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Research on concentration force of goods in ports across the Taiwan strait

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Declaration

I certify that all the material in this research paper that is not my own work has been identified, and that no materials are included for which a degree has previously been conferred on me. The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University.

(Signature):
(Date):

Supervised by
Professor Liu Wei
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Abstract

Research on Concentration force of goods in ports across the Taiwan strait

Degree: MSc

It is found that there is no concept of goods concentration force in the literature, and this paper is a pioneering topic. Good concentration force is an appeal for the goods, which is a kind of competitive capacity for port to get the goods, so it should be analogous to the competitiveness of the port. However, the research dimensions of port competitiveness is for the evaluation of comprehensive port capacity, and the research dimensions of goods dimension is for the relationship of supply and demand, rates, and customs clearance time. The concentration force of port cargo refers to the cooperation between relevant port industries and other ports in a certain region to attract cargo together. The concentration of port goods is closely related to the comprehensive capacity of the port. For this study, it is comprehensive. We need to evaluate port facilities and supporting facilities, freight volume, routes, logistics, banking and insurance, geographical factors, preferential policies, etc.

This paper models the concentration force of goods through two methods, and ranks and scores the concentration force of goods in ports on both sides of the Taiwan straits.

One is the principal component analysis method, which the author used excel to analyze. Most of the data were from China port network, but some of the index data were lacking, so the author supplemented the data with equal proportion. This method is a practice of the model of goods concentration force. The other is the concentration coefficient of complex network research, calculated by dividing the number of ports is simply port directly connected route related port number. With this part of the data fully, the author have already generated by the crawler from China port network directly, combining with the programming and data analysis tools to the original data for secondary development, found the hidden information in the data. Through data analysis, this paper analyzes the internal reasons and historical reasons of the cargo concentration force in the ports on both sides of the Taiwan straits.

Keywords: Concentration force of goods ,Taiwan strait, principal component analysis, complex network research

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LIST OF ABBREVIATIONS

TEU	Twenty-feet Equivalent Unit
PCA	Principal Component Analysis
ECFA	Economic cooperation framework agreement
TDI	Direct investment

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1.Introduction

1.1. Background of this dissertation

Chinese mainland and Taiwan face each other across the Taiwan Straits. Since the middle and late 19th century, the port transport links between the two sides have changed sharply because of the impacts of the international politics and international trades. Under the influence of the special policies, the cross-strait container port system has gone through three stages: the bud stage of direct flight, the development stage of direct flight and the mature stage of direct flight.

Taiwan has obvious geographical advantages, but because it is an island with a narrow hinterland, it makes full use of geographical advantages and geographical advantages to increase regional economy.

It is the key to the sustainable economic development of Taiwan area that the long center forms the close maritime transportation link as its own inland area. Improving relations with the Chinese mainland, sharing the development opportunities of the Chinese mainland and promoting the cross-straits port transport links should be the policy of the Taiwan region.

1.2. The purpose of the dissertation

China's ports have risen rapidly in recent years, the container throughput of the top ten ports has increased rapidly in recent years, and the cargo throughput of major coastal ports has increased continuously in the past 10 years. China stands out in terms of the growth of the volume of container trade, with an average annual growth rate of about 30% in the last 10 years, ranking first in growth rate of the world. At the same time, the competition among east Asian ports is very fierce.

In order to respond to the national policy of maritime silk road, it is necessary to summarize the valuable experience of direct flights between the two sides of the

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Taiwan straits and analyze the structure of cargo flow in the Taiwan strait, so as to improve and optimize the planning and functions of ports in the mainland, especially in Fujian.

Under the condition that the quantity and demand of goods in a certain area are relatively fixed, how to solve the optimal distribution of goods is the research direction of this paper.

In this paper, a relatively new concept is put forward which is called the cargo concentration force. The cargo concentration force refers to the port's attraction to cargo. For example, when supply and demand are relatively constant, ports with greater capacity to gather goods are more likely to receive them, and vice versa.

After consulting the literature, more literature is based on the competitiveness of the port itself. This paper is more based on the reality and the relationship between supply and demand, when the supply of goods is relatively fixed, from the perspective of optimal selection of freight to analyze the port's cargo concentration force.

In this paper, the paper will discuss two parts, one is how to model and evaluate the cargo concentration force, and the other is how to increase the cargo concentration force.

1.3. Overview of Research methodology

In this paper, factor analysis method is used to evaluate the cargo concentration force. Factor analysis is a method of grouping variables according to the internal dependence of correlation matrix and the size of correlation rows. On the premise of minimizing information loss, a small number of irrelevant indicators are extracted from many indicators, and then the weight is determined with the contribution rate of variance, so as to calculate the comprehensive score. Its biggest advantage is that the weight of each comprehensive factor is determined according to the contribution rate of variance rather than subjective value, which avoids the randomness of determining the weight artificially. In addition, the whole process of factor analysis can be easily awakened by the use of computer software, with strong operability. Therefore, compared with other methods, factor analysis is a scientific, practical and constructive comprehensive

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evaluation method, which is suitable for the evaluation of the concentration force of goods.

The author analyzes the evaluation methods related to ports, including lever measurement method, TOPSIS method, ahp French fuzzy comprehensive evaluation method. On the basis of analyzing the characteristics of each method, it is concluded that each method has some limitations. Based on this, this paper selects the factor analysis method to evaluate the concentration force of goods, and cites it in the process of establishing the concentration force index system and analyzing the advantages and disadvantages of port development.

At the same time, the author is interested in big data analysis, and intends to use python programming and some data analysis tools to analyze the port cargo concentration force from the perspective of big data analysis.

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2.Literature review

2.1. Changes in cross-strait port transport links

Under the influence of the special policies of indirect navigation , pilot direct flight and then comprehensive direct flight , the cross-strait container port system has gone through three stages: the bud stage of direct flight, the development stage of direct flight and the mature stage of direct flight. According to the history, before it was ceded to Japan, Taiwan had a close maritime connection with the mainland, and Xiamen port was the most important transshipment port in Taiwan. After the confrontation between the two sides, two sides of the port transport links cut, Taiwan - the United States - Japan formed a triangle trade network. After 1979, Hong Kong became the most important transshipment port for cross-strait transport links. After the direct flights between the two sides, the port transportation links between Taiwan and the mainland have been expanded in breadth and depth.

2.2. The development of port in Taiwan strait region

The Taiwan strait lies off the southeastern coast of China, across the strait from Fujian and Taiwan.

The following Figure 1 is Geographical map of Taiwan Strait. The map shows the geographical position of the Taiwan Strait. There are three major ports in Fujian which are Xiamen port, Fuzhou port and Quanzhou port and three relatively small ports which are Ningde port, Putian port and Zhangzhou port, and Taiwan's Kaohsiung port, Keelung port and Taichung port on both sides of the straits.

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Figure 1 - Geographical map of Taiwan Strait

Xiamen port currently has 122 berths, including 33 deep-water ports. The main goods include grain, coal, petroleum, natural gas, iron ore, steel, building materials and chemicals. Service areas include the establishment of southeast shipping center, the improvement of port bonded area supporting facilities, the development of modern logistics industry. Xiamen has a free trade zone, which includes automobile manufacturing, ship repair, petrochemicals and energy. There are 96 international routes, 75 international routes, 19 international cooperation ports.

Fuzhou port has 9 port areas and 179 berths. The main goods include coal, oil, natural gas, steel, mining materials, cement, food. Fuzhou has a free trade zone, focused on the development of steel industry, shipbuilding and repair, power plants. It has opened several international routes covering North America, Africa, Europe, the Middle East, South Asia, Japan and South Korea, and two ports for international cooperation.

Kaohsiung port is the largest international port in Taiwan. It is located on the southwest coast of Taiwan and has 3 auxiliary ports. The main goods include imported fertilizer, oil, machinery, wood, coal, grain, and export sludge, sugar, aluminum, salt, water fruit,

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tank head, service territory including global container transfer center, logistics center and support for tourism and trade. Kaohsiung free trade zone, related industries including steel industry, petrochemical industry, shipbuilding industry, 7 export processing zones, and 3 industrial parks; Sea routes can reach more than 60 countries.

Taichung port has 50 terminals, the main goods include mineral products, chemicals, plastic products, rubber, vegetables, coal, iron ore, cement, service areas include regional container goods, Taiwan logistics center, cross-strait passenger and freight ports. There are three free trade zones. It operates 18 liners and 67 international routes.

Keelung port has 56 piers and 2 auxiliary ports. The main goods include coal, oil, ore, grain, household goods, machinery import as well as chemicals, electronic products, light industrial products, textiles, processed food. The service areas include regional container goods, cross-strait and international cruise ships, Asia Pacific shipping center. Keelung port free trade zone, with the world's major container port exchanges and cooperation.

2.3. The theory and application of modern port competitiveness

Because of the port in the region economic development important position and the benefit distribution mechanism tilt and so on some factors. Fierce competition between domestic ports is always what the government and port enterprises try to avoid. The main contents of port competition include: goods supply, investment and national preferential policies. Competition is based on quality of service, port rates and facilities and operational effectiveness. Quality of service includes vessel time at port, port operation and financing, technical service reliability or face, cost of intermodal transport segments and availability of facilities and operations including utilization and technology.

The research on port competition mainly starts from two aspects, one is the influence of port policy on port competition, the other is the strategy of port competition.

In recent years, with the development of container transportation, many ports have invested in the construction of container terminals

The competition for the hinterland container goods launched a fierce competition. With

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the integration of global economy, the container port industry is both competitive and cooperative.

In the market competition, the game behavior is widespread. Game Theory, also known as Game Theory,

Is to study the rational behavior and its decision equilibrium in the case of risk uncertainty, when the behavior of multiple decision subjects affects each other

The problem. Game theory, which dates back to the study of models of entertainment such as chess and bridge, is now used in politics, economics,

Military, managerial science, cultural entertainment and many other fields. In a nutshell, game theory is the study of mutual dependence,

The rational decision behavior of the decision-making subject and the equilibrium result of these decisions.

At present, it has been widely used in the field of transportation. However, it is seldom reported in the port, an industry with obvious characteristics of social welfare.

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3.Method for evaluating the concentration force of goods

3.1. Factors that influence the concentration force of goods

Ports are hubs for transporting goods. From the perspective of the definition of port, the main aspects include geographical area, port function, social economy, international shipping, ship operation, port management, port economy, port logistics, etc.

Based on the influence of port definition dimension on cargo attraction, the author summarizes two dimensions of the factors in cargo concentration force.

Firstly, port customer demand analysis needs to be considered. The traditional analysis of supply and demand mainly considers that the choice of port by shippers is mainly based on the port rate, but the author thinks this is one-sided and incomplete. The author classifies the influencing factors and then rank the factors considered by shippers in the selection of ports in order of importance. Specific factors are shown in the table 1.

Table 1 - Specific factors affecting the choice of ports by shippers

The serial number	The specific factors
1	Punctual departure
2	responsibility
3	price
4	punctual delivery
5	transit time
6	service scope
7	document accuracy
8	good equipment
9	quality control
10	claim procedures
11	ability to track information

Secondly, port strength analysis needs to be considered. In order to improve the concentration force of goods, it is necessary to improve the situation of various

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influencing factors, so as to improve the competitiveness in the three aspects of time, economy and security. The table 2 of factors affecting the concentration force is as follows.

Table 2 - Specific factors affecting the concentration force

Specific factors	The specific explanation
Geographical location	As a natural attribute of the port, the geographical position will determine the innate competitiveness of the port. For example, the distance from the international main navigation, a variety of transport modes such as the main hub.
natural condition	Channel water depth is the degree of adaptation to the development trend of modern ships. Port operation is affected by the degree of climate, the extent of the spacious waters, etc.
Economic hinterland status	From a certain point of view, the advantages and disadvantages of the local collection and distribution system than the advantages and disadvantages of the Marine conditions can determine the competitive strength of the port. For example, the national economy and foreign trade. Transportation development plan, inland station layout and scale, national policy on regional development, etc.
relying on the city environment	National economy and foreign trade, especially export-oriented economic development level and poor situation; Its popularity in the world and its attraction to foreign investment; The development level of shipping industry, finance and insurance industry, communication industry, logistics industry and processing industry, and the emphasis of local governments on the development of multimodal transport and the organizational capacity of cooperation.
port soft environment	The customs inspection and supervision department handles the multimodal transport formalities the convenience degree, the clearance speed, the settlement speed, the rate system superiority degree and so on.
operating conditions	The smoothness of the means of transport connected to the port; Ship capacity

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hardware facilities	Loading and unloading equipment capacity, storage equipment capacity, mechanical efficiency, facilities capacity and so on.
operating mechanism &management level	The management mechanism of wharf and the cooperative operation of Chinese and foreign investors; Effective measures to arrange goods and attract shipping companies; Diversified operation: management efficiency: business personnel ability; Degree of computerization, etc.
service quality	Evaluation of shipping companies, shippers and other customers and partners: concept of service of employees with on-time rate of vehicles and ships, innovation consciousness: efficiency of port operation; Port congestion: ship arrival time and detention, etc
Port fees collection	Rates, though, are no longer crucial in determining the competitiveness of ports. But the low rate of the port has a competitive advantage such as rationality, transparent degree.
application of information technology	A good information infrastructure is essential to improve the speed of cargo transport, and a prominent indicator is the extent to which port EQI is being used.
potential development opportunities	The utility and opportunity of relevant national policies: the development of domestic and foreign ports may be limited.
future challenges	Internal and external environment changes, may appear new competitors; The development of domestic adjacent ports rapidly exceeds that of Hong Kong and so on.

In addition to the factors mentioned above, other factors such as marketing strategy, port planning rationality and many other factors also affect the goods concentration force. Among the above many factors, some are exogenous, so the port itself can not control, such as geographical location; Others are endogenous, such as rates, quality of service, etc. These endogenous factors should be considered when the port makes the competitive countermeasures, and they constitute the strategic space of the concentration force model. Because the port has a certain geographical location of the

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integrity, so the port in the geographical location is always the most important factor. Hinterland economy, natural conditions, service quality and relying on cities have always played an extremely important role in the concentration force of goods.

3.2.Indicators describing the concentration force of goods.

According to the influencing factors of the port's cargo concentration force, the author summarized the specific indicators under several factors. The author has established an index evaluation system to quantitatively describe the concentration force of goods.
In practice, concentration force indicators are reduced due to insufficient data or individual level. The following table 3 lists all the indicators describing the concentration force of goods.

Table 3 - Indicators describing the concentration force of goods

A1.The policy environment	Shipping development index
	International transit cargo free port policy
	Simplified procedures for domestic goods
	Preferential policies
A2.The financial environment	National and foreign trade volume
	Investment and financing channels
A3.Competitive market environment	Size of tax declaration logistics park
	Port public facilities
A4.Customs clearance environment	Import and export cargo customs clearance
B1.Navigation condition	Depth of inlet and outlet channel
	Work days
B2. Hinterland economy	Annual net export trade volume
	Hinterland city annual GDP
B3.Shipping development	Number of shipping lines
	Number of shipping agents
	Route density
	Route coverage

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C1. infrastructure	The total number of berths
	Total number of handling machinery
	Total area of storage yard
	Channel class
C2. Collection and distribution facilities	Set card number
	Railway article number
C3. Degree of informatization	Number of port business information systems
	Message types
	Message
C4. Port attraction	Bonded policy
	Marketization and internationalization
	Rate system
	Types of value-added services
C5. The human resources	Employee skill structure
	Per capita training time
	Training cost per person
D1. Port passing capacity	Container throughput
	Anchor voyage
D2. Ability to transfer	Container transfer capacity
D3. Facility efficiency	Berth utilization
	Warehouse utilization
	Yard utilization
D4. Concentration and transportation capacity	Efficiency of barge collection
	Collecting and transporting machinery
D5.The level of fees	Port rates at all levels
	Customer pays cost per unit throughput
D6.The service level	Cargo damage rate
	Length of stay at port
	Efficiency of ship handling

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E1. Investment scale	Total port investment
	Wharf investment
E2. Project under construction	Number of berths under construction
	Number of channel under construction
F1. Investment growth	Port investment growth rate
	Growth rate of foreign direct investment
F2. Operating growth	Cargo throughput growth rate
	Passenger growth rate
	Rate of ship arrivals
F3.Infrastructure potential	Available shoreline ratio
F4. Asset growth	Growth rate of net assets

3.3. Principal Component Analysis

Principal Component Analysis (PCA) is a statistical method. Through orthogonal transformation, a group of variables that may be correlated are converted into a group of linearly unrelated variables, and the converted variables are called principal components.

The model is as follows:

$$Fp = a_{1i}*Z_{X1} + a_{2i}*Z_{X2} + \ldots\ldots + a_{pi}*Z_{Xp} \quad (1)$$

Where a1i, a2i... , api, (i = 1,... , m) to the covariance matrix of X eigenvectors corresponding to eigenvalue, ZX1 ZX2,... , ZXp is the normalized value of the original variable.

$$A = (aij)p\times m = (a1,a2,\ldots am) \quad (2)$$

$$Rai = \lambda ia \quad (3)$$

R is the correlation coefficient matrix

λi、ai are the corresponding eigenvalues and unit eigenvectors

$\lambda 1 \geq \lambda 2 \geq \ldots \geq \lambda p \geq 0$

The main steps of principal component analysis are as follows:

1. Standardized index data (SPSS software is automatically implemented)

2. Determine the correlation between indicators

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3. Determine the number of principal components M

4. Principal component Fi expression

5. Principal component Fi naming

3.4. Coefficient of concentration

The degree Ki of node I is defined as the number of other nodes that the node connects to. The greater the degree of a node is, the closer the node is to other nodes in the network. In the container liner shipping network, the degree of the port node is the number of ports connected with the port by a route, and represents the contact range of the port.

The concentration coefficient is used to measure the parameters of local concentration forceing of ports in the shipping network. The concentration forceing coefficient C I of a node I refers to the proportion of the actual number of connecting edges between all adjacent nodes of I to the largest number of possible edges. The mathematical expression is

$$C\ i = 2E\ i / K\ i \times (K\ i - 1). \qquad (4)$$

K I is the degree of node I. E I is the actual number of edges between the adjacent points of node I. From the perspective of geometric characteristics, the value range of the cargo concentration force coefficient is $0 \leqslant C\ I \leqslant 1$. In the container liner shipping network, the concentration force coefficient of the port node measures the degree of freight flow between the adjacent ports at the port I.

The higher the concentration force coefficient of the node, the higher the closeness of the adjacent ports, and the port is easy to form regional concentration force with the sub-network formed by the neighboring ports.

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4. Port analysis of concentration force on both sides of the Taiwan strait

4.1 Principal Component Analysis of good concentration force across the Taiwan Straits

The following Figure 2 is Port map of Taiwan Strait. In this method, 6 ports on both sides of the Taiwan Straits as well as Hong Kong, Shanghai and Shenzhen are selected. It can be seen from the figure that the 6 ports are Quanzhou port, Fuzhou port, Xiamen Port , Kaohsiung Port, Taichung Port and Keelung Port.

Figure 2 - Port map of Taiwan Strait

According to index evaluation system to describe the concentration force, the author

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selected 5 indicators to build the model. They were chosen because they are easy to query and conform to the index system. One thing that needs to be added is that for the lack of data, the author carried out an equal proportion of supplementary data processing. The principal component analysis model is intended to be a systematic and scientific description of the concentration forces of goods, as well as a pilot experiment in data processing. Through the relevant port website, the author obtains the original data, and carrys out equal proportion for the value lacking in the data. The Table 4 below shows the actual raw data.

Table 4 - Actual raw data of ports

Ports	Throughput (million teus)	berth number	Average cost	Loading and unloading efficiency	Average clearance time	Maximum depth
Shanghai	4201.0	1191.0	350.0	50.0	0.1	19.0
Fuzhou	334.0	220.0	320.0	20.0	1.3	18.5
Quanzhou	240.0	196.0	320.0	20.0	1.3	16.5
Xiamen	1070.0	1000.0	340.0	22.0	1.0	17.0
Kaohsiung	1045.0	900.0	600.0	26.0	0.1	18.5
Hong Kong	1960.0	900.0	800.0	34.0	0.1	17.0
Shenzhen	2574.0	1000.0	600.0	28.0	1.2	19.0
Keelung	147.0	130.0	600.0	23.0	0.9	18.5
Taichung	174.0	140.0	600.0	23.0	0.9	16.5
Average	1305.0	630.8	503.3	27.3	0.8	17.8
standard deviation	1380.5	444.5	174.2	9.6	0.5	1.1

By standardizing the raw data, the paper get the following Table 5. Through standardization, the paper obtain a matrix value in a certain interval, and solve the quantitative difference of different indexes.

Table 5 - Standardizing the raw data of ports

Standardized data						
Ports	Throughput (million teus)	berth number	Average cost	Loading and unloading efficiency	Average clearance time	Maximum depth
Shanghai	2.10	1.26	-0.88	2.37	-1.34	1.10
Fuzhou	-0.70	-0.92	-1.05	-0.77	1.02	0.63
Quanzhou	-0.77	-0.98	-1.05	-0.77	1.02	-1.26
Xiamen	-0.17	0.83	-0.94	-0.56	0.45	-0.79
Kaohsiung	-0.19	0.61	0.55	-0.14	-1.22	0.63
Hong Kong	0.47	0.61	1.70	0.70	-1.28	-0.79
Shenzhen	0.92	0.83	0.55	0.07	0.83	1.10
Keelung	-0.84	-1.13	0.55	-0.45	0.25	0.63
Taichung	-0.82	-1.10	0.55	-0.45	0.25	-1.26

The following Table 6 is the correlation coefficient matrix of goods concentration force. And then the paper compute their correlation matrix, which the paper can use to figure out the characteristic roots.

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At the same time in the actual calculation the paper need to make the identity matrix to assist the calculation.

In Table 6，The matrix belongs to the stage conclusion, indicating the size of the correlation coefficient.

Table 6 - Correlation coefficient matrix of goods concentration force

Correlation coefficient matrix					
1.00	0.84	0.02	0.92	-0.55	0.50
0.84	1.00	0.29	0.62	-0.45	0.21
0.02	0.29	1.00	0.85	-0.69	0.31
0.92	0.62	0.85	1.00	-0.58	0.04
-0.55	-0.45	-0.69	-0.58	1.00	0.27
0.50	0.21	0.31	0.04	0.27	1.00

The following table 7 is the unit matrix.

The identity matrix is used for orthogonal decomposition of the correlation coefficient matrix. This identity matrix is a 6-by-6 matrix.

Table 7 - Unit matrix

Unit matrix					
1.00	0.00	0.00	0.00	0.00	0.00
0.00	1.00	0.00	0.00	0.00	0.00
0.00	0.00	1.00	0.00	0.00	0.00
0.00	0.00	0.00	1.00	0.00	0.00
0.00	0.00	0.00	0.00	1.00	0.00
0.00	0.00	0.00	0.00	0.00	1.00

The following table 8 is a description of the five characteristic roots.

Five characteristic roots were observed by excel, because when the observed values changed in a positive or negative way, the existence of characteristic roots was indicated.

Through the indicator of positive and negative changes, the paper always find 5 characteristic roots, which are respectively 0,0.3205, 0.7465, 1.2365 and 2.9635.

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Table 8 - Five characteristic roots of matrix

Observed characteristic root		
Number	Value	Positive negative change
1	0	0
	0.001	-0.001387931
	0.002	-0.001385348
	...	...
2	0.32	-2.05011E-06
	0.321	1.5681E-06
	0.322	5.17104E-06
	...	...
3	0.746	1.14127E-06
	0.747	-1.6645E-06
	...	...
4	1.236	-2.52121E-06
	1.237	4.463E-06
	...	...
5	2.963	9.9642E-05
	2.964	-9.63574E-05
	2.965	-0.000293031

The following Table 9 is the variance contribution rate calculation.

Next, the paper calculate the variance contribution rate. After calculation, it is found that the cumulative contribution rate of the first three characteristic roots has reached 94%, indicating that the establishment of three factors can express the accuracy of 94% of the cargo concentration model.

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Table 9 - Variance contribution rate calculation

Variance contribution rate calculation		
Characteristics of the root	contribution	Cumulative contribution rate
2.9635	0.56	0.56
1.2365	0.23	0.80
0.7465	0.14	0.94
0.3205	0.06	1.00
0	0.00	1.00

The following Table 10 is the solution diagram.

The solution of the equations is obtained by programming. The paper solved for each of the five characteristic roots, but only took the first three factors.

Table 10 - Solution of the system

Solution of the system					
x1	-0.25909	1.965994	-0.12306	-1.89386	0.807425
x2	-0.32142	1.345782	-0.19803	4.017176	-0.44627
x3	-0.28316	-2.27208	0.790754	1.030672	0.619047
x4	-0.48065	-0.34535	0.197218	-3.63046	-1.21396
x5	0.526948	1.443497	0.903869	-1.35078	-0.31029
x6	1	1	1	1	1

The following Table 11 is the Solution vector normalization.

And then when the paper normalize the solution vectors, the paper can get a formula for the three principal component factors. However, it is important to note that excel processing will reverse the standard resolution vector, and the paper need to identify and manually adjust it.

F1=0.19533x1+0.24232x2+0.21348x3+0.36238x4-0.397279x5-0.753924x6

F2=0.524656x1+0.359143x2-0.60634x3-0.09216x4+0.385219x5+0.266865x6

F3=-0.07728x1-0.12437x2+0.4966x3+0.123855x4+0.567638x5+0.628009x6

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Table 11 - Solution vector normalization

Solution vector normalization					
x1	-0.19533	0.524656	-0.07728	-0.31223	0.413966
x2	-0.24232	0.359143	-0.12437	0.662288	-0.2288
x3	-0.21348	-0.60634	0.4966	0.169921	0.317385
x4	-0.36238	-0.09216	0.123855	-0.59853	-0.6224
x5	0.397279	0.385219	0.567638	-0.2227	-0.15909
x6	0.753924	0.266865	0.628009	0.164864	0.512699

By integrating F1, F2 and F3, the paper get the value of F. The research sorted the F value from high to low and found that Shanghai, Shenzhen and Hong Kong ranked the top three respectively. The Table 12 below shows the F value of the cargo concentration force.

Table 12 - Evaluation on the value of cargo concentration force

Evaluation on the value of the cargo concentration force					
Ports	**F1**	**F2**	**F3**	**F**	**Rank**
Shanghai	1.08590065	1.64804657	-0.5299256	2.20402164	1
Fuzhou	-1.7434341	0.56930524	0.52690845	-0.6472204	6
Quanzhou	-0.348204	0.01098457	-0.6452999	-0.9825194	8
Xiamen	0.18126897	0.79089844	-0.8649623	0.10720506	4
Kaohsiung	0.18795555	-0.5063384	-0.0990423	-0.4174252	5
Hong Kong	1.95427016	-1.3312676	-0.3975722	0.2254303	3
Shenzhen	-0.6345947	1.05107138	1.27186771	1.68834437	2
Keelung	-1.0570237	-0.8739171	0.96326038	-0.9676805	7
Taichung	0.37386122	-1.358783	-0.2252341	-1.2101559	9

To sum up briefly, the model of goods accumulation force established by principal component analysis is objective and there is no subjective rating. Different quantities of principal component factors can be set up. Generally speaking, the higher the quantity, the higher the accuracy. It should be noted that too many factors can lead to overfitting problems, and considering the cost and effort, sometimes the paper don't need too much accuracy. 90 to 95 percent accuracy is appropriate.

By building the model of goods accumulation force in my practice, the three principal component factors have different emphasis. F1 emphasizes hinterland economy and freight volume, F2 emphasizes operational efficiency, and F3 emphasizes port facilities.

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Looking at the F value, Shanghai and Shenzhen and Hong Kong ranked in the top three. This ranking illustrates the phenomenon of the concentration of the two ports at the port of transshipment and the port of hub. Special transshipment ports refer to Hong Kong, hub ports refer to Shanghai, Kaohsiung. With the development of ports and the increase of navigation ports, the function of kaohsiung hub gradually declined until it was lower than that of xiamen port and other secondary ports. The port of Hong Kong, which is ranked after Shanghai and shenzhen, has lowered its links because it no longer has the function of third place transshipment.

4.2. The calculation of the coefficient of concentration on both sides

The calculation of agglomeration coefficients is derived from complex network research. This is the second method used in this paper to define the cargo concentration force of the port.

Sufficient data are needed to calculate the concentration force coefficient, so the paper crawled the data on the Chinese port network. I used python for crawling technically. The diagram below is a partial code diagram. The Figure 3 is the crawler code.

```
from bs4 import BeautifulSoup
from urllib import request
import xlwt

# 获取数据
value = 1
while value <= 919:
    value0 = str(value)
    url = "http://www.chinaports.com/chuanqibiao/" + value0 + "/null/null/null/query"
    # url="http://www.chinaports.com/chuanqibiao/1/null/null/null/query"
    '''此行可以自行更换代码用来汇集数据'''
    response = request.urlopen(url)
    html = response.read()
    html = html.decode("utf-8")
    bs = BeautifulSoup(html, 'lxml')

    # 标题处理
    title = bs.find_all('th')
    data_list_title = []
    for data in title:
        data_list_title.append(data.text.strip())

    # 内容处理
    content = bs.find_all('td')
    data_list_content = []
    for data in content:
        data_list_content.append(data.text.strip())
    new_list = [data_list_content[i:i + 5] for i in range(0, len(data_list_content), 5)]

    # 存入excel表格
    book = xlwt.Workbook()
    sheet1 = book.add_sheet('sheet1', cell_overwrite_ok=True)

    # 标题存入
    heads = data_list_title[:]
    ii = 0
    for head in heads:
        sheet1.write(0, ii, head)
        ii += 1
```

Figure 3 - Partial crawler code

The following Figure 3 is the partial crawler code. It can show how the research uses computer to work. By crawling 919 pages of website data, 18370 liner route data were

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obtained, making the data volume fully meet the requirements of this study. The Table 13 below shows the route chart of the regular ship.

Table 13 - Original data of liner route

Carrier	Course name	Shipment	Destination	Port of call
k-line(川崎)	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN (YANTIAN) -SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAI
k-line(川崎)	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN (YANTIAN) -SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAI
k-line(川崎)	American line	DALIAN	YOKOHAMA	DALIAN-TIANJIN (XINGANG) -QINGDAO-SHANGHAI-Prince Rubert-LONG BEACH CA-OAKLAND CA-YOKOHAMA
k-line(川崎)	American line	KAOHSIUNG	PANAMA CITY	KAOHSIUNG-HONGKONG-SHENZHEN (YANTIAN) -BUSAN-PANAMA CITY-SAVANNAH GA-CHARLESTON SC-WIL
k-line(川崎)	African Line	SHANGHAI	SINGAPORE	SHANGHAI-NINGBO-XIAMEN-SINGAPORE
k-line(川崎)	Euro Line	XIAMEN	HONGKONG	XIAMEN-KAOHSIUNG-SHENZHEN (YANTIAN) -SINGAPORE-PORT SUEZ-ROTTERDAM-FELIXSTOWE-HAMBURG-/
k-line(川崎)	American line	SHENZHEN (YAN	KAOHSIUNG	SHENZHEN (YANTIAN) -HONGKONG-KAOHSIUNG-KEELUNG-LOS ANGELES CA-OAKLAND CA-KEELUNG-KAOH
k-line(川崎)	American line	SHENZHEN (YAN	KAOHSIUNG	SHENZHEN (YANTIAN) -HONGKONG-KAOHSIUNG-KEELUNG-LOS ANGELES CA-OAKLAND CA-KEELUNG-KAOH
k-line(川崎)	SouthEast-Asian Line	QINGDAO	MANILA(N)	QINGDAO-BUSAN-SHANGHAI-HONGKONG-SINGAPORE-MANILA(S)-MANILA(N)
k-line(川崎)	Mid-South American Line	KEELUNG	YOKOHAMA	KEELUNG-HONGKONG-SHENZHEN (CHIWAN) -XIAMEN-SHANGHAI-QINGDAO-BUSAN-MANZANILLO-IQUIQUE-VA
k-line(川崎)	American line	SHANGHAI	VANCOUVER	SHANGHAI-NINGBO-BUSAN-TACOMA WA-VANCOUVER
k-line(川崎)	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line(川崎)	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line(川崎)	American line	SHANGHAI	KOBE	SHANGHAI-XIAMEN-SHENZHEN (YANTIAN) -HONGKONG-LONG BEACH CA-OAKLAND CA-KOBE
k-line(川崎)	Austrilian and Zelanian Line	QINGDAO	BRISBANE	QINGDAO-SHANGHAI-NINGBO-XIAMEN-GUANGZHOU (NANSHA) -SHENZHEN (SHEKOU) -HONGKONG-SYDNEY
k-line(川崎)	Japanese and Kokean Line	BUSAN	QINGDAO	BUSAN-YANTAI-QINGDAO
k-line(川崎)	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN (YANTIAN) -SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAI
k-line(川崎)	Japanese and Kokean Line	YINGKOU	TIANJIN (XINGAN	YINGKOU-BUSAN-TIANJIN (XINGANG)
k-line(川崎)	American line	KAOHSIUNG	PANAMA CITY	KAOHSIUNG-HONGKONG-SHENZHEN (YANTIAN) -BUSAN-PANAMA CITY-SAVANNAH GA-CHARLESTON SC-WIL
k-line(川崎)	Mediterranean Sea Line	SHANGHAI	HONGKONG	SHANGHAI-NINGBO-HONGKONG-SHENZHEN (SHEKOU) -SINGAPORE-PORT SUEZ-ASHDOD-PIRAEUS-THESSAI
k-line(川崎)	American line	SHANGHAI	SHENZHEN (YAN	SHANGHAI-BUSAN-SEATTLE WA-PORTLAND OR-VANCOUVER-KWANGYONG-HONGKONG-SHENZHEN (YANTIAN
k-line(川崎)	American line	HONGKONG	BUSAN	HONGKONG-SHENZHEN (YANTIAN) -YOKOHAMA-Prince Rubert-VANCOUVER-SEATTLE WA-CHICAGO IL-MEMPH
k-line(川崎)	Mediterranean Sea Line	SHANGHAI	HONGKONG	SHANGHAI-NINGBO-HONGKONG-SHENZHEN (SHEKOU) -SINGAPORE-PORT SUEZ-ASHDOD-PIRAEUS-THESSAI

The Table 14 below shows the number of routes of relevant ports.

Through the processing of the original data, the number of routes between the ports of the two sides can be obtained. As can be seen from the figure, Shanghai is involved in the largest number of routes, indicating that Shanghai has the function of a hub and is also a global port. Shanghai is closely followed by shenzhen and Hong Kong, which also have more routes of about 8000. It is worth noting that among the numerous routes, Shanghai's port of departure accounts for up to 30, kaohsiung's port of destination accounts for up to 18 and taichung's port of destination accounts for up to 20 respectively.

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Table 14 - Number of routes of relevant ports

Ports	Routes Number	departure	destination
Shanghai	11851	30	0
Fuzhou	66	1	2
Quanzhou	10	0	0
Xiamen	3776	8	0
Kaohsiung	2831	6	18
Hong Kong	9246	2	2
Shenzhen	8409	9	0
Keelung	649	0	18
Taichung	91	3	20

The following Table 15 below shows the calculation on C value.

As the paper showed you earlier with the model of concentration coefficient, the mathematical expression is C i = 2E i K i ×(K i - 1). We mainly focus on the C value. The higher the C value is, the closer the port is to the port in the region, and the more likely it is for the goods to gather. The C value reflects the strength of the concentration force of goods.

Table 15 - Calculation on C value

Ports	K	E	C	Rank
Shanghai	16	80	0.667	1
Fuzhou	9	14	0.389	8
Quanzhou	8	11	0.393	9
Xiamen	13	41	0.526	5
Kaohsiung	14	59	0.648	2
Hong Kong	14	56	0.615	3
Shenzhen	15	62	0.590	4
Keelung	17	64	0.471	6
Taichung	11	24	0.436	7

As can be seen from the figure, the C value of Shanghai is 0.667, Kaohsiung 0.648,

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Hong Kong 0.615, Shenzhen 0.590, Xiamen 0.526, Taichung 0.471, Fuzhou 0.389, and Quanzhou 0.393. It can be seen from the data that the areas with strong concentration of goods in the ports are mainly distributed in the south China region and the economic zone on the west coast of the straits.

4.3. The analysis of changes in shipping links between ports

Based on principal component analysis, the paper obtain a description and ranking of the port's cargo agglomeration force. Through the phenomenon of internalization, the research finds that it is changes in shipping links between ports.

Throughout history, the ports on both sides of the Taiwan straits have experienced three periods, namely indirect navigation, direct flights and comprehensive direct flights. This paper wants to discuss the core factor of the concentration force of goods, so the author will pay more attention to the historical changes in the period of direct flights. Because according to the time series, the closer the time point is, the greater the influence weight will be. In the period of comprehensive direct flight, the development stage changed step by step from the embryonic stage, the development stage and the mature stage.

Based on the analysis of the relationship indicators, the development mode of direct flights and the special policies and systems of ports, the relationship between the two sides of the Taiwan straits can be divided into two stages: from the embryonic stage to the development stage, and from the development stage to the maturity stage.

During the period from 2004 to 2008, the shipping links between the two sides were still in the period of indirect container liner transport , and the main characteristics of the port shipping links were as follows: Firstly, the two ports of xiamen and fuzhou in mainland China could be directly navigable to kaohsiung port. Secondly, the container liner between xiamen and fuzhou shall be transshipped through the third place, such as Hong Kong or ishigaki, before sailing.

As a result, the phase of the ports on both sides to participate in the port number is less, in addition to foreign ports of call routes include only on both sides of a total of 14, on both sides of the port space contact weaker, but have third transfer function of the port

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and one of the few international hub port with contact range, intensity big space characteristics, scope of ishigaki port, the port of Hong Kong contact is opposite bigger, frequency of contact with the other ports are relatively high, has the important influence in the port system. Besides the two transshipment ports of ishigaki and Hong Kong, kaohsiung and Shanghai are the most important ports on both sides of the Taiwan straits. From 2009 to 2013, containers between the two sides of the Taiwan straits did not need to be transferred from a third port during this period, and the number of direct flights increased with the development of port concentration forces on both sides of the Taiwan straits. Port of space connection pattern evolution characteristics of main performance is: 1, on the whole, the port space began to expand and enhance contact scope and strength, contact range of big ports in 2009 only three, and most connections to clear focus on kaohsiung port, contact range of big ports in 2013 to 6, respectively, keelung, taichung, kaohsiung, Shanghai and xiamen and Hong Kong. 2. The status of secondary ports is prominent, and the connections between ports are developing from hierarchy to network. From the evolution of the connection range and intensity of the shipping network, it can be seen clearly that compared with the mature period of direct flights, the overall connection range of cross-strait routes was smaller in 2009, but the main trunk lines had a larger weight. However, in 2013, with the increase of navigable ports, the connection range was expanded and the connection intensity of the trunk lines was reduced.

At the same time, from the perspective of China's coastal areas, the sea route connection intensity and contact range in the bohai rim region have weakened, while the connection intensity in the pearl river delta region has weakened and the contact range has remained roughly the same, the connection range in the Yangtze river delta region has increased and the contact intensity has weakened, and the contact range and contact intensity in the haixi region have gradually increased. The weakening of the trunk line weight and the expansion of the connection scope of the port system reflect the main trend of the development of the connection between ports from the hierarchy to the network.

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4.4. Comparison of functions of transport hubs between ports

Based on principal component analysis, except for changes in shipping links between ports, the paper finds that it is comparison of functions of transport hubs between ports. As the basic unit of the cross-strait port system, the port differentiates different functions due to its spatial advantages, such as hub port, trunk port and branch port. The spatial advantages can be roughly divided into two categories: one is the convenience degree of other port nodes to a certain port node; the other is the difficulty degree of a certain port node to other port nodes, which forms different functional types due to the spatial differentiation of centrality, which reflects the hub status of the port in the shipping network.

Under the background of direct flights, the cross-strait port transport links mainly show the following two characteristics. Based on the above characteristics, the author still has divided the direct flight into two processes for analysis.

At the beginning, when direct flights sprouted, the ports on both sides of the Taiwan strait presented two characteristics as a whole. One is the concentration of specific transshipment ports, the other is the concentration of hub ports.

In the embryonic period of direct flights, under the influence of the special shipping mode of indirect container liner transport , ports gather at specific transshipment ports. The accessibility and transshipment functions of ishigaki port and Hong Kong port, among which, ishigaki port has a high hub and a high transshipment function in the shipping network. At the same time, affected by the rising status of east Asia in the global trade network and economic system, routes are set in important international hub ports to form hub center concentration force , such as Shanghai port and kaohsiung port. Among the ports on both sides of the strait, Shanghai port has the highest number of routes, and the C value of kaohsiung port is high, indicating that Shanghai port has a strong transshipment function, while kaohsiung port has a high accessibility, and they all occupy an important pivotal position in the container shipping network.

During the development and maturity period of direct flights, the spatial distribution of the hub functions of the cross-strait port groups shows a trend from hub port

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concentration to edge diffusion .

The evolution of the port system is not influenced by the specific transshipment ports. In 2009, the hub centers of the cross-strait port concentration forces were mainly located in kaohsiung, Hong Kong, Shanghai and other ports. Among them, kaohsiung has a strong connection function and a strong transport function. Compared with the embryonic period of direct flight, the hub function of Hong Kong has weakened somewhat, but it still maintains high accessibility in the port system. Shanghai port still has a strong transfer function. In 2013, with the increase of direct ports in China's coastal areas, the central transfer function was no longer concentrated in the three regional hub ports, and the centrality of small ports around the hub system began to strengthen, gradually sharing or even replacing the connectivity and transfer function of the original hub ports in the cross-strait container port system. The transshipment function and accessibility of kaohsiung port are particularly significant. In the mature stage of direct flight, keelung port has occupied the highest access function and transfer function of the port system, and has become a port with strong access and important transfer function in the region. The transshipment function of Shanghai port was reduced to a level lower than that of Qingdao port. Compared with the development period of direct flights, the accessibility of Hong Kong has been enhanced. In addition, the accessibility of xiamen port has been greatly improved compared with the past, second only to that of Hong Kong. In general, the spatial distribution of the centrality of the port system at this stage is characterized by the gradual decrease of the centrality of the hub port and the gradual increase of the secondary port, and the evolution from hierarchical structure to regional network.

The figure 2 below shows the Cargo concentration force ranking based on F value. As described earlier, changes in port transport functions affect the F value. As shown in the figure, the size of the area reflects the size of the concentration force of the goods. Shanghai, Shenzhen and Hong Kong rank the second and third. Shanghai and Shenzhen are in the first tier, judging by their F value. Hong Kong and Xiamen are in the second tier.

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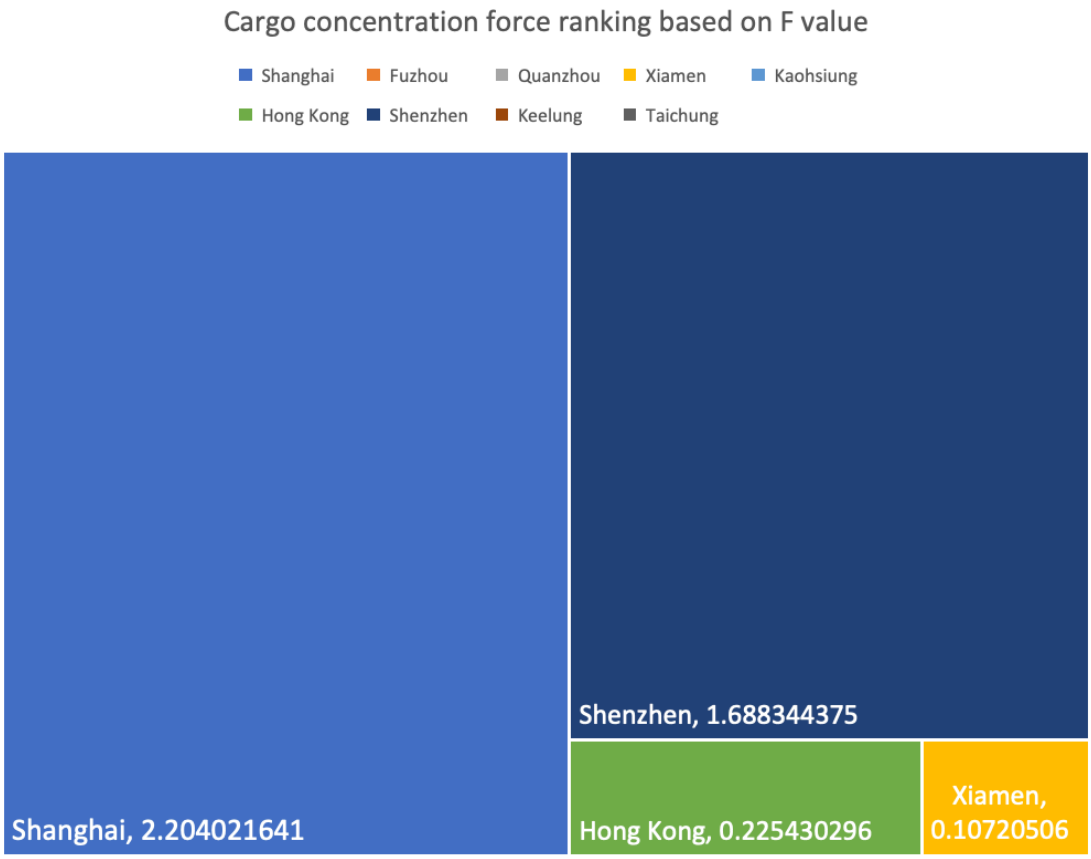

Figure 4 - Cargo concentraion force ranking based on F value

4.5 Coefficient of concentration of goods at ports on both sides of the strait

Based on the calculation on coefficient of concentration, We get another way of describing the concentration force of goods. Through the conclusion of coefficient, the research finds that it is Coefficient of concentration of goods at ports on both sides of the strait.

The study of the classical port system model shows that the concentration or diffusion is the result of the spatial interaction of ports, which can reflect the development trend of the port system under the social and economic environment at that time.

The figure 3 below shows the Coefficient of cargo concentration force. The C value in the figure is used to describe the concentration force of port goods. And the size of C is positively correlated with the size of K value and E value. Shanghai, Kaohsiung and Hong Kong are in the top three. Shenzhen, Xiamen and Keelung are in the second tier.

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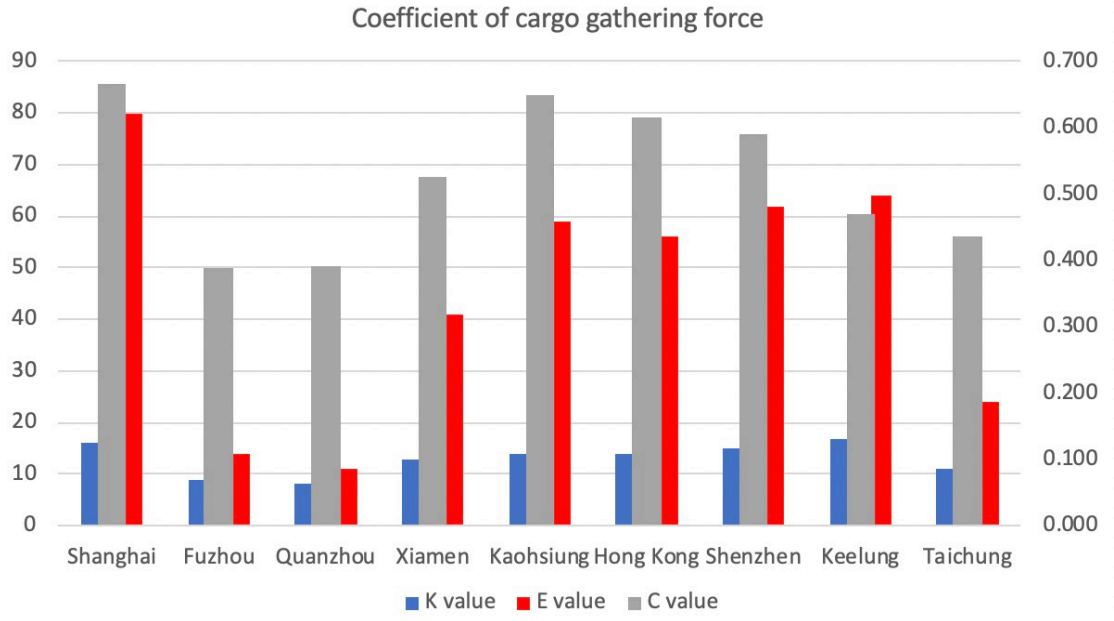

Figure 5 - Coefficient of cargo concentration force

According to the previous analysis, the spatial connection pattern and centrality of the port system are characterized by centralization of hub ports and transshipment ports before direct flights, and centralization of hub centers to regionalization and networking after direct flights. Moreover, with the development and maturity of the shipping network, regional centralization becomes more and more obvious. In this study, the concentration force coefficient is used to measure the current situation of the port. The larger the concentration force coefficient of the port is, the closer it is to the neighboring port, and the more attractive it is to the cargo in the area formed by the neighboring port. When the concentration force coefficient is 1, it means that the port is fully connected with the neighboring ports, and it is usually fed to the new, small or regional ports. The hub port has a small concentration force factor because of its role of radiation nuclear in the network system.

Before the direct flights between the two sides of the Taiwan straits in 2004, the port area concentration force was mainly distributed around the pearl river delta and the hub port of Hong Kong as well as the region around the bohai sea. The small ports with high concentration force had the direct transportation of goods to the neighboring hub port, which showed the spatial characteristics of small world in the regional shipping network. In 2009-2013, the port system are mainly distributed in south China region

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concentration force phenomenon and the channel west bank economic zone, such as guangzhou port (whose concentration force coefficient is 0.5), quanzhou and zhangzhou port (concentration force coefficient is 0.583) Hong Kong (concentration force coefficient is 0.5), wenzhou port (concentration force coefficient is 1.00), and the adjacent Hong Kong port, xiamen, ningbo port has a close relation between the direct shipping. At the same time, new and small ports in Taiwan, such as mailiu and Taipei (concentration force coefficient is 0.667), also show significant regional concentration force after the opening of direct flights, and realize the feeding function of major ports such as keelung and taichung. In general, with the formation and development of the cross-strait port system, the maritime freight infrastructure and transport conditions of many newly opened small ports have been improved day by day. However, due to the restrictions of location conditions, resource endowment and other factors, the transport function and accessibility of these ports are still relatively weak.

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5. Internal drive of the concentration force in cross-strait ports

5.1. The influence of shipping mode across Taiwan strait

Before, the paper used to model and analyze the agglomeration force of goods in two ways. Now, the paper needs to analyze the internal driving force that generates the concentration force of goods. The first analysis is the influence of shipping mode across Taiwan strait.

From third-place entrepot shipping to comprehensive direct shipping , and then to the special container shipping mode with steady development of direct shipping between the two sides, the overall spatial structure of the port system of the two sides has shown a trend from the concentration of specific transshipment ports to the concentration of hub ports , and then to the direction of regional networking .

Direct flights in the begining, the situation in Taiwan strait and the impact of policy making on both sides of the container cargo transportation mode is relatively complex and show the cargo ship impassability characteristics, rely mainly on special navigation model of indirect container liner routed through third countries (ishigaki, Hong Kong) in single, except otherwise provided by the Shanghai - Japan - kaohsiung triangle trade routes, as well as fuzhou, xiamen to kaohsiung harbor pilot direct transport modes coexist. Therefore, the spatial connection and centrality of cross-strait ports at this stage both present the phenomenon of special transshipment ports such as ishigaki port, Hong Kong and hub ports concentration such as Shanghai, kaohsiung. With the development of the port system and the continuous increase of navigable ports after the direct flights between the two sides of the Taiwan straits, the connection strength and hub function of the major hub ports such as Shanghai and kaohsiung gradually declined, until it was lower than the secondary ports such as xiamen, Qingdao and keelung. The spatial connection of Hong Kong port is reduced because it no longer has the function of third place transshipment , but its central accessibility has always occupied an important position in the port system.

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From third-place entrepot shipping to comprehensive direct shipping , and then to the special container shipping mode with steady development of direct shipping between the two sides, the overall spatial structure of the port system of the two sides has shown a trend from the concentration of specific transshipment ports to the concentration of hub ports , and then to the direction of regional networking . Direct flights in the bud, the situation in Taiwan strait and the impact of policy making on both sides of the container cargo transportation mode is relatively complex and show the cargo ship impassability characteristics, rely mainly on special navigation model of indirect container liner routed through the third place such as ishigaki, Hong Kong. However, there is also a triangle trade route between Shanghai, Japan and kaohsiung, as well as a pilot direct transport mode between fuzhou and xiamen ports and kaohsiung ports. Therefore, the spatial connection and centrality of cross-strait ports at this stage both present the phenomenon of special transshipment ports such as ishigaki port, Hong Kong and hub ports concentration such as Shanghai, kaohsiung. With the development of the port system and the continuous increase of navigable ports after the direct flights between the two sides of the Taiwan straits, the connection strength and hub function of the major hub ports such as Shanghai and kaohsiung gradually declined, until it was lower than the secondary ports such as xiamen, Qingdao and keelung. The spatial connection of Hong Kong port is reduced because it no longer has the function of third place transshipment , but its central function and accessibility have always occupied an important position in the port system.

5.2. The influence of the economic development and policy implications

The next thing the paper wants to analyze is the internal driving force is the influence of the economic development and policy implications.

Generally speaking, the economic development of port cities and national and local policies will influence each other, and both factors will work together to attract goods from both sides of the Taiwan straits.

The figure 6 below shows the proportion of routes in relevant ports. As described earlier, economic development and policy implications affect the numbers of routes. The

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innermost ring reflects the number of routes involved in the port, the middle ring reflects the number of relevant ports in the route as the starting ports, and the outer ring reflects the number of relevant ports in the route as the arriving ports. It is not hard to see that Hong Kong port, Shanghai port and Shenzhen Port have taken off under the influence of the economic development and policies of the mainland. Taichung, Kaohsiung and Keelung are under the influence of China Taiwan's economy and policies.

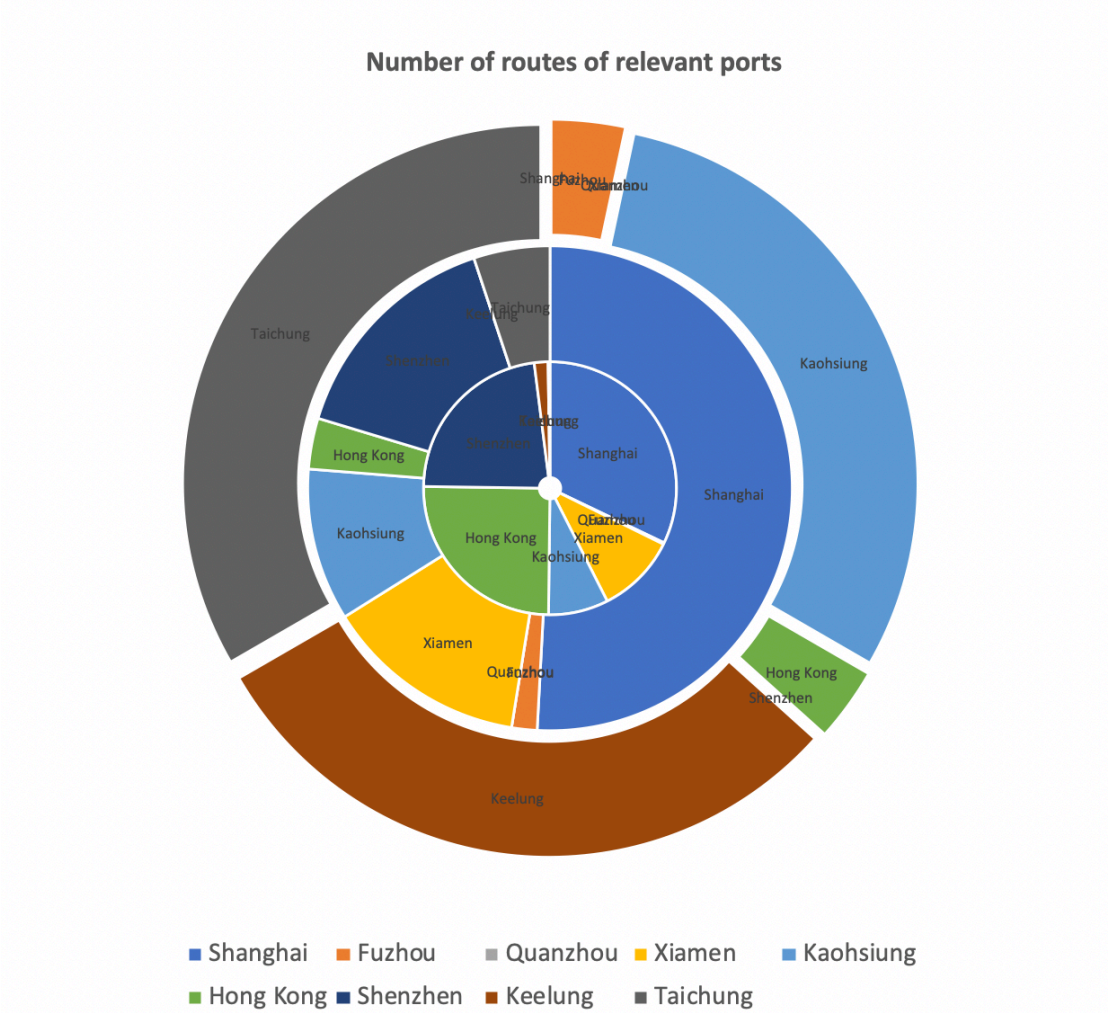

Figure 6 - Number of routes of relevant ports

Regional economic development and strategic planning are the basis for the formation of port supply. Cross-strait economic and trade cooperation development since the 1990 s to enter phase, after 1992 years on the basis of the people on both sides of the Taiwan relations act enacted a series of measures for the licensing of the mainland investment,

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trade and other fields gradually open the mainland imports with the scale and scope of Taiwanese investment in mainland China, at the same time also to have the loose, indirect direct flights until 2008 cross-strait three links , significant progress on both sides of the trade from $7.41 billion in 1992 to $106.23 billion in 2009. At the same time, Taiwan has further accelerated the adjustment of economic structure, accelerated the transfer of intensive industries to the mainland, and driven the pace of investment in the middle and upper reaches of the heavy chemical industry to the mainland. Since the signing of the economic cooperation framework agreement (ECFA) in 2010, the ports of the two sides of the Taiwan straits will have the advantages of more frequent port calls on container routes and more responsibility for the supply of goods between the two sides. Although the port of kaohsiung in Taiwan transfer function declined, but, the development trend of the whole, the three largest ports in Taiwan in space range, strength, or center sexual side has the very big enhancement, thus the reshaping of the cross-strait economic and trade relations and reengineering in addition to better promote Taiwan's industrial structure upgrade, but also increase the contact between the two shipping.

From 2004 to 2013, the relatively concentrated areas of Taiwan business investment and the concentrated areas of cross-strait ports' spatial connection mainly include the four economic zones of west sea , pearl river delta , Yangtze river delta and bohai rim . Jiangsu province has always occupied the highest proportion of Taiwan capital, followed by guangdong province. At present, a large number of taiwan-funded enterprises gather in the Yangtze river delta and pearl river delta regions. Bohai rim area has not formed a strong attraction; The western region of Taiwan is more and more favored by Taiwanese businessmen because of its geographical culture and low labor cost. In the bud period of direct flights, the space connection between Shanghai and Hong Kong was the strongest. During the period of direct flight development, Shanghai port, xiamen port, Qingdao port and dalian port developed rapidly. In the mature stage of direct flights, Shanghai port is the port with the strongest connection strength in the cross-strait port system, followed by xiamen port. Compared with the early stage of direct flights, the route setting of hub ports in the bohai sea and the pearl

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river delta region has decreased somewhat, but many small ports have gradually developed and formed. On the whole, in the past decade, Taiwan businessmen's investment in the mainland has been pushed northward from the pearl river delta to the western region of hainan, and northward from the Yangtze river delta to the bohai rim economic circle with the beijing-tianjin region as the center and the shandong peninsula and the liaodong peninsula as the two sides. The spatial structure of the port system evolves from the hub port concentration to the network pattern of the gradual rise of small ports along with the regional differentiation of cross-strait economic and trade cooperation. The evolution of the spatial structure of the port system has a certain connection with the location choice of direct investment (TDI) by Taiwanese businessmen. Therefore, the evolution of the role of the port is determined by the economic development of the two sides and the market mechanism. At the same time, it also determines the concentration capacity of the port for goods.

5.3. The influence of port technology upgrade on cargo concentration force

The last thing the research wants to analyze is the internal driving force is the influence of port technology upgrade on cargo concentration force.

The theory of the classical port shows that the port system will be diffused when the concentration reaches a certain level.

Represented by Hayuth's five-stage theoretical model, the stage of marginal challenge is formed when shipping enterprises start to move from the hub port to the surrounding small ports, and the competition between the central port and the sub-central port intensifies, resulting in the change and adjustment of the scale, class and spatial structure of the port system. At the beginning of the formation on both sides of the port system development, the spatial structure in hub port of centralized tendency, such as Shanghai, Kaohsiung, Hong Kong hub port on the sea shipping alliance and shipping route layout has strong attraction, part of the small port restricted by water depth conditions, transportation network and so on, failed to achieve containerization, route easily concentrated in hub port, thus forming a hierarchical system of port.

In recent years, the technical conditions of many secondary ports on the edge of the hub

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port have been improved, and the route layout of shipping companies has begun to change from the hub port to the regional secondary port, and the hub port has declined in the central function of the port system. For example, due to external environmental factors such as geographical location, in kaohsiung port, the increase of goods supply is greatly impacted by keelung port, which has increasingly developed internal conditions. Despite the rapid growth of throughput in Shanghai port in recent years, due to the lag of deep-water berth construction, it fails to form a hub centrality corresponding to the handling scale. The marginal challenge is the competition between small ports and large ports, which is realized through technological improvement and low cost. The result is the diversion of containers in hub ports and the rise of secondary ports. The technological innovation of small ports is mainly reflected in the relocation of port areas to improve the water channel and berth depth, such as the construction of tanggu new port in tianjin port, the relocation of dalian port area from the downtown to the suburbs, and the reclamation of fuzhou port to construct jiangyin port area. By direct account for more than 60% on both sides of the line and capacity after the top on both sides of the three shipping companies 6 shipping companies call at the port of adjustment can be seen that Taiwan air transport enterprise of market saturation and the meager profit dock port in south China to shrink, trying to develop more transport: supply of goods by the Taiwan region in north China, east China area is given priority to with Shanghai, ningbo double. Major shipping companies in the mainland have taken the initiative to increase the route allocation of some small and medium-sized ports in Taiwan such as Taipei and mailiu. Therefore, in the mature period of direct flights, xiamen port, Qingdao port and keelung port have improved their status as hubs in the port system, while Shanghai port and kaohsiung port have significantly decreased their centrality. At the same time, the reduction of the affiliated ports in south China and the increase of the affiliated ports in Taiwan also make many small ports mainly rely on the feeding function for cargo transshipment, presenting an obvious feature of small world. In addition to technological innovation, point-to-point direct flights have the advantages of cost and time in the space between mainland China and Taiwan. Shipping enterprises choose to arrange routes between small regional ports and Taiwan ports,

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such as wenzhou to keelung, zhangzhou to kaohsiung, so that some container goods do not transfer through trunk ports. The port system presents the overall diffusion and the regional centralization and hierarchy develops to the regional network.

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6. Conclusion and Suggestion

6.1. Conclusion

Under the influence of the special social background and development mode of direct flights across the Taiwan straits, the port system of the two sides of the Taiwan straits has the special spatial evolution characteristics. Based on the analysis of the principal component analysis method and the coefficient of concentration force, this paper models and evaluates the concentration force of the current port goods. By analyzing, sorting out and summarizing the evolution mode of the special cross-strait navigation, this paper mainly describes and discusses the influencing mechanism of the concentration force of the cross-strait ports under the background of direct navigation. The following conclusions are drawn below.

Firstly, from the implementation of the policy of indirect container liner shipping in 1997 to 2013, the space structure of the container port system on both sides of the Taiwan straits has evolved from the concentration of specific transshipment ports to the concentration of hub ports and then to the development of regional network. In the embryonic period of direct flights, under the special shipping mechanism of direct flights, the spatial connection pattern and central function of the port system both formed a strong concentration force effect in the third transfer port of ishigaki and Hong Kong. Kaohsiung port showed the strongest connection function and hub in the port system, and the overall connection between the two ports was weak. During the period of direct flight development, with the construction of cross-strait shipping network and the preliminary formation of port system, Shanghai, kaohsiung, Hong Kong and other international hub ports showed the characteristics of spatial contact scope, strength and centralized development of port center access, and the port system showed characteristics of hierarchical structure.

In the mature period of direct flight, routes are concentrated in regional trunk ports and some marginal small ports, forming the network features of spatial connection and

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centrality decentralized development of the port system and regional concentration force of peripheral ports. In general, on both sides of the port system by the hierarchization of development and maturity of network transformation, also means that the size of the port cargo concentration force changes, main show is line contact of expanding the range of trunk lines and the reduction in weight, center of sexual weakening in hub port, in the secondary port, and presents the small world of new small port concentration phenomenon, reflect the complexity of the sides of the Taiwan straits port system.

Secondly, the internal influence mechanism of cross-strait port goods concentration is influenced by system, market and technology.

Among them, the special shipping policy is an important social system environment for the formation, development and evolution of the container port system. The development of economic and trade links between the two sides of the Taiwan straits and the comprehensive promotion of ECFA have greatly affected the shipping links between the four major ports in China's coastal economic zones. At the same time, the port competition mechanism based on technological innovation also affects the route allocation of shipping enterprises. Under the influence of system, market and technology, the container port system of the two sides of the Taiwan straits has developed from hierarchy to network.

This study describes in detail the spatial evolution characteristics of the port's cargo concentration force after the direct flight between the two sides of the strait, and makes a preliminary discussion on the institutional policies, market factors and technical conditions affecting the formation and development of the port's cargo concentration force. In future research on cross-strait cargo concentration mechanism still needs further analysis, the influence of such as in the aspect of system, it is need to be used to open foreign shipping companies on both sides of the container shipping business, whether to help maintain international hub port status, and on both sides of the container port system should consideration from a macro point of view, in addition to consider establishing policy and ECFA, should also consider the change of external environment, such as east Asia shipping policy on the influence of the port cargo cohesion on both

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sides. In terms of market economy, should the paper further optimize the layout of ports and shipping routes, enhance the distribution function of ports, maintain a scientific and efficient cross-strait port cargo concentration and cooperation mechanism, and promote the coordinated development of the port system.

6.2. Suggestion for concentration force of goods in Fujian ports

Under the background of comprehensive direct flights, fujian has not only favorable conditions, foundation and experience, but also bottleneck problems. Based on the analysis of the internal influence mechanism of the port's cargo concentration force, the following are my suggestions for fujian coastal ports to increase the cargo concentration. Direct flights have two effects on fujian coastal ports. One is the growth effect. Fujian ports, along with direct navigation, have improved their status and role in cross-strait cargo transport. Second, the substitution effect, the mainland's other ports to obtain cross-strait cargo transport rights and opportunities. In general, the growth effect will be greater than the substitution effect.

Under the new situation, the construction of Fujian ports, especially Xiamen port, Fuzhou port, should be speeded up to improve the cargo concentration force. We will accelerate the planning and construction of Lingang logistics parks such as gulei port, Xiamen bay, Meizhou bay. We will improve the port collection and distribution system and expand internal and taiwan-facing channels and the port hinterland. In order to integrate and make full use of the advantages of fujian and Taiwan's air and sea ports and other resources, the paper will promote the docking with lingang logistics parks in kaohsiung, taichung and keelung, as well as the outlying islands in penghu, kinmen and matsu. We will build an international trade center and logistics distribution center across the Taiwan straits to become an important link in the cross-straits and international logistics chain, and give better play to the role of regional radiation and direct flights. The research has elaborated on the five recommendations below.

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Accelerating port planning and construction

In fujian coastal port layout planning, construction of container and bulk cargo ports which form a transport hub. At the same time, the ro-ro wharf and corresponding supporting measures are added. Building a group of coastal and taiwan-facing ports with xiamen port in the south and fuzhou port in the north as hub ports is to form a coordinated development, and further improve the efficiency of port services such as customs clearance, inspection and quarantine. We will promote fujian's major coastal ports to become important channels for goods from the central and western regions of the mainland to enter and leave Taiwan, and gateway ports for the southeast coast of the mainland to the asia-pacific region and Taiwan.

In terms of the layout of container ports, the paper will focus on promoting the construction of two container transport centers, mainly xiamen port and jiangyin port of fuzhou port, so as to build them into international ports with smooth collection and distribution of ports and complete supporting facilities, so as to dock container transport with Taiwan. In terms of the distribution of bulk cargo ports to Taiwan, meizhou bay and luoyuan bay should strengthen efforts to promote the berths of bulk cargo terminals, so as to form a bulk cargo center connecting with Taiwan, and promote meizhou bay and luoyuan bay to become the transshipment ports for bulk cargo imports from Taiwan, such as ore and oil. In the layout of the rolling dock, priority should be given to layout in xiamen port, fuzhou port, quanzhou port.

Improving the port distribution and collection system

Speeding up the port construction which is connected with the regional railway, highway, form as an unimpeded radiation center. Promoting the land, sea and air transport, to enhance the distribution in the internal regions and connect the mainland provinces in communication network. We can expand hinterland and service area, and enhance cargo concentration force and radiation capacity.

We should continue and accelerate the construction of expressways and regular highway networks. At the same time, the emphasis should be put on strengthening the construction of coastal railway, and the construction of the port area on the north shore

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of meizhou bay, kemen port area and jiangyin port area, so as to strengthen the radiation range of fujian port by means of sea-land combined transport, and strive to become a major channel from the central and western regions to Taiwan.

Expanding channels between fujian and the central and western regions

In addition to accelerating the construction of the transport corridor between fujian and the central and western regions, the transport corridor can also be expanded from the following aspects.

First, the paper need to strengthen cooperation with provinces and cities in the central and western regions in regional customs clearance, and further promote the construction of regional customs clearance for the comprehensive passageway between haixi and western regions. Second, the paper need to promote the construction of a regional customs clearance and inspection cooperation platform, and implement a cross-provincial customs clearance model for different customs areas and inspection areas, so as to expand the scope of clearance. Third, the paper should promote cooperation between fujian ports and production and logistics enterprises in neighboring provinces and the central and western regions. Fourth, the paper need to expand the coverage of e-ports in fujian, achieve connectivity and information sharing with e-port platforms in jiangxi and hunan provinces in the central and western regions, and open one-stop, whole-process, personalized comprehensive service projects for port customs clearance law enforcement and logistics information, so as to provide remote services for import and export to Taiwan.

Integration of port logistics resources in Fujian and Taiwan region

By fujian and Taiwan port alliance, logistics alliance form, realize the coordinated development of fujian and Taiwan port, not only to realize direct flights between the ports of the alliance, and the coalition port can rely on resources complement each other and make full use of the principle of common planning port and shipping system, joint construction of port and logistics information platform, to jointly develop international routes, build international shipping hub in the Taiwan straits.

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Focusing on xiamen, fuzhou port and port of kaohsiung, taichung port, keelung harbor, penghu, kinmen and matsu islands region docking ports, integrate and make the air and advantages of fujian and Taiwan, and other resources, building international trade center, logistics distribution centers across the Taiwan straits, be sides of the Taiwan straits and an important link in international logistics chain, to play a role of regional radiation function and better.

Expanding the flow of people and materials in the comprehensive channel

In order to play the role of the comprehensive direct flight channel, fujian ports should not only have the hardware and software facilities as the channel itself, but also need to expand the flow of people in the comprehensive channel and cultivate and expand the demand of cross-strait logistics market.

The demand of logistics market includes the demand of international and domestic transshipment and the demand of economic exchange and cooperation between fujian and Taiwan. At present, the following measures can be taken to expand the demand of mintai logistics market.

Firstly, the paper should seek the approval of relevant departments to build small trade markets with Taiwan in mawei, meizhou in putian, shijing in quanzhou and sansha in ningde, so as to increase the scale and level of small trade between fujian and Taiwan. Second, the paper must improve and perfect the wheel mooring, speed up the wheel machine mooring joint inspection units round reception center and other supporting facilities, perfect the Taiwan fruit transportation function of docking stations, for there will be a condition of wheel anchor point planning and construction to meet the aquatic products, agricultural products, native products, Taiwan express cargo in and out and Taiwan enterprises, such as transport ships to Taiwan comprehensive wharf. Third, the paper need to complete xiamen Taiwan fruit sales hub as soon as possible the strait, fuzhou, quanzhou fujian and Taiwan agricultural products market, with dongshan lake kasumigaura aquatic products wholesale market for agricultural products center construction, approved for cross-strait aquatic products distribution center, to expand the council for labor export, the expansion of Taiwan fruits, aquatic products zero tariffs

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on imports. Fourth, the paper will attract large logistics and business enterprises from Taiwan to operate cross-straits trade and logistics in lingang logistics park, bonded area, bonded port area and small trade market with Taiwan, and encourage business organizations from both sides of the Taiwan straits to participate in the operation of the commodity trading area, comprehensive service area and storage area.

Building a major channel across the Taiwan straits

In addition to taking advantage of open air and direct channel, the Shajin bridge project and the channel tunnel project should be pushed into planning and implementation. We will push forward the planning of the fuzhou-taiwan high-speed railway project. We will strive to build as early as possible a major Taiwan strait corridor that runs through the two sides of the Taiwan straits and extends to the asia-pacific region. Overcoming the inherent limitations of the sea and air channel，the paper should fully exploit the potential of the geographical advantages of fujian and Taiwan.

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Appendix A: Complete crawler code

```
from bs4 import BeautifulSoup
from urllib import request
import xlwt
value = 1
while value <= 919:
    value0 = str(value)
    url = "http://www.chinaports.com/chuanqibiao/" + value0 + "/null/null/null/query"
    # url="http://www.chinaports.com/chuanqibiao/1/null/null/null/query"
    response = request.urlopen(url)
    html = response.read()
    html = html.decode("utf-8")
    bs = BeautifulSoup(html, 'lxml')
    title = bs.find_all('th')
    data_list_title = []
    for data in title:
        data_list_title.append(data.text.strip())
    content = bs.find_all('td')
    data_list_content = []
    for data in content:
        data_list_content.append(data.text.strip())
    new_list = [data_list_content[i:i + 5] for i in range(0, len(data_list_content), 5)]
    book = xlwt.Workbook()
    sheet1 = book.add_sheet('sheet1', cell_overwrite_ok=True)
    heads = data_list_title[:]
    ii = 0
    for head in heads:
        sheet1.write(0, ii, head)
        ii += 1
    i = 1
    for list in new_list:
        j = 0
        for data in list:
            sheet1.write(i, j, data)
            j += 1
        i += 1
    book.save('船期表'+value0+'.xls')
    value += 1
    print(value0 + "写入完成！")
print("全部完成")
```

Figure 7 - Complete crawler code

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Appendix B: Sailing schedule

Table 16 - Sailing schedule

Carrier	Course name	Shipment	Destination	Port of call
k-line(川崎)	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN（YANTIAN）-SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAND OR-KOBE-TOKYO-NAGOYA-HONGKONG
k-line(川崎)	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN（YANTIAN）-SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAND OR-KOBE-TOKYO-NAGOYA-HONGKONG
k-line(川崎)	American line	DALIAN	YOKOHAMA	DALIAN-TIANJIN（XINGANG）-QINGDAO-SHANGHAI-Prince Rubert-LONG BEACH CA-OAKLAND CA-YOKOHAMA
k-line(川崎)	American line	KAOHSIUNG	PANAMA CITY	KAOHSIUNG-HONGKONG-SHENZHEN（YANTIAN）-BUSAN-PANAMA CITY-SAVANNAH GA-CHARLESTON SC-WILMINGTON.NC-PANAMA CITY
k-line(川崎)	African Line	SHANGHAI	SINGAPORE	SHANGHAI-NINGBO-XIAMEN-SINGAPORE
k-line(川崎)	Euro Line	XIAMEN	HONGKONG	XIAMEN-KAOHSIUNG-SHENZHEN（YANTIAN）-SINGAPORE-PORT SUEZ-ROTTERDAM-FELIXSTOWE-HAMBURG-ANTWERP-PORT SUEZ-JEDDAH-HONGKONG
k-line(川崎)	American line	SHENZHEN（YAN	KAOHSIUNG	SHENZHEN（YANTIAN）-HONGKONG-KAOHSIUNG-KEELUNG-LOS ANGELES CA-OAKLAND CA-KEELUNG-KAOHSIUNG
k-line(川崎)	American line	SHENZHEN（YAN	KAOHSIUNG	SHENZHEN（YANTIAN）-HONGKONG-KAOHSIUNG-KEELUNG-LOS ANGELES CA-OAKLAND CA-KEELUNG-KAOHSIUNG
k-line(川崎)	SouthEast-Asian Line	QINGDAO	MANILA(N)	QINGDAO-BUSAN-SHANGHAI-HONGKONG-SINGAPORE-MANILA(S)-MANILA(N)
k-line(川崎)	Mid-South American Line	KEELUNG	YOKOHAMA	KEELUNG-HONGKONG-SHENZHEN（CHIWAN）-XIAMEN-SHANGHAI-QINGDAO-BUSAN-MANZANILLO-IQUIQUE-VALPARAISO-LIRQUEN-YOKOHAMA
k-line(川崎)	American line	SHANGHAI	VANCOUVER	SHANGHAI-NINGBO-BUSAN-TACOMA WA-VANCOUVER
k-line(川崎)	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line(川崎)	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line(川崎)	American line	SHANGHAI	KOBE	SHANGHAI-XIAMEN-SHENZHEN（YANTIAN）-HONGKONG-LONG BEACH CA-OAKLAND CA-KOBE
k-line(川崎)	Austrilian and Zelanian Line	QINGDAO	BRISBANE	QINGDAO-SHANGHAI-NINGBO-XIAMEN-GUANGZHOU（NANSHA）-SHENZHEN（SHEKOU）-HONGKONG-SYDNEY-MELBOURNE-ADELAIDE-BRISBANE
k-line(川崎)	Japanese and Kokean Line	BUSAN	QINGDAO	BUSAN-YANTAI-QINGDAO
k-line(川崎)	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN（YANTIAN）-SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAND OR-KOBE-TOKYO-NAGOYA-HONGKONG
k-line(川崎)	Japanese and Kokean Line	YINGKOU	TIANJIN（XINGANG	YINGKOU-BUSAN-TIANJIN（XINGANG）
k-line(川崎)	American line	KAOHSIUNG	PANAMA CITY	KAOHSIUNG-HONGKONG-SHENZHEN（YANTIAN）-BUSAN-PANAMA CITY-SAVANNAH GA-CHARLESTON SC-WILMINGTON.NC-PANAMA CITY
k-line(川崎)	Mediterranean Sea Line	SHANGHAI	HONGKONG	SHANGHAI-NINGBO-HONGKONG-SHENZHEN（SHEKOU）-SINGAPORE-PORT SUEZ-ASHDOD-PIRAEUS-THESSALONIKI-PORT SUEZ-SINGAPORE-HONGKONG
k-line(川崎)	American line	SHANGHAI	SHENZHEN（YANT	SHANGHAI-BUSAN-SEATTLE WA-PORTLAND OR-VANCOUVER-KWANGYONG-HONGKONG-SHENZHEN（YANTIAN）
k-line(川崎)	American line	HONGKONG	BUSAN	HONGKONG-SHENZHEN（YANTIAN）-YOKOHAMA-Prince Rubert-VANCOUVER-SEATTLE WA-CHICAGO IL-MEMPHIS TN-NEW YORK NY-YOKOHAMA-SHANGHAI-BUSAN
k-line(川崎)	Mediterranean Sea Line	SHANGHAI	HONGKONG	SHANGHAI-NINGBO-HONGKONG-SHENZHEN（SHEKOU）-SINGAPORE-PORT SUEZ-ASHDOD-PIRAEUS-THESSALONIKI-PORT SUEZ-SINGAPORE-HONGKONG
k-line(川崎)	Euro Line	SHANGHAI	KAOHSIUNG	SHANGHAI-NINGBO-XIAMEN-KAOHSIUNG-SHENZHEN（YANTIAN）-SINGAPORE-PORT SUEZ-ROTTERDAM-HAMBURG-FELIXSTOWE-ANTWERP-LE HAVRE-PORT SUEZ-SINGAPORE-KAOHSIUNG
k-line(川崎)	Mediterranean Sea Line	QINGDAO	MARSAXLOKK	QINGDAO-SHANGHAI-NINGBO-SHENZHEN（YANTIAN）-SINGAPORE-PORT KELANG-PORT SUEZ-PORT SAID-LA SPEZIA-GENOA-FOS-MARSAXLOKK
k-line(川崎)	Mediterranean Sea Line	QINGDAO	MARSAXLOKK	QINGDAO-SHANGHAI-NINGBO-SHENZHEN（YANTIAN）-SINGAPORE-PORT KELANG-PORT SUEZ-PORT SAID-LA SPEZIA-GENOA-FOS-MARSAXLOKK
k-line(川崎)	Euro Line	XIAMEN	SINGAPORE	XIAMEN-SHENZHEN（YANTIAN）-HONGKONG-GUANGZHOU（NANSHA）-QINGDAO-HAMBURG-FELIXSTOWE-ROTTERDAM-ANTWERP-SINGAPORE
k-line(川崎)	Euro Line	XIAMEN	SINGAPORE	XIAMEN-SHENZHEN（YANTIAN）-HONGKONG-GUANGZHOU（NANSHA）-QINGDAO-HAMBURG-FELIXSTOWE-ROTTERDAM-ANTWERP-SINGAPORE
k-line(川崎)	Japanese and Kokean Line	QINGDAO	KWANGYONG	QINGDAO-KWANGYONG-BUSAN-MASHAN-YOKOHAMA-TOKYO-SHIMIZU-NAGOYA-YOKKAICHI-BUSAN-ULSAN-KWANGYONG
k-line(川崎)	SouthEast-Asian Line	QINGDAO	HONGKONG	QINGDAO-TIANJIN（XINGANG）-BUSAN-SINGAPORE-HONGKONG
k-line(川崎)	Mediterranean Sea Line	SHANGHAI	BARCELONA	SHANGHAI-NINGBO-HONGKONG-SINGAPORE-PORT SUEZ-PORT SAID-NAPLES-LA SPEZIA-BARCELONA
k-line(川崎)	American line	QINGDAO	PYONGTAEK	QINGDAO-NINGBO-SHANGHAI-BUSAN-PANAMA CITY-NEW YORK NY-ELIZABETH NJ-WILMINGTON.NC-SAVANNAH GA-PANAMA CITY-BUSAN-PYONGTAEK
k-line(川崎)	American line	HONGKONG	TORONTO	HONGKONG-SHENZHEN（YANTIAN）-XIAMEN-TACOMA WA-VANCOUVER-CHICAGO IL-MEMPHIS TN-NEW YORK NY-TORONTO
k-line(川崎)	Japanese and Kokean Line	SHANGHAI	YOKOHAMA	SHANGHAI-TOKYO-YOKOHAMA
k-line(川崎)	Euro Line	NINGBO	SINGAPORE	NINGBO-SHANGHAI-HONGKONG-GUANGZHOU（NANSHA）-PORT SUEZ-ROTTERDAM-HAMBURG-FELIXSTOWE-ANTWERP-PORT SUEZ-SINGAPORE
k-line(川崎)	Euro Line	KWANGYONG	KWANGYONG	KWANGYONG-BUSAN-NINGBO-SHANGHAI-SINGAPORE-PORT SUEZ-HAMBURG-ROTTERDAM-LE HAVRE-PORT SAID-PORT SUEZ-SINGAPORE-HONGKONG-KWANGYONG
k-line(川崎)	SouthEast-Asian Line	SHANGHAI	HOCHIMINH(CAT L	SHANGHAI-HONGKONG-DANANG-HOCHIMINH(CAT LAI)
k-line(川崎)	Euro Line	SHANGHAI	ANTWERP	SHANGHAI-ROTTERDAM-HAMBURG-FELIXSTOWE-ANTWERP
k-line(川崎)	American line	SHANGHAI	VANCOUVER	SHANGHAI-NINGBO-BUSAN-TACOMA WA-VANCOUVER
k-line(川崎)	SouthEast-Asian Line	SHANGHAI	HOCHIMINH	SHANGHAI-LAEM CHABANG-BANGKOK(PAT)-HOCHIMINH
EMC(长荣)	Mid-South American Line	BUSAN	CURACAO	BUSAN-SHANGHAI-NINGBO-QINGDAO-LOS ANGELES CA-COLON CONTAINER TERMINAL-CARTAGENA-BARRANQUILLA-CURACAO
EMC(长荣)	Mid-South American Line	BUSAN	PAITA	BUSAN-SHANGHAI-NINGBO-QINGDAO-LOS ANGELES CA-COLON CONTAINER TERMINAL-PANAMA CANAL-BUENA VENTURA-GUAYAQUIL-CALLAO-VALPARAISO-IQUIQUE-Matarani-PAITA
EMC(长荣)	Mid-South American Line	BUSAN	PAITA	BUSAN-SHANGHAI-NINGBO-QINGDAO-LOS ANGELES CA-COLON CONTAINER TERMINAL-PANAMA CANAL-BUENA VENTURA-GUAYAQUIL-CALLAO-VALPARAISO-IQUIQUE-Matarani-PAITA
EMC(长荣)	Mid-South American Line	BUSAN	PAITA	BUSAN-SHANGHAI-NINGBO-QINGDAO-LOS ANGELES CA-COLON CONTAINER TERMINAL-PANAMA CANAL-BUENA VENTURA-GUAYAQUIL-CALLAO-VALPARAISO-IQUIQUE-Matarani-PAITA
EMC(长荣)	SouthEast-Asian Line	NINGBO	PORT KELANG(WE	NINGBO-SHANGHAI-SHENZHEN（YANTIAN）-HONGKONG-PASIR GUDANG-TANJUNG PELEPAS-PENANG-PORT KELANG(WEST)
EMC(长荣)	SouthEast-Asian Line	SHANGHAI	PORT KELANG(WE	SHANGHAI-NINGBO-GUANGZHOU（NANSHA）-HONGKONG-SHENZHEN（SHEKOU）-SINGAPORE-TANJUNG PELEPAS-PENANG-PORT KELANG(WEST)
EMC(长荣)	SouthEast-Asian Line	KAOHSIUNG	KUANTAN	KAOHSIUNG-HONGKONG-SHENZHEN（SHEKOU）-SINGAPORE-PORT KELANG-PENANG-TANJUNG PELEPAS-PASIR GUDANG-KUANTAN
EMC(长荣)	SouthEast-Asian Line	TOKYO	PORT KELANG(WE	TOKYO-OSAKA-SHANGHAI-NINGBO-KAOHSIUNG-HONGKONG-SHENZHEN（YANTIAN）-TANJUNG PELEPAS-PENANG-PORT KELANG(WEST)
EMC(长荣)	SouthEast-Asian Line	TOKYO	PORT KELANG(WE	TOKYO-OSAKA-SHANGHAI-NINGBO-KAOHSIUNG-HONGKONG-SHENZHEN（YANTIAN）-TANJUNG PELEPAS-PENANG-PORT KELANG(WEST)
EMC(长荣)	Mediterranean Sea Line	SHANGHAI	TARANTO	SHANGHAI-NINGBO-HONGKONG-SHENZHEN（YANTIAN）-TANJUNG PELEPAS-SUEZ CANAL-ALEXANDRIA-LIMASSOL-ASHDOD-MERSIN-TARANTO
EMC(长荣)	Mediterranean Sea Line	SHANGHAI	TARANTO	SHANGHAI-NINGBO-HONGKONG-SHENZHEN（YANTIAN）-TANJUNG PELEPAS-SUEZ CANAL-ALEXANDRIA-LIMASSOL-ASHDOD-MERSIN-TARANTO
EMC(长荣)	Euro Line	DALIAN	THAMESPORT	DALIAN-TIANJIN（XINGANG）-QINGDAO-HONGKONG-TANJUNG PELEPAS-SUEZ CANAL-LE HAVRE-HAMBURG-ROTTERDAM-THAMESPORT
EMC(长荣)	SouthEast-Asian Line	NINGBO	PORT KELANG(WE	NINGBO-SHANGHAI-SHENZHEN（YANTIAN）-HONGKONG-PASIR GUDANG-TANJUNG PELEPAS-PENANG-PORT KELANG(WEST)
EMC(长荣)	SouthEast-Asian Line	SHANGHAI	KUANTAN	SHANGHAI-NINGBO-GUANGZHOU（NANSHA）-HONGKONG-SHENZHEN（SHEKOU）-SINGAPORE-TANJUNG PELEPAS-PASIR GUDANG-KUANTAN
EMC(长荣)	Mediterranean Sea Line	SHANGHAI	IZMIR	SHANGHAI-NINGBO-HONGKONG-SHENZHEN（YANTIAN）-TANJUNG PELEPAS-SUEZ CANAL-ALEXANDRIA-TARANTO-THESSALONIKI-ISTANBUL-HAYDARPASA-GEMLIK-IZMIR
EMC(长荣)	Mediterranean Sea Line	SHANGHAI	IZMIR	SHANGHAI-NINGBO-HONGKONG-SHENZHEN（YANTIAN）-TANJUNG PELEPAS-SUEZ CANAL-ALEXANDRIA-TARANTO-THESSALONIKI-ISTANBUL-HAYDARPASA-GEMLIK-IZMIR
EMC(长荣)	Mediterranean Sea Line	DALIAN	TANJUNG PELEPA:	DALIAN-TIANJIN（XINGANG）-QINGDAO-HONGKONG-SHENZHEN（YANTIAN）-TANJUNG PELEPAS-SUEZ CANAL-HAIFA-ASHDOD-LIMASSOL-PIRAEUS-ISTANBUL-PORT SAID-TANJUNG PELEPAS
EMC(长荣)	Indian and Pakinstani line	DALIAN	NHAVA SHEVA	DALIAN-TIANJIN（XINGANG）-QINGDAO-HONGKONG-SHENZHEN（SHEKOU）-SINGAPORE-PORT KELANG(WEST)-COLOMBO-NHAVA SHEVA

**

Appendix C: Route chart of scheduled ship

Table 17 - Route chart of scheduled ship

Carrier	Course name	Shipment	Destination	Port of call
k-line	Mediterranean Sea Line	SHANGHAI	PORT SUEZ	SHANGHAI-NINGBO-SHENZHEN (SHEKOU) -SINGAPORE-PORT KELANG-PORT SUEZ-DAMIETTA-KUMPORT-ISTANBUL-Con
k-line	Mediterranean Sea Line	SHANGHAI	PORT SUEZ	SHANGHAI-NINGBO-SHENZHEN (SHEKOU) -SINGAPORE-PORT KELANG-PORT SUEZ-DAMIETTA-KUMPORT-ISTANBUL-Con
k-line	Japanese and Kokean Line	DALIAN	KWANGYONG	DALIAN-QINGDAO-BUSAN-KWANGYONG
k-line	Japanese and Kokean Line	DALIAN	BUSAN	DALIAN-QINGDAO-ULSAN-BUSAN
k-line	SouthEast-Asian Line	QINGDAO	HONGKONG	QINGDAO-TIANJIN (XINGANG) -BUSAN-SINGAPORE-HONGKONG
k-line	Japanese and Kokean Line	DALIAN	BUSAN	DALIAN-BUSAN
k-line	Mid-South American Line	SHANGHAI	CALLAO	SHANGHAI-NINGBO-BUSAN-MANZANILLO-BUENA VENTURA-CALLAO
k-line	Mid-South American Line	SHANGHAI	CALLAO	SHANGHAI-NINGBO-BUSAN-MANZANILLO-BUENA VENTURA-CALLAO
k-line	American line	HONGKONG	TORONTO	HONGKONG-SHENZHEN (YANTIAN) -XIAMEN-TACOMA WA-VANCOUVER-CHICAGO IL-MEMPHIS TN-NEW YORK NY-TORO
k-line	Euro Line	NINGBO	SINGAPORE	NINGBO-SHANGHAI-HONGKONG-GUANGZHOU (NANSHA) -PORT SUEZ-ROTTERDAM-HAMBURG-FELIXSTOWE-ANTWERP
k-line	American line	SINGAPORE	HALIFAX	SINGAPORE-HOCHIMINH-SHENZHEN (SHEKOU) -HONGKONG-SHENZHEN (YANTIAN) -PANAMA CITY-NORFOLK VA-NEW
k-line	SouthEast-Asian Line	SHANGHAI	HOCHIMINH(CAT	SHANGHAI-HONGKONG-DANANG-HOCHIMINH(CAT LAI)
k-line	SouthEast-Asian Line	SHANGHAI	PASIR GUDANG	SHANGHAI-PASIR GUDANG
k-line	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line	American line	SHANGHAI	KOBE	SHANGHAI-XIAMEN-SHENZHEN (YANTIAN) -HONGKONG-LONG BEACH CA-OAKLAND CA-KOBE
k-line	American line	SHANGHAI	KOBE	SHANGHAI-XIAMEN-SHENZHEN (YANTIAN) -HONGKONG-LONG BEACH CA-OAKLAND CA-KOBE
k-line	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN (YANTIAN) -SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAND OR-KOB
k-line	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN (YANTIAN) -SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAND OR-KOB
k-line	American line	DALIAN	YOKOHAMA	DALIAN-TIANJIN (XINGANG) -QINGDAO-SHANGHAI-Prince Rubert-LONG BEACH CA-OAKLAND CA-YOKOHAMA
k-line	American line	KAOHSIUNG	PANAMA CITY	KAOHSIUNG-HONGKONG-SHENZHEN (YANTIAN) -BUSAN-PANAMA CITY-SAVANNAH GA-CHARLESTON SC-WILMINGTON.N
k-line	Euro Line	XIAMEN	HONGKONG	XIAMEN-KAOHSIUNG-SHENZHEN (YANTIAN) -SINGAPORE-PORT SUEZ-ROTTERDAM-FELIXSTOWE-HAMBURG-ANTWERP-
k-line	Euro Line	TIANJIN (XINGAN	FELIXSTOWE	TIANJIN (XINGANG) -DALIAN-QINGDAO-NINGBO-SHENZHEN (YANTIAN) -SINGAPORE-PORT SUEZ-PORT SAID-ROTTERD
k-line	American line	SHENZHEN (YAN	KAOHSIUNG	SHENZHEN (YANTIAN) -HONGKONG-KAOHSIUNG-KEELUNG-LOS ANGELES CA-OAKLAND CA-KEELUNG-KAOHSIUNG
k-line	American line	SHANGHAI	KWANGYONG	SHANGHAI-NINGBO-BUSAN-TACOMA WA-LOS ANGELES CA-OAKLAND CA-BUSAN-KWANGYONG
k-line	SouthEast-Asian Line	QINGDAO	MANILA(N)	QINGDAO-BUSAN-SHANGHAI-HONGKONG-SINGAPORE-MANILA(S)-MANILA(N)
k-line	Japanese and Kokean Line	YANTAI	BUSAN	YANTAI-DALIAN-BUSAN
k-line	American line	TIANJIN (XINGAN	BUSAN	TIANJIN (XINGANG) -DALIAN-QINGDAO-NAGOYA-YOKOHAMA-LOS ANGELES CA-PHILADELPHIA PA-YOKOHAMA-BUSAN
k-line	American line	TIANJIN (XINGAN	BUSAN	TIANJIN (XINGANG) -DALIAN-QINGDAO-NAGOYA-YOKOHAMA-LOS ANGELES CA-PHILADELPHIA PA-YOKOHAMA-BUSAN
k-line	American line	QINGDAO	PANAMA CITY	QINGDAO-SHANGHAI-NINGBO-YOKOHAMA-LAZARO CARDENAS-PANAMA CITY-CRISTOBAL-SAVANNAH GA-NEW YORK NY-E
k-line	Mediterranean Sea Line	BUSAN	VALENCIA	BUSAN-SHANGHAI-NINGBO-KAOHSIUNG-HONGKONG-SINGAPORE-PORT SUEZ-PORT SAID-MARSAXLOKK-NAPLES-LA SPEZ
MOL	African Line	TIANJIN (XINGAN	DAR ES SALAAM	TIANJIN (XINGANG) -DALIAN-BUSAN-SINGAPORE-COLOMBO-MAHE-MOMBASA-TANGA-DAR ES SALAAM
MOL	Austrilian and Zelanian Line	SHENZHEN (YAN	BRISBANE	SHENZHEN (YANTIAN) -DALIAN-YINGKOU-TIANJIN (XINGANG) -BUSAN-GUANGZHOU (NANSHA) -SHENZHEN (SHEKOU
MOL	SouthEast-Asian Line	TIANJIN (XINGAN	BANGKOK	TIANJIN (XINGANG) -DALIAN-BUSAN-MANILA(S)-MANILA-LAEM CHABANG-BANGKOK
MOL	American line	FUZHOU	KWANGYONG	FUZHOU-KAOHSIUNG-KEELUNG-HONGKONG-SHENZHEN (YANTIAN) -SHANGHAI-BUSAN-TOKYO-TACOMA WA-SEATTLE
MOL	American line	FUZHOU	KOBE	FUZHOU-KAOHSIUNG-BUSAN-KOBE-TOKYO-NAHA-BALBOA-PANAMA CITY-MANZANILLO-COLON-MIAMI FL-CHARLESTON
MOL	American line	FUZHOU	KOBE	FUZHOU-KAOHSIUNG-BUSAN-KOBE-TOKYO-NAHA-BALBOA-PANAMA CITY-MANZANILLO-COLON-MIAMI FL-CHARLESTON
MOL	Mid-East Line	SHANGHAI	SINGAPORE	SHANGHAI-NINGBO-HONGKONG-SHENZHEN (CHIWAN) -SINGAPORE-Jebel Ali DUBAI-FUJAIRAH-SINGAPORE
MOL	American line	TIANJIN (XINGAN	KWANGYONG	TIANJIN (XINGANG) -DALIAN-BUSAN-TOKYO-TACOMA WA-SEATTLE WA-VANCOUVER-TACOMA WA-BUSAN-KWANGYON
MOL	American line	DALIAN	KWANGYONG	DALIAN-BUSAN-TOKYO-TACOMA WA-SEATTLE WA-VANCOUVER-TACOMA WA-BUSAN-KWANGYONG
MOL	American line	DALIAN	LOS ANGELES CA	DALIAN-BUSAN-LOS ANGELES CA
MOL	American line	DALIAN	LOS ANGELES CA	DALIAN-BUSAN-LOS ANGELES CA
MOL	Mid-South American Line	TIANJIN (XINGAN	YOKOHAMA	TIANJIN (XINGANG) -DALIAN-BUSAN-MANZANILLO-IQUIQUE-VALPARAISO-LIRQUEN-YOKOHAMA
MOL	Mediterranean Sea Line	DALIAN	SHENZHEN (CHI	DALIAN-TIANJIN (XINGANG) -SHANGHAI-HONGKONG-SHENZHEN (CHIWAN) -SINGAPORE-PORT KELANG(WEST)-SUEZ C
MOL	American line	TIANJIN (XINGAN	KOBE	TIANJIN (XINGANG) -DALIAN-BUSAN-KOBE-TOKYO-NAHA-BALBOA-PANAMA CITY-MANZANILLO-COLON-MIAMI FL-CHARLE
MOL	American line	DALIAN	KOBE	DALIAN-BUSAN-KOBE-TOKYO-NAHA-BALBOA-PANAMA CITY-MANZANILLO-COLON-MIAMI FL-CHARLESTON SC-SAVANNAH
MOL	Canadian line	YANTAI	MONTREAL	YANTAI-QINGDAO-BUSAN-TOKYO-TACOMA WA-SEATTLE WA-VANCOUVER-TORONTO-MONTREAL
MOL	American line	NINGBO	KOBE	NINGBO-SHANGHAI-LOS ANGELES CA-TACOMA WA-VANCOUVER-TOKYO-KOBE
MOL	American line	NINGBO	LOS ANGELES CA	NINGBO-SHANGHAI-KWANGYONG-BUSAN-LOS ANGELES CA
MOL	American line	NINGBO	LOS ANGELES CA	NINGBO-SHANGHAI-KWANGYONG-BUSAN-LOS ANGELES CA
MOL	American line	XIAMEN	TOKYO	XIAMEN-SHENZHEN(Dachan Bay) -HONGKONG-SHENZHEN (YANTIAN) -OAKLAND CA-LOS ANGELES CA-OAKLAND CA-TOK
k-line	Mediterranean Sea Line	QINGDAO	MARSAXLOKK	QINGDAO-SHANGHAI-NINGBO-SHENZHEN (YANTIAN) -SINGAPORE-PORT KELANG-PORT SUEZ-PORT SAID-LA SPEZIA-GEN
k-line	Mediterranean Sea Line	SHANGHAI	PORT SUEZ	SHANGHAI-NINGBO-SHENZHEN (SHEKOU) -SINGAPORE-PORT KELANG-PORT SUEZ-DAMIETTA-KUMPORT-ISTANBUL-Con
k-line	Euro Line	XIAMEN	SINGAPORE	XIAMEN-SHENZHEN (YANTIAN) -HONGKONG-GUANGZHOU (NANSHA) -QINGDAO-HAMBURG-FELIXSTOWE-ROTTERDAM
k-line	Japanese and Kokean Line	DALIAN	BUSAN	DALIAN-QINGDAO-ULSAN-BUSAN
k-line	Japanese and Kokean Line	QINGDAO	KWANGYONG	QINGDAO-KWANGYONG-BUSAN-MASHAN-YOKOHAMA-TOKYO-SHIMIZU-NAGOYA-YOKKAICHI-BUSAN-ULSAN-KWANGYONG
k-line	Mediterranean Sea Line	SHANGHAI	BARCELONA	SHANGHAI-NINGBO-HONGKONG-SINGAPORE-PORT SUEZ-PORT SAID-NAPLES-LA SPEZIA-BARCELONA
k-line	American line	QINGDAO	PYONGTAEK	QINGDAO-NINGBO-SHANGHAI-BUSAN-PANAMA CITY-NEW YORK NY-ELIZABETH NJ-WILMINGTON.NC-SAVANNAH GA-PANA
k-line	American line	HONGKONG	TORONTO	HONGKONG-SHENZHEN (YANTIAN) -XIAMEN-TACOMA WA-VANCOUVER-CHICAGO IL-MEMPHIS TN-NEW YORK NY-TORO
k-line	Japanese and Kokean Line	SHANGHAI	YOKOHAMA	SHANGHAI-TOKYO-YOKOHAMA
k-line	Euro Line	KWANGYONG	KWANGYONG	KWANGYONG-BUSAN-NINGBO-SHANGHAI-SINGAPORE-PORT SUEZ-HAMBURG-ROTTERDAM-LE HAVRE-PORT SAID-PORT
k-line	American line	SINGAPORE	HALIFAX	SINGAPORE-HOCHIMINH-SHENZHEN (SHEKOU) -HONGKONG-SHENZHEN (YANTIAN) -PANAMA CITY-NORFOLK VA-NEW
k-line	Euro Line	SHANGHAI	ANTWERP	SHANGHAI-ROTTERDAM-HAMBURG-FELIXSTOWE-ANTWERP
k-line	Mediterranean Sea Line	BUSAN	FOS	BUSAN-SHANGHAI-NINGBO-SHENZHEN (YANTIAN) -HONGKONG-SINGAPORE-PORT SUEZ-PORT SAID-ASHDOD-MALTA-N
k-line	SouthEast-Asian Line	SHANGHAI	HOCHIMINH	SHANGHAI-LAEM CHABANG-BANGKOK(PAT)-HOCHIMINH
k-line	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line	American line	SHANGHAI	NAGOYA	SHANGHAI-KOBE-YOKKAICHI-NAGOYA-TOKYO-LONG BEACH CA-OAKLAND CA-TOKYO-NAGOYA
k-line	American line	SHANGHAI	KOBE	SHANGHAI-XIAMEN-SHENZHEN (YANTIAN) -HONGKONG-LONG BEACH CA-OAKLAND CA-KOBE
k-line	Japanese and Kokean Line	BUSAN	QINGDAO	BUSAN-YANTAI-QINGDAO
k-line	American line	XIAMEN	HONGKONG	XIAMEN-HONGKONG-SHENZHEN (YANTIAN) -SHANGHAI-NAGOYA-TOKYO-TACOMA WA-VANCOUVER-PORTLAND OR-KOB
k-line	American line	DALIAN	YOKOHAMA	DALIAN-TIANJIN (XINGANG) -QINGDAO-SHANGHAI-Prince Rubert-LONG BEACH CA-OAKLAND CA-YOKOHAMA

**

Appendix D: MATLAB Code for PCA Method

```
from bs4 import BeautifulSoup
from urllib import request
import xlwt
value = 1
while value <= 919:
    value0 = str(value)
    url = "http://www.chinaports.com/chuanqibiao/" + value0 + "/null/null/null/query"
    # url="http://www.chinaports.com/chuanqibiao/1/null/null/null/query"
    response = request.urlopen(url)
    html = response.read()
    html = html.decode("utf-8")
    bs = BeautifulSoup(html, 'lxml')
    title = bs.find_all('th')
    data_list_title = []
    for data in title:
        data_list_title.append(data.text.strip())
    content = bs.find_all('td')
    data_list_content = []
    for data in content:
        data_list_content.append(data.text.strip())
    new_list = [data_list_content[i:i + 5] for i in range(0, len(data_list_content), 5)]
    book = xlwt.Workbook()
    sheet1 = book.add_sheet('sheet1', cell_overwrite_ok=True)
    heads = data_list_title[:]
    ii = 0
    for head in heads:
        sheet1.write(0, ii, head)
        ii += 1
        print(head)
    i = 1
    for list in new_list:
        j = 0
        for data in list:
            sheet1.write(i, j, data)
            j += 1
        i += 1
    book.save(' Sailing schedule '+value0+'.xls')
    value += 1
    print(value0 + "done！ ")
print("done")
```