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The correlation analysis between financial and shipping industry

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THE CORRELATION ANALYSIS BETWEEN FINANCIAL AND SHIPPING INDUSTRY

By

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China

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2009

DECLARATION

I certify that all the material in this research paper that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature): _____

(Date): _____

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Shanghai Maritime University

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Last but not least, I wish to express my indebtedness to my beloved parents, who have offered me full support and encouragement. I am fortunate to have their measureless love as I go forward in my life and career.

Abstract

Title of research paper: **The Correlation Analysis Between Financial and Shipping Industry**

Degree: **MSc**

The globalization make the world shipping market highly related with the world economy, the world shipping market locates at the end of the world economy. According to the Long Whip Effect, the financial crises broken out in United Stated of America could lead the world economy transmit to the shipping economy and the ratio is 1: 10, that means the 1% of world economy decrease will cause 10% lower increase of the world shipping market.

This article analyzed the relationship between financial and shipping industry in macro and micro ways. In the macro way, the author analysis the reason and the transmission mechanism of the financial crisis to present the relation between the two industries. In the micro way, the author use the financial and shipping index as the benchmarks to analyze the micro relation between the two industries quantitatively and get the result as well as some suggestions according to the results.

KEYWORD: Financial Index, Shipping Index, Principal Component Analysis, Correlation Analysis, Regression Analysis, Co-integration Analysis

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LIST OF ABBREVIATIONS

BDI	**The Baltic Dry Index**	**31**
BCI	**The Baltic Capesize Index**	**31**
BPI	**The Baltic Panamax Index**	**31**
BSI	**The Baltic Supramax Index**	**31**
CCFI	**The China Containerized Freight Index**	**31**
PCA	**Principal Component Analysis**	**31**

Chapter 1 Introduction

1.1 Background and meanings

In recent years, the high-speed increase of our economy mainly depend on the large-margin expansion of the foreign trade. In the national income, thee net export rate accounts over 20%, and the ratio of the total amount of import and export and the GDP(Gross Domestic Product) is between 60% and 70%, which ranks top class in the large economic countries. This situation of over dependent on the overseas market illustrates that the change of the world economy can have a large impact on our economy and society.

The globalization make the world shipping market highly related with the world economy, the world shipping market locates at the end of the world economy. According to the Long Whip Effect, the financial crises broken out in United Stated of America could lead the world economy transmit to the shipping economy and the ratio is 1: 10, that means the 1% of world economy decrease will cause 10% lower increase of the world shipping market. The BDI index fell from 12000 to nearly 600 in only half of a year. According to the statistics of shippingchina website (http: www.shippingchina.com), the freight rate of top eight ports in China of three main lines including Europe, North America and Mid East had a decreasing trend in recent few months. And according to their prediction, the shipping market will also decrease in 2009 and 2010 or even longer period.

As we all know, the year of 2009 will be the most difficult year in shipping industry, many companies will suffer the loss without any question. The common sense is that the ‘winter’ of shipping industry will be longer or even last to the year of 2010. If so, people should not be surprised that the peak of bankruptcy takes place. In the

prosperity of shipping industry, many ship-owners run into debt to book new vessels, including the conformity of merged Maersk. But now, see what has happened: the 'low valley' of the credit market, unwillingness of the banks to lend money, the sharp decrease of the cargo as well as the advanced delivery of vessels of the shipyard. Under the duel press of peak of advanced delivery of vessels and the recession of the shipping market, many ship-owners will probably choose to discard their vessels or use their vessels to compensate for the loans. According to the prediction of Clarkson Research, the transport power will increase by 14% and 16% in this year and next year. Obviously, the supply cannot be satisfied by the demand. The basic condition of next prosperity in shipping industry is the balance of supply and demand. Faced with the large crises, large impact, large turbulence, large pattern, large opportunity brought by the financial crisis, the analysis of correlation between the finance and shipping industry is absolutely necessary.

1.2 Literature Review

The financial crisis and its impact on the entity economy and shipping industry

Cao Yuanzheng (2008) declared that the subprime lending crisis cannot be the reason of global financial crisis. He had three reasons to support his point: (1) countries around the world had already had experience in dealing with the crisis like this. (2) faced with this financial crisis, all the countries in the world were strengthening their international cooperation. (3) Since the subprime lending crisis broken out, the financial institutes suffered were still Citibank, Merryill Lynch, there was no evidence of expansion.

However, Fan Qiaoyan (2008) believed that there were three reasons that caused the financial crisis: (1) the constant rise of interest rate imposed heavier burden on the buyers. (2) the constant cooling after the expanding of the real-estate market leaded to the declining of the credit quality of the mortgage. (3) Insufficient rate of saving of American local people cause no ability of resistance. (4) the distortion of the credit

ranking institutes expanded the financial risk.

Fu Jianyuan and Zhang Shilin (2008) declared that the transmission mechanism is based on two ways: (1) trade spillover means that the financial crisis in one country could make other countries with which has direct or indirect trade relation suffer the same economical problems through the price and income effect. (2) finance spillover means that the crisis in one market could make other related markets such as FDI, lending of the bank, bond market lack of mobility.

Chen Lei (2008) had the same idea with Fu Jianyuan and Zhang Shilin (2008), besides two ways of transmission mechanism such as trade channel and finance channel, she added another channel named psychological channel which means the crisis in one country could make local people recall the memory of the past and have a great impact on the future planning of these people, economists call it ‘ wake-up effect’.

Zhou Caiyun held another idea on the international transmission mechanism of financial crisis, he believed that there were three kinds of mechanisms: (1) the ripple effect of the crisis transmission means that the crisis in one country did harm to the base of macro economy of another country, then make the crisis happen in that country. (2) monsoonal effect of the crisis transmission means that the change of the global economical environment dominated by the developed countries definitely have great impact on the developing countries. (3) the trade effect of crisis transmission means that when there is a financial crises, the currency devaluation usually happens, and then strengthen its export competency , then make its trade partners suffer the trade deficit and economic deterioration.

Guo Qinggen (2008) made it clear that the financial crisis did a lot of harm to the entity economy including : twisted manner of resource allocation, low efficiency of resource allocation, agriculture and industry halt, etc. The rise of cost lowers the

international competency of the entity department and blocks the increase of trade.

Liu Bin (2008) held that The globalization make the world shipping market highly related with the world economy, the world shipping market locates at the end of the world economy. According to the Long Whip Effect, the financial crises broken out in United Stated of America could lead the world economy transmit to the shipping economy and the ratio is 1: 10, that means the 1% of world economy decrease will cause 10% lower increase of the world shipping market.

Wu Xin (2008) believed that the year of 2009 will be the most difficult year in shipping industry, many companies will suffer the loss without any question. The common sense is that the 'winter' of shipping industry will be longer or even last to the year of 2010. If so, people should not be surprised that the peak of bankruptcy takes place.
Liu Bin (2008) also said that according to the prediction of Clarkson Research , the transport power will increase by 14% and 16% in this year and next year. Obviously, the supply cannot be satisfied by the demand. The basic condition of next prosperity in shipping industry is the balance of supply and demand.

However, Wu Xin (2008) declared in another journal that the financial crisis has a positive impact on the reshuffling in the shipping industry which makes the shipping industry more transparency.

Ding Gang (2008) had the same idea with Wu Xin (2008), he believed that the financial crisis will definitely promote the change of the shipping pattern and blue economy (high efficiency , low cost, high service quality) will be the trend and the target of the shipping industry.

Cai Jingwei (2008) also added that to some extent, the financial crisis has shocked the shipping industry , but also make the warning for the new develop trend of shipping industry.

Research Methods

Song Zhihua and Jiang Huiyuan (2008) used the Principle Component Analysis in their Logistics Distribution Selection. They discarded the AHP (analysis hierarchy process), because they believe that the AHP has verbose processes and increase the subjectivity in the estimation. So they choose the PCA method. They believe that the PCA can reflect the weight of each sample objectively to avoid the subjectivity, thus it is a comprehensive method in the selection of logistics distribution center.

Tang Feng and Li Xiaoxia (2008) also used the Principle Component Analysis in their research on the impact of the logistics cost on the finance achievement. They believed that the PCA can give full play of all the databases, using the principle component contribution rate as the weight, which is comprehensive and objective. So the PCA is an effective way of solving the quantification problems.

Yang Zhen (2005) used the analysis of correlation in its research on the correlation between the economic development and rural urbanization. She used the correlation coefficient as the measurement of the intensity of both, the correlation coefficient can be divided into four types: slight, low, prominence and high. So she has a quantification standard to measure the correlation between the economic development and rural urbanization.

Liu Xiaoguang and Yang Haoxi (2006) also used the analysis of correlation in their research on the correlation between the foreign direct investment and the GDP growth in our country. They used another way of analysis of correlation. They drew the graph of trend according to the data, then observe the graph to get the overall relation of both, finally use some mathematic model to get the exact relationship of both.

1.3 Research content of the dissertation

The objectives of the paper are:

- make clear the transmission mechanism of the financial in a macro way, which means that analysis the relationship between finance and shipping industry in a macro way.
- analysis the actual relationship between the financial index and shipping index in a micro way by using some mathematics model.
- help the shipping companies to know the extent of the correlation between finance and shipping industry and minimize the loss in the financial crisis and help them to make quick response to the fluctuation in the finance industry because of the initial limitation of lag for the shipping industry.

The author does the analysis in two parts:

1. Analysis the relationship between financial and shipping industry in a macro way. Mainly analysis the transmission mechanism of the financial crisis and the impact of the economic recession on the shipping industry including container, dry bulk, oil as well as the shipbuilding industry.
2. Analysis the correlation between financial and shipping industry in a micro way.

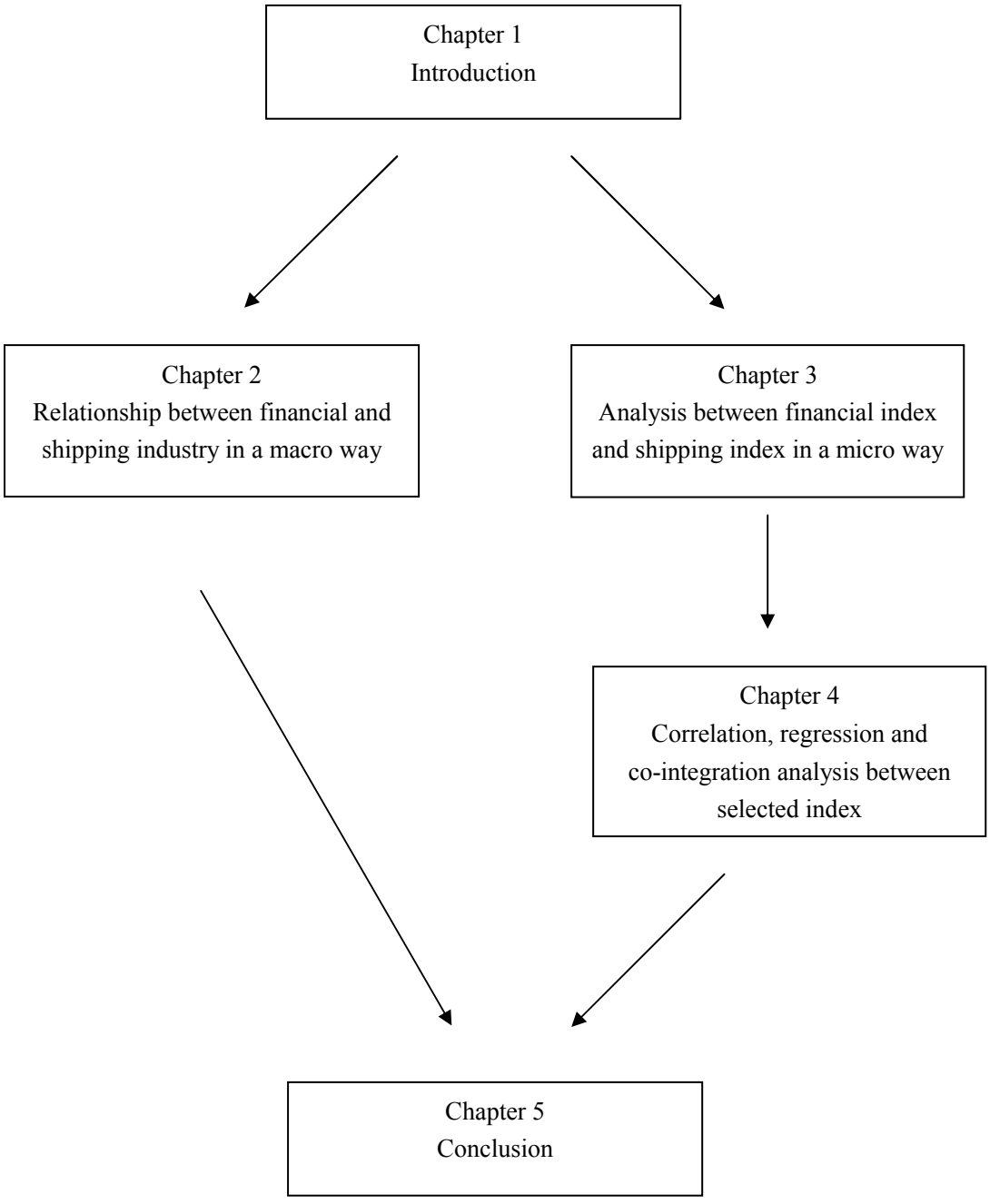
- Select the principal financial index and shipping index to compare with each other in the method of Principal Component Analysis.
- Do the correlation analysis, regression analysis and co-integration analysis between the selected financial and shipping index.

1.4 Organization & Structure of the dissertation

The organization of the dissertation is as follows: Chapter 1 is the introduction of the background and meaning of the thesis, literature review, research objectives, methods and creative points are covered. Chapter 2 highlights the relationship between financial industry and shipping industry in a macro way : the transmission

mechanism of the financial crisis and the impact of the economic recession on the shipping industry including container, dry bulk, oil as well as the shipbuilding industry. Chapter 3 gives the introduction of the financial and shipping index and the method to select 2 index from these and the introduction of the method of Principal Component Analysis and the steps as well as the result of the selection. Chapter 4 covers the correlation analysis of the two selected financial and shipping index, the regression analysis between the relative value of the two selected index as well as the necessity of the co-integration analysis and the results. Finally, Chapter 5 gives a conclusion that have been derived from the research, suggestions in practice as well as the comments of the author.

Figure 1.4.1 Structure of the Research Paper:



Chapter 2 The transmission mechanism of the financial industry

2.1 The reason of the economic crisis

Since 2001, in order to stimulate the economy, the Federal Reserve started to bring into the police of low interest rate into effect, then cause a large demand of purchasing the houses. In order to use the fund efficiently and follow the market, the financial institutions invested a series of financial innovations, then forms a complicated financial product chain based on housing. The salability of these financial innovation encourages the greedy of the financial institutions and these innovations are lack of strict supervision and the long financial product chain as well as the asymmetric of the information, the financial institutions loose the identification of the related risk and control, the vicious circle cause the break out of the subprime mortgage crisis and extended globally, make the American financial system suffered a serious defeat and lead to the crisis extend globally and the break out of the global financial crisis.

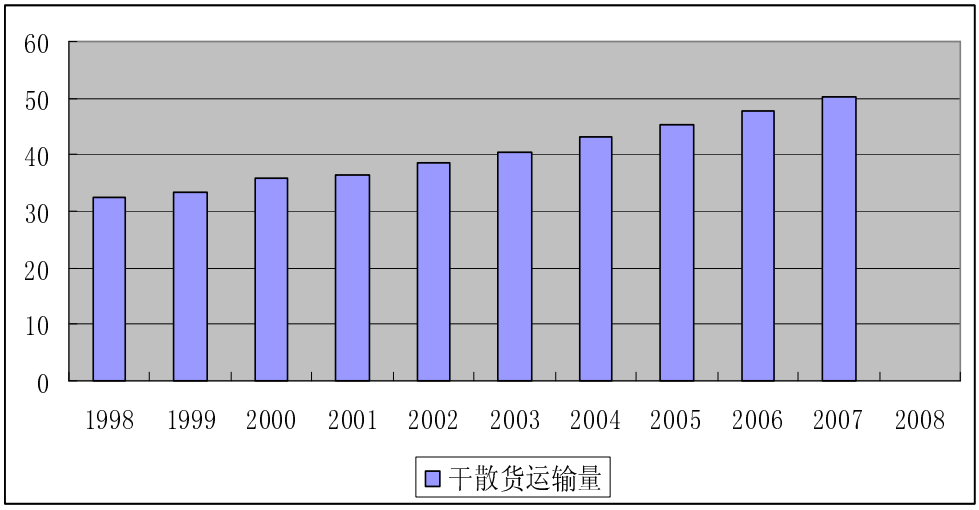
The financial crisis caused by the subprime mortgage crisis, are having is impact on the real economy and cause the global economic crisis. In order to stop the extension of the crisis, the U.S. Treasury Department put forward the emergency package of as high as 700 billion US dollar, but it is only the emergency policy of reliving the negotiability of the financial institutions. The deeper reason of the global financial crisis is the pursuing the maximum profit of creating the financial innovations, meanwhile neglecting the undertaking and control of the related risks. Hence, it is very important to supervise the operation of the financial institutions and make them identify and manage its business and its risks when encouraging the financial innovations.

2.2 The impact of the financial crisis on the shipping industry

2.2.1 International dry bulk cargo market

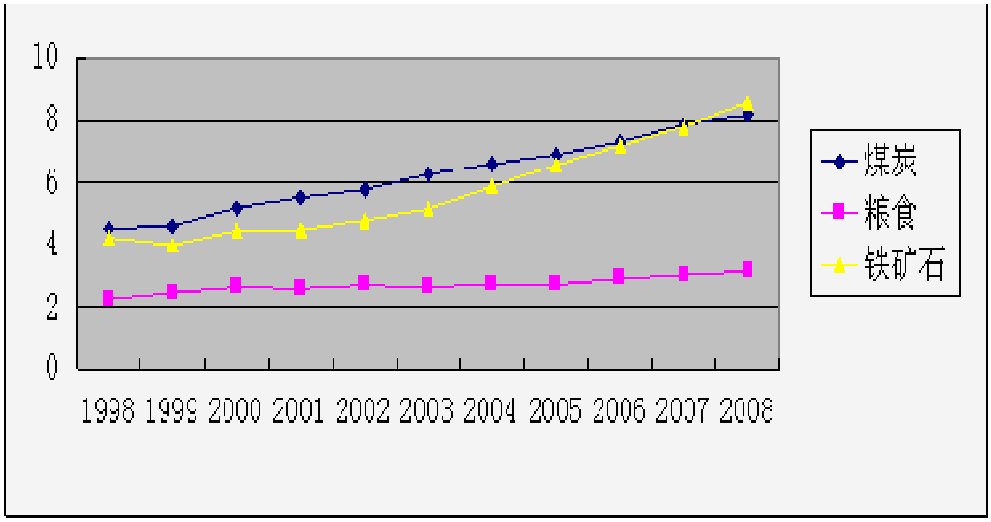
（1）Traffic

Firstly, the change of global dry bulk cargo traffic from 1998 to 2008 are listed as the follow graph.



Graph 2-1 the amount of the global dry bulk cargo from 1998 to 2008

(unit: 100million tons)



Graph 2-2 the main kind of the global dry bulk cargo from 1998 to 2008

(unit : 100million tons)

We can make a conclusion from the graph above, in recent decade, the amount of global dry bulk cargo has a stable trend of growth, especially it has a increase of 4% each year since 2002. Among them, the amount of the coal and the iron ore had a trend of tremendous increase while the growth of the grain had a relatively slower. It worth notice that the growth of the global dry bulk cargo is slower because of the decline of the world economy growth. And in the 4th quarter of 2008, the amount of the dry bulk cargo appeared the negative increase, the amount of the iron ore and coal slipped in different degree, as the sheet below shows:

2008	1Q	2Q	3Q	4Q
Amount of the dry and bulk cargo	779.6	795.4	809.2	798.5
Increasing rate	0.004	0.02	0.017	-0.013

Sheet 2-1 the amount of global dry and bulk cargo in 2008

(unit : 10 thousand tons)

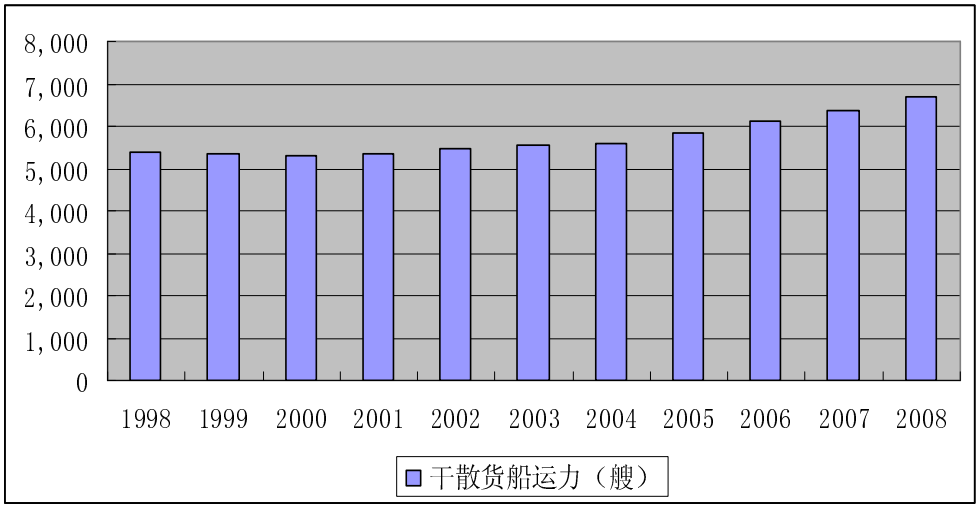
2008	1Q	2Q	3Q	4Q
Iron ore	219	230.5	228.1	211.8
Coal	203.9	211	217.2	223.6
Grain	62.4	57.1	57.6	60.2
Others	294.3	296.8	306.3	303

Sheet 2-2 the main kind of the global dry and bulk cargo

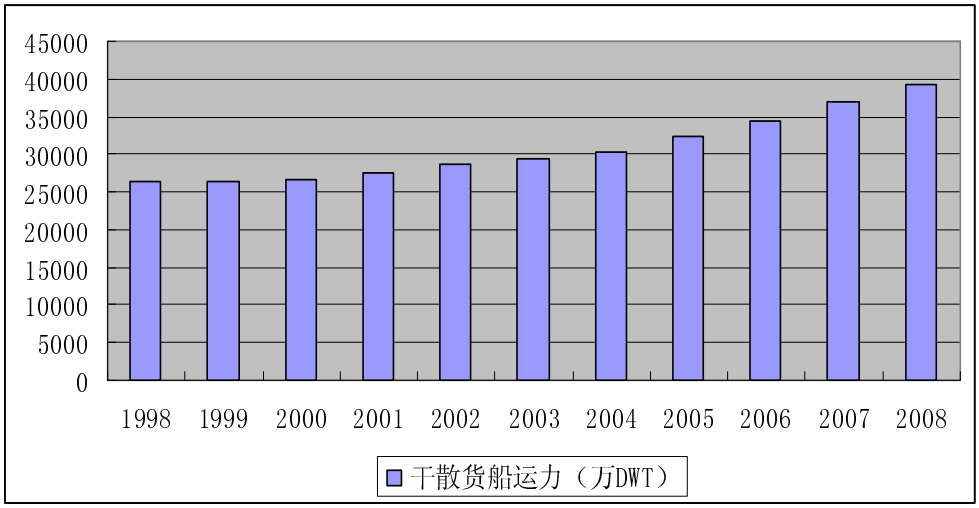
(unit : 10 thousand tons)

（2）Capacity.

As the growth of the world dry and bulk transport scale, the capacity of the dry and bulk cargo is increasing tremendously, which can be showed as the graph below:



Graph 2-3 the number of the world dry bulk cargo vessels from 1998 to 2008



Graph 2-4　The deadweight of the world dry bulk vessels from 1998 to 2008

（unit：10 thousand tons ）

It can be showed from the graph above, in recent decade, it has an obvious increasing in the investment of the capacity of the world dry and bulk vessels, especially since 2005, in increasing rate has kept over 4% in the number of vessels and 6% increase in the deadweight of the vessels because of the prosperity of the shipping market and the large investment to the market.

（3）Freight.

On the whole, the world dry and bulk shipping market has a strong cyclical fluctuation. According to the statistics, the dry bulk market has experienced 12 circles, and each of them takes about 7 years.

The recent shipping prosperity started from 2004, especially from the second half of 2007 to the first half of 2008, the tremendous growth of the freight is caused not only the increase of the shipping demand and sensationalization in the FFA market, but the insufficient capacity as well. According to the statistics, the increasing range of the capacity from 2003 to 2007 are 2.5%、6.73%、6.98%、6.73%、6.32% respectively.

Since the second half of 2008, the BDI started decline because of the negative

impact of quick growth of capacity and the demand of dry and bulk cargo, and it has already reached its lowest level in history.

Graph 2-5 BDI index from November 2007 to November 2008

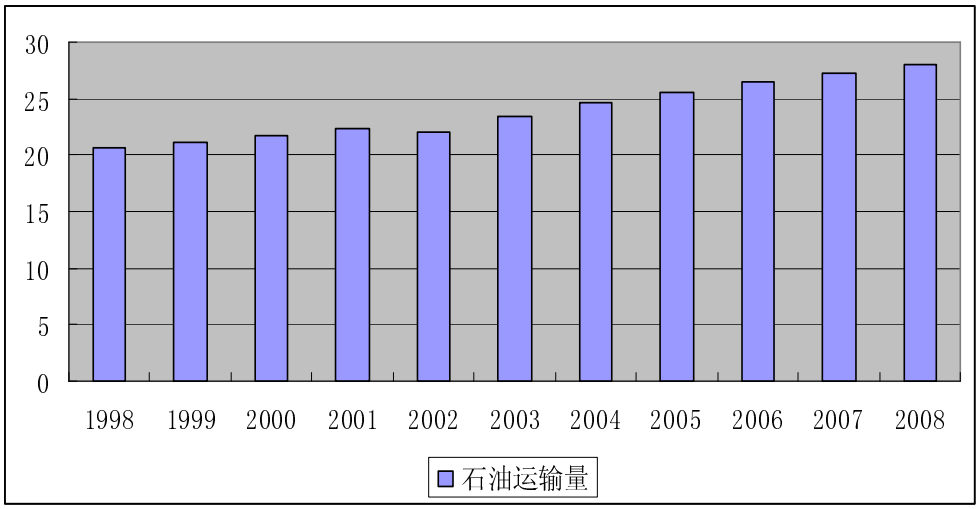
Looking into the future, on one hand, the world economic crisis will cause the another slip of the demand of dry and bulk cargo. Simultaneously, the dry bulk vessels delivered in 2009 and 2010 will reach 67.58 million deadweight and 109 million deadweight respectively. Because of the slip of the world economy, difficulty of the shipping finance, it is estimated that there will be more vessels delayed and the actual delivered capacity will far less than the data above.

We assume that 20% of the vessels in 2009 can not be delivered on time, and the launch of the market capacity will be 54.06 million deadweight tons, year-on-year growth rate 12.9%. And we assume that 45%-50% of the vessels can not be delivered in 2010, the launch of the market will be 50.5 million deadweight tons. In any case, it will definitely surpass the rate of the launch of 25 million deadweight tons in yeas before. By this token, the dry bulk shipping market will be the fact that supply exceeds demand, the freight of the market will keep downturn.

2.2.2 Oil Transportation

（1）Traffic.

Firstly, I list the change of world oil capacity from 1998 to 2008 as follows:



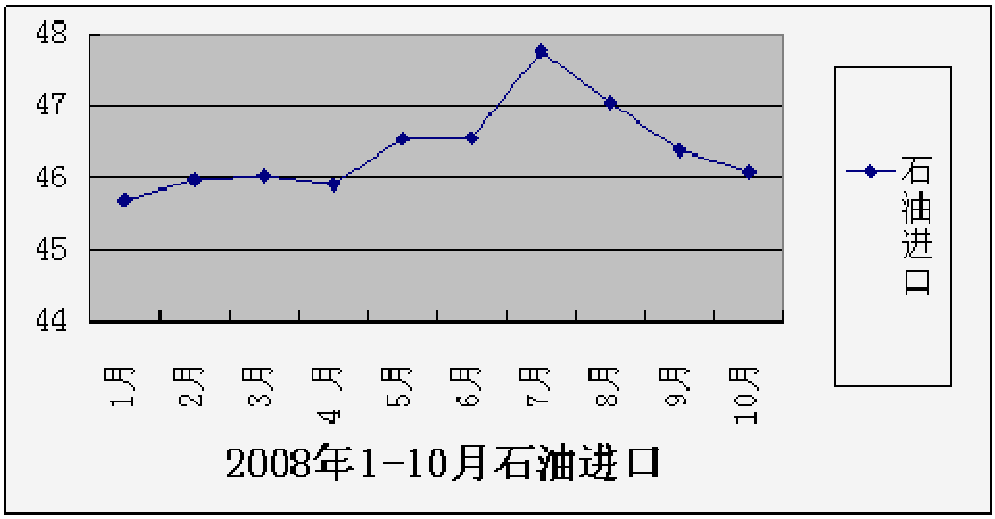
Graph 2-6 the capacity of the world oil from 1998 to 2008

(unit : 100million tons)

We can see from the graph above, the world oil capacity presents a increasing trend, and since 2003, another round of high-growth circle has started. Until 2007, the world oil capacity started decline, and reached its lowest point of less than 3%.

Among others: the recent strong fluctuation of the world oil price has a great impact on the oil transportation. Since the second half of 2007, the world oil price started increasing unprecedented, and on 11th July 2008, the oil price created a new record of $147.27 per barrel but after the second quarter in 2008, the world oil price started decline. On 5th December 2008,the price fell under $41 per barrel meanwhile reaching its lowest level since 10th December 2004.

The world oil capacity is declining because of the relief growth of the world economy and the decline of the oil price. I list the oil import capacity in major countries in the world in 2008.



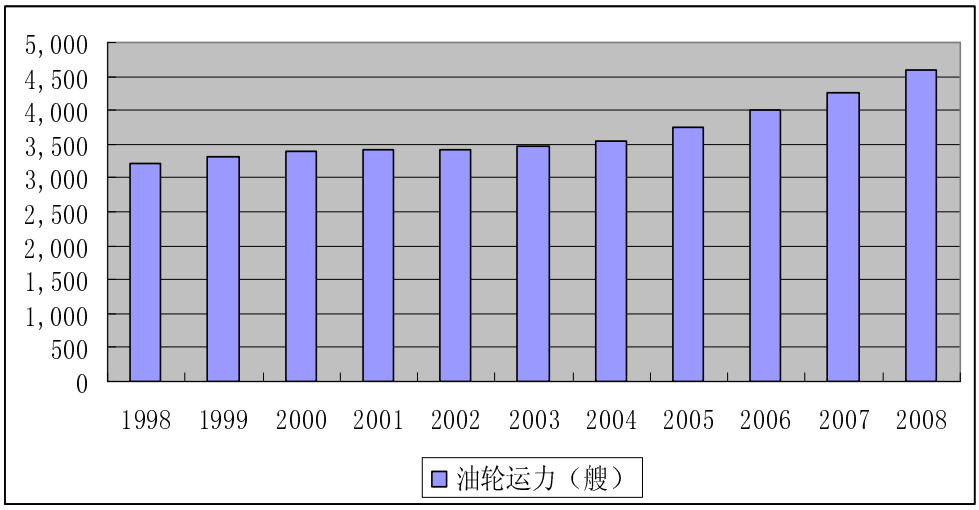
Graph 2-8 the world oil import capacity from January to October in 2008

(unit: 10 thousand tons)

We can draw from the graph above, since August in 2008, the world oil import capacity has presented a slipping trend, and it is aggravating since October in 2008.

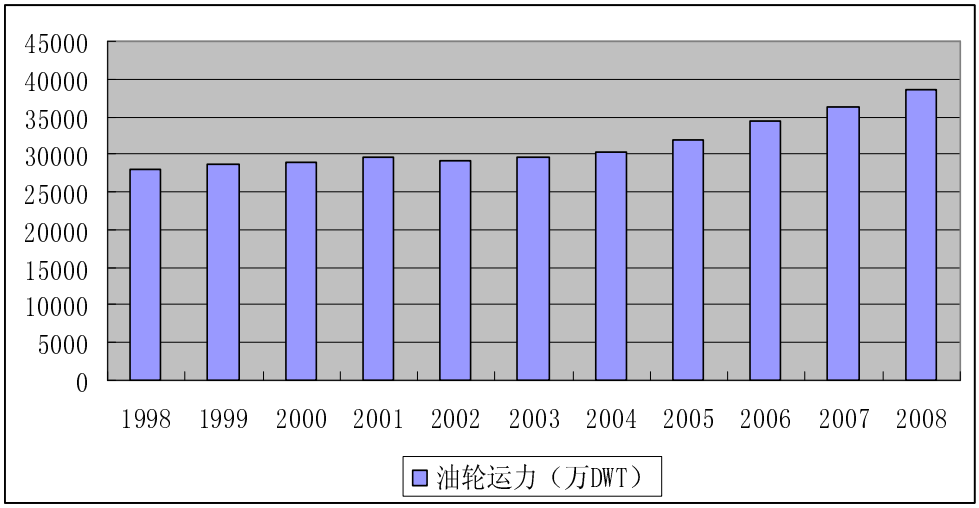
（2）Capacity

I list the change of the capacity of the oil tanker from 1998 to 2008.



Graph 2-9 the number of the oil tanker in the world from 1998 to 2008

(unit: vessel)

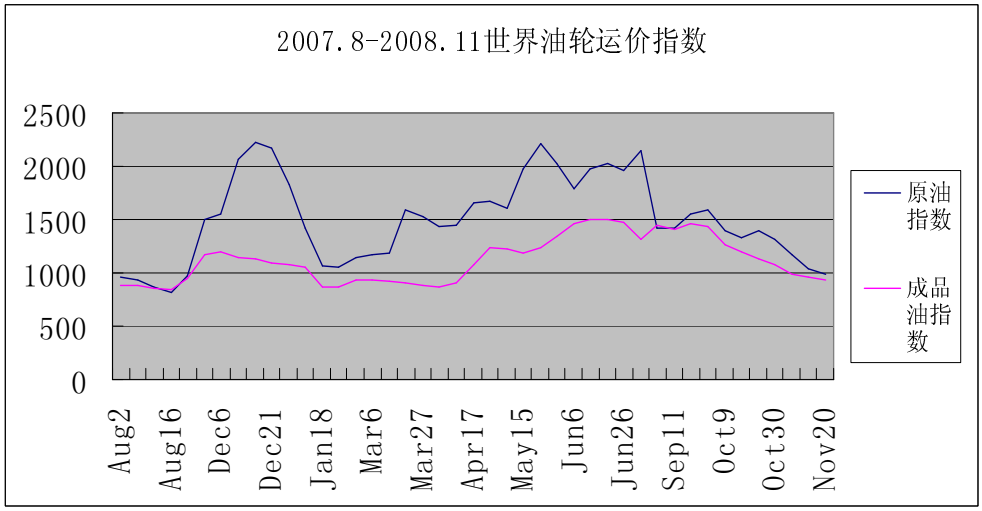


Graph 2-10 the deadweight ton of the oil tanker in the world from 1998 to 2008 (unit : 10 thousand tons)

We can see from the graph above, in the recent decade, there is a increasing trend no mater in the number of the oil tankers or the deadweight tons in the world, especially since 2005, the trend has increased tremendously and the margin reached over 5%.

（3）Freight.

I list the change of the BDTI from August 2007 to November 2008.



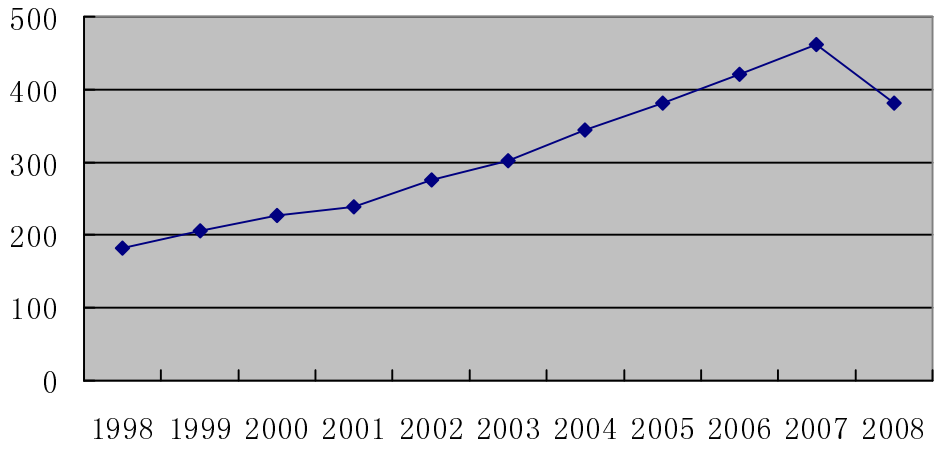
Graph 2-11 BDTI from August 2007 to November 2008

I can draw the conclusion that the BDTI fluctuated strongly while the BCTI has a steady trend. But compared with the BDI, the oil transportation market is relatively steady, which has a close relationship with the relative rigidity of the demand of the oil.

2.2.3 Container Transportation

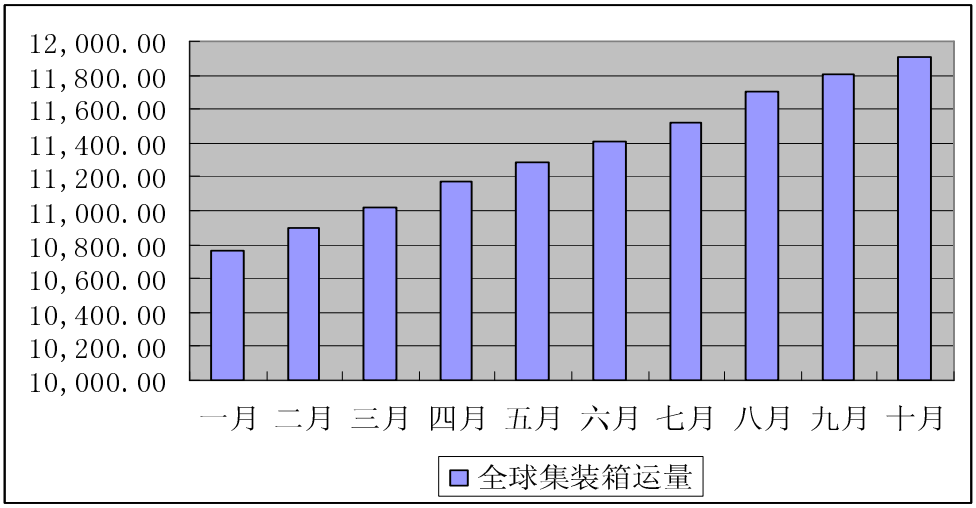
（1）Traffic

The amount of the container in the world transported is listed from 1998 to 2008.



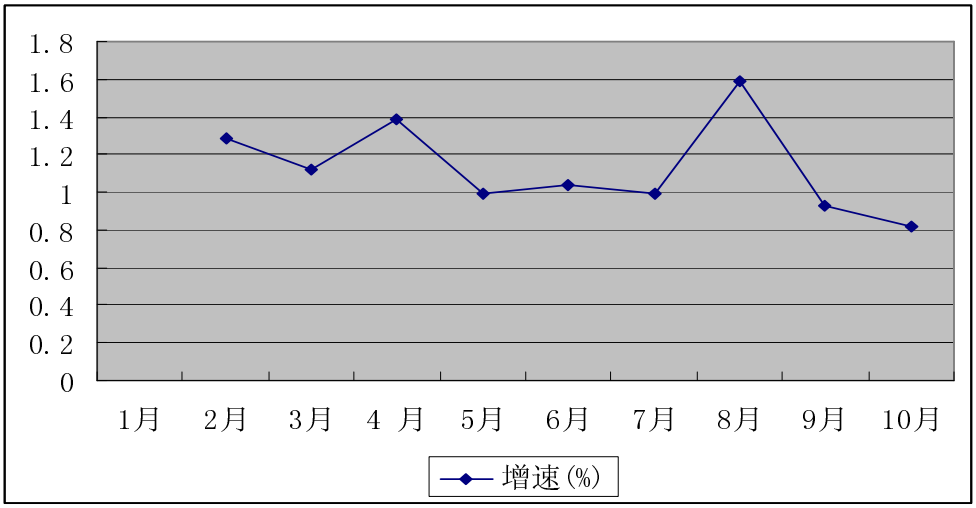
Graph 2-12 the amount of the container transported in the world from 1998 to 2008. (unit : 100 million TEU)

We can see from the graph above, in recent decade, the amount of the container in the world has increased, especially the margin in 2002 reached 15.2%. In the coming 5 years, the growth margin of stayed over 10%. But in 2008, because of the negative impact of global economy recession, and international trade shrink, the increasing rate of the container slowed down, in October 2008, the rate only stayed 0.82%. According to in completely figures, the amount of the container in 2008 only 38.14 billion TEU, and will decline after 10 years as the graph below shows:



Graph 2-14 the amount of container in the world in 2008

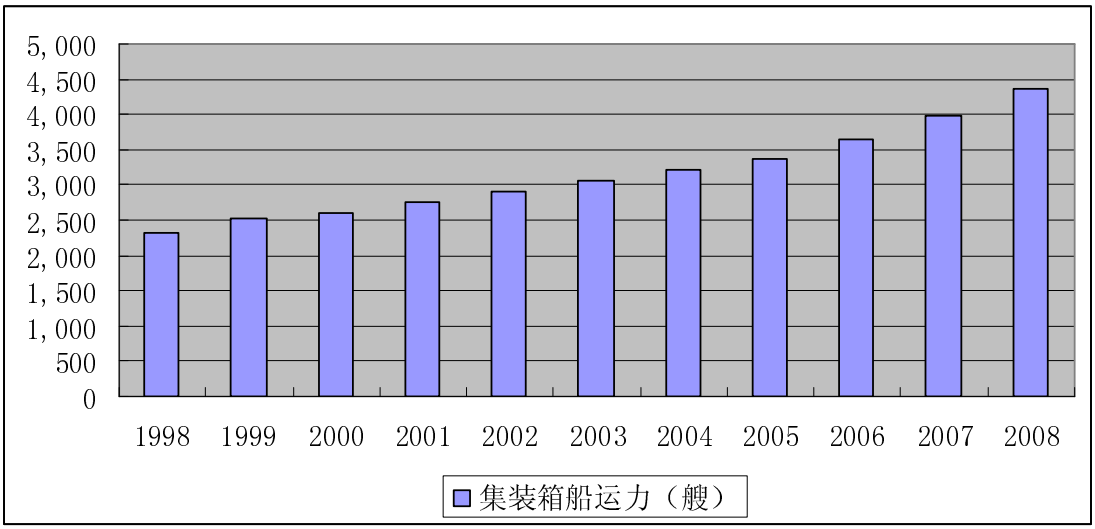
(unit :10 thousand TEU)



Graph 2-15 the increasing rate of the amount of the container in 2008

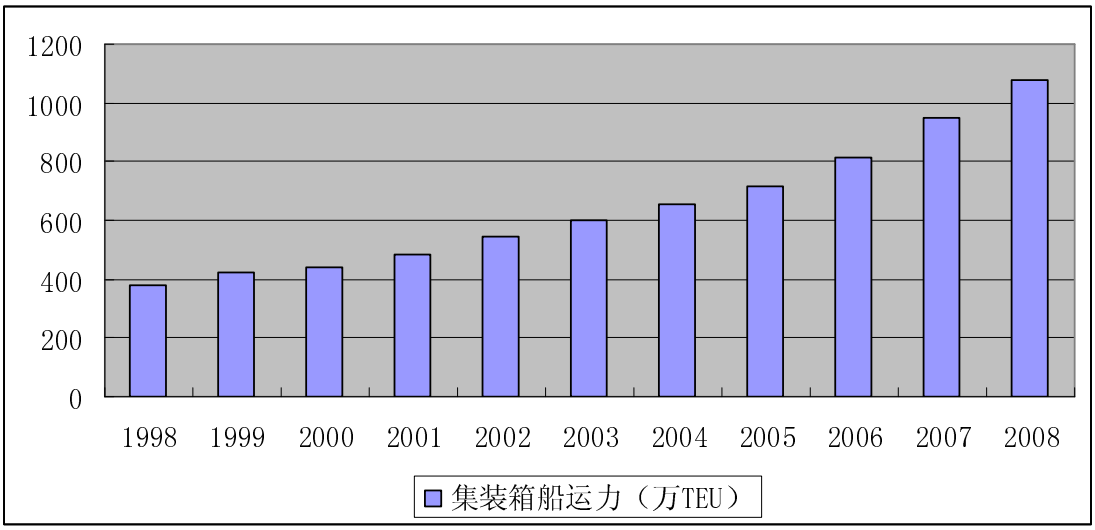
（2）Capacity.

I list the capacity of the world container from 1998 to 2008:



Graph 2-16 the number of the world container vessel from 1998 to 2008

(unit : vessel)



Graph 2-17 the deadweight ton of the container vessels from 1998 to 2008

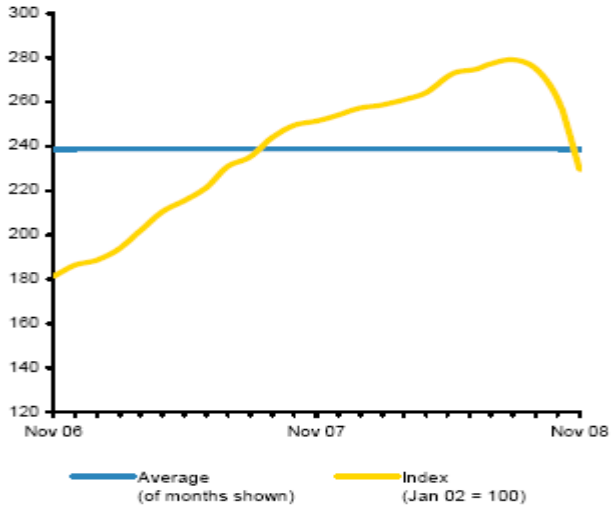
(unit: 10 thousand TEU)

We can see from the graph above, in recent decade, the capacity of the world container has increased tremendously and reached the peak in 2007 and 2008.

2.2.4 Shipbuilding industry.

（1）Price of dry bulk vessel

Firstly, I list the new-building price index published by Drewry:

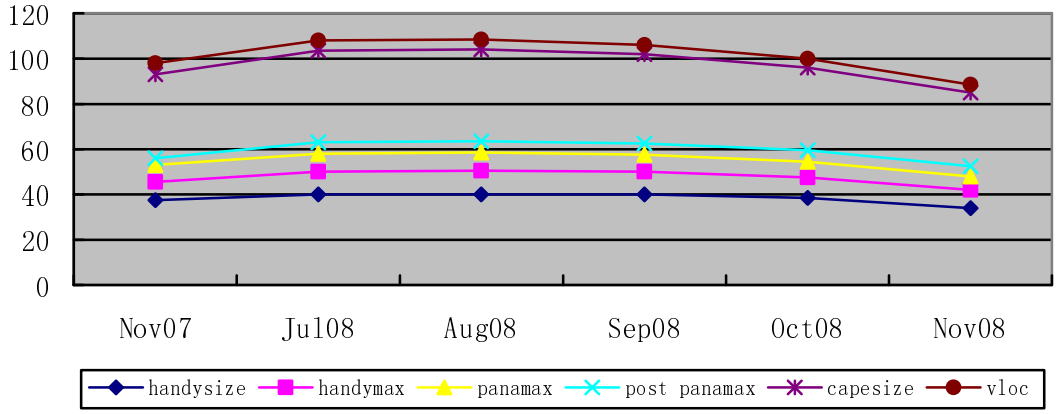


The dry bulk new-building index from November 2006 to November 2008

Secondly, I also list the change of all types of dry bulk vessels from November 2007 to November 2008.

	Deadweight	Nov07	Jul08	Aug08	Sep08	Oct08	Nov08
handysize	30000	37.5	40	40	40	38.5	34
handymax	55000	45.5	50	50.5	50	47.5	42
panamax	75000	53	58	58.5	57.5	54.5	48
Post panamax	95000	56	63	63.5	62.5	59.5	52.5
Capesize	170000	93	103.5	104	102	96	85
Vloc	220000	98	108	108.5	106	100	88.5

The price of the new-building from Nov 2007 to Nov 2008.



The price of the new-building from Nov 2007 to Nov 2008.

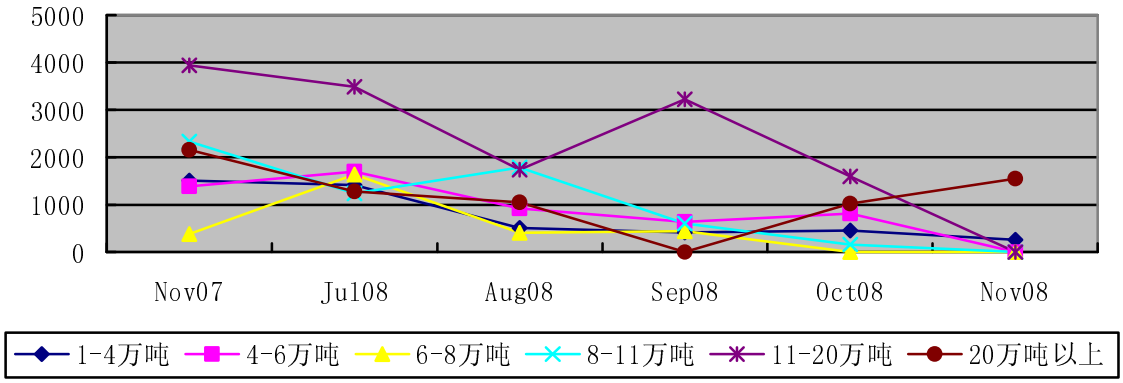
We can see that thee price of all types dry bulk vessels present the trend of decline.

（2）Amount of shipbuilding

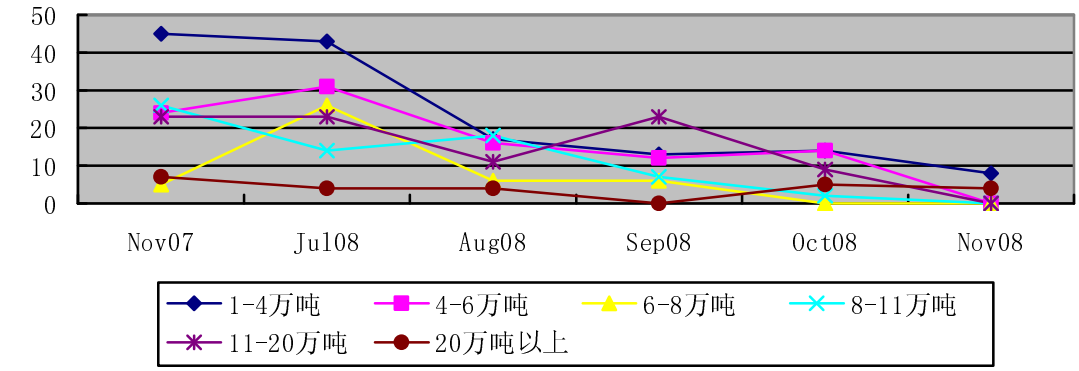
Here, I list the new-building order of dry bulk vessels from November 2007 to November 2008.

	Nov07		Jul08		Aug08		Sep08		Oct08		Nov08	
Deadweight	no	dwt	no	dwt	no	dwt	no	dwt	no	dwt	no	dwt
10-40thousand ton	45	1512	43	1413	17	509	13	420	14	460	8	262
40-60thousand ton	24	1386	31	1695	16	920	12	642	14	812	0	0
60-80thousand ton	5	381	26	1640	6	410	6	442	0	0	0	0
80-110thousand ton	26	2334	14	1239	18	1787	7	606	2	160	0	0
110-200thousand ton	23	3941	23	3489	11	1738	23	3230	9	1600	0	0
Over 200thousand ton	7	2154	4	1280	4	1050	0	0	5	1025	4	1552

The order of new-building from Nov 2007 to Nov 2008



the order of new-building from Nov 2007 to Nov 2008 (Deadweight ton)



the order of new-building from Nov 2007 to Nov 2008 (vessels)

We can see that amount of new-building of all types of dry bulk vessels present a trend of decline to different extent, except the vessels over 200 thousand deadweight tons started rebound in September 2008 in the amount of shipbuilding.

（3）Price of the container vessel

teu	dwt	type	Aug08	Sep08	Oct08	Nov08
500	8000	geared	20.8	20.7	20	23.8
1000	135000	geared	27	26.9	25.8	30.1
1500	22000	geared	42	42	39	38
2000	29000	gearless	52	50.3	40	54
2500	35000	gearless	60	59.7	54.8	56.5
3500	45000	gearless	66	66.6	63.8	61.3
5500	65000	gearless	94.5	94.5	95	95
6500	75000	gearless	113	110.5	105	105
8000	105000	gearless	139	137.5	125	125
10000	120000	gearless	151.5	151.5	151.5	151.5
12000	140000	gearless	167	167	167	167

We can see that the price of all the new-building container vessel declined to different extent.

（4）The cancelling of the order.

According to the market report of Pacific Carriers, the number of cancelling order held by the shipyard globally is 382. Most of them are dry bulk vessels, about 241, taking up 63% of all the vessels, then 69 VLCC, taking up 18%, other including 27 container vessels, 15 crude oil tankers,6 chemical products tankers and 6 multi-purpose cargo vessels. Besides, the rest 18 vessels includes RO-RO vessel, liquefied gas carrier, ore carrier and other vessels, presented as the sheet below:

Vessel type	No.	Percentage
Dry bulk vessel	241	63%
Oil tanker	69	18%
Container vessel	27	7.06%
Crude oil tanker	15	4.04%
Chemical tanker	6	1.6%
MP cargo carrier	6	1.6%
RO-RO LGC	18	4.7%
Total	382	100%

Sheet 3-7 the cancelling order globally and the distribution situation of the vessel type

Meanwhile, the shipyard in China have also suffered the cancelling order, about 197 dry bulk vessels, including 78 suprasizes, 39 panamaxes, 44 capasizes. As it shower below:

Type	No.	Percentage	DWT（10 thousand DWT）
Capasize	48	24.3%	816
Panamax	39	19.8%	234
Super-panamax	8	4.1%	64
suprasize	78	39.6%	468
handysize	12	6.1%	48
VLOC	12	6.1%	336
Total	197	100%	1966

Sheet 3-8 the number type and DWT of the cancelling order in China.

2.3 conclusion

Whereas the close correlation amount port, shipping and trade industry, the world economic change will definitely have an impact on the shipping market.

Comprehensively, the world economy will slip dramatically in 2009 and the economic power in Europe and America will suffer the recession and shrink of the international trade, this situation will last at least 2 years. Although our financial system does not open completely, the shock to our country is limited, the shrink of the international trade will also have a negative impact on the economic development. The GDP in 2009 could stay 8%, the export and import will slip. As the policy of promoting domestic demand carried out and the investment of the 400 billion, in 2010,the economy in China will rebound and resume increasing before other countries in the world.

International shipping market will face the low demand, low freight and low rent situation because of the influence of the economic situation at home and abroad, and it will last at least 2 years. Domestic shipping market may adjust periodic and suffer the downturn period, but resume before international shipping market.

Especially the internal trade transport market and break bulk service will recover at first, but the foreign trade transport market and container transport market will have a long cycle influenced by international trade.

Based on the research above, in 2008, the port capacity in China also increased but the rate was relatively slow, in 2009, after the adjustment, the foreign trade container and break bulk capacity will probably present negative growth, while the internal trade cargo , oil and other critical materials capacity will keep increasing but also suffer a slow increasing rate.

Chapter 3: The analysis of the financial and shipping index

3.1 the meaning of each financial index

3.1.1 The Dow Jones Industrial Average.

The Dow Jones Industrial Average which is also called the DJIA, Dow30,INDP,or informally the Dow Jones or The Dow is one of several stock market indices, created by nineteenth-century Wall Street Journal editor and Dow Jones & Company co-founder Charles Dow. It is an index that shows how certain stocks have traded. Dow compiled the index to gauge the performance of the industrial sector of the American stock market. It is the second-oldest U.S. market index. The index is computed from the stock prices of 30 of the largest and most widely held public companies in the United States.

3.1.2 The Nasdaq Composite Index

Nasdaq Composite Index is the average index which reflects the change of the Nasdaq stock market, the basic index is 100. The listed company of Nasdaq covers all new technologies including software and computers, telecommunication, biology technology, retail and wholesale trade and so on. It comprises of hundreds of American companies which have the fastest developing advanced technology, telecommunication and biology company, including Microsoft, Intel, America on line, Yahoo. Hence, it is regarded as the name of ‘New Economy’ of the America.

Nasdaq Composite Index is the barometer which reflects the change of the market value in all industries. Hence, Nasdaq Composite Index is more comprehensive ,compared with other index such as S&P 500, Dow Jones and so on. At current stage, Nasdaq Composite Index covers more than 5000 companies, surpassing any stock market. Because of its wide basis, Nasdaq Composite

Index has already been one of the most influential stock market index.

3.1.3 The S&P 500 Index

The S&P 500 is a value weighted index published since 1957 of the prices of 500 large cap common stocks actively traded in the United States. The stocks included in the S&P 500 are those of large publicly held companies that trade on either of the two largest American stock markets, the New York Stock Exchange and NASDAQ. Almost all of the stocks included in the index are among the 500 American stocks with the largest market capitalizations.

After the Dow Jones Industrial Average, the S&P 500 is the most widely followed index of large-cap American stocks. It is considered a bellwether for the American economy, and is included in the Index of Leading Indicators. Some mutual funds, exchange traded funds, and other managed funds, such as pension funds, are designed so as to mimic the performance of the S&P 500 index. Many hundreds of billions of US$ have been invested in this fashion.

3.1.4 The FTSE 100

The FTSE 100 Index is a share inex of the 100 most highly capitalized UK companies listed on the London Stock Exchange. The index began on 3 January 1984 with a base level of 1000. It is the most widely used of the FTSE Group's indices, and is frequently reported as a measure of business prosperity.

The index is maintained by the FTSE Group, an independent company which originated as a joint venture between the Financial Times and the London Stock Exchange. It is calculated in real-time and published every 15 second. The FTSE 100 Index companies represent about 81% of the market capitalization of the whole London Stock Exchange. Even though the FTSE All-Share Index is more comprehensive, the FTSE 100is by far the most widely used UK stock market indicator.

3.1.5 The DAX Index

DAX index is a Blue Chip Index promoted by the Deutsche Börse Group . It contains over 30 important Germany companies. The DAX index is a stock index which is so important as Financial Times Index in Europe, meanwhile it is also one of the important index in world stock market.

DAX index is a stock index which has been paid attention in Germany, however, it only comprises 30 Blue Chip Index, and is considered not to be a benchmark reflecting the whole performance of the market because of its narrow scope.

Different from other index, DAX index is able to reflect the situation of the gross income in Germany stock market, while other index could only reflect the change of the price in market. It is traded by the Xetra trading system, and different from the traditional open trade manner, it is executed by the electronic trade manner which is fit for the global trade.

3.1.6 The CAC 40 Index

The CAC 40 Index is index in French stock market, which comprises 40 French stocks. Compiled by Paris Stock Exchange and other 40 main listed companies, the benchmark is the end of 1987. This index began to publish on 5th June 1988 and can reflect the price fluctuation of the French stock market.

3.1.7 The Nikkei 225 Index

Nikkei 225 is a stock market index for the Tokyo Stock Exchange (TSE). It has been calculated daily by the Nihon Keizai Shimbun (Nikkei) newspaper since 1950. It is a price-weighted average (the unit is Yen), and the components are reviewed once a year. Currently, the Nikkei is the most widely quoted average of Japanese equities, similar to the Dow Jones Industrial Average. In fact, it was known as the "Nikkei Dow Jones Stock Average" from 1975 to 1985.

The Nikkei 225 began to be calculated on September 7, 1950, retroactively calculated back to May 16, 1949.

3.1.8 The Hang Seng Index

The Hang Seng Index is a freefloat-adjusted market capitalization-weighted stock market index in Hong Kong. It is used to record and monitor daily changes of the largest companies of the Hong Kong stock market and is the main indicator of the overall market performance in Hong Kong. These 45 companies represent about 67% of capitalization of the Hong Kong Stock Exchange.

The Hang Seng Index was started on November 24, 1969, and is currently compiled and maintained by HSI Services Limited, which is a wholly owned subsidiary of Hang Seng Bank, the largest bank registered and listed in Hong Kong in terms of market capitalization.

3.1.9 Shanghai Security Composite Index

Shanghai Security Composite Index is compiled by the Shanghai Stock Exchange, computed in the scope of all the stocks listed, and measured the circulation as the weight. Shanghai Security Composite Index is able to reflect the trend on the whold of the Shanghai Stock market.

3.1.10 Shenzhen Security Component Index

Shenzhen Security Component Index is an important index in the Shenzhen Stock Exchange. It is a stock index compiled in a comprehensive way. 40 listed companies are selected as the component stocks according to some standard, weighed by the negotiability. It is computed on 1st May 1995, the benchmark is 1000. The basic formulas are as follows:

Stock Indexes＝Aggregate value of the component stock at current stage／Aggregate value of the component stock in base period×1000

The method is as follows: 40 listed companies' stocks are selected from all the stocks of all listed companies in Shenzhen Stock Exchange as samples, weighed by the negotiable capital ,computed in the method of weighed average, the base date is 20th June 1994 and the index in base date is 1000.

3.2 the meaning of shipping index

3.2.1 Baltic Dry Index

The Baltic Dry Index (BDI) is a number issued daily by the London-based Baltic Exchange. The index provides "an assessment of the price of moving the major raw materials by sea. Taking in 26 shipping routes measured on a timecharter and voyage basis, the index covers Handymax, Panamax, and Capesize dry bulk carriers carrying a range of commodities including coal, iron ore and grain.

3.2.2 Other shipping index

Besides the Baltic Dry Index, I will choose other major shipping index including: Baltic Panamax Index (BPI), Baltic Capesize Index (BCI), Baltic Supramax Index (BSI) and China Containerized Freight Index (CCFI).

3.3 The Principal Component Analysis of Financial index and shipping index

3.3.1 The introduction of the Principal Component Analysis.

Principal component analysis (PCA) is a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called principal components. The objective of PCA is to reduce the dimensionality (number of variables) of the dataset but retain most of the original variability in the data. The fist principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible.

PCA is a bilinear modeling method that gives an interpretable overview of the main information in a multidimensional table.

The information carried by the original variables is projected onto a smaller number of underlying (“latent”) variables called principal components. The first principal component covers as much of the variation in the data as possible. The second principal component is orthogonal to the first and covers as much of the remaining variation as possible, and so on.

By plotting the principal components, one can view interrelationships between different variables, and detect and interpret sample patterns, groupings , similarities or differences.

Large data tables usually contain a large amount of information, which is partly hidden because the data are too complex to be easily interpreted.

PCA is a projection method that helps visualize all the information contained in a data table.

PCA helps find out in what respect one sample is different from another, which variables contribute most to this difference, and whether those variables contribute in the same way (i.e. are correlated) or independently from each other. It also enables to detect sample patterns, like any particular grouping.

Finally, it quantifies the amount of useful information-as opposed to noise or meaningless variation-contained in the data.

3.3.2 The principle of the Principal component analysis

The principal component analysis is a statistic analysis method that could turn many variables into few comprehensive samples. From the point of view of Mathematics, it is a technology of reducing demisions. We assume there are n samples, each sample has p variable descriptions, thus it constitutes a matrix of n×p

$$X = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ M & M & & M \\ x_{n1} & x_{n2} & & x_{np} \end{pmatrix} \qquad (1)$$

How to find the internal regulation from so many variables? To solve the problem, we should observe it from space of p dimensions, which is very difficult. So we need the technology of reducing dimensions, which means we use few comprehensive index to instead many variables, and make these few index could reflect the information as much as possible. So, how to choose these index is a problem. Obviously, the easiest form is the linear matrix of these variables, adjust the coefficient of the matrix and make these variable could stand for most of the information.

If we assume the original variables are x_1，x_2，…，$x_{p,}$, their new variables are x_1，x_2，…，zm（m≤p), so:

$$\begin{cases} x_1 = l_{11}x_1 + l_{12}x_2 + \cdots, + l_{1p}x_p \\ x_2 = l_{21}x_1 + l_{22}x_2 + \cdots, + l_{2p}x_p \\ \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ z_m = l_{m1}x_1 + l_{m2}x_2 + \cdots, + l_{mp}x_p \end{cases} \qquad (2)$$

In the Formula（2)，coefficient l_{ij} depends on principles as follows：

（1)z_i and z_j（i≠j；i，j=1，2，…，m)are irrelated；

（2)z_1 has the biggest variance from all the linear matrix comprised by x_1，x_2，…，x_p；z_2 and z_1 are irrelated.

The new samples z_1，z_2，…，zm are named the first second ..m principal component of the original samples x_1，x_2，…，x_p Among them, z_1 covers the most proportion，z_2，z_3，…，z_m decrease one by other. In the real problem, we usually select the few principal components to not only reduce the variables but simplify the relation among the variables as well.

3.3.3 The calculation of the Principal component analysis

Steps of principal component analysis:

（1)compute the coefficient matrix

$$R = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1p} \\ r_{21} & r_{22} & \cdots & r_{2p} \\ M & M & & M \\ r_{p1} & r_{p2} & \cdots & r_{pp} \end{pmatrix} \qquad (3)$$

In formula（3)，r_{ij}（i，j=1，2，…，p) is the coefficient of x_i and x_j , the formula is as follows:

$$r_{ij} = \frac{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)(x_{kj} - \bar{x}_j)}{\sqrt{\sum_{k=1}^{n}(x_{ki} - \bar{x}_i)^2 \sum_{k=1}^{n}(x_{kj} - \bar{x}_j)^2}} \qquad (4)$$

（2)compute the eigenvalue and eigenvector.

Compute the eigenvalue λ_i（i=1，2，…，p) from the formula ｜λI-R｜=0 and arrange them according to the sequence: $\lambda_1 \geq \lambda_2 \geq \ldots, \geq \lambda_p \geq 0$,and compute the eigenvector e_i（i=1，2，…，p) of the eigenvalue λ_i

（3)Compute the contribution rate and accumulated contribution rate of the principal components.

λ_1 λ_2 $\lambda_m$are usually regarded as the first ,second and m components which covers the 85%-95% eigenvalue.

（4)Compute the load of the principal component.

$$p(z_k, x_i) = \sqrt{\gamma_k} e_{ki} \quad (i, k = 1, 2, \cdots, p) \qquad (5)$$

By using the formula , we could compute the score of the components:

$$Z = \begin{pmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ M & M & & M \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{pmatrix} \qquad (6)$$

3.3.4 The Principal Component Analysis of the financial index.

3.3.4.1 The building of the system assessment, selection of the data and the method of assessment.

Firstly, we definite the 5th , 15th and the 25th day of 13 months as 39 variables from X_1 to X_{39}, which means the 5th March of 2008 is X_1, the 15th March 2008 is X_2, the 25th March is X_3 and so on.

Secondly, we make use of the software of SPSS 16.0 to select the main factors from many index which have practical meanings. Most (more than 85%) could reflect the information covered by the original components and at the meantime, we consider the weight of the main factor and compute the score of the components, which could reflect the meaning of the financial index in a practical and objective way.

The data are selected from March 2008 to March 2009, the 17th of each is selected to represent the average index of the whole month.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Dow Jones	12254	11972	12532	12609	12620	12891	12969
Nasdaq	2260	2177	2341	2370	2341	2422	2464
S&P 500	1333	1276	1352	1370	1365	1397	1407
FTSE 100	5853	5414	5689	5947	5980	6091	6215
DAX	6683	6182	6524	6763	6681	6896	7052
CAC 40	4756	4431	4692	4900	1862	4978	5063
NIKKEI 225	12972	11787	12745	13293	13398	13863	14102
Hang Seng	23114	21084	22464	24264	24258	25516	26183
Shanghai	4293	3820	4192	3599	3223	3557	3761
Shenzhen	15601	13207	13427	12652	11657	13104	13860

	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
Dow Jones	12986	12548	12604	12160	11811	11231	11446
Nasdaq	2177	2481	2549	2457	2401	2243	2312
S&P 500	1425	1385	1404	1350	1231	1252	1260
FTSE 100	6304	6087	5995	5861	5666	5412	5286
DAX	7156	6953	6941	6796	6641	6272	6271
CAC 40	5078	4937	4907	4686	4536	4266	4225
NIKKEI 225	14219	13690	14341	14348	13829	13237	12887
Hang Seng	25618	24127	24255	23054	22635	21913	21734
Shanghai	3624	3364	3351	2795	2905	2669	2685
Shenzhen	13314	11890	11860	9430	9982	9400	9288

	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}
Dow Jones	11370	11615	11479	11386	11230	10609	11022
Nasdaq	2310	2349	2416	2365	2255	2098	2186
S&P 500	1257	1284	1278	1266	1242	1156	1209
FTSE 100	5352	5454	5450	5470	5240	4912	5197
DAX	6436	6518	6432	6296	6127	5860	6173
CAC 40	4377	4386	4448	4355	4196	4000	4226
NIKKEI 225	13334	12914	13165	12878	12212	11749	12006
Hang Seng	22740	21949	20930	21104	19933	17637	18934
Shanghai	2865	2690	2320	2413	2202	1929	2297
Shenzhen	9923	9080	7833	8065	7264	6680	7376

	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}
Dow Jones	10325	8852	8378	9139	8273	8479	8636
Nasdaq	1862	1711	1505	1681	1482	1464	1509
S&P 500	1056	940	876	952	850	857	876
FTSE 100	4589	4063	3852	4530	4132	4171	4049
DAX	5387	4781	4334	5166	4557	4560	4381
CAC 40	3711	3329	3193	3618	3182	3209	2988
NIKKEI 225	10473	8693	7649	9521	8522	8323	7917
Hang Seng	16803	14554	11015	14840	13529	12878	13846
Shanghai	2173	1930	1839	1760	2030	1888	2018
Shenzhen	7217	6209	6158	5865	6783	6489	7279

	X_{29}	X_{30}	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}
Dow Jones	8824	8468	8952	8281	8116	8063	7552
Nasdaq	1579	1524	1628	1529	1489	1546	1470
S&P 500	904	872	927	850	836	845	789
FTSE 100	4324	4216	4579	4147	4209	4228	4034
DAX	4708	4629	4983	4366	4326	4510	4216
CAC 40	3241	3116	3359	3016	2955	3066	2875
NIKKEI 225	8612	8599	9043	8230	7682	7949	7645
Hang Seng	15460	14184	15563	13339	12578	13178	12945
Shanghai	1976	1852	1880	1954	1990	2098	2319
Shenzhen	7267	6785	6634	6917	7015	7413	8461

	X_{36}	X_{37}	X_{38}	X_{39}
Dow Jones	7270	6594	7395	7749
Nasdaq	1425	1299	1462	1528
S&P 500	764	682	778	813
FTSE 100	3879	3529	3857	3900
DAX	3846	3696	3987	4223
CAC 40	2096	2569	2767	2893
NIKKEI 225	7461	7433	7949	8479
Hang Seng	13005	12211	12878	13622
Shanghai	2206	2221	2218	2291
Shenzhen	8241	8242	8389	8756

3.3.4.2. Data processing

（1）Model vertification.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.791
Bartlett's Test of Sphericity	Approx. Chi-Square	271.405
	df	45
	Sig.	.000

KMO is used to testify whether the index is fit for the principal component analysis, if it is between 0.5-1.0, it fits. If it is less than 0.5, it does not. Bartlett's Test of Sphericity is to testify the mutual independence of the variables. If the statistics is too large , the principal component analysis is suitable. Here the KMO is 0.791, between 0.5-1.0; It also pass the Bartlett's Test of Sphericity because the value is 271.405 which is large enough, and the related significance probability （Sig）. is less than 0.001, which means highly significant. So we could make a conclusion that the data is fit for the principal component analysis.

（2）Data standardization.

Through the use of function of data standardization of SPSS 16.0, we could get the standardized index data.

（3）Build the model to compute the score.

In this model., we find the eigenvalue which is no less than 1 and get the matrix of variance contribution and factor load as follows:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	38.449	98.587	98.587	38.449	98.587	98.587
2	.404	1.037	99.624			
3	.103	.264	99.888			
4	.020	.050	99.938			
5	.016	.042	99.980			
6	.006	.016	99.996			
7	.001	.002	99.998			
8	.000	.001	99.999			
9	.000	.001	100.000			
10	9.286E-15	2.381E-14	100.000			
11	1.568E-15	4.020E-15	100.000			
12	9.281E-16	2.380E-15	100.000			
13	7.479E-16	1.918E-15	100.000			
14	6.628E-16	1.699E-15	100.000			
15	5.188E-16	1.330E-15	100.000			
16	4.589E-16	1.177E-15	100.000			

17	4.277E-16	1.097E-15	100.000				
18	3.502E-16	8.979E-16	100.000				
19	2.835E-16	7.269E-16	100.000				
20	2.306E-16	5.912E-16	100.000				
21	1.933E-16	4.956E-16	100.000				
22	1.398E-16	3.585E-16	100.000				
23	8.908E-17	2.284E-16	100.000				
24	7.578E-17	1.943E-16	100.000				
25	4.341E-18	1.113E-17	100.000				
26	-3.894E-17	-9.986E-17	100.000				
27	-1.586E-16	-4.066E-16	100.000				
28	-1.822E-16	-4.673E-16	100.000				
29	-2.195E-16	-5.629E-16	100.000				
30	-2.659E-16	-6.819E-16	100.000				

31	-3.215E-16	-8.243E-16	100.000			
32	-3.556E-16	-9.118E-16	100.000			
33	-4.523E-16	-1.160E-15	100.000			
34	-4.645E-16	-1.191E-15	100.000			
35	-5.599E-16	-1.436E-15	100.000			
36	-6.390E-16	-1.638E-15	100.000			
37	-7.303E-16	-1.872E-15	100.000			
38	-8.960E-16	-2.297E-15	100.000			
39	-1.759E-15	-4.510E-15	100.000			

Extraction Method: Principal Component Analysis.

We can draw from the sheet above, according to the principle of accumulated contribution rate more than 85%, when m=1, the accumulated contribution rate has already been 98.597%, which covers the 98.597% information of the original variables, so we select only one component , marked as Z_1 .

Component Matrix[a]

	Component
	1
x1	.977
x2	.988
x3	.991
x4	.997
x5	.992
x6	.996
x7	.994
x8	.997
x9	.999
x10	.999
x11	.994
x12	.997
x13	.996
x14	.997
x15	.997
x16	.996
x17	.990
x18	.992
x19	.989
x20	.986
x21	.991

x22	.995
x23	.995
x24	.984
x25	.988
x26	.998
x27	.995
x28	.997
x29	.999
x30	.999
x31	.996
x32	.998
x33	.996
x34	.997
x35	.987
x36	.986
x37	.982
x38	.988
x39	.989

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

According to the sheet above, the first principal component has a high relevance with X_1-X_{39}, and each column divided by $\sqrt{\lambda 1}$, then we could get the unit eigenvector related to each eigenvalue.

For example：$e_1=1/\sqrt{38.449}\begin{pmatrix}0.977\\0.988\\0.991\\0.997\\0.992\\.\\.\\.\\0.987\\0.986\\0.982\\0.988\\0.989\end{pmatrix}=\begin{pmatrix}0.158\\0.159\\0.160\\0.161\\0.160\\.\\.\\.\\0.159\\0.159\\0.158\\0.159\\0.159\end{pmatrix}$

So, we could get the expression of the first principal component analysis:

Z_1=0.158ZX_1+0.159ZX_2+0.160ZX_3+0.161ZX_4+0.160ZX_5+0.161ZX_6+0.160ZX_7+0.161ZX_8+0.161ZX_9+0.161ZX_{10}+0.160ZX_{11}+0.161ZX_{12}+0.161ZX_{13}+0.161ZX_{14}+0.161ZX_{15}+0.161ZX_{16}+0.160ZX_{17}+0.160ZX_{18}+0.159ZX_{19}+0.159ZX_{20}+0.160ZX_{21}+0.160ZX_{22}+0.160ZX_{23}+0.159ZX_{24}+0.159ZX_{25}+0.161ZX_{26}+0.160ZX_{27}+0.161ZX_{28}+0.161ZX_{29}+0.161ZX_{30}+0.161ZX_{31}+0.161ZX_{32}+0.161ZX_{33}+0.161ZX_{34}+0.159ZX_{35}+0.159ZX_{36}+0.158ZX_{37}+0.159ZX_{38}+0.159ZX_{39}

According to the function of data standardization of SPSS 16.0, we could get the standardized data ZX1-ZX13 respective as follows:

	ZX_1	ZX_2	ZX_3	ZX_4	ZX_5	ZX_6	ZX_7
Dow Jones	0.484	0.617	0.600	0.548	0.593	0.519	0.484
Nasdaq	-0.964	-0.959	-0.953	-0.917	-0.830	-0.903	-0.905
S&P 500	-1.098	-1.104	-1.104	-1.060	-0.966	-1.042	-1.045
FTSE 100	-0.443	-0.438	-0.443	-0.405	-0.327	-0.405	-0.409
DAX	-0.323	-0.314	-0.316	-0.288	-0.230	-0.295	-0.298
CAC 40	-0.602	-0.596	-0.595	-0.555	-0.897	-0.556	-0.561
NIKKEI 225	0.588	0.588	0.632	0.646	0.701	0.651	0.634
Hang Seng	2.058	2.084	2.114	2.216	2.204	2.233	2.232
Shanghai	-0.669	-0.694	-0.671	-0.741	-0.708	-0.749	-0.734
Shenzhen	0.969	0.816	0.736	0.554	0.460	0.548	0.602

	ZX_8	ZX_9	ZX_{10}	ZX_{11}	ZX_{12}	ZX_{13}	ZX_{14}
Dow Jones	0.511	0.548	0.539	0.577	0.555	0.541	0.589
Nasdaq	-0.944	-0.904	-0.894	-0.871	-0.877	-0.873	-0.863
S&P 500	-1.046	-1.062	-1.057	-1.036	-1.055	-1.028	-1.030
FTSE 100	-0.389	-0.384	-0.403	-0.363	-0.380	-0.374	-0.390
DAX	-0.274	-0.259	-0.268	-0.223	-0.232	-0.239	-0.233
CAC 40	-0.554	-0.549	-0.558	-0.538	-0.552	-0.554	-0.559
NIKKEI 225	0.677	0.713	0.787	0.903	0.862	0.857	0.818
Hang Seng	2.212	2.219	2.199	2.202	2.202	2.222	2.225
Shanghai	-0.749	-0.776	-0.779	-0.820	-0.800	-0.806	-0.804
Shenzhen	0.555	0.453	0.433	0.170	0.277	0.253	0.246

	ZX_{15}	ZX_{16}	ZX_{17}	ZX_{18}	ZX_{19}	ZX_{20}	ZX_{21}
Dow Jones	0.514	0.600	0.640	0.626	0.697	0.754	0.717
Nasdaq	-0.867	-0.866	-0.846	-0.850	-0.851	-0.873	-0.883
S&P 500	-1.027	-1.035	-1.033	-1.030	-1.026	-1.053	-1.060
FTSE 100	-0.403	-0.375	-0.349	-0.342	-0.336	-0.335	-0.338
DAX	-0.238	-0.207	-0.188	-0.207	-0.183	-0.154	-0.161
CAC 40	-0.552	-0.544	-0.513	-0.525	-0.516	-0.509	-0.514
NIKKEI 225	0.813	0.805	0.917	0.870	0.866	0.972	0.896
Hang Seng	2.247	2.235	2.191	2.217	2.198	2.098	2.151
Shanghai	-0.782	-0.812	-0.862	-0.842	-0.860	-0.905	-0.863
Shenzhen	0.294	0.199	0.042	0.083	0.013	0.003	0.057

	ZX_{22}	ZX_{23}	ZX_{24}	ZX_{25}	ZX_{26}	ZX_{27}	ZX_{28}
Dow Jones	0.803	0.796	1.049	0.789	0.744	0.853	0.812
Nasdaq	-0.911	-0.903	-1.012	-0.926	-0.975	-0.990	-0.949
S&P 500	-1.074	-1.086	-1.201	-1.093	-1.134	-1.150	-1.106
FTSE 100	-0.359	-0.343	-0.308	-0.271	-0.304	-0.279	-0.321
DAX	-0.197	-0.172	-0.164	-0.124	-0.197	-0.177	-0.239
CAC 40	-0.536	-0.518	-0.506	-0.480	-0.544	-0.532	-0.584
NIKKEI 225	0.833	0.758	0.831	0.877	0.807	0.812	0.634
Hang Seng	2.115	2.152	1.840	2.100	2.073	2.009	2.100
Shanghai	-0.848	-0.851	-0.912	-0.908	-0.836	-0.879	-0.823
Shenzhen	0.174	0.167	0.383	0.036	0.367	0.330	0.477

	ZX_{29}	ZX_{30}	ZX_{31}	ZX_{32}	ZX_{33}	ZX_{34}	ZX_{35}
Dow Jones	0.703	0.736	0.713	0.773	0.813	0.724	0.607
Nasdaq	-0.922	-0.943	-0.920	-0.956	-0.985	-0.977	-0.984
S&P 500	-1.074	-1.100	-1.076	-1.130	-1.162	-1.160	-1.162
FTSE 100	-0.306	-0.292	-0.262	-0.286	-0.247	-0.277	-0.313
DAX	-0.220	-0.192	-0.172	-0.230	-0.215	-0.203	-0.265
CAC 40	-0.549	-0.558	-0.534	-0.575	-0.587	-0.580	-0.616
NIKKEI 225	0.656	0.767	0.733	0.760	0.695	0.694	0.632
Hang Seng	2.193	2.117	2.187	2.067	2.024	2.059	2.018
Shanghai	-0.833	-0.864	-0.864	-0.847	-0.849	-0.833	-0.762
Shenzhen	0.354	0.329	0.196	0.423	0.514	0.554	0.845

	ZX_{36}	ZX_{37}	ZX_{38}	ZX_{39}
Dow Jones	0.580	0.477	0.579	0.570
Nasdaq	-0.927	-0.969	-0.964	-0.956
S&P 500	-1.097	-1.138	-1.142	-1.132
FTSE 100	-0.294	-0.360	-0.341	-0.374
DAX	-0.303	-0.315	-0.307	-0.295
CAC 40	-0.754	-0.623	-0.624	-0.621
NIKKEI 225	0.630	0.706	0.723	0.749
Hang Seng	2.059	2.012	2.005	2.011
Shanghai	-0.725	-0.718	-0.767	-0.769
Shenzhen	0.831	0.927	0.838	0.817

So we could compute the score and comprehensive score of the principal component, using the variance of each component as weight μj , and we build the comprehensive weight assessment Y= $\mu 1\, Z_1$ as follows:

	Z_1	Y	RANK
Dow Jones	4.063676	4.006256	3
Nasdaq	-5.74201	-5.66087	9
S&P 500	-6.759	-6.66349	10
FTSE 100	-2.1723	-2.1416	6
DAX	-1.4595	-1.43887	5
CAC 40	-3.55778	-3.50751	7
NIKKEI 225	4.723023	4.656287	2
Hang Seng	13.30805	13.12	1
Shanghai Composite	-5.01495	-4.94409	8
Shenzhen Component	2.610783	2.573893	4

We can draw a conclusion from the sheet above, Hang Seng Index Rank the first place, so we could use it to represent the whole financial index to make the correlation analysis with the shipping index.

3.3.5 The Principal Component Analysis of Shipping Index

3.3.5.1 The building of the system assessment , selection of the data and the method of assessment.

Firstly, we definite the 5th , 15th and the 25th day of 13 months as 39 variables from X_1 to X_{39}, which means the 5th March of 2008 is X_1, the 15th March 2008 is X_2, the 25th March is X_3 and so on.

Secondly, we make use of the software of SPSS 16.0 to select the main factors from many index which have practical meanings. Most (more than 85%) could reflect the information covered by the original components and at the meantime, we

consider the weight of the main factor and compute the score of the components, which could reflect the meaning of the shipping index in a practical and objective way.

The data are selected from March 2008 to March 2009, the 17th of each is selected to represent the average index of the whole month.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
BDI	8162	7972	7619	7737	7957	9329	9855
BCI	11863	10519	9894	11326	11459	13890	15133
BPI	8067	8280	7982	7552	8160	9287	9464
BSI	5038	5394	5184	4733	4705	5400	5559
CCBFI	2420	2390	2307	2228	2238	2277	2442

	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
BDI	11067	11465	11689	9419	9244	8854	9150
BCI	16999	17911	19687	13553	13053	12488	13200
BPI	10552	10398	9986	8660	9218	8909	9378
BSI	6252	6741	6307	6339	5999	5648	5474
CCBFI	2551	2836	2887	2743	2643	2340	2144

	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}
BDI	8637	8100	7557	7115	5663	4747	4163
BCI	13417	12695	12581	11263	7708	6369	5206
BPI	7754	7288	6379	6012	5844	4712	4157
BSI	5155	4686	4198	4379	3475	3102	3012
CCBFI	2098	2011	1995	1927	1847	1738	1700

	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}
BDI	2992	1615	1102	826	841	804	663
BCI	4310	1992	1504	1185	1016	932	871
BPI	2325	1309	921	772	953	804	504
BSI	2276	1294	817	512	556	641	548
CCBFI	1554	1491	1423	1291	1253	1188	1181

	X_{29}	X_{30}	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}
BDI	803	774	772	908	995	1498	1846
BCI	1454	1337	1386	1850	2049	2734	3170
BPI	450	558	525	502	562	1128	1335
BSI	486	421	403	413	446	783	1209
CCBFI	1197	1273	1268	1218	1198	1160	1097

	X_{36}	X_{37}	X_{38}	X_{39}
BDI	1960	2167	2058	1960
BCI	3124	2830	2365	3124
BPI	1470	2096	2045	1470
BSI	1385	1653	1694	1385
CCBFI	1080	848	841	1080

3.3.5.2 Data processing

（1）Model verification.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.606
Bartlett's Test of Sphericity	Approx. Chi-Square	179.953
	df	10
	Sig.	.000

KMO is used to testify whether the index is fit for the principal component analysis, if it is between 0.5-1.0, it fits. If it is less than 0.5, it does not. Bartlett's Test of Sphericity is to testify the mutual independence of the variables. If the statistics is too large , the principal component analysis is suitable. Here the KMO is 0.606, between 0.5-1.0; It also pass the Bartlett's Test of Sphericity because the value is 179.953, which is large enough, and the related significance probability （Sig）. is less than 0.001, which means highly significant. So we could make a conclusion that the data is fit for the principal component analysis.

（2）Data standardization.

Through the use of function of data standardization of SPSS 16.0, we could get the standardized index data.

（3）Build the model to compute the score.

In this model., we find the eigenvalue which is no less than 1 and get the matrix of variance contribution and factor load as follows:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	28.314	72.601	72.601	28.314	72.601	72.601
2	9.795	25.116	97.717	9.795	25.116	97.717
3	.867	2.223	99.940			
4	.024	.060	100.000			
5	1.217E-15	3.121E-15	100.000			
6	7.970E-16	2.043E-15	100.000			
7	5.977E-16	1.533E-15	100.000			
8	5.591E-16	1.433E-15	100.000			
9	5.018E-16	1.287E-15	100.000			
10	4.757E-16	1.220E-15	100.000			
11	4.355E-16	1.117E-15	100.000			
12	3.250E-16	8.334E-16	100.000			
13	3.067E-16	7.864E-16	100.000			

14	2.560E-16	6.563E-16	100.000				
15	2.172E-16	5.570E-16	100.000				
16	1.699E-16	4.357E-16	100.000				
17	1.395E-16	3.578E-16	100.000				
18	1.241E-16	3.182E-16	100.000				
19	5.690E-17	1.459E-16	100.000				
20	2.376E-17	6.093E-17	100.000				
21	-2.418E-17	-6.199E-17	100.000				
22	-4.059E-17	-1.041E-16	100.000				
23	-6.354E-17	-1.629E-16	100.000				
24	-9.217E-17	-2.363E-16	100.000				
25	-1.018E-16	-2.611E-16	100.000				
26	-1.383E-16	-3.546E-16	100.000				
27	-1.730E-16	-4.436E-16	100.000				

28	-2.352E-16	-6.032E-16	100.000			
29	-2.645E-16	-6.782E-16	100.000			
30	-3.583E-16	-9.187E-16	100.000			
31	-4.056E-16	-1.040E-15	100.000			
32	-4.365E-16	-1.119E-15	100.000			
33	-5.212E-16	-1.336E-15	100.000			
34	-5.512E-16	-1.413E-15	100.000			
35	-6.312E-16	-1.619E-15	100.000			
36	-6.999E-16	-1.795E-15	100.000			
37	-8.941E-16	-2.292E-15	100.000			
38	-1.137E-15	-2.914E-15	100.000			
39	-4.028E-15	-1.033E-14	100.000			

Extraction Method: Principal Component

Analysis.

We can draw from the sheet above, according to the principle of accumulated

contribution rate more than 85%, when m=2, the accumulated contribution rate has already been 97.717%, which covers the 97.717% information of the original variables, so we select only one component , marked as Z_1 and Z_2 .

Component Matrix[a]

	Component	
	1	2
x1	.990	-.117
x2	.958	-.256
x3	.951	-.275
x4	.991	-.108
x5	.982	-.134
x6	.989	-.114
x7	.995	-.068
x8	.995	-.076
x9	.999	-.047
x10	.999	.041
x11	.991	-.130
x12	.982	-.169
x13	.979	-.181
x14	.979	-.166
x15	.998	-.054
x16	.999	-.037
x17	.998	.042
x18	.998	-.011
x19	.973	-.166

x20	.981	-.158
x21	.963	-.250
x22	.973	.080
x23	.769	.595
x24	.305	.952
x25	.124	.970
x26	-.057	.847
x27	-.211	.935
x28	-.225	.972
x29	.374	.911
x30	.260	.965
x31	.295	.955
x32	.551	.825
x33	.632	.764
x34	.868	.491
x35	.934	.306
x36	.957	.210
x37	.972	-.233
x38	.902	-.430
x39	.937	-.233

Extraction Method:

Principal Component

Analysis.

a. 2 components extracted.

According to the sheet above，the first principal component is highly related with X_1 ,X_2 ,X_3 , X_4 ,X_5 ,X_6 ,X_7 ,X_8 ,X_{10} , X_{11} ,X_{12} ,$X_{13,}$ X_{14},X_{15} ,X_{16} ,X_{17} ,X_{18} ,X_{19} cX_{20} ,X_{21} X_{22} ,X_{23} ,X_{32} ,X_{33} ,X_{34} ,X_{35} ,X_{36} ,X_{37} ,X_{38} and X_{39}，while the second principal component is highly related with X_{23} ,X_{24},X_{25} ,X_{26} X_{27} ,X_{28} ,X_{29} ,X_{30} ,X_{31} ,X_{32} and X_8，the value in each column dived by $\sqrt{\lambda 1}$ and $\sqrt{\lambda 2}$ respective，then we get the unit eigenvector related to each eigenvalue.

For example：$e_1 = 1/\sqrt{28.314}$ $\begin{pmatrix} 0.99 \\ 0.958 \\ 0.951 \\ 0.991 \\ 0.982 \\ . \\ . \\ . \\ 0.934 \\ 0.957 \\ 0.972 \\ 0.902 \\ 0.937 \end{pmatrix} = \begin{pmatrix} 0.1861 \\ 0.1800 \\ 0.1787 \\ 0.1862 \\ 0.1845 \\ . \\ . \\ . \\ 0.1755 \\ 0.1799 \\ 0.1827 \\ 0.1695 \\ 0.1761 \end{pmatrix}$

In like manner：$e_2 = 1/\sqrt{9.795}$ $\begin{pmatrix} -0.117 \\ -0.256 \\ -0.275 \\ -0.108 \\ -0.134 \\ . \\ . \\ . \\ 0.306 \\ 0.21 \\ -0.233 \\ -0.43 \\ -0.233 \end{pmatrix} = \begin{pmatrix} -0.0374 \\ -0.0818 \\ -0.0879 \\ -0.0345 \\ -0.0428 \\ . \\ . \\ . \\ 0.0978 \\ 0.0671 \\ -0.0744 \\ -0.1374 \\ -0.0744 \end{pmatrix}$

So, we can draw the expression of the first principal component:

Z_1=0.1861ZX_1+0.1800ZX_2+0.1787ZX_3+0.1862ZX_4+0.1845ZX_5+0.1859ZX_6+0.1870ZX_7+0.1870ZX_8+0.1877ZX_9+0.1877ZX_{10}+0.1862ZX_{11}+0.1845ZX_{12}+0.1840ZX_{13}+0.1840ZX_{14}+0.1876ZX_{15}+0.1877ZX_{16}+0.1876ZX_{17}+0.1876ZX_{18}+0.1829ZX_{19}+0.1844ZX_{20}+0.1810ZX_{21}+0.1829ZX_{22}+0.1445ZX_{23}+0.0573ZX_{24}+0.0233ZX_{25}-0.0107ZX_{26}-0.0397ZX_{27}-0.0423ZX_{28}+0.0703ZX_{29}+0.0489ZX_{30}+0.0554ZX_{31}+0.1036ZX_{32}+0.1188ZX_{33}+0.1631ZX_{34}+0.1755ZX_{35}+0.1799ZX_{36}+0.1827ZX_{37}+0.1695ZX_{38}+0.1761ZX_{39}

The expression of the second principal component:

Z_2=-0.0374ZX_1-0.0818ZX_2-0.0879ZX_3-0.0345ZX_4-0.0428ZX_5-0.0364ZX_6-0.0217ZX_7-0.0243ZX_8-0.0150ZX_9+0.0131ZX_{10}-0.0415ZX_{11}-0.0540ZX_{12}-0.0578ZX_{13}-0.0530ZX_{14}-0.0173ZX_{15}-0.0118ZX_{16}+0.0134ZX_{17}-0.0035ZX_{18}-0.0530ZX_{19}-0.0505ZX_{20}-0.0799ZX_{21}+0.0256ZX_{22}+0.1901ZX_{23}+0.3042ZX_{24}+0.3099ZX_{25}-0.2706ZX_{26}+0.2988ZX_{27}+0.3106ZX_{28}+0.2911ZX_{29}+0.3083ZX_{30}+0.3051ZX_{31}+0.2636ZX_{32}+0.2441ZX_{33}+0.1569ZX_{34}+0.0978ZX_{35}+0.0671ZX_{36}-0.0744ZX_{37}-0.1374ZX_{38}-0.0744ZX_{39}

According to the function of data standardization of SPSS 16.0, we could get the standardized data ZX1-ZX13 respective as follows:

	ZX_1	ZX_2	ZX_3	ZX_4	ZX_5	ZX_6	ZX_7
BDI	0.295	0.341	0.349	0.298	0.298	0.293	0.284
BCI	1.332	1.159	1.127	1.344	1.288	1.329	1.384
BPI	0.268	0.440	0.473	0.244	0.355	0.284	0.203
BSI	-0.581	-0.487	-0.483	-0.578	-0.622	-0.599	-0.611
CCBFI	-1.315	-1.452	-1.466	-1.308	-1.319	-1.307	-1.260

	ZX_8	ZX_9	ZX_{10}	ZX_{11}	ZX_{12}	ZX_{13}	ZX_{14}
BDI	0.291	0.283	0.249	0.320	0.310	0.315	0.304
BCI	1.380	1.428	1.510	1.357	1.283	1.264	1.267
BPI	0.196	0.094	-0.020	0.130	0.303	0.329	0.359
BSI	-0.594	-0.556	-0.600	-0.452	-0.519	-0.522	-0.569
CCBFI	-1.273	-1.250	-1.139	-1.354	-1.377	-1.386	-1.360

	ZX_{15}	ZX_{16}	ZX_{17}	ZX_{18}	ZX_{19}	ZX_{20}	ZX_{21}
BDI	0.291	0.286	0.254	0.282	0.332	0.347	0.385
BCI	1.425	1.435	1.513	1.478	1.231	1.264	1.166
BPI	0.081	0.083	-0.041	-0.037	0.412	0.327	0.381
BSI	-0.536	-0.568	-0.587	-0.508	-0.630	-0.583	-0.475
CCBFI	-1.261	-1.237	-1.139	-1.215	-1.345	-1.355	-1.457

	ZX_{22}	ZX_{23}	ZX_{24}	ZX_{25}	ZX_{26}	ZX_{27}	ZX_{28}
BDI	0.290	0.262	-0.170	-0.287	-0.325	-0.343	-0.325
BCI	1.559	1.582	1.160	0.842	0.362	0.286	0.423
BPI	-0.353	-0.810	-0.769	-0.456	0.115	-0.343	-0.897
BSI	-0.400	-0.862	-1.113	-1.273	-1.443	-1.143	-0.739
CCBFI	-1.096	-0.172	0.892	1.175	1.292	1.542	1.538

	ZX_{29}	ZX_{30}	ZX_{31}	ZX_{32}	ZX_{33}	ZX_{34}	ZX_{35}
BDI	-0.170	-0.238	-0.225	-0.120	-0.086	0.050	0.134
BCI	1.308	1.119	1.173	1.490	1.567	1.686	1.685
BPI	-0.972	-0.758	-0.787	-0.814	-0.765	-0.440	-0.464
BSI	-0.890	-1.088	-1.065	-0.966	-0.947	-0.897	-0.612
CCBFI	0.724	0.965	0.904	0.410	0.232	-0.398	-0.743

	ZX_{36}	ZX_{37}	ZX_{38}	ZX_{39}
BDI	0.195	0.339	0.439	0.435
BCI	1.644	1.246	0.962	1.265
BPI	-0.416	0.242	0.417	-0.179
BSI	-0.522	-0.363	-0.182	-0.047
CCBFI	-0.902	-1.464	-1.636	-1.475

So we could compute the score and comprehensive score of the principal component, using the variance of each component as weight μj , and we build the comprehensive weight assessment Y= $\mu 1\, Z_1$+ $\lambda 2\, Z_2$ as follows:

	Z_1	Z_2	Y	RANK
BDI	1.511062	-0.7807	0.900966	2
BCI	7.782423	2.179572	6.197538	1
BPI	0.238447	-2.57664	-0.47403	3
BSI	-3.19956	-2.255	-2.88928	4
CCBFI	-6.33237	3.432764	-3.73519	5

We could also make a conclusion that the BCI Index rank the first place and we could use it to represent the shipping index to make the correlation analysis with financial analysis.

Chapter 4 The correlation between financial index and shipping index

4.1 The correlation analysis between financial index and shipping index

4.1.1 The principal of correlation analysis.

We will use the Pearson correlation analysis in this case, it is the reflection of two controlled interval variables. We use ρ to stand for the correlation coefficient of X and Y, r stands for the simple correlation coefficient estimated according to a certain sample, named sample correlation coefficient. If joint distribution two-dimensional normal distribution of random variables X and Y, （X_1,Y_1）, (X_2,Y_2), …, (Xn,Yn)is n-dimensional independent of observation, we could definite the formula of ρ and r as follows:

$$\rho = E[X - E(X)][Y - E(Y)] \Big/ \sqrt{D(X)\sqrt{D(Y)}}$$

$$r = \sum_{i=1}^{n}(xi - \bar{x})(yi - \bar{y}) \Big/ \sqrt{\sum_{i=1}^{n}(xi - \bar{x})\sum_{i=1}^{n}(yi - \bar{y})}$$

Among them ， $\bar{x}$ =1/n$\sum_{i=1}^{n} xi$ $\bar{y}$ =1/n$\sum_{i=1}^{n} yi$

And we could also testify, the sample correlation coefficient r is the maximum likelihood estimator of the population correlation coefficient.

The character of the correlation coefficient r:

1）-1≤r≤1，the bigger the｜r｜，the higher correlation between the two variables.

2）0＜r≤1，meaning that the two variables are positive correlation. If r=1，meaning that

the two variables are absolute positive correlation.

3）-1≤r＜0，meanning that the two variables are negative correlation. If r=-1，meanning that the two variables are absolute negative correlation.

4）r=0，meanning that the two variables have no linear relation— ‘zero correlation’

4.1.2 Correlation analysis using the SPSS software.

We will do the correlation analysis between the Hangseng Index and BCI index from last chapter after the principal component analysis using the software SPSS. After entering the data, through the computing , we can get the average and standard deviation of the two variables, as follows:

Descriptive Statistics

	Mean	Std. Deviation	N
Hangseng	1.85E4	4832.897	39
BCI	7603.08	5847.531	39

Meanwhile, we get the correlation analysis sheet of the two variables Hangseng index and BCI index, as follows:

Correlations

		Hangseng	BCI
Hangseng	Pearson Correlation	1	.941**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	8.876E8	1.011E9
	Covariance	2.336E7	2.660E7
	N	39	39
BCI	Pearson Correlation	.941**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	1.011E9	1.299E9
	Covariance	2.660E7	3.419E7
	N	39	39

**. Correlation is significant at the 0.01 level (2-tailed).

Display results: the correlation coefficient of the two variables Hangseng index and BCI index is 0.941, which is significant at the level of 0.01. We can draw the conclusion from two aspects: one is the upper right of the correlation coefficient has a double-star '**', the other is significance probability（Sig）is no more than 0.01 after the two-sided test. Hence, we can draw the conclusion that the correlation coefficient of the two variables Hangseng index and BCI index is 0.941, belonging to the high correlation.

4.2 The regression analysis between financial and shipping index

4.2.1 The principle of the regression analysis:

The regression analysis is to assume that there is relation between dependent variable and independent variable, we could use some regression model to fit the data of dependent variable and independent variable, and then get the regression

formula according to the model parameter.

4.2.2 Do the regression analysis using the SPSS software:

Firstly, we will list the financial Hangseng index and Shipping BCI index after the principal component analysis in last chapter.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Hangseng	21084	24258	25618	23054	21734	20930	17637
BCI	10379	11337	17685	13890	13336	12673	6578

	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
Hangseng	21084	24258	25618	23054	21734	20930	17637
BCI	10379	11337	17685	13890	13336	12673	6578

	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}	X_{20}	X_{21}
Hangseng	21084	24258	25618	23054	21734	20930	17637
BCI	10379	11337	17685	13890	13336	12673	6578

	X_{22}	X_{23}	X_{24}	X_{25}	X_{26}	X_{27}	X_{28}
Hangseng	21084	24258	25618	23054	21734	20930	17637
BCI	10379	11337	17685	13890	13336	12673	6578

	X_{29}	X_{30}	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}
Hangseng	21084	24258	25618	23054	21734	20930	17637
BCI	10379	11337	17685	13890	13336	12673	6578

	X_{36}	X_{37}	X_{38}	X_{39}
Hangseng	21084	24258	25618	23054
BCI	10379	11337	17685	13890

Then, we will use the relative value to measure the impact of the change of the Hangseng Index on the change of the BCI index. So we will calculate the relative value by using the formula as follows:

$$\Delta \text{Hangseng} = (X_n - X_{n-1}) / X_{n-1}$$

$\Delta BCI = (X_n - X_{n-1}) / X_{n-1}$

And we will list the change of the Hangseng index and the change of the BCI index as the sheet below:

	Δ Hangseng index	Δ BCI index
1	-0.087826	-0.113293
2	0.065452	-0.059416
3	0.080128	0.144734
4	-0.000247	0.011743
5	0.051859	0.212148
6	0.026140	0.089489
7	-0.021579	0.123307
8	-0.058201	0.053650
9	0.005305	0.099157
10	-0.049516	-0.311576
11	-0.018175	-0.036892
12	-0.031898	-0.043285
13	-0.008169	0.057015
14	0.046287	0.016439
15	-0.034785	-0.053812
16	-0.046426	-0.008980
17	0.008313	-0.104761
18	-0.055487	-0.315635
19	-0.115186	-0.173716
20	0.073539	-0.182603
21	-0.112549	-0.172109
22	-0.133845	-0.537819
23	-0.243163	-0.244980
24	0.347254	-0.212101
25	-0.088342	-0.142616
26	-0.048119	-0.082677
27	0.075167	-0.065451
28	0.116568	0.669346
29	-0.082536	-0.080468
30	0.097222	0.036649
31	-0.142903	0.334776
32	-0.057051	0.107568
33	0.047702	0.334309
34	-0.017681	0.159473
35	0.004635	-0.014511

36	-0.061053	-0.094110
37	0.054623	-0.164311
38	0.057773	-0.071036

Secondly, we will choose the appropriate regression model. We assume that the regression model is linear model or other curve model to compare with each using the SPSS software:

Including: Linear: $Y= b_0 +b_1X$

Quadratic:$Y=b_0+b_1+b_2X^2$

Cubic: $Y=b_0+ b_1 X+b_2X^2+b_3X^3$

Model Summary and Parameter Estimates

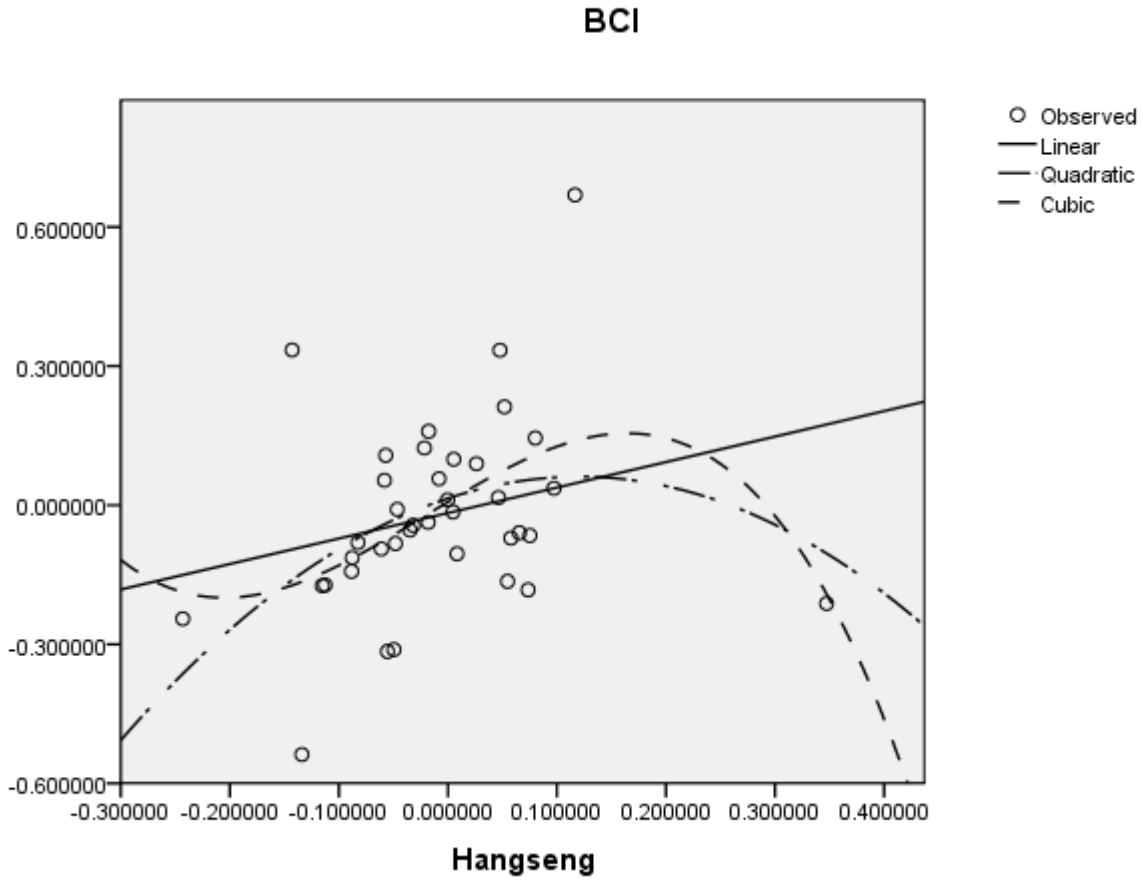
Dependent Variable:BCI

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	.766	2.525	1	36	.121	-.017	.550		
Quadratic	.862	3.384	2	35	.045	.015	.775	-3.216	
Cubic	.912	3.046	3	34	.042	.007	1.422	-.862	-14.051

The independent variable is Hangseng.

After the test of the curve model above, the R Square of the Cubic is bigger and closet to 1, so compared with other model, the Cubic model is more likely to be the result fitted.

We can compare the curve fitted with each other as follows:



Summing up the above, we can get the regression formula between the change of Hangseng index and the change of BCI index:

$$\Delta BCI = -14.051 \times (\Delta Hangseng)^3 - 0.862 \times (\Delta Hangseng)^2 + 1.422 \times \Delta Hangseng + 0.007$$

4.3 The co-integration analysis:

4.3.1 The principle of the co-integration analysis:

The traditional regression analysis in econometrics has the requirements that the

time series must be stable, or it will could the phenomenon of the artificial or false regression. Here, it seems that the two time series are hardly satisfied the requirements of stability. In recent decade, there is another method dealing with the non-stable data named co-integration analysis and error correction model. This article will analysis on the base of co-integration.

4.3.1.1 The stability and its test of the time series:

To macro economic series, if they are seemed to be the random linear process, there will be one or at least one root of unity in their auto-regression process. Many positive analysis indicate that the macro-economy series usually shows I (1) process, i.e. including only one unit root. This indicates that there are some external vibrating factors eternally influencing on the macro-economy. Generally speaking, the ADF (Augmented Dickey-Fuller) technique is the most effective tool for testing series stability at present. The revised regression equation of ADF test is:

$$\Delta Yt = \alpha + \beta T + \phi \sum_{i=1}^{p} \varphi i \Delta Yt - i + \varepsilon t$$

The Yt is the time series ready for test;

α is a constant;

T is the time tendency;

P is the delayed value;

et is the random error.

ADF test statistics is so-called T statistics. Fuller had described its distribution. It is stable I (0) series without unit root in case without difference if the T statistics is smaller than the critical value; It will be the unstable I (1) series with a unit root if series could not refuse testing without difference, but refuse testing once it encounters first difference. Accordingly, we name it as the unstable I (2) series with two unit roots if it could not refuse testing with none of or first encounter of

difference, but refuse testing once it encounters second difference.

4.3.1.2 Conception and economic significance of the co-integration.

The linear combination of the variable X and Y if they are I (1) series may be co-integrated and be stable process of I (0). Granger put forward the conception of co-integration in 1981 and 1983; Engle and he did further analysis of it in 1987. Vector Xt element is co-integrated to order (d, b), named as Xt~CI (d, b), If there exist a nonzero vector A and Xt is I (d), and aTXt~I(d，b)，d=b=0, then the vector A is called co-integrated vector. Though many factors will cause external change to the single element of Xt, there still exist some long-run balanced relations among these elements whose linear combinations are available and can be presented by aTXt . In addition, the Xt element (variable) may in short time deviate from the balanced state, but it will back to balance

constantly under the push of some economy power. In other words, these variables may be in unstable state in short period, but apt to change evenly together in a long run. So, we can say there is long run balanced increment relation between both economy variables if their time series have
the relation of co-integration. That is right the economy significance of co-integration.

If there are two unstable variables, X and Y of I (1) series, there exists the co-integrated relation between them at the same time. It is necessary to show their linear relation according to Engle and Granger's (1987) 'Granger representation theory'[12] by using error correction model which comes from the VAR (Value at Risk) analysis after the first difference embeds with error correction (EC).

$$\Delta Yt = \lambda + \sum_{i=0}^{p} \alpha i \Delta Xt - i + \sum_{j=0}^{p} \beta j \Delta Yt - j + \phi Z\mathrm{t}\text{-}1 + \mu t$$

$Z_{t-1}=(Y_{t-1}+\omega_0+\omega_1 X_{t-1})$

The $Z_{t-1}=(Y_{t-1}+\omega_0+\omega_1 X_{t-1})$ is the co-integrated vector, which represents the long run balanced relation between X and Y. It makes them back to the long run balanced state from unbalanced (deviated from the long run and common trend) in a short period. So we calledΦZt-1 as EC, p is delayed value, t is time, t m is errors interfere. All items are I (0) stable.

4.3.1.3 The Granger Causality Test.

It is a common question what is the variable to the other in economics, and 'has the logistics increment caused the GDP growth increment, or both are developed independently ?'. To this question the best answer is to check by Granger & Sims causality test.

The principle of Granger & Sims causality test is very simple: X's change should be advanced to the Y's change if the X's change caused Y's change. Particularly, it must meet two conditions if we say that X's is the cause of Y's. The first, X should be helpful to predict Y. That means considering X's foregone value as the independent variable during the Y's regression of Y's foregone value should apparently increase the explanation capability of regression. Secondly, Y should not be helpful to predict X, or there possibly exists variables other than X or Y if they are helpful to predict each other, which are the real cause of the change of X or Y.

To check whether these conditions are satisfied, we need a zero hypothesis that one variable is helpless to the other one. For example, to check the zero hypothesis of 'X is not the cause of Y's change', we do Y's regression of Y's and X's delayed value (unlimited condition model), then regress Y of Y's delayed value only (limited condition model). Finally, we use a simple F test model to recognize if

the X's delayed data are apparently contributive to the explanation capability of first regression. If yes, we can refuse the zero hypothesis and consider that data are same as X and are the cause of Y's change. Vice versa to test the zero hypothesis that 'Y is not the cause of X's change'

4.3.2 The co-integration analysis between Hangseng index and BCI index.

（1）Using the software of Eviews 5.0 to compute and test the unit root in the method of ADF of the Hangseng index, and the result as follows:

Test Type	ADF Test	Significant level	Critical value	Outcome
Hangseng	-0.892310	1%	-3.615588	Unstable
		5%	-2.941145	Unstable
		10%	-2.609066	Unstable
Hangseng First-order	-7.216446	1%	-3.621023	Stable
		5%	-2.943427	Stable
		10%	-2.610263	Stable

We can draw the conclusion that Hangseng time series has unit root at the significant level of 1%, belonging to the unstable series, after the test of first difference does not have any unit root at the significant level of 1%, belonging to the stable series. So, the Hangseng series belongs to I（1）series.

We also do the same unit root test to the BCI index, the results as follows:

Test Type	ADF Test	Significant level	Critical value	Outcome
BCI	-0.659070	1%	-3.615588	Unstable
		5%	-2.941145	Unstable
		10%	-2.609066	Unstable
BCI First-order	-4.926435	1%	-3.621023	Stable
		5%	-2.943427	Stable
		10%	-2.610263	Stable

We can also draw the conclusion that the BCI index has unit root at the significant level of 1%, belonging to the unstable series, and after the first difference test, it does not have any unit root at the significant level of 1%, belonging to the stable series. So, BCI index belongs to the I（1）series.

(2) The Ganger Causality Test between Hangseng time series and BCI time series.

Zero Hypothesis	Freedom degree	F	P
Hangseng does not Granger Cause BCI	38	1.42908	0.23995
BCI does not Granger Cause Hangseng		4.44015	0.04234

We can draw the conclusion from the Ganger Causality Test that we should select the result where P is less than 0.05, so we could consider to deny the zero hypothesis that Hangseng can not Granger cause the BCI, meanwhile accept the zero hypothesis that BCI can not Granger cause Hangseng. So we have reason to believe that there is one-way Granger Causality between Hangseng index and BCI index.

(3) Build the error correction model.

For the Hangseng and BCI are non-stable series according to the results above, and the first difference series IHangseng and IBCI are stable, so we can make a conclusion that the Hangseng and BCI are first integrated of order series, satisfied the precondition of the co-integration test.

We can use the Eviews software to do the general least square regression to the Hangseng and BCI, then get the results as follows:

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-13417.32	1281.162	-10.47277	0.0000
Hangseng	1.138804	0.067200	16.94640	0.0000

Then, we do the unit root test to the residual value after the regression using the method of ADF:

Test Type	ADF Test	Significant level	Critical value	Outcome
Residual value	-3.121185	1%	-3.615588	Unstable
		5%	-2.941145	Stable
		10%	-2.609066	Stable

Then we can make a conclusion that the estimated residual series are non-stable series because the value of the ADF Test is -3.121185, bigger than the critical value -3.615588 at the significant level of 1%, thus, we have reason to believe that the Hangseng and BCI series do not have co-integration relation.

Chapter 5 Conclusion, Suggestion & Comments:

5.1 Conclusion.

According to the Chapter 3, through the principal component analysis, the Hangseng index is selected as the principal component of the financial index, while the BCI index is selected as the principal component of the shipping index.

Then I did the correlation analysis in Chapter 4, the correlation coefficient is as high as 0.914, belonging to the high correlation. So we can make a conclusion that the financial industry and shipping industry have a close relation qualitatively.

Quantitatively, I also did a regression analysis between Hangseng index and BCI index, in order to get the exact number between these two index. In other words, we use the relative value to measure how much the change of BCI index is caused by the change of Hangseng index. After the regression index, we get the regression formula between the two index as follows:

$$\Delta BCI = -14.051 \times (\Delta Hangseng)^3 - 0.862 \times (\Delta Hangseng)^2 + 1.422 \times \Delta Hangseng + 0.007$$

That means if the Hangseng index increase by 1%, the BCI index will also increase by 2.11% and if the Hangseng index decrease by 3%, the BCI index will also decrease 4.85%.

Then in order to avoid the artificial or false regression, I did the co-integration analysis to measure whether the Hangseng index and BCI index do have the co-integration relation and need the error correction model to do the correction. After the co-integration analysis, I make the conclusion that the Hangseng index and BCI index do not have the co-integration relation, so the regression formula we got above does not include artificial or false regression.

5.2 Suggestion.

Through the research above, I get the relationship between financial industry and the shipping industry and according to the objective of the dissertation, I present some suggestions meant to strengthen the relationship between the both industries and accelerate the recovery not only of the financial but the shipping industry as well.

1. In aim of strengthening the relationship between financial and shipping industry, the investment banks should be encouraged to invest in shipping industry. The global economical recession is really an threat to some enterprises, but is opportunities to others. As the shipbuilding and shipping industry have a large amount of debt, and some banks in Germany and Britain including Royal Bank of Scotland are playing an active role in the industry. As the decreasing of the global trade, a lot of vessels are left unused and even they are not used, the cost and the debt are still consuming, so it is really an opportunity for the investment banks to take some measures to enter the shipping industry to do some investments. And now, the Bank of Morgan Stanley has already entered this field, it is making a debt fund with other two greek shipping companies intend to invest 40 million dollars into the shipping industry and the object of the fund is to invest the shipping debt and sell the discount.
2. In order to save the shipping market, it is encouraged that the old vessels should be dismantled as soon as possible. To get this goal, the ship-owners should have a full and overall understanding of the recession in shipping market, they should never have fluke mind. According to incomplete figures, even if half the shipbuilding orders cancelled, the situation of over capacity still cannot be improved in the next two years, so it is the obligation of all the owners to save the market. Only all the owners join together, the recession can be overcome and the owners cannot be benefited until the market is recovered, and the market cannot save the owners unless the owners save the market at first. According to the

French consulting institute AXS-Alphaliner, there were 52 vessels dismantled in the first quarter and the dismantled capacity reached 91,000 TEU, and it is estimated that the capacity of container vessels dismantled will make a new record and reach as large as 200,000TEU.

Besides, there are two other meanings for the dismantling old vessels: one is saving energy and reducing emissions which complies with the environment protecting and promoting the safety of shipping industry, the other is help owners to renovate new vessels and promote their competiveness in the market.

3. For the carriers, it is advisable to reduce the speed of fleet expansion instead to cooperate with others to overcome the tough situation. The cooperation among carriers could help them to reduce the cost, increase the efficiency and solve the problem of over-capacity. At current stage, some large carriers have already taken the measure to cooperate with each other or create new lines, such as Yang Ming and OOCL have cooperated to promote the efficiency of the China-India Line, COSCO and OOCL have cooperated to create the CGX (China Gulf Express), CMA-CGM and MAERSK join together to strengthen the Black Sea Express.

5.3 Comments.

In the tough situation of the global economic recession, as a graduate of maritime university, it is natural to combine the financial industry and shipping industry and it is necessary to do some research to analysis the relationship between the financial and shipping industry.

In this dissertation, the relationship is analyzed in two main aspects: one is the macro aspects, the impact of the financial crisis on the shipping industry are covered as well as the transmission mechanism of the financial crisis, the other is the micro aspects, the financial and shipping index are analyzed to select the

principal one to compare with each other, after the correlation analysis, regression analysis as well as the co-integration analysis, the impact of the fluctuation of the financial industry on the shipping industry could be measured quantitatively.

The innovation of the dissertation is the quantitative analysis between the two industry, we can get the exact fluctuation of shipping industry if there is a change in financial industry.

Through doing the research, I could not only get the result of the analysis, the process of the analysis really impressed me a lot as well. The application of the statistics software SPSS and the econometrics software EVIEWS really make me master the related skill to do the research, and know much more on the financial and shipping industry and the relation of both.

For the time limitation, this dissertation is only a initial research between financial and shipping industry. The relationship of both can be reflected in almost each field, so it is only the first step. As I said above, the innovation of the dissertation is the quantitative measurement, but it could be done more specifically and more diversified. Because of the limitation of the practice and experience, the suggestion in practice are limited and need to be deepen for the people who wants to do the further study on this topic.

Last but the most important is my appreciation to my tutor Prof. LIU Wei, the enriched knowledge , flexible idea as well as the rigorous scholarship really make me learnt how to do a research and how to analysis, all of which impressed me a lot and will make me benefited for my whole life.

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