports specialize their businesses. Every port has its own customer to serve. Except for some really large and modern ports which have a comprehensive and sophisticated business covering from container cargoes all the way to bulk cargoes and chemicals, it is good for any single port to develop in certain direction. Specialization will not only shape the competitiveness of an individual port but also improve the attractiveness of the whole port group in the end.

Cooperation among ports can enable ports to strengthen bargaining power over shipping alliance. Price-based competition is common in current ports competition, but with the help of cooperation, ports can form an agreement on the lowest service charges in order to maintain minimum profit. Uniting the power of individual port is the best way against pressures from the shipping alliance within the scope of a port group.

3.3.2 Current situation of cooperation

Cooperation has been carried out in recent around different port groups in the world and evolve into two types, the government-leading one and enterprise-leading one.

For government-leading one, Tokyo port group is a good example. Under the help of Japanese Transportation Bureau, Port of Yokohama, Tokyo, Chiba, Kimitsu and Kisarazu carried out cooperation. Port of Yokohama became the second largest

container port in Japan and Port of Chiba the largest vehicle exporting port for ro-ro ships. Other ports are mainly responsible for exporting and importing bulk cargoes. In current, the Port of Guangzhou, Shenzhen and Hongkong have also cooperated with each other in the suggestion of Ministry of Transport of the People's Republic of China. Hongkong will be mainly responsible for providing financial and insurance support to the ships, Port of Shenzhen will be focus on containers and Port of Guangzhou will be concentrated on bulk cargoes in the soon future.

For enterprise-leading one, European Sea Ports Organization(ESPO) shows a good illustration. Funded by European Union in 1993, ESPO is designed to help and manage all ports in Europe without direct intervene. ESPO provides technical consultancy for European ports and bring capitals for them. At the same time, ESPO ensures the right of European ports according to legitimate laws. When there is any conflict between any two ports, ESPO will handle conflicts through General Assembly. Thanks to ESPO, ports in Europe can work as a group and achieve better development.

3.3.3 Result of cooperation

Cooperation can bring lots of positive outcomes, following are four of them.

3.3.3.1Unification and harmonization

Cooperation among ports can avoid price-based competition and unification and harmonization can form a sustainable development in the long term. But a solid authority need to be in charge of cooperation in order to achieve harmonization and regulation need to be made for the purpose of unification. In Europe, ESPO take advantage of General Assembly and legitimate law to maintain unification and harmonization among ports. In Japan and China, Japanese Transportation Bureau and Ministry of Transport of the People's Republic of China have the final decision-making right to leading cooperation.

3.3.3.2 Further cooperation in environmental protection and digitalization

Primary cooperation among ports lay a significant foundation on which further cooperation can be carried out. With the popularity of green awareness and digitalization, more researches can be leaded by ports and knowledge and outcomes can be shared among port members so that ecological environment could be better protected. Digitalized platform where online cargo-collecting and online promotion can take place can be built together by cooperated ports for increasing revenues.

3.3.3.3 Exploration on port group planning

With the data collected from ports' cooperation, the transportation bureau can better analyze how far has cooperation gone and how much potential it has left. New exploration can be initiated based on analysis done by the government. One good aspect about exploration is that, besides traditional ideology of specialization of ports, the development of port can be combined with heavy and light industries nearby port areas, thus creating more concrete and related suggestions for development.

3.3.3.4 Security of port's individualism

Cooperation can bring lots of conflicts and mistakes among ports. Those errors can enforce port to look back at its operations individually, checking its effectiveness, efficiency and accuracy. With the scrutiny from the outside and self-exam from the inside, port can better shape its competitiveness and help each other.

3.4 Measures to coordinate competition and cooperation

In details, competition and cooperation among ports can be reflected in capital tie-ups, technical training, reciprocal protocol, researching partnerships, franchise, exchange of employee, share of information, transfer of paten, service agreement and so on. There are hundreds of ways to carry out competition and cooperation, however, in general

speaking, they can be divided into six categories.

3.4.1 Association-oriented competition and cooperation

As mentioned before, ESPO in Europe is an excellent example of association-oriented competition and cooperation. Difficulties and conflicts can be discussed and studied among association members, and association itself can serve as a good buffer if intense relationship shows among association members. Besides that, association members can set up price agreement to ensure the profit. As the loosest alliance, association-oriented competition and cooperation is easy to build up, and it covers every part of industry, which is suitable for port group. The bad thing is that it is easy to breakdown, and since every party has its own interest to defend, association cannot play its roles in front of crisis.

3.4.2 Specialization-oriented competition and cooperation

Specialization-oriented competition and cooperation is where different ports within a port group develop their own unique businesses and altogether form a comprehensive port group, the Tokyo port group mentioned above is one of the instances. Specialization of ports can avoid price-base competition and waste of resources, but it is hard to achieve in reality and distribution of profit is imbalance among ports, unless the government has endorsed and enforced such kind of cooperation.

3.4.3 Joint Venture-oriented competition and cooperation

The essence of Joint Venture-oriented competition and cooperation is to complement one with other's advantages. This kind of competition and cooperation is widely used in coast liner shipping area, where fixed port, route, vessel, cargo and sailing date are all arranged and it shows a typical sustainable relationship between hub and spoke ports. Joint Venture-oriented competition and cooperation is very flexible, easy to see the

effect and relieve competition among ports instantly, but it is a short-term cooperation. In addition, it also require both cooperated ports have certain advantage over others which them can take advantage of, otherwise, the cooperation is hard to reach.

3.4.4 Equity-based competition and cooperation

A few reputable ports will invest in certain ports to create chance of cooperation, and this is equity-based competition and cooperation. Sometimes ports will even invest and set up a new enterprise to help develop their port-related business. In current, equity-based competition and cooperation has become the mainstream tendency for cooperation among ports. However, this method has capital requirement and in reality, more restrictions will be put on equity purchase. In most cases, no matter how much capital you can provide, the percentage of purchasable equity is restricted for buyers.

3.4.5 Double[5] hubs competition and cooperation

Double hubs refer to two competitive ports which are close to each other in geography, but different from each other in function. In this method, two competitive ports can complement to each other and take full advantage of their hinterland by working together. Meanwhile, two ports can maintain competition as well to ensure effectiveness and efficiency. However, double hubs method needs an accurate investigation of hinterland market. It must ensure the market capacity is big enough for both two ports, otherwise, fierce competition will gradually take place of cooperation among two ports in long term.

3.4.6 Group-oriented competition and cooperation

Group-oriented competition and cooperation is a very special method where merger and acquisition take place. Merger and acquisition can reorganize assets and industrial

[5] Dai Ziyan, *Study on the cooperation and competition of container ports in the Yangtze River Delta,* china,2005, p52

structure to optimize the competitiveness of port group as a whole. It can cut off duplicated facilities, avoid homogeneous competition and better arrange precise resources. But since ports have their own purses and interests at the very beginning, it is extremely difficult to carry out merge and acquisition according to their own wills. In such case, government plays a huge roles in persuading different ports of merger and acquisition. And only by assistance from the government can the following reorganization of assets and structure be completely established.

Chapter 4 A case study on the port competition and cooperation between Shanghai and Ningbo

4.1 Current situation of port competition and cooperation between Shanghai and Ningbo

4.1.1 Reasons of the selection of Shanghai and Ningbo ports

From 2010 until now, Shanghai Port container throughput exceeded that in Singapore port and become the world's first. And in the past few years, the throughput error between Shanghai port and Singapore port has become more and more big. By 2015, Shanghai Port has been stable for consecutive six years that the container throughput is the first of the world.

While Ningbo port is another big port near Shanghai port. They are geographically close and are all world-class ports. These two years, Ningbo Port has developed rapidly. Its cargo throughput has become the first of the world from 2013 and beyond that in Shanghai. In 2015, it became the world's fifth port whose container annual throughput exceeded 20 million TEUs.

Whether the port of Shanghai or Ningbo port is an international port that is rich in resources, owns excellent equipment and great amount of throughput. And on account of their geographically adjacent, there is more possibility for them to cooperate and

competition. They are both Chinese high-producted port that under the same regulatory conditions and legal environment. That makes it easier to compare their competitiveness and it's more necessary to analysis their cooperation and competition in order to give some suggestions that make them develop better in the future.

According to Drewry analysis, according to the three major big alliance weekly anchored port count, Shanghai port and Ningbo port are the two most frequent ports. They are respectively 58 and 54 times. It can be said to be neck and neck. But after the change of the pattern of shipping alliance, the week service reduced 5 voyages and 50 ships deployment in Shanghai port. And the members of alliances selected the average size of berthing ship is 11400TEU, which is less than Singapore port. So there exists some competition because the port who get more times and bigger vessel to ahchored means that it get more important status in the port industry and will get more profit from alliances. Therefore, the competition for the shipping alliance's favor and cooperation to enhance the right to negotiate with alliances are all worthy to pay attention.

Also, after COSCO and China Shipping merged together and joined Ocean Alliance, Shanghai port and Ningbo port have the same opportunity to get business. This eliminates the interference of different ports in different countries cooperated with different alliance. But after that COSCO Shipping line's "Zhonghai Busan" vessel loaded and unloaded in Beilun second container terminal which is belong to Ningbo port and complete the 2500TEU loading and unloading operations, Ningbo Port cargo throughput exceeded 900 million tons in 2016, which make it become the world's first port that cargo throughput over 900 million tons. Moreover, Ningbo port have made a cooperation with Maersk and its 2M Alliance. These differences between Shanghai port and Ningbo port show different development of these two ports and actually they have much competition in these aspects.

4.1.2Behaivior of port competition and cooperation between Shanghai and Ningbo

The competition between Shanghai port and Ningbo Port starts long time ago. These competition is not only about the goal of status, but also about the construction of infrastructure and equipment, or even about hinterland resources.

As we all known, Shanghai port's target is to be international hub port and international shipping centre. While Ningbo port also plans to build the international first-class deep-water hub port. In this aspect, these two ports have similar objective. To achieve these goals, Ningbo port combined with Zhoushan port which is also a big port near Ningbo port in Zhejiang province and establish a bigger port called 'Ningbo-Zhoushan port'. Besides this, expanded Ningbo port used its natural surroundings to build deep-water port in order to serve larger and larger vessels who have high acquirement of draught. Facing with the pressure, Shanghai port open up a new terminal, Yangshan deep-water terminal, which can berth over 15 meters deep vessels. Facts have proved that after Yangshan deep-water terminal being constructed and put into operation, Shanghai port developed rapidly. However, Shanghai port is not good at sea-rail transportation. While Ningbo port focus on sea-rail transport development. That's benefit from Ningbo as an important hub station in Chinese railway network. Not only Xiaoyong railway, but also Yongjin railway can help Ningbo port distribute the cargo from all around the world. Added to the building of high-speed rail in recent years, Ningbo port can easily distribute its large amount of cargo in and out of China or transport to inland. In order to cover the defect, Shanghai port depend on the golden watercourse, 'Yangtze River', to enhance its distribution ability and get its large amount of supply of cargo. In all, the competition between Shanghai port and Ningbo port are continuous and explosive.

4.2 Competitiveness analysis compared between Shanghai and Ningbo ports

4.2.1 Theory of port competitiveness

4.2.1.1 The definition of port competitiveness

Port competitiveness, as the name shows, is the ability to compete between ports, specifically, is the ability to compete between port enterprises. Now the port business has two properties. The first property is to make profit by management like other enterprises; the second property is that the port has huge impacts on the national economy, so the port enterprises have sociality. It means that the port not only needs to meet their own profits, at the same time, it also has the obligation to promote national economic growth. The port should have the ability to drive the regional economy and the development of the industry near the port. Based on these two aspects of the property, the port competitiveness in fact includes two aspects. The first is the competitiveness of the port economy, that is, the profitability of port enterprises. Second, the sociality competition in the port, that is to say, the competition that port's ability to promote the national economy. When evaluating port competitiveness, it usually only measures the first aspect.

4.2.1.2 The aspects to affect port competitiveness

Based on the dual properties of port enterprises, the factors that affect port competitiveness should also be divided into economic competitive factors and social competitive factors. As far as economic competitiveness is concerned, Foster puts forward routes, flights, port density and service conditions as the main factors affecting competitiveness; By studying the reasons for the high throughput of Hongkong port and Kaohsiung port, Haynes finds that efficiency is the key factor of port competitiveness. Other angles, such as the user's point of view and the enterprise's point of view, are also the direction of evaluating port competitiveness. So on the basis of the study of all scholars, this dissertation puts forward the following three factors:

• Factors of production in ports

It mainly includes the natural condition, infrastructure level and capital operation ability of the port. With the large scale of ships and the deepening of berth depth, natural conditions become an important factor affecting the development of a port. Whether there is sufficient wharf length and the deepwater channel that meets the ship's entrance and departure has a bearing on the future development of a port. The level of infrastructure in a port is related to the capacity of the port to hold goods and ships, and the efficiency of its operation. The capacity of port capital operation is mainly used to evaluate whether a port has sufficient liquidity to meet the daily expenses. Among these factors, the natural condition and infrastructure level are quantitative factors, which can be quantitatively compared by the number of berths and yard area, but the capacity of capital operation cannot be quantitatively compared.

Table 1-Factors of port production

Quantitative factors	Qualitative factors
natural condition Infrastructure level	- Capital operation capability

• Port management ability

The management ability of port mainly includes the throughput of port, the efficiency of port handling and the quality of port service. Port throughput is undoubtedly the most important factor to evaluate the strength of a port, and it is also the most important embodiment of the port strength. The efficiency of port loading and unloading is the main factor that affects the ship company's affiliation, so the shipping company will choose the port with high efficiency to shorten the berthing time and shorten the whole voyage time. The service quality of port mainly includes the degree of congestion in port and the complexity of handling the berthing procedure. It is closely related to customer satisfaction. Among them, the port throughput and handling efficiency can be quantitatively compared, and the quality of port service can only be qualitatively

measured.

Table 2- Port management capability

Quantitative factors	Qualitative factors
Throughput Handling efficiency	- Service quality

• port demand conditions

The port demand refers to the economic strength of the hinterland, port distribution ability and number of routes. A port has developed the economic strength of the hinterland, then the import and export trade will increase, and indirectly increase the cargo supply. A high-competitive port is bound to be a busy port and needs a large amount of cargo supply to support. Among them, the economic strength of the hinterland and the number of routes can be compared quantitatively, distribution ability cannot be quantitative measured.

Table 3- port demand conditions

Quantitative factors	Qualitative factors
economic strength of the hinterland number of routes	- distribution ability

4.2.2 Selection of model

There are several ways to evaluate port competitiveness. Here compare some common ways and select the most suitable way for this dissertation.

4.2.2.1 AHP (analytic hierarchy process)

The analytic hierarchy process (AHP) divides the factors into several levels, compares each element at each level, and finally determines a sort of research method based on the weight. Compared with other evaluation methods, AHP has the advantage of relatively simple, no need to build complex models. The optimal scheme is dependent on the selection of weights, and the problem is that the weight is usually subjective, so the

method is not objective and not convincing enough.

4.2.2.2 FCE (Fuzzy Comprehensive Evaluation)

The fuzzy comprehensive evaluation method constructs some fuzzy sets to quantify some indexes which are not easily quantified. These indicators, which can only be qualitatively compared, can be quantitatively compared. The advantage of this approach is that it makes up for deficiencies. In other research methods it cannot be compared with qualitative indicators. However, although the method is quantitative, it is not real enough to evaluate the data accurately compared with the original quantitative index

4.2.2.3 ERA (evdential reasoning approach)

ERA first compares all the data directly, and then transforms the data under the premise of ensuring the data is not distorted. Finally, the final evaluation result is obtained by function. ERA mainly has the following two advantages: (1) the data requirements are simple, without standardized processing; (2) it can reduce the subjectivity of the evaluation results.

4.2.2.4 Entropy TOPSIS method

Compared with other evaluation methods, the entropy TOPSIS method is easier to understand, and it does not need too large sample size. So it can avoid the problem that the data cannot be found. Moreover, this method perfectly solves the problem that the weights in analytic hierarchy process cannot be determined.

4.2.2.5 BP neural network evaluation method

The evaluation method of BP neural network is mainly constructed by neural network model, and needs to be calculated by neural network toolbox, which is a theoretical mathematical model imitating the human brain. The shortcoming of this method is that

the neural network is very complex and has strong nonlinearity, so it is not easy to understand and operate.

4.2.2.6 Factor analysis method

Factor analysis is to simplify a large number of data processing, the ultimate goal is to find a number of core indicators in the original large number of indicators. And through the comparison of these indicators, the competitiveness of the port strength can be found. The advantage of this method is that it can avoid the interference caused by a large number of useless indicators, and can find the most essential factors through the phenomenon.

Table 4- Comparison of various evaluation methods

	AHP	FCE	ERA	entropy TOPSIS method	BP neural network evaluation method	Factor analysis method
Objective evaluation			√	√	√	√
Can handle multiple problems		√		√	√	√
The main influencing factors can be found						√
Easy calculation	√		√	√		√
Simple model	√		√			√
No large amount of data is needed	√			√		

Through the observation Table 4, we can find that amond the various competitiveness evaluation methods, the factor analysis method does not need a large amount of data which item does not have advantages, and all other projects meet the requirements of the competitiveness evaluation of this dissertation. In particular, considering the item of "can find the most important factor in the competitiveness of", other methods are not satisfied. When evaluating the port competitiveness of Shanghai port and Ningbo port, this dissertation hopes to find out which or which main factors affect the competitiveness of the port. So that it can be considered if it is related with shipping

alliances' influence. And for the need for a large amount of data, although the factor analysis needs to collect more data, but fortunately all data can be more convenient to find. Based on the above analysis, this dissertation chooses factor analysis as the evaluation method of the two port competitiveness.

Factor analysis usually has four steps to analyze:

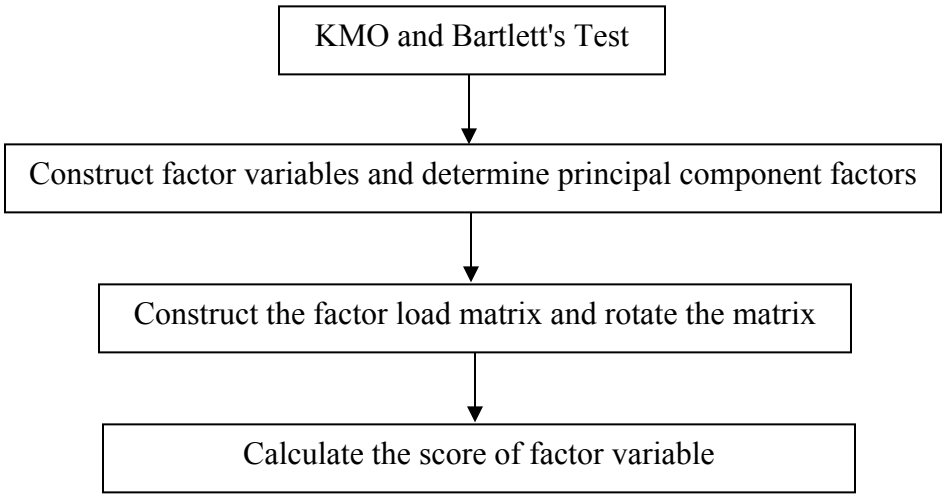

Figure 2- Factor analysis procedure

4.2.3 Operation on the model

In order to compare the competitiveness of Shanghai and Ningbo ports, I use SPASS23.0 to do the operation of factor analysis. For the KMO and Bartlett test of sphericity, it required that the selected variables should be less than the number of indicators that parameters. That is to say, compared indicators need to be less than the number of ports. And in order to achieve this goal, this dissertation has taken the following measures:

(1) Dividing the 18 factors into 3 groups, i.m. production factors, management capabilities and demand conditions.
(2) Selecting Dalian Port, Tianjin port, Qingdao port, Suzhou port, Guangzhou port and Shenzhen port to be compared with Shanghai port and Ningbo port.

Table 5-Port raw data[6]

Ports / Indicators	X	Shanghai port	Ningbo port	Dalian port	Tianjin port	Qingdao port	Suzhou port	Guangzhou port	Shenzhen port
I. Factor of production index									
Ten thousand ton berths for production	X_1	156.0	150.0	98.0	107.0	32.0	61.0	69.0	67.0
Number of container berths	X_2	43.0	34.0	14.0	17.0	21.0	23.0	23.0	44.0
Length of wharf for production/thousand m	X_3	75.1	80.1	38.7	36.0	25.8	31.7	47.0	31.4
Port yard area/sq km	X_4	220.2	138.4	253.0	197.5	232.4	148.9	215.0	220.8
Water depth of main channel of port/m	X_5	15.0	20.0	17.5	17.0	15.5	12.0	14.4	14.5
Number of container bridge cranes	X_6	155.0	137.0	58.0	67.0	89.0	40.0	92.0	120.0
II. Management capability index									
Annual cargo throughput/hundred million tons	X_7	7.6	8.7	3.5	5.4	4.7	4.8	5.0	2.2
Annual cargo throughput growth rate/%	X_8	-2.6	6.9	3.5	5.0	8.6	6.8	4.0	-4.6
Container throughput per year/ten thousand TEU	X_9	3528.5	1945.0	1001.0	1406.0	1658.0	445.0	1663.0	2441.0
Annual growth rate of container throughput %	X_{10}	5.0	1.2	1.0	8.1	7.0	2.9	7.2	3.3
Annual throughput of foreign trade goods /hundred million	X_{11}	3.8	4.2	1.2	2.9	3.1	1.2	1.2	1.8
Annual throughput growth rate of foreign trade goods/%	X_{12}	1.4	9.0	6.8	10.3	8.6	12.6	5.6	1.2
The number of standard	X_{13}	2.4	2.7	3.3	2.9	12.5	5.0	1.2	2.8

[6] Data resources: People's Republic of China's official the National Bureau of Statistics website, Chinese ports Yearbook (2016), Shanghai international port group's official official website, the Ningbo Port Co official network, Chinese ports website, Shanghai, Dalian, Tianjin , Suzhou 2016 statistical bulletin 2015 statistical bulletin, Tianjin Port Group Co. Ltd. Website, etc.

heavy boxes for handling per thousand yuan									
Loading and unloading efficiency of container ships（Unit/a ship an hour）	X_{14}	118.5	122.5	112.7	127.8	131.5	105.0	125.0	110.2
III. Demand condition index									
Number of ports and routes	X_{15}	296.0	235.0	105.0	120.0	155.0	180.0	123.0	219.0
Port city GDP (100 million yuan)	X_{16}	24965.0	9105.5	7731.6	16538.2	9300.1	14504.1	18100.4	17503.0
Port city second industry output value (100 million yuan)	X_{17}	8167.7	4480.4	3697.8	7731.9	3890.4	4834.9	5591.0	6812.0
Import and export volume of ports (US $100 million)	X_{18}	4666.2	1347.0	657.7	1608.5	798.9	2710.9	1305.9	4877.7

Since the original data units are different, standardized processing should be taken as follows:

Calculate the mathematical expectation of each port's original data in each index, then using STDEVPA formula which is easiest way to do the standardization to calculate the standard deviation of each port's original data in each index. Finally, use this formulas as follows:

$$x' = (x_i - \overline{x})/s \quad (1)$$

to normalize the raw data.

Table 6- Data after normalization

Port / Indicators	X	Shanghai port	Ningbo port	Dalian port	Tianjin port	Qingdao port	Suzhou port	Guangzhou port	Shenzhen port
I. Factor of production index									
Ten thousand ton berths for production	X_1	1.550	1.403	0.134	0.354	-1.476	-0.769	-0.573	-0.622
Number of container berths	X_2	1.449	0.614	-1.241	-0.962	-0.591	-0.406	-0.406	1.542
Length of wharf for production/thousand m	X_3	1.519	1.780	-0.362	-0.506	-1.029	-0.724	0.064	-0.742
Port yard area/sq km	X_4	0.451	-1.730	1.326	-0.154	0.777	-1.450	0.313	0.467
Water depth of main channel of port/m	X_5	-0.327	1.888	0.781	0.559	-0.105	-1.656	-0.593	-0.548
Number of container cranes	X_6	1.609	1.129	-0.982	-0.741	-0.154	-1.463	-0.073	0.674
II. Management capability index									
Annual cargo throughput/hundred million tons	X_7	1.191	1.799	-0.893	0.085	-0.286	-0.234	-0.116	-1.546
Annual cargo throughput growth rate/%	X_8	-1.454	0.538	0.083	0.538	1.051	0.899	0.178	-1.832
Container throughput per year/ten thousand TEU	X_9	2.028	0.211	-0.872	-0.407	-0.118	-1.510	-0.112	0.780
Annual growth rate of container throughput %	X_{10}	0.205	-1.257	-1.334	1.398	0.975	-0.587	1.064	-0.464
Annual throughput of foreign trade goods /hundred million	X_{11}	1.208	1.530	-1.092	0.406	0.580	-1.049	-1.066	-0.517
Annual throughput growth rate of foreign trade goods/%	X_{12}	-1.456	0.543	-0.036	0.885	0.438	1.490	-0.359	-1.504
The number of standard	X_1	-0.521	-0.416	-0.226	-0.369	2.525	0.274	-0.874	-0.393

heavy boxes for handling per thousand yuan	$_3$								
Loading and unloading efficiency of container ships（UNIT/a ship an hour）	X_{14}	-0.075	0.385	-0.748	1.005	1.432	-1.640	0.678	-1.037
III. Demand condition index									
Number of ports and routes	X_{15}	1.875	0.896	-1.189	-0.948	-0.387	0.014	-0.900	0.640
Port city GDP (100 million yuan)	X_{16}	1.882	-1.031	-1.283	0.334	-0.995	-0.039	0.621	0.511
Port city second industry output value (100 million yuan)	X_{17}	1.555	-0.723	-1.206	1.286	-1.087	-0.504	-0.037	0.717
Import and export volume of ports (US $100 million)	X_{18}	1.541	-0.573	-1.012	-0.407	-0.922	0.296	-0.599	1.676

4.2.3.1 Shanghai port and Ningbo port production factor competitiveness evaluation

Table 7- KMO and Bartlett's Test（After modification）

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.672
Bartlett's Test of Sphericity	Approx. Chi-Square	13.5911
	df	6
	Sig.	.035

After deleting two interference term: number of berth over 10 thousand class, which is similar to container berth number; The yard area of the port, which cannot actually reflect the capabilities of the port. Then the index can meet requirements.

Table 8- Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.835	70.886	70.886	2.835	70.886	70.886
2	.715	17.869	88.755			
3	.370	9.239	97.994			
4	.080	2.006	100.000			

From this table, the eigenvalues over 1 can be used as principal component factors: Length of wharf for production.

Table 9- Rotated Component Matrixa

	Component
	1
Length of wharf for production X3	.949
Ten thousand ton berths for production X1	.922
Number of container cranesX6	.790
Water depth of main channel of portX5	.679

Since there is only one principal component factor, the principal component matrix does not need to be rotated. From this component matrix, it can be found that the public factor has a higher load on the length of production terminals and 10000 ton berths for production, so these two indexes are the most important factors affecting the port production factors.

Using this formula:

‘Total score = principal component factor 1’s score * variance contribution rate of principal component factor 1+.....+Principal component factor n’s score * variance contribution rate of principal component factor n (2)

we can get the following score table by SPASS 23.0.

Table 10-Scores in all ports

Ports	$FAC_{1\text{-}1}$	FAC_1	Rank
Shanghai port	1.29307	0.9166056	2
Ningbo port	1.70106	1.205813392	1
Dalian port	-0.15349	-0.108802921	4
Tianjin port	-0.11859	-0.084063707	3
Qingdao port	-0.83441	-0.591479873	7
Suzhou port	-1.21281	-0.859712497	8
Guangzhou port	-0.30637	-0.217173438	5
Shenzhen port	-0.36845	-0.261179467	6

As can be seen from table 10, the Ningbo port transcend over the Shanghai port.

4.2.3.2 Shanghai port and Ningbo port management ability competitiveness evaluation

Table 11- KMO and Bartlett's Test（After modification）

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.664
Bartlett's Test of Sphericity	Approx. Chi-Square	18.438
	df	10
	Sig.	.048

After deleting Annual cargo throughput growth rate, The number of standard heavy boxes for handling per thousand yuan and loading and unloading efficiency of container ships these three index, the KMO and Bartlett's Test can pass.

Table 12- Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.619	52.383	52.383	2.619	52.383	52.383	2.367	47.331	47.331
2	1.928	38.565	90.948	1.928	38.565	90.948	2.181	43.617	90.948
3	.179	3.576	94.524						
4	.155	3.106	97.630						
5	.118	2.370	100.000						

There are two eigenvalues in table12 bigger than 1, so there are two principal component factors, and the cumulative contribution rate of these two factors is 91%.

Table 13- Rotated Component Matrixa

	Component	
	1	2
Annual throughput growth rate of foreign trade goods(%)X12	.945	
Annual cargo throughput growth rate （%）X8	.941	
Annual throughput of foreign trade goods /hundred million X11		.936
Annual cargo throughput/hundred million tons X7		.809
Container throughput per year/ten thousand TEU X9		.788

As can be seen from table 13, the first principal component factor has a higher load factor on the annual growth rate of foreign trade goods and the annual cargo throughput growth rate. So the two principal component factor can be named as the growth rate. The second principal component factors have high load in annual foreign cargo throughput, annual cargo throughput and annual container throughput, so it can be named as throughput.

The variance contribution rate of principal component factor 1 was 52%, and the variance contribution rate of principal component factor 2 was 39%. The score of the two factor is worked out by SPSS23.0.

Table 14- Scores in all ports

ports	$FAC_{2\text{-}1}$	$FAC_{2\text{-}2}$	FAC_2	Rank
Shanghai port	-0.36925	1.63524	0.445734	2
Ningbo port	0.63354	1.27199	0.825517	1
Dalian port	-0.09516	-1.05235	-0.4599	7
Tianjin port	0.50183	0.02027	0.268857	4
Qingdao port	0.5243	0.09623	0.310166	3
Suzhou port	1.19249	-1.0964	0.192499	5
Guangzhou port	-0.28455	-0.49246	-0.34003	6
Shenzhen port	-2.10321	-0.38251	-1.24285	8

As can be seen from Table 14, Shanghai port falls behind Ningbo port, but they are both in leading role.

4.2.3.3 Shanghai port and Ningbo port demand condition competitiveness evaluation

Table 15-KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.712
Bartlett's Test of Sphericity	Approx. Chi-Square	15.652
	df	6
	Sig.	.016

These index are all suitable for factor analysis, and the KMO and Bartlett sphericity tests are perfect.

Table 16- Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.018	75.441	75.441	3.018	75.441	75.441
2	.703	17.575	93.016			
3	.172	4.290	97.306			
4	.108	2.694	100.000			

Only one eigenvalue in table 16 is greater than 1, so there is only one principal component factor.

Table 17- Component Matrix[a]

	Component
	1
Import and export volume of ports (US $100 million) X18	.922
Port city GDP (100 million yuan) X16	.915
Port city second industry output value (100 million yuan) X17	.878
Number of ports and routesX15	.748

Since there is only one principal component factor, there is no need to rotate. Table 17 shows that the public factor has a higher load on the import and export volume of the port and the GDP of the city where the port is located, so the two factors are the most important factor affecting the port demand condition.

Table 18-Scores in all ports

ports	$FAC_{3\text{-}1}$	FAC_3	Rank
Shanghai port	1.83205	1.381366	1
Ningbo port	-0.44504	-0.33556	6
Dalian port	-1.25722	-0.94794	8
Tianjin port	0.10864	0.081915	3
Qingdao port	-0.93146	-0.70232	7
Suzhou port	-0.06059	-0.04568	4
Guangzhou port	-0.21391	-0.16129	5
Shenzhen port	0.96752	0.72951	2

In this part, shanghai port is better than Ningbo port. But Ningbo port's rank is a little bit backward.

4.2.3.3 Shanghai port and Ningbo port comprehensive competitiveness evaluation

Table 19- Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.532	51.059	51.059	1.532	51.059	51.059	1.422	47.401	47.401
2	1.078	35.938	86.997	1.078	35.938	86.997	1.188	39.595	86.997
3	.390	13.003	100.000						

These two factors whose characteristic value is greater than 1 are Principal component factor. Their contribution rate was 51% and 36% respectively.

Table 20- Component Matrixa

	Component	
	1	2
FAC2	.916	
FAC1	.764	
FAC3		.959

Table 20 shows that the factors of production and management ability can be classified as the first principal component factor, and the demand condition is the second principal component factor.

Table 21-Comprehensive scores of ports

ports	$FAC_{综-1}$	$FAC_{综-2}$	$FAC_{综}$	Rank
Shanghai port	0.88027	1.75964	1.082408	1
Ningbo port	1.75472	-0.14376	0.843154	2
Dalian port	-0.40406	-0.90443	-0.53167	8
Tianjin port	0.20971	-0.05775	0.086162	3
Qingdao port	0.02691	-1.16976	-0.40739	7
Suzhou port	-0.3881	-0.52593	-0.38727	6
Guangzhou port	-0.48052	-0.14	-0.29547	4
Shenzhen port	-1.59893	1.182	-0.38993	5

As can be seen in table 21, after considering three aspects, the port competitiveness is ranked as Shanghai port, Ningbo port, Tianjin port, Guangzhou port, Shenzhen port, Suzhou port, Qingdao port, and Dalian Port.

4.2.4 Outcome analysis

Table 22- Score of Shanghai and Ningbo port

evaluating indicator	Shanghai port	Ningbo port
Port production factors FAC_1	0.916606	1.20581
FAC_{1-1}	1.29307	1.70106
Port management ability FAC_2	0.445734	0.825517
FAC_{2-1}	-0.36925	0.63354
FAC_{2-2}	1.63524	1.27199
Port demand condition FAC3	1.381366	-0.33556
FAC_{3-1}	1.83205	-0.44504
$FAC_{comprehensive}$	1.082408	0.843154

$FAC_{comprehensive-1}$	0.88027	1.75472
$FAC_{comprehensive-2}$	1.75964	-0.14376

Through table 22, it can be found that considering the comprehensive competitiveness, Shanghai port is stronger than Ningbo port.

In the aspect of production factors, Shanghai port is inferior to Ningbo port. The reason is related to the two port indexes of Shanghai port have been deleted, they are the yard area and the number of container berth. In addition, due to only Guandong and Shengdong terminal in Yangshan are harbor wharf, other terminals are inland port through Yangtze River. So the index of main channel depth is less than Ningbo port.

In terms of management capabilities, Shanghai port is still inferior to Ningbo port. The reason is that Ningbo port is the world's largest cargo throughput and foreign trade cargo handling port, while in Shanghai port, only container throughput index is leading. In addition, the Ningbo port has developed rapidly after the merger with Zhoushan port, which can be seen from the growth rate of throughput in recent years.

In terms of demand conditions, Shanghai port is far ahead of Ningbo port. This mainly depends on the strong hinterland economic strength of Shanghai port. In the case of GDP in the port city, Shanghai is almost three times the size of the two cities of Ningbo and Zhoushan. The strong hinterland economy has stimulated the demand for goods transportation, so in this respect, Shanghai port wins the Ningbo port.

Judging from the final scoring results, the competitiveness of Shanghai port is better than that of Ningbo port, but the two port has its own advantages and disadvantages in different aspects.

4.3 Analysis of competition and cooperation of Shanghai and Ningbo ports

4.3.1 Competition between Shanghai and Ningbo ports

Through the comparison of the fourth chapter, the dissertation finds that Shanghai port and Ningbo Zhoushan port are not only near geographically, but also similar to many other indexes, such as number of container handling bridge, loading and unloading efficiency of container ships, number of routes opened, even the annual cargo throughput is almost the same. Because there are so many similarities, the shipping alliance will inevitably consider which port is more worth berthing, or analyze the order of its affiliation when choosing the port of call. In order to obtain a large number of container resources brought by the shipping alliance, there must be various competitions between the two ports.

According to the actual situation, we can get the following four aspects of competition:

4.3.1.1Number of routes and liners

Having multiple routes around the world is a necessary factor for a mega port, while a dense course and a large number of liners are the guarantee that the goods will arrive at the destination on time. With the larger-size vessel trend, relying on the Yangshan deep-water port to attract the shipping of large liner companies, Shanghai port has opened about 300 routes. While Ningbo port who relies on natural deep water condition and low disbursement, also attracted large liner company to berth, that already opened more than 200 routes all over the world at present. In order to meet the needs of shipping alliance for better, faster and cheaper delivery, the number of ports and the number of liners in the port of two are very competitive.

4.3.1.2Port infrastructure

The infrastructure of the port includes many aspects, like the number of berths, the number of port machinery and the yard area. The more berths there are, the shorter the length of stay in the anchorage after the ship arrives at the port, and the shipping company certainly does not want to spend precious time waiting for berthing. The more

the port machinery, including the loading and unloading machinery, the horizontal transport machinery and the yard machinery, the faster the port will operate. The larger the yard area, the more containers or goods can be placed, which can alleviate the saturation of the port. Shanghai port and Ningbo port has invested a lot of money and manpower in port infrastructure construction, especially in the construction of 10000 ton berths on. In order to meet the requirements of large-scale ships, the competition between the two ports is very fierce.

4.3.1.3 Deepwater resources

The port of Shanghai originally had no harbour, and the main port was situated at Waigaoqiao, mainly a estuary port. In order to build Shanghai as an international shipping center, the State Council approved the scheme of Shanghai to build the Yangshan deep-water port, which was originally a part of Zhejiang Province, which can fill the shortage of water depth in its harbor part. Although the Ningbo harbor has the natural water depth superiority, but still unceasingly seeks the new deepwater port area for the future development. Especially in this Shipping alliance prevail times, one of the most important signs is the large scale of ships trend. Deepwater resources have become an important advantage in attracting alliances to choose. The two port now are in the continuous development of new deep-water coastline. Shanghai port is still in progress of developing the new automatization terminal. While Ningbo port added the Baiquan terminal in 2015, and it also has the longest undeveloped deepwater coastline in china.

Besides these aspects about shipping alliance's choice, other competition are always exist all the time. For example, because of the close geographical position, the most important competition between the two ports is undoubtedly the competition in the economic hinterland. The main hinterland of Shanghai port is the Yangtze River Delta and the mainland along the Yangtze River, including Wuhan, Chongqing and other cities. The hinterland of Ningbo port contains a part of the Yangtze River Delta and a

small part of Fujian province. It can be seen that the two major ports are very dependent on the Yangtze River Delta's supply support. In order to attract the supply of goods in the Yangtze River Delta region, the two ports are bound to introduce a series of policies to attract goods.

While excessive competition in these two ports can lead to many bad results. The major is waste of resources because of port construction which is too frequent. In order to expand the port to a larger and stronger direction, it is understandable to seek and build a new port area. However, in the background of so close geographical location of Shanghai port and Ningbo port, shanghai port changed to be a harbor which used to be aestuary port, spent huge sums to build the Donghai Bridge, built two big container terminal named Guandong and Shengdong in Yangshan port and it still in the construction of new unmanned automated terminal. And in 2015, Zhejiang province finally completed the merger of Ningbo port and Zhoushan port, and with the support of the State Council, it established the positioning of Zhoushan international logistics Island. It will unescapablely spend a lot of manpower and financial resources to develop the Zhoushan islands in the future. However, when today the shipping industry is not booming, and even Shanghai port experienced the decline in cargo throughput for two consecutive years. In this context, these two ports still spend much money on expansion their port construction in order to improve the port competitiveness, that is a waste of resources. What’s more, it can be forecasted that in 2020, these two ports’ design capacity will greatly exceed the demand. By then, even without competition between these two ports, there is also much waste of resources. It's very unfavorable for both sides.

Another one is depressing port charge which will cause a vicious circle. In order to obtain more goods, and to occupy a larger market share, Shanghai port and Ningbo port make price war by reducing port costs to obtain goods and increase throughput. As a result, the profits of the two major ports have been reduced, resulting in adverse cash

flow and affecting normal operating expenses. Thus it will reduce the quality of service in the port, so that customer satisfaction will decline. At this time, the port who would like to attract goods has to decline the prices again and compress profit margins. In the long run, there is a vicious circle, which is obviously not conducive to the long-term development of the port.

4.3.2Cooperation between Shanghai and Ningbo ports

Although the two ports are now in the stage of intense competition, in order to attract large supply by making price war, the port city also invested heavily in supporting port development, which leads to waste of resources. But first of all, based on the premise that the Yangtze River Delta region has sufficient supply of goods, the cooperation between the two ports is the basis. Secondly, port group does not exist only in the Yangtze River Delta in our country, Pearl River Delta and Circum-Bohai-Sea have big port groups, and there also some port groups in other nearby countries like Japan and so on. So Shanghai port and Ningbo port should unite together to fight with other ports competition. Finally, both of two ports have their own strength. Shanghai port's advantage is strong economic strength, the hinterland of the construction of Shanghai international shipping center and policy support. While Ningbo port's advantage lies in its natural water conditions and long port undeveloped shoreline resources, two ports has reason to learn from each other, and develop together.

4.4 Suggestions on competition and cooperation of Shanghai and Ningbo ports

The principle of competition and cooperation between Shanghai port and Ningbo port shall be as follows:

(1)Competition and cooperation between the two ports will exist for a long time and it cannot be avoided. There is no contradiction between them. It should not deliberately avoid cooperation between the two ports and even hostile to each other just because of fierce competition.

(2)The cooperation between Shanghai port and Ningbo port should be mainly reflected in the construction of transportation. But the competition in the supply of goods is still more intense which cannot be eliminated, we must have correctly view.

(3)Shanghai port and Ningbo port should have the correct orientation, a clear division of labor, and give full play to their respective advantages of the port.

(4)In order to achieve the cooperation between the two ports, it is necessary to set up corresponding organizations and formulate relevant cooperation rules, and the two ports must strictly abide by the consensus reached.

And double hub strategy &differential development are the recommendable mode of competition and cooperation at present:

Considering that after the change of shipping alliance, due to the new shipping alliance line adjustment, resulting in some goods need to dock at the front of the box reloading; with the volume of unloading in Shanghai port is increasing continuously that cause yard space looks insufficient; Yangshan Harbor Road traffic efficiency is restricted by its single limitation; Fog is frequent these days. Shanghai port's congestion problem is serious, especially in Yangshan port. As the nearest large deep-water port of Shanghai port, Ningbo port should exist as an ally of two hub ports, and ought to help Shanghai harbor to bear part of the loading and unloading pressure. Especially with rail transport and sea transport advantages of Beilun port which is belong to Ningbo port, Shanghai

port can solve transportation pressure faster. The Ningbo port can be used as outer and auxiliary port of Shanghai port, which is used to make up some of the deficiencies and weaknesses of Shanghai port. It also can improve the container throughput of Ningbo port itself as well as achieve a win-win situation that makes the construction of one of the most important hub port group in the world.

The homogenization of competition is bound to form a vicious cycle in continuously decline prices and self-destructive development, which affecting the long-term development of both sides. Shanghai port should focus on the construction of Shanghai international shipping center, improve the port throughput capacity and distribution capacity, do some innovation by using information systems and customs cooperation, and improve the efficiency of loading and unloading to keep the container throughput in the first position in the world. While Ningbo port should fit into one of the construction of Shanghai port, Shanghai international shipping center double hub port; make full use of their own deep water conditions and rich coastal resources advantages to attract large ship handling, so that make the throughput continues to maintain a rapid growth rate, and firmly occupy the throne of the world's first cargo throughput.

Chapter 5 Conclusions

5.1Main findings and suggestions

Because of the depression of the world economy and the prevailingness of big vessel strategy which can obtain the economies of scale, in recent years the big liner companies all over the world choose to make shipping alliances and cooperate by sharing space, building ship operations center, sharing information and joint procurement etc. Until now, there are three big shipping alliances which includes most of the shipping companies in the top 20 liner capacity in the world. With the development of shipping alliance, great changes have taken place in the world shipping pattern. And this phenomenon made some effect on the development of ports in the world.

Many new policies and habits in shipping industry begin to be formed. For example, as the 2M and O3 Alliance abandoned transit port in the early 2015, the practice of direct sailing to discharging ports became more prevalent. According to the relevant institutions statistics, after the establishment of2M and O3 Alliance, the number of direct ports are more than that Maersk and MSC who now are the members of 2M Alliance can be achieved separately. Not only that, recently Ocean Alliance also plans to distribute goods in the form of a "special ship terminal" in the Trans-Pacific route market to increase the punctuality. This change will reconstruct the port network pattern. Under the large shipping alliance, the negotiating position of many ports will decline and be in

a disadvantageous position.

On the other hand, in the case of no significant increase in the volume of containers, the large-scale trend of ships and the operation of alliances will also lead to a decrease in the number of ships in main lines. The number and frequency of the ship's anchored port will decline as a whole, and the container terminal hub will show the trend of centralization, so as to simplify the port network and reduce the transportation cost. Due to the reduction of hub ports in the region, the competition of hub ports in the region will become increasingly fierce, and the status and functions of the hubs will be more and more concentrated to a few ports. At the same time, it will also promote the rapid development of regional transport and enable the feeder ports to usher in an opportunity for rapid development. In the background of the fierce competition lead by shipping alliance, feeder ports need more mutual cooperation, so as to promote the distribution ability between hub and feeder port to extended to a regional transport development.

Facing with the fierce competition from shipping alliance, if the port enterprise blindly give in to the shipping alliances and suppress opponents through the price war, or through the sacrifice of the interests of the port to obtain liner company affiliated, in the long run, it not only will gradually lose their right to negotiate with liner companies, but also it will affect the profitability and core competitiveness of port enterprises, and restrict the development and expansion of ports. In order to cope with the strong impact of the shipping alliance, the Port Alliance came into being. Port enterprises make agreement together and obtain greater economic benefits by common management, risk sharing, coordinated operation price, developing regional port strategic objectives, reasonable division of ports, making full use of resources, gradually reduce the cost finally. At the same time, the port gradually formed a mutual help, mutual benefit, complementary good relationship and positive pattern of win-win cooperation, so as to enhance the international competitiveness of port enterprises. Even the nearby port like Shanghai port and Ningbo port can make double-hub port strategy to facing several

problem shipping alliances bring, like congestion problem, loading and unloading efficiency problem. Or trying to get a preference from different shipping alliances by their different absolute or comparative advantages should be a willing. So the ports should form a reasonable new competition and cooperation mode. Also, in addition to considering the operation situation, shipping alliances selecting the terminal will also consider the rapid multi-model transport ability to distribute large quantities of containers to hinterland transit warehouse. So only focusing on infrastructure construction and price war cannot achieve long term development. Differentiation competition and cooperation is significant for building future shipping pattern.

5.2Possible future extensions

Because of some restrict, I do not make necessity and feasibility analysis of port alliance. I only compare the competitiveness between Shanghai port and Ningbo port in order to provide some suggestions for differentiation development in these two ports. If possible, making cooperative simulation model can better show the outcome of port cooperation in shipping alliance era. What's more, the choice of ports by the shipping alliances is manifold. If I can get more materials from shipping alliance to know the reason about why they choose or not choose a specific port, it will help advice for the port's competition and cooperation better. Moreover, comparing another nearly ports in other countries with the case of shanghai and Ningbo port can indicate more problems of competition and cooperation in different background. That will be more comprehensive.

References

Barry, Z., Pietro, B., Padideh G & Gerard de, J.(2010), Port competition modeling including maritime, port, and hinterland characteristics, *Maritime Policy & Managemen*t. 37(3),179–194.

Brian, S., Claude, C. & Robert, M. (2010), Strategic alliances in the container shipping industry: a global perspective, *Maritime Policy & Management, 29(1)*, 65-76.

Changli, L., Chuanxu, W. (2007), Comparative advantage analysis and competitive cooperation strategy of China's ports，*Enterprise Economy, 12,*64-66.

Christopher, M., Yong-An, P., Young-Tae, C., Chang-Ho, Y., Tae-Woo, L. & Meifeng Luo(2008), A game-theoretic analysis of competition among container port hubs: the case of Busan and Shanghai, *Maritime Policy & Management, 35(1),*.5–26.

D. K. Ryoo & H. A. Thanopoulou(2010), Liner alliances in the globalization era: a strategic tool for Asian container carriers, *Maritime Policy & Management, 26,* NO. 4, 349- 367.

Douglas K. F. & Alfred J. B.(2010), Comment Some reflections on port competition in the United States and western Europe, *Maritime Policy &Management, 26(4),*383-394.

Dong-Wook, S.(2010), Port co-opetition in concept and practice, *Maritime Policy & Management, 30(1),*29–44.

Hiroshi, H.(2010), "Competition and Collaboration among Container Ports", *The Asian Journal of Shipping and Logistics, 26(1)*, 031-048.

Jasmine Siu L- L.& Wei Yim, Y.(2008), Competition for transhipment containers by major ports in Southeast Asia: slot capacity analysis，*Maritime Policy & Management*，*35(1),*89–101.

Jia-bin L7.& Yong-sik O.(2010), A Research on Competition and Cooperation Between Shanghai Port and Ningbo-Zhoushan Port, *The Asian Journal of Shipping and Logistics, 26(1),*67-92.

Jianhua, X (2014), How does the port respond to the challenge of the shipping company's Super League? Retrieved May 19, 2014 from the World Wide Web: http://www.ship.sh/column_article.php?id=1664

Kevin, C., Yahui, T. & Teng-Fei, W.(2006), Port competition between Shanghai and Ningbo, *Maritime Policy & Management, 32(4),*331–346.

Kun, W., Adolf K.Y-N., Jasmine Siu Lee, L. & Xiaowen, F.(2012), Cooperation or competition? Factors and conditions affecting regional port governance in South China, *Maritime Economics & Logistics*, *14(3),* 386–408.

Libing, L& Lili, H,(2017) The development opportunities of shipping industry under the shipping alliance, *Containerliazaiton,24(4),* 4-7.

Miao, C.(2007), *Research on the issue of port group's competition and cooperation——taking Bohai Ring area ports froup as an example Abstract.* Shanghai Maritime University master degree research paper.

Min Ju, B. , Ek Peng, C. , Loo Hay, L. & Anming, Z.(2013)，Container transshipment and port competition，*Maritime Policy & Management*, *40(5),* 479–494.

Nasrin, A. , Reza Zanjirani, F. , Mark, G.(2012), "Network design approach for hub ports-shipping companies competition and cooperation", *Transportation Research Part A* (48).1–18.

NOTTEBOOM, T.E. (2009), Complementarity and Substitutability among Adjacent Gateway Ports, *Environment and Planning A, 41*,743-762.

Pengyu, T.(2016), On the survival and development of port under the background of shipping alliance, *China Water Transport. 16(3),* 59-61.

Renato, M.& Alessandro, P.(2010), *Maritime Policy & Management, 27(1),* 31-40.

Tae Seung, K. (2015), The Revealed Competitiveness of Major Ports in the East Asian Region: An Additive Market Share Analysis, *The Asian Journal of Shipping and Logistics, 31(4)*, 429-435.

Tangpeng, Y(2016), The way of port survival and development under the background of shipping alliance, *China Water Transport, 16(3),* 59-61.

Theo, N.(2007), Strategic challenges to container ports in a changing market environment, *Research in Transportation Economics,17,*29–52.

Tingfa, Z.(2009), *Research on Container port competition analysis and strategy.* Shandong Normal University doctor degree research paper.

Wei Yim, Y a,1, Jasmine S.L. L.(2005), "Competition dynamics between container ports in East Asia", *Transportation Research Part A* (40), 35–51.

Wei Yim, Y. & Theo, N.(2011), Dynamics of liner shipping service scheduling and their impact on container port competition, *Maritime Policy & Management, 38(5),*471–485.

Xiao, L.(2017), How ports changes in the shipping alliance era, *China Ship Survey,2,*38-41.

Xianghui, Y.(2012), *Research on Port competition and cooperation of the Bohai Sea port cluster.* Dalian Maritime University master degree research paper.

Xianjing, Z.(2009), Analysis of game theory for cooperation of ports, *Logistics engineering and management. 9(31).* 13-15.

Xin, T., Liming, L. & Shouyang, W.(2015), *Maritime Policy & Management, 42(8)*, 729–745.

Yi, Z.(2012),*Research on the competitiveness and competition strategy of container port enterprises,* Wuhan University of Technology master degree research paper.

Yunxia, W.(2003), *Discussion on the cooperation and competition of large port enterprises in China*，Shanghai Maritime University master degree research paper.

Zhenqiu, J& Ye, M(2014), The Three Major Shipping Alliance Effect on Port and Its Countermeasures, *Logistics Sci-Tech, 7,* 142-145.