7-20-2013

Influencing factors of China containerized freight index

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Research on the Influencing factors of China Containerized Freight Index

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China

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

MASTER OF SCIENCE

In

INTERNATIOANL TRANSPORT AND LOGISTICS

2013

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 research paper reflect my own personal views, and are not necessarily endorsed by the University.

Wang Haishu

…Wang haishu……

Supervised by

Associate Professor Sha Mei

Shanghai Maritime University

ACKNOWLEDGEMENT

Firstly I desire to thank for all the teachers and professors in WMU and SMU including Ma Shuo ,Shi Xin ,Sha Mei ,Liu Wei, Wang Xuefeng, Jiang Zhengfei and Hu Fangfang, all of them encourage me a lot in the process of ITL program in the past 2 years master life. During this period of years , what impressed me most is the advanced international teaching force coming from the world , which enriched my full range of knowledge especially on the field of Shipping and Logistics.

Also I want to sincerely feel grateful to my supervisor associate professor Sha Mei for the 3 month dissertation academic support, no matter how busy she is , she always spend a lot of time with us researching on the dissertation .

Last but not least , I feel so thankful to my parents and classmate. In the all 1.5 years, every time I felt in deep disappointed , it is you that helped me out of trouble and lead me to the bright way of keep fighting all the time, without you , every achievement I got means nothing to me .

Hope everyone loves me and I love live a peaceful life and wish happy around them all the time.

ABSTRACT

Title of research paper: **Research on the influencing factors of China Containerized Freight Index**

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

The container plays a vital role among the shipping industry , which undertake the capacity volume from departure place to destination location . As a shipping industry well developed country—China, we establish the CCFI (stand for China Containerized Freight Index) in order to reveal the whole shipping market about the supply and demand movements ,also it can help to hedge the risk of shipping market and prepare for the possible future shipping index. Secondly , CCFI is the tool for a company to protect the index value and make better business decisions.

So in my dissertation ,I plan to clarify the formation and fluctuation of CCFI first, and make use of the collection data to do qualitative analysis to define all the influencing factors of CCFI, and make comparative study of these factors to find the relationship between the variables of factors and CCFI .Secondly , I will take advantage of software of Eviews to make a model of multiple regressions based on the data from 2003 to 2012 to find out the exactly function relationship between the factors and freight rate. As to the choice of variables , I am going to select the most important factors from all aspects to analysis according to Maritime Economics. especially the economics factors. Finally , VAR model is used to find out the further correlation between CCFI and BDI based on the result of multiple regression model ,I also try to find out the causality relationship with each other in terms of statistical aspect, and get the conclusion by means of the combination of both

timeservers(Granger Test) and crosswise data (formulation from result based on Eviews) .

KEYWORD: CCFI , BDI , Multiple Regression Model,VAR model

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List of Abbreviations

CCFI	China Containerized Freight Index
BDI	Baltic Dry Index
VAR	Vector Auto Regression
FFA	Forward freight agreement
ADF	Augmented Dickey Fuller
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
PP	Phillips-Perron

Chapter 1 Introduction

1.1 Background and purpose of the dissertation

1.1.1 Research Background

In the past few years, from the development experience of world shipping market development, if we want to make the shipping market more maturity , it will be always introduced a suitable freight index . Because the freight index stand for the demand of the market, people saw the shipping development in our country and established the China Containerized Freight Index to reflect the up and down in China shipping market, which is also taken as the important basis of enterprise management decision in foreign or domestic .The cargo owner and forwarder are both take great care towards the CCFI in order to adjust port management strategy and adapt to market changes.

Figure 1 CCFI from 2011 to 2013

***Source*:Shanghai Shipping Exchange website**

As we all know, the container liner shipping market is unstable and uncertain, it is easily influenced by economic development , natural conditions ,international

political situation and many uncertain factors, and the running condition can be reflected by the level of container freight rate. In the market economic condition, the freight rate plays a guiding role in the process of resource allocation ,combination of production factors and the adjustment of supply and demand.

So the container freight rate is the core issue of container liner shipping marker, it is called the regulator and leverage of the state in the shipping market, its stability is the key to the stability of container liner transport. Thus , it has important significance of studying the container liner freight rate.

In the former oligopoly market , the factors that influence the decision of container freight rate is the agreement of monopoly . But with the shipping companies' engaged in container liner , there was some changes that taken place in this market , that is the increasing number of independent operation of container transport union ,which broke the liner conference oligopoly market structure. Under this condition of competition , the main factors influencing the container liner freight rate was changed. Therefore, it has important realistic significance in finding out the main factors of freight rate and analysis how the factors affect the container liner freight rate. Especially in the current situation of financial crisis' bringing huge impact upon shipping industry , the study of container freight rate is more prominent.

1.1.2 Research purpose

However, what factors really influence the CCFI is still unclear. In this essay, the variables that influence the CCFI are discussed and the multiple linear regression is used to examine the relationship between variables and freight rate .

Only through the research on the influence factors of CCFI , can the owner hold the changeable direction of freight rate timely according to the change of market and calculate the import and export trade cost when negotiating; only in this way, can the liner companies follow the trend of market to make the market become mature gradually and form the benign operation of the market mechanism; only by doing this ,may government understand the necessary market information, formulate the corresponding shipping policy to keep the stable and orderly development of container shipping market.

1.2 Recent research of the factors influence the freight rate

1.2.1 Foreign research

Juselius K established the Cointegrated VAR model to analysis the relationship between many important factors in shipping market, and other part of the article is to claim how the freight rate market influence the shipping company and calculated the dynamic risk of time charter market based on random spot market freight . Steen K built the forward freight mathematical model and analysis the relationship between FFA and Asian Options. Roar A , after a study of dry bulk shipping market recent years and the price problem of second hand ship and new shipbuilding , then used different forecast model to analysis the demand and supply of dry bulk shipping market . Martin S made a state of features of maritime market and price curve by using a classic economic theory. Albert W.V. Introduced the variable time series model into the freight rate model and found the strong relationship between Panama ship freight index and the Channel type ship freight index. Hawdon is the first person to use the econometric analysis into the shipping market and forecast the freight rate by using linear model. Manolis found the relationship of seaborne spot market and FFA market and thought the factors influence the freight are related

with spot market and FFA market, but the FFA market reflected more quickly.

As we can see, in these years, the maritime market has suffered with huge changes . Therefore, I using econometric methods to analysis the current shipping market and try to find a more reasonable model to predict the China containerized freight rate.

1.2 .2Domestic research

Dong Y made the analysis of the correlation between the China containerized freight index and export tariffs by using the single regression analysis of the Hong Kong line , Korea line, Japan line , then got the conclusion that the decide factors are not only related with real demand also influenced by other factors, what is more , the other factors have a huge influence .

Sun Y. introduced the CCFI and BDI in detail and described the basic characteristics of CCFI , also made a comparison research with the BDI

Su H.Q got the conclusion that the CCFI cycle fluctuations have relationship with world economic cycle. On the other hand , she studied in the relationship between the container freight and transportation costs.

Hou R.H simulated the price mechanism by building a shipping enterprise production and cost functions, and found the marginal cost is not sensitive towards demand in a large range. But if we made full use of the fleet , the marginal cost and price requested by ship owner will rise quickly.

Zou J.S made the comparison of the characteristics of Sino-US line and Sino-Japan by introducing the price volatility relate to market structure theory and industrial

economics from the degree of market concentration, product differentiation , market entry and exit barriers, market supply and demand as well as the tariff consultation with the regulatory mechanisms five level fluctuations in freight rate analysis , and revealed the market characteristics differences under different tariff fluctuation .

Qie W.B used the theory of supply and demand and other economic theory to analysis the factors affecting the freight container liner from a different perspective. In the article, the influencing factors are divided into direct factors and indirect factors, the direct factors including : market supply and demand on the transportation cost, government regulation; the indirect factor including the market structure of the world economy, science and technology. In the last part of the paper, the author proposed guidance by using qualitative and quantitative analysis method based on the current situation for the enterprise , and the quantify the empirical analysis of these factors . He used the Marshall partial equilibrium in the analysis to get the conclusion of the last comprehensive analysis of various factors .

1.2.3 Existing problems

However, problem still exists in the research of CCFI

- ✧ *The quantitative analysis is difficult to be found in the research of the influencing factors .*

For instance, Wang S.F found it was hard to do the quantitative analysis of influencing factors when writing the paper , because the data of this article are difficult to collect and the statistical standards are different which made it difficult to unified factors based on quantitative model to enter ， so Wang gave up the quantitative analysis of the impact factors , but with a time series model to analyze the fluctuations by the necessary qualitative analysis to discuss the CCFI level

factors . So this kind of methods is not as accurate as quantitative analysis.

- ✧ *A lot of authors neglect the essential factors when doing the research of factors influence the freight rate*

In the research of China International container shipping freight study , Zhang wrote the rigid demand curve by using the game theory model to analysis and explain the mechanism of the increase in international liner shipping market freight. Then Zhang used Eviews statistical measurement software to analysis the correlation of the data under the huge compilation relevant data for two major ocean lines. Finally , she found the conclusion that the unbalanced volume are influenced by unbalanced freight rate. Although Zhang analysis the influencing factors by using Eviews software , she only took into account the variable factors in the shipping process and ignored the economic factors, including the exchange rate and the trade volume..

- ✧ *The research on CCFI are mainly focus on the single method of time series or forecast , but the combination of time series and cross-sectional data is rarely .*

He J.T and Liang S.G used the Grander Causality Test when doing the research of "the research of the comparison between CCFI and BDI" .They apply the Granger test and find the BDI and CCFI exist a certain lag(1) correlation ,and CCFI is the Granger cause factor of BDI ,while BDI is not .But this test only reflects the single time series result finally ,it is not convincible enough to explain the research , so I decide to combine the cross-sectional data with time series model together to clarify my point of view in a more convincible extent.

1.3 The structure of the dissertation

In this essay , firstly ,I will use the qualitative analysis to define all the influencing factors of CCFI, and make comparative study of these factors to find the relationship

between the variables of factors and CCFI .Secondly , I will use the software of Eviews to make a model of multiple regressions based on the data from 2003 to 2012 to find out the exactly function relationship between the factors and freight rate. As to the choice of variables , I am going to select the most important factors from all aspects to analysis according to Maritime Economics(Mr.Stopford)[1].Finally , VAR model is used to find out the further time series correlation between CCFI and BDI based on the result of multiple regression model in the statistical aspect . As to the VAR model result and Eviews model result , if I find both has the promotion effect in the result ,then this means that the result is proved to be rigorous in both side of cross-sectional data or time series data.

[1] Stopford, M. (2009), Maritime Economics, *U.S.A and Canada, Routledge.*

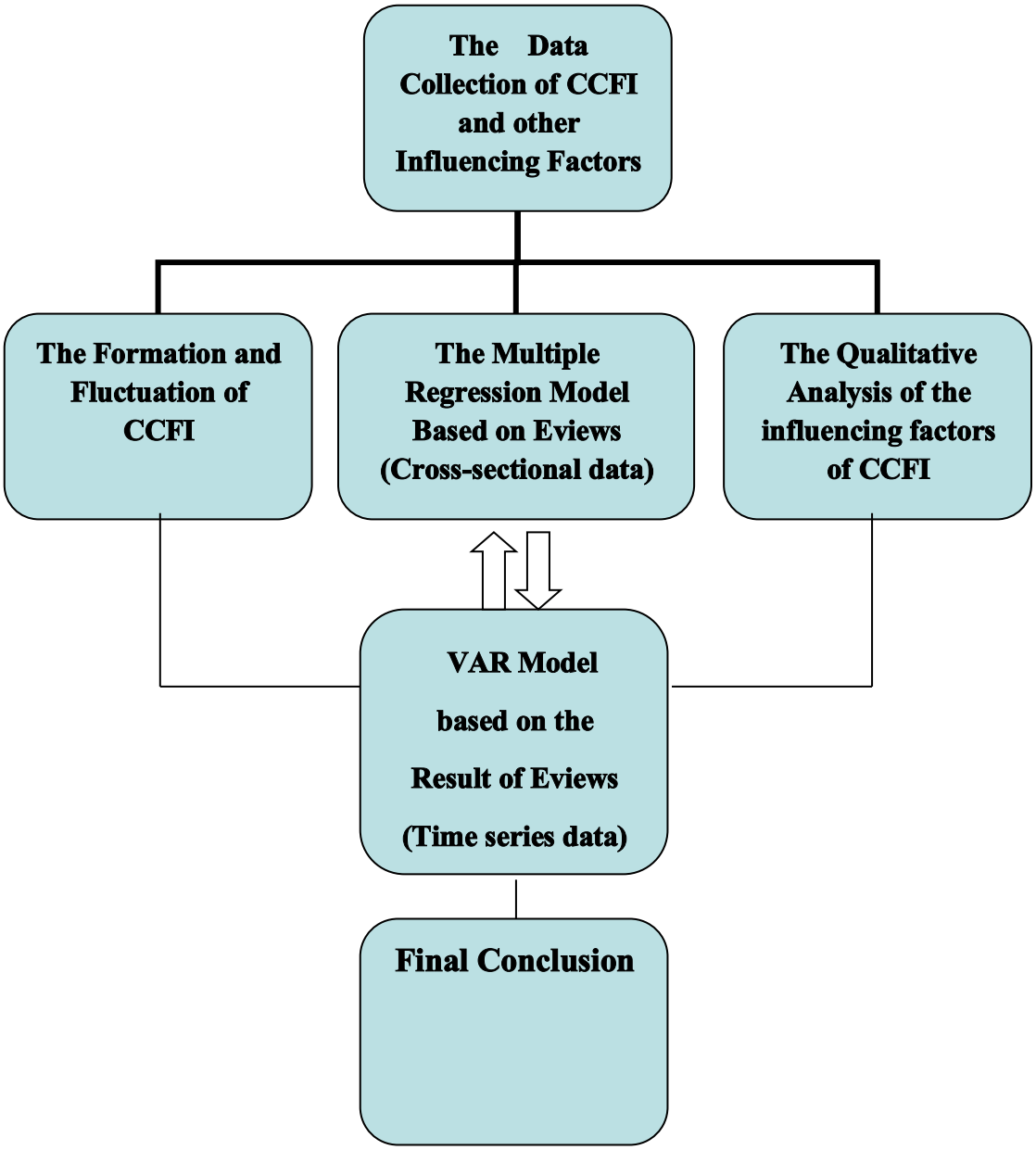


Figure 2 Research Methodology

Chapter 2 The Formation and Fluctuation of CCFI

2.1 The formation process of CCFI

2.1.1 The history of CCFI

Index is the standard way of measuring the macro and micro economics , so the establishment of scientific and reasonable index is able to reflect the social and economic phenomenon of a period time ,and also bring us the development of current society and trend of industry.

The shipping freight index as a form of price index, is more and more widely used by shipping operators and agencies in shipping market, all the people involved in this market , they all have to pay great attention on the freight rate.

In 1998 ,under the supporting from government and board committee , the Shanghai Exchange decide to establish a export containerized comprehensive freight rate and eleven branch route index once a week , which make the China containerized Freight Index come to our daily life.

The idea of CCFI foundation comes from the Shanghai shipping exchange

In 1996. August , the Shanghai shipping exchange decide to send a expert group to Europe to study , after which , we got the big conclusion that: shanghai shipping exchange as the important supporting instigation of shanghai international shipping center, should own the freight rate that face to the international shipping market and

reflect the trend of international shipping information.

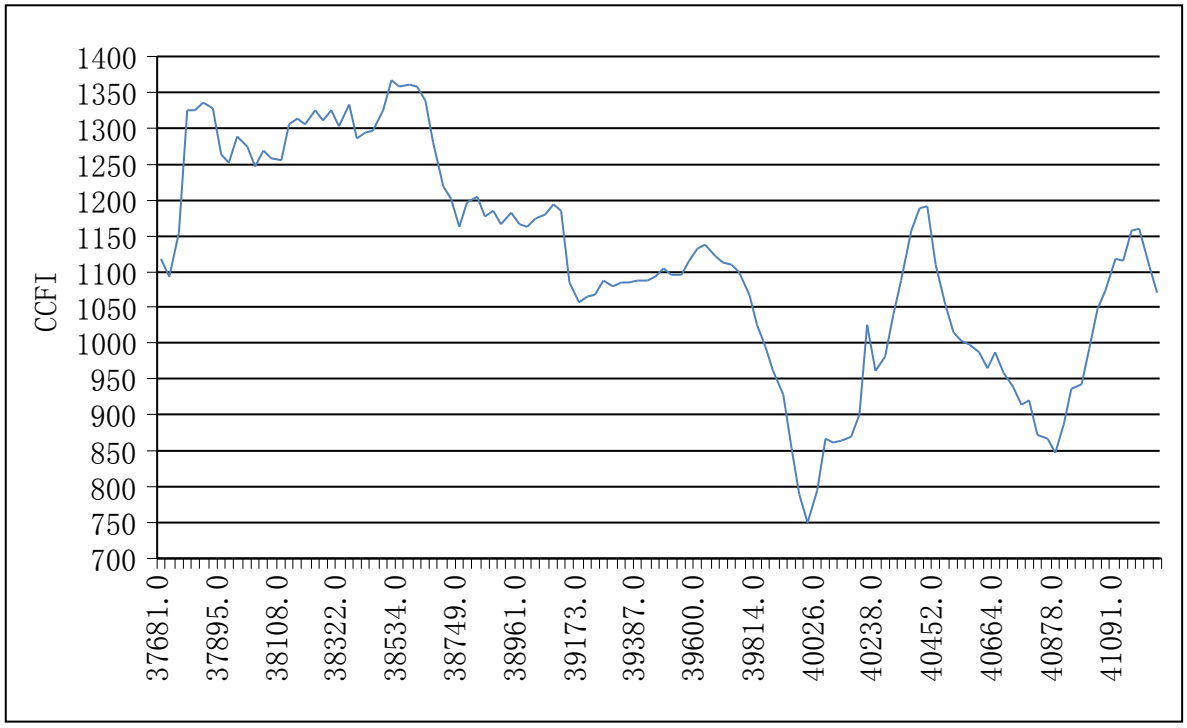


Figure 3 CCFI from 2003-2012

***Source*: Clarkson's Shipping Intelligence Network**

2.1.2 The calculation formulation of CCFI

In 1998 , 1st January , the CCFI as playing the role of freight market barometer, was hosted by the ministry of traffic and navigation .

(1).The formation and operation mode of CCFI

the calculation formula of CCFI

In order to take all the economic and actual data behind the fact into account ,

shanghai shipping exchange goes through theoretical deduction and empirical analysis an d finally decide to use Laplace equation to formula the China export container freight index ,the weight of the index is the transport income.

$$CCFI = \sum p_t \frac{w_{0t}}{p_{0t}} \qquad w_{0t} = \frac{p_{0t} q_{0t}}{\sum p_{0t} q_{0t}}$$

(2) the samples choice of CCFI route

Because of the fact that in the shipping route that involved in the china container market is too much and the transportation volume of each is not huge , so there is necessary to pick up some representative airline route sample among all the shipping routes. The freight index is also coming from the result after calculation on freight rate , price and container volume.

The principle of the sample route is below: The typicality of all type, the regional distribution and correlation. According to this principle , we selected a sample of eleven route : Hong Kong , South Korea , Japan ,Southeast Asia, Australia , The Mediterranean, Europe , East west Africa , South America and West America and South

Africa . The departure port of the route above are: DALIAN ,TIANJIN , QINGDAO , SHANGHAI , NANJING, NINGBO ,XIAMEN , FUZHOU , SHENZHEN , GUANGZHOU.）

(3) The shipping company that choose for the sample of CCFI

The basic principle of the sample company choice is that : every route must cover 3-5 domestic or foreign ship companies , the shipping company must has the independent legal qualification ,good commercial reputation and wide distribution, large market share and volunteered for the freight index compilation committee, and

is able to offer the accurately information on time according to the shanghai shipping exchange.

(4) The time period choice and frequency of CCFI establishment

As the basic timetable to measure the price index , the freight rate should be a more stable and standard index, not only reflect the normal freight rate levels , also has to take the availability and comparability of the price information into consideration . In the long term, the composition of freight rate and distribution of liner route will become more complicated, so the time period shouldn't apart from the report period. The basic time period of CCFI is on 1998 , the basic index is 1000. The shanghai shipping exchange release the index once a week the compile and publish it on every Friday

(5)The type identification of CCFI

Based on the derivation and proof on theoretical , the comprehensive freight rate is feasible only in the way if it is influenced by every possible factors, also it may show us the volatility trend under the inner factors worked on it.

(6) The modification of CCFI and the maintenance of basic time period

As the time goes by, the compiled method of the freight index will be changed in order to adapt to the current condition. So keeping the comparable advantage between the adjustment before and after adjustment is a vital principle

2.1.3 The Features of CCFI

(1)The comparable advantage : CCFI is the weighted arithmetic average number that weighted by fixed calculation of the average price of each route, so the price

index in different period has comparable advantage .

Representative advantage .The selection sample of CCFI is very scientific and vital, they choose 11 global routes all around the world ,also pick up good representative shipping company among the various routes, and the number of shipping companies is depend on the route capacity ,which makes the CCFI that made by all the rules more representative in shipping industry , and are able to reflect the container export market trend ,this is very important and vital effect for CCFI

(2)Relativity advantage: CCFI enable us to make horizontal comparison among different routes , thus , it reflect different freight rate in different country .CCFI also enable us to make vertical comparison in different time period ,which means CCFI shows us the time trend and makes us to forecast the future index of the shipping market , so for the shipping scholars and experts ,CCFI is more than a number , for the ship owner and traders , CCFI may tell them the cost of their transportation , and makes them choose the most sensible route of lowest cost . So , in all , CCFI has the ability of relativity.

(3) Comprehensive advantage : From the surface meaning of the CCFI , it is only a number , but what behind the word meaning is complex influencing factors, to point out is too much like: the cost of transportation , the shipping market supply and demand relationship and the decision making behavior made by market participants. All the complicated and complex factors are expressed by the simple index—CCFI, which makes so clear and easy to understand for all people no matter work in shipping or not. The comprehensive advantage also can be performed at the sample route choice, all the routes cover the Asia, Americas, Africa , Oceania, Europe and the Mediterranean , the departure port including the top ports in domestic.

(4)Limitation : according to the point of view from CHEN lijiang and Yu siqing, CCFI is made as following the Laplace index method , it is the fixed weighted comprehensive index in same depending factors. As we all know , Laplace price index is reporting the Chinese export container different level only when assuming the trading volume of container is fixed , so despite CCFI may reflect the price trend , it can't bring us the variation of Chinese export container trade capacity, thus , CCFI exsit a certain of limitation .

2.1.4 The process of the establishment of CCFI

The compiled process of the CCFI actually is made from many regular route freight rate in china export container transportation ,then after the comprehensive calculation through specific statistics index calculation formula to reflect the comprehensive indicator index for the market prices in China export transportation..

Among all the route , according to the sample selection area distribution and representative principle, CCFI includes : Japan route , Hong Kong route, South Korea route, Southeast Asia ,Australia ,European route and Eastern route , South Africa ,South America routes , and the domestic port toward above port is : Dalian , Tianjin , Qingdao, Shanghai, Nanjing ,Ningbo, Xiamen, Fuzhou, Shenzhen, Guangzhou

After making certain of the routes, the choice of the shipping company is also follow three vital principles:

(1) the biggest cargo capacity shipping company in every route

(2) The number of shipping companies in each route is determined by the capacity in each route

(3) The good reputation and stable management of a shipping company is also important for the choice.

Only according to the three basic principles, Cosco container lines , China shipping container lines, Maersk shipping and other companies are the first batch into the sample

2.2 The Fluctuation Analysis of CCFI

2.2.1 The data collection of CCFI

I select the data from 2007 .1 to 2012.12 as my research object ,totally72 observation numbers. Each index stand for the average China containerized freight index in one month.

	2007	2008	2009	2010	2011	2012
Jan	1195	1094	1025	901	1005	887
Feb	1185	1103	995	1027	998	937
Mar	1086	1096	962	963	986	942
Apr	1056	1096	928	982	965	994
May	1064	1116	854	1040	987	1048
Jun	1069	1133	790	1089	960	1074
Jul	1088	1139	749	1158	940	1117
Aug	1078	1122	794	1188	915	1116
Sep	1086	1113	868	1190	920	1156
Oct	1084	1110	861	1109	872	1160
Nov	1087	1099	864	1053	868	1108
Dec	1089	1068	869	1014	847	1071
Average	1097	1107	880	1060	939	1051

Table 1 CCFI from 2007-2012

***Source*: Clarkson's Shipping Intelligence Network**

2.2.2 The Volatility analysis of CCFI

According to the CCFI come from the Figure 4, we can get the volatility trend from below trend.

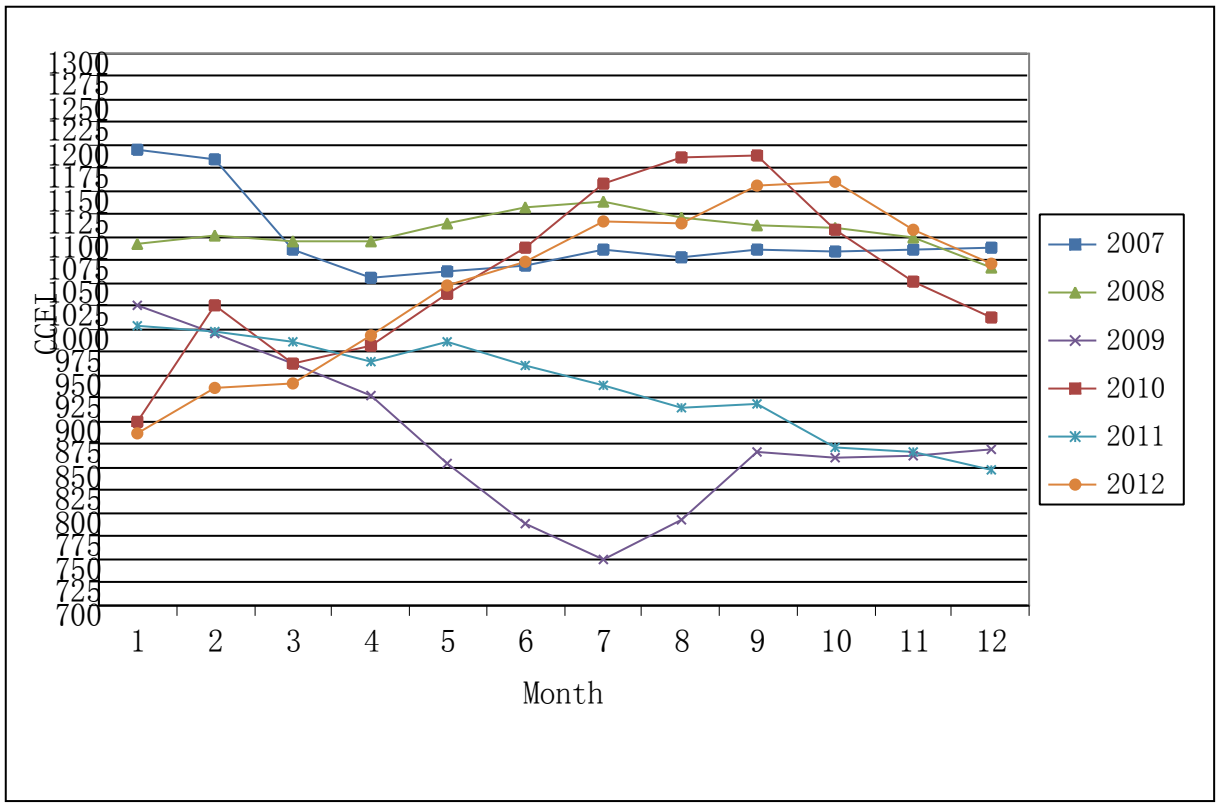


Figure 4 CCFI from 2007-2012

***Source*: Clarkson's Shipping Intelligence Network**

From the table above , we are able to get conclusion that :

(1) CCFI in 2007 and 2011 is sharply decreased among the whole year , especially in 2011, the highest point is 1005 , the lowest is 847 .

(2) From the result of average CCFI , it is obviously that 2009 went through the lowest point while the 2008 enjoyed the highest point , and no one in the years can keep the increasing trend in to next time.

(3) The freight rate is changeable while following the seasonable cycle , which means the comparative lower index is happened in the first quarter of one year , while the comparative higher index come out in the last quarter of whole year.

Chapter 3 The Qualitative Analysis of the Influencing factors of CCFI

As the “barometer” of the freight index, CCFI reflects the trend of shipping market price ,and revealing the shipping market of the supply and demand situation , which also offers the decision making advises to the operators and government department . The cargo owner can easily get fully information of the market price wave according to the freight rate , and what is more important is calculate the cost of every product when doing the negotiations, and cut the economic loss of wrong decision brings; the shipping company is able to enhance the adjustable ability and balance capacity by using the freight rate and make themselves adapt to the mature market and form to a perfect operation formulation ; the government will get profit from the freight rate wave in order to establish the corresponding policy . In addition , when considering the evading of market risk , many shipping managers tend to treat the freight rate trade as a means of hedging

3.1 The indirect influencing factors of CCFI

3.1.1 The Domestic macroeconomic policy factors

The shipping policy and import export policy that established by China influence a lot to the CCFI , for example , one freight rate filling system is introduced by transport department in 2006 really control the malignant competition and make the freight rate stable. The basic principle of the policy is that the international container price is the market regulation that formulated by the ship operators

independently.

The operators should follow the business principles of honesty and improve the service quality and efficiency , reduce the operation cost and offer reasonable service according to the supply and demand situation , also the “zero freight rate “ even “negative freight rate” and prohibited. In 2010, the communication department established the “ announcement of non-vessel shipping operator on the freight rate “, which control the malignant competition of the market to further extent and also helpful to the freight rate stability . Another example is export tax rebate policy , since the tax reformation in 1994, the china export tax rebate policy has been thought a huge process of reform, once is in the 2010 about the 2 high and 1 resource means high energy-consuming ,high pollution and energy resources. In the basic theory , the tax rebate policy enable to stimulate the export capacity and enhance the demand of container market , thus make the CCFI goes up as a result . The other policies in China such as the support policy of export industry , the monetary policy and fiscal policy will directly or indirectly affected the trends of CCFI .

3.1.2 The capacity factors of CCFI

The capacity factor of container enterprises constitute the supply of export container market. The container transportation market supply means in a certain time , the total ship tonnage that the carrier willing to offer in every freight condition , and the capacity supply is expressed by the total net dead weight of container operation ship in a certain time .

Under the condition of other variables unchanged , according to the basic economic principle of supply and demand , when the capacity increased , it will lead to the fact of CCFI goes down ; while the shortage of capacity supply will raise the

CCFI

The china export of container shipping market is not a fully competitive market, it is monopolied by some large shipping companies . So the formulation of the freight rate is mainly depend on the COSCO , Maersk and other big shipping company.

3.2 The direct influencing factors of CCFI

3.2.1 The Baltic Dry-bulk Index

BDI : this index is mainly used to reflect the freight rate level of the global dry bulk cargo market , also used to indicate the supply and demand situation lf the dry bulk market . The Baltic global freight rate also worked by means of the tool of BDI . We are also able to take the BDI as the standard sample when doing the voyage renting and time renting. In additional , many experts take the BDI as the reference when establish other freight rate.

Because of the fact that the BDI is able to be adapted into the current shipping market development by changing the composition of the freight rate by following the strict and clear rules , BDI is capable of showing the freight rate level of global dry bulk cargo market. What's more , the Baltic freight index is the foundation of the Baltic shipping exchange and plays a very important role in when making the analysis and forecast about the dry bulk shipping market .

BDI Initially, a lot of factors have been tested in regression model, like current exchange, world economy. However, China has a mighty and powerful government which influences the market. Take current exchange for example, in 2005, People's Bank of China, Central Bank, began to implement "managed floating exchange - rate regime ". Before that, RMB obeyed to Pegged Exchange Rate .Therefore, it is

hard to explain the relationship between the exchange rate and CCFI. In fact, the test of regression proved the current exchange rate failed besides growth of world economy. BDI, Baltic Dry-bulk Index, can reflect many factors in the markets such as the world economy, seaborne commodity trades and so on. BDI coves the demand side and supply side together and seems to be simultaneous with CCFI. Many Chinese scholars analyzed the relationship between the CCFI and BDI and found out that the BDI might affect the CCFI after conducting the Granger test.

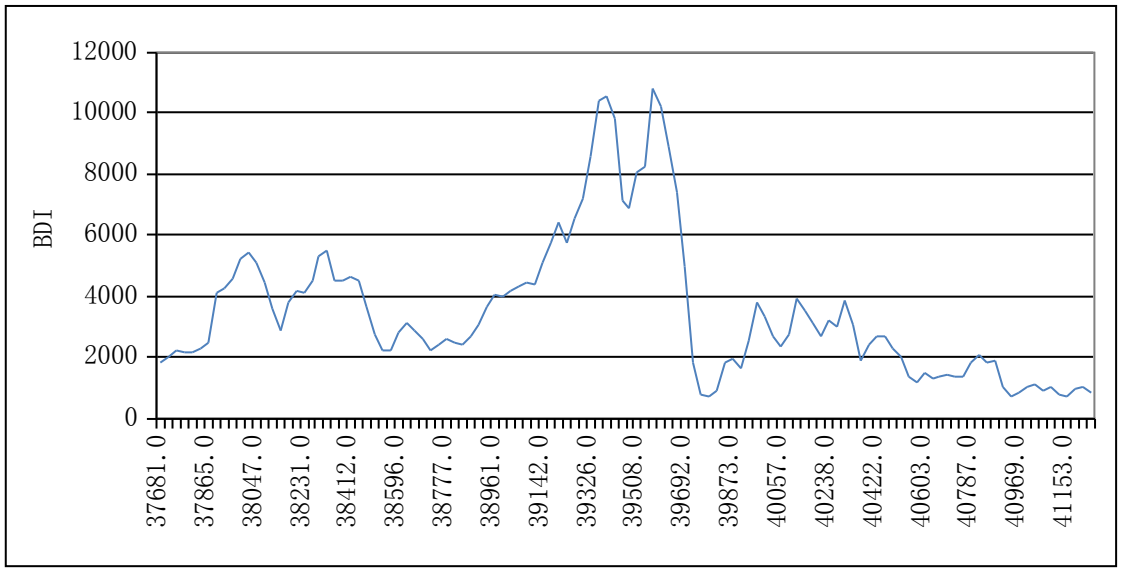


Figure 5 BDI from 2003-2012

***Source*: Clarkson's Shipping Intelligence Network**

3.2.2 The Bunker price factor

The bunker prices severely influence global shipping industry since the prices account for 20 to 25 percent of shipping company's operation expense. Hence, it is essential for us to consider the bunker price as one of the variables since the rate of the operation expense may affect the containership's rate in the direct way.

So I choose the 380cst bunker prices($/Tonne) for the factors.

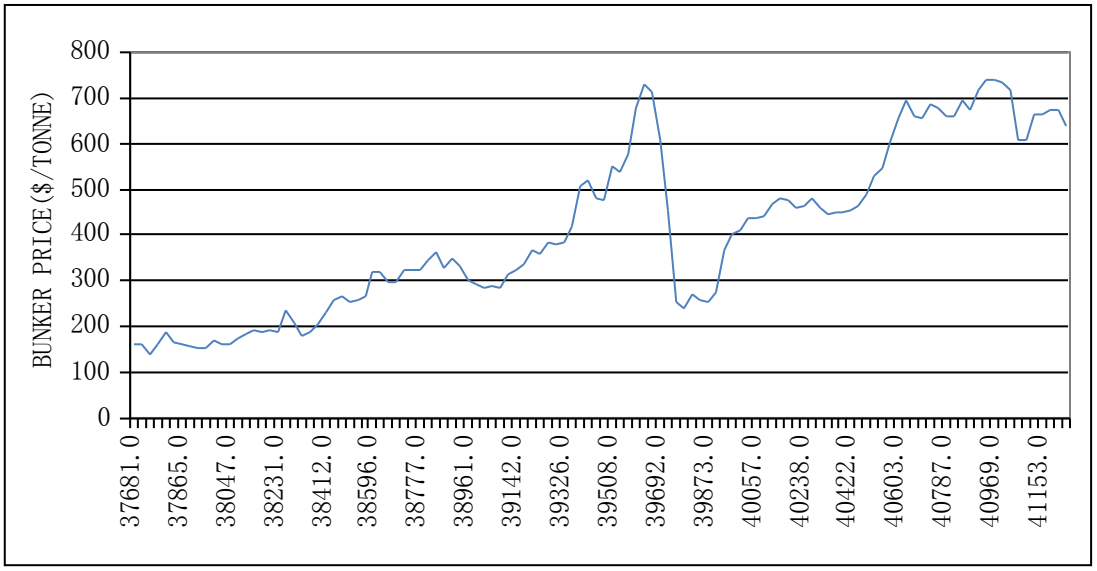
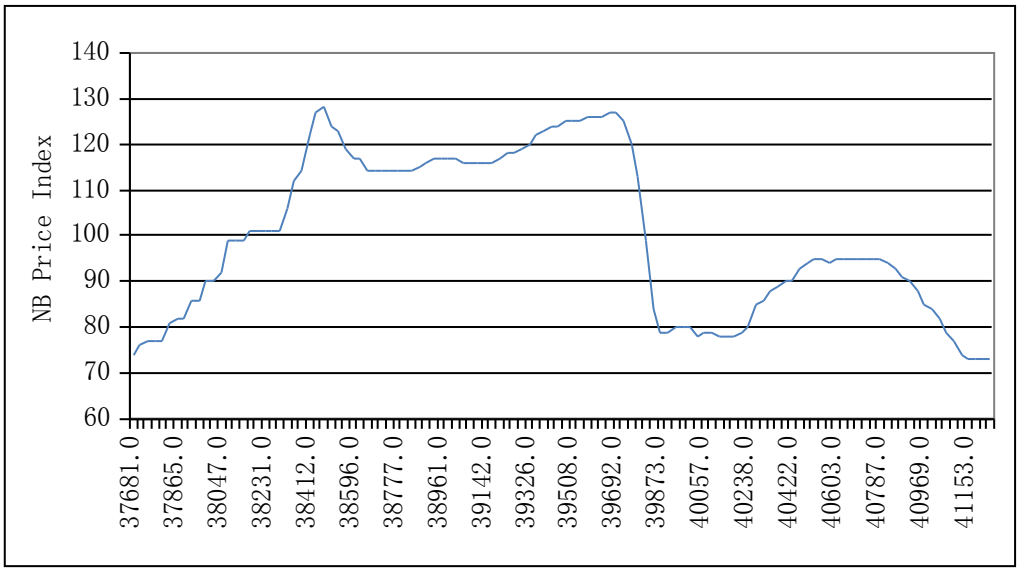


Figure 6 380cst Bunker prices from 2003-2012

***Source*: Clarkson's Shipping Intelligence Network**

3.2.3The Containership New building prices index factor

Since the shipping business is a long cycle business and the ordering and delivering ship period may last to 4 years long. The timing to purchase a ship becomes critical since the price can influence the fix cost. [2]From this point of view, the amounts of ordering and delivering could influence the supply market and then affect the whole container market rate.



[2] Stopford, M. (2009), Maritime Economics, *U.S.A and Canada, Routledge.*

Figure 7 NB Prices from 2003-2012

***Source*: Clarkson's Shipping Intelligence Network**

3.2.4 Fleet development

This data is from Clarksons and expresses the increase or decrease of container fleet in the market. The variable explains the shipbuilding and scraping markets at the same time. Fleet development provides capacity and moves the supply chain to the right, which increases the freight, and because the fleet development is always keeping increasing , so I choose the diversity between the month minus last month to be the variable.

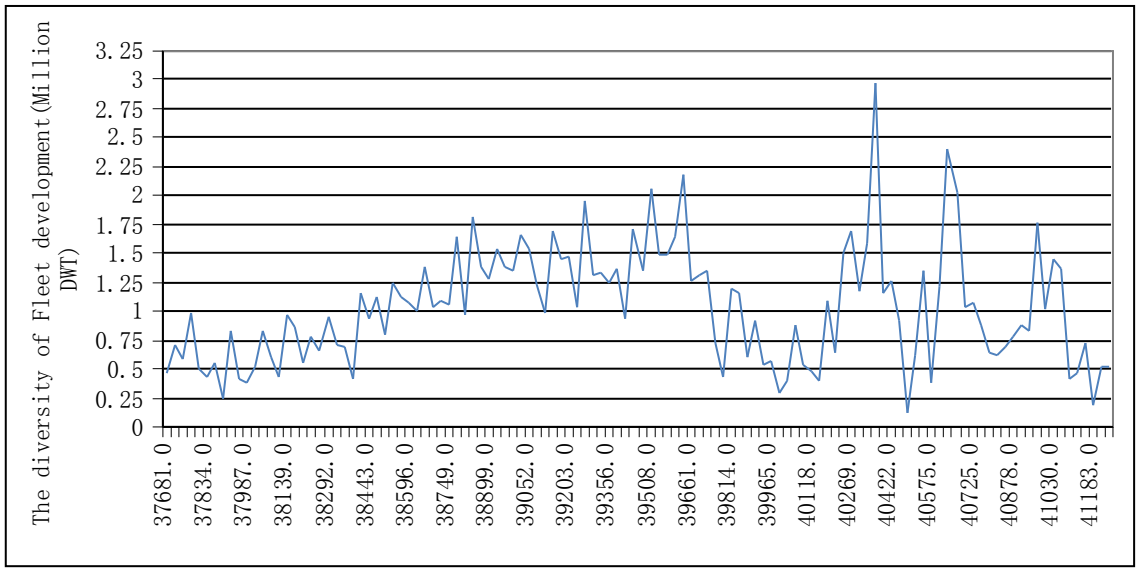


Figure 8 The diversity of Fleet development from 2003-2012

***Source*: Clarkson's Shipping Intelligence Network**

Chapter 4 The building of multiple regression model based on Eviews

4.1 The construction of the multiple regression model

To meet the increasing demand of China's container transport market, China (Export) Containerized Freight Index (CCFI) was introduced on April 1998 by Shanghai Shipping Exchange. After ten year developing, it has become one of the world's leading maritime indicators. However, the study on the CCFI is rare and the factors that affect CCFI are still unknown. As a result, in this essay some variables that may have relation to the freight rate of China container line will be presented and the multiple liner regression will be used to exam the relationship between a couple of variables and freight rate. In this project Baltic Dry Index (BDI), Fleet development in containership sector, Containership New Building index, and Bunker price are used as variables. Data in this essay are all collected from Clarkson.

The analysis is divided into three parts. In the first part, the reason why the variables are selected and the definition of each variable are presented. In the second part, the process is illustrated that several tests conducted to exam and the variables that are chosen to see whether they are suitable or not. In the last part, the result of test is analyzed and the relationship between the variables and CCFI are shown.

4.2 The correlation and selection of the model variables

4.2.1 Chosen of variables

Shipping market is full of volatility which can be affected by a large quantity of

factors[3], comb all the possible elements and summary 10 variables based on the demand and supply of the shipping market . The variables, chosen in the essay, are built on the theory of Stopford, namely BDI, bunker price, container ship new building price and the diversity of fleet development.

Demand	Supply
1. The world economy	1. World fleet
2. Seaborne commodity trades	2. Fleet productivity
3. Average haul	3. Shipbuilding production
4. Random shocks	4. Scrapping and losses
5. Transport costs	5. Freight revenue

Table 2 Ten Variables in the shipping market model

Source: **Stopford,M,2008 ,Maritime Economics**

Data collection :

Year	BDI	Bunker price($/Tonne)	NB Price index	Diversity of fleet development(Milion DWT)
3/Mar	1850	159.62	74	0.47
3/Apr	2064	160.62	76	0.71
3/May	2231	142	77	0.59
3/Jun	2136	160.38	77	0.98

[3] Stopford, M. (2009), Maritime Economics, *U.S.A and Canada, Routledge.*

3/Jul	2192	188.25	77	0.5
3/Aug	2286	164.2	81	0.43
3/Sep	2463	161.88	82	0.56
3/Oct	4163	155.9	82	0.25
3/Nov	4250	152.5	86	0.83
3/Dec	4609	150.88	86	0.42
4/Jan	5229	170	90	0.38
4/Feb	5450	160.5	90	0.52
4/Mar	5131	160.25	92	0.83
4/Apr	4489	174.5	99	0.61
4/May	3596	182.12	99	0.44
4/Jun	2902	193.88	99	0.96
4/Jul	3778	187.2	101	0.87
4/Aug	4169	192.25	101	0.56
4/Sep	4141	187.25	101	0.77
4/Oct	4539	238.1	101	0.65
4/Nov	5309	210.5	101	0.95
4/Dec	5519	180.7	106	0.71
5/Jan	4502	187.25	112	0.69
5/Feb	4532	203.5	114	0.41
5/Mar	4678	232.12	122	1.15
5/Apr	4532	257.7	127	0.94
5/May	3667	266.25	128	1.12
5/Jun	2746	254.25	124	0.79
5/Jul	2220	256.3	123	1.25
5/Aug	2203	266.25	119	1.12
5/Sep	2803	319.5	117	1.08
5/Oct	3161	318.5	117	1
5/Nov	2916	299	114	1.38
5/Dec	2600	299.2	114	1.04
6/Jan	2262	322.88	114	1.09
6/Feb	2444	323.88	114	1.06
6/Mar	2599	325.3	114	1.65
6/Apr	2465	345.25	114	0.96
6/May	2442	362	114	1.81
6/Jun	2718	328	115	1.39
6/Jul	3050	348.25	116	1.28
6/Aug	3687	332.5	117	1.53
6/Sep	4039	300.7	117	1.39
6/Oct	4028	291.5	117	1.35

6/Nov	4190	284.25	117	1.66
6/Dec	4336	287	116	1.53
7/Jan	4462	284.12	116	1.23
7/Feb	4398	316.88	116	0.98
7/Mar	5123	325	116	1.69
7/Apr	5754	335.62	116	1.46
7/May	6402	369.25	117	1.47
7/Jun	5772	358	118	1.04
7/Jul	6572	382.88	118	1.96
7/Aug	7195	380.5	119	1.31
7/Sep	8586	386	120	1.33
7/Oct	10426	417.88	122	1.24
7/Nov	10543	505.1	123	1.37
7/Dec	9854	518.75	124	0.93
8/Jan	7170	478.75	124	1.71
8/Feb	6874	475.2	125	1.35
8/Mar	8063	549.75	125	2.06
8/Apr	8287	538.38	125	1.49
8/May	10844	574.9	126	1.48
8/Jun	10245	678.5	126	1.65
8/Jul	8936	729.75	126	2.17
8/Aug	7402	714.2	127	1.26
8/Sep	4975	609.12	127	1.32
8/Oct	1808	454.4	125	1.34
8/Nov	819	253	120	0.73
8/Dec	747	238.5	113	0.43
9/Jan	905	269.5	99	1.2
9/Feb	1816	256.62	84	1.16
9/Mar	1958	253.75	79	0.6
9/Apr	1659	275.62	79	0.92
9/May	2540	366.5	80	0.53
9/Jun	3823	402.5	80	0.57
9/Jul	3362	412.4	80	0.3
9/Aug	2685	439.12	78	0.39
9/Sep	2358	435.62	79	0.88
9/Oct	2746	443	79	0.54
9/Nov	3941	465.62	78	0.49
9/Dec	3572	481.12	78	0.4
10/Jan	3168	476.9	78	1.09
10/Feb	2678	458	79	0.64

10/Mar	3207	465	80	1.5
10/Apr	3043	478.9	85	1.7
10/May	3838	460.75	86	1.17
10/Jun	3088	447	88	1.59
10/Jul	1910	448.4	89	2.98
10/Aug	2432	452	90	1.15
10/Sep	2719	454.75	90	1.27
10/Oct	2693	464	93	0.92
10/Nov	2321	490.5	94	0.12
10/Dec	2031	529.7	95	0.63
11/Jan	1401	547.25	95	1.34
11/Feb	1181	604.25	94	0.38
11/Mar	1493	655.25	95	1.21
11/Apr	1343	693.6	95	2.4
11/May	1352	661	95	2.03
11/Jun	1433	655.5	95	1.03
11/Jul	1366	684.9	95	1.07
11/Aug	1387	679.12	95	0.89
11/Sep	1840	660.9	95	0.64
11/Oct	2072	659.12	94	0.62
11/Nov	1835	694.5	93	0.69
11/Dec	1869	675	91	0.78
12/Jan	1039	717.38	90	0.89
12/Feb	703	737.75	88	0.83
12/Mar	859	740.5	85	1.77
12/Apr	1021	734.88	84	1.02
12/May	1101	716.5	82	1.46
12/Jun	937	609.5	79	1.37
12/Jul	1056	605.75	77	0.41
12/Aug	761	664.3	74	0.47
12/Sep	707	665.25	73	0.73
12/Oct	952	672.5	73	0.19
12/Nov	1025	675.1	73	0.52
12/Dec	856	637	73	0.52

Table 3 The variables data from 2003-2012

***Source*: Clarkson's Shipping Intelligence Network**

4.2.2 The unit root test

Firstly, the unit root test is conducted to discover whether the variables are stationary or not. From the Table 4 below it can be seen that three tests are used and compared. New building prices index is level stationary in both ADF and PP test while fleet development factor is level stationary in PP test.

	BDI	Bunker/Price	Fleet/Development	New/Building/Index
ADF	No (1^{st})	No(1^{st})	No(1^{st})	Stationary
PP	No(1^{st})	No(1^{st})	Stationary	Stationary
KPSS	No(1^{st})	No(1^{st})	No(1^{st})	No(1^{st})

Table 4 Unit Root Test

As the variables have to stay in the same level of stationary in order to conduct the co-integration test, KPSS test is selected where all the variables were rejected by the null hypothesis under the first difference. Also the variables' descriptive statistics are checked and all of the results are in the Appendix I.

4.2.3 correlation test

Secondly, the correlation test is conducted to test if there is correlation among the variables. From the result it can be found that there are no correlation between the X variables with each other since the value in the matrix, which are shown in the Table 5 below, are all less than 0.8, so the next step can be done without changing any of the variables.

	RCCFI	Rfleet development	Rnew building	RBUNKER	RBDI
RCCFI	1.000000	0.071625	0.080299	-0.086104	-0.239878
Rfleet/development	0.071625	1.000000	0.111877	-0.092422	0.356779
Rnew building	0.080299	0.111877	1.000000	0.129427	0.075273
RBUNKER	-0.086104	-0.092422	0.129427	1.000000	-0.072527
RBDI	-0.239878	0.356779	0.075273	-0.072527	1.000000

Table 5 Correlations table for all variables

4.3 The process of the multiple regression model

4.3.1 F . test

After we put original data into the Eviews 6.0 to make the liner regression analysis:

The multiple estimate regression is computed. Base on the result which is shown in the Table 6 below it is found that three of the variables, Rbunker, Rnew building, and Rfleet development are insignificant, which means that they has relatively lower impact on the dependent variable (CCFI). The three variables were eliminated at last because of the insignificant results.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.702375	0.790187	-0.888871	0.3760
RN	0.065426	0.115473	0.566593	0.5721
RBUNKER	0.000533	0.036808	0.014488	0.9885
RBDI	-0.038187	0.015619	-2.444859	0.0160
RF	0.853535	0.945571	0.902667	0.3686

R-squared	0.968422	Mean dependent var	-0.036708
Adjusted R-squared	0.035152	S.D. dependent var	3.597992
S.E. of regression	3.534188	Akaike info criterion	5.404639
Sum squared resid	1398.935	Schwarz criterion	5.522681
Log likelihood	-311.1714	Hannan-Quinn criter.	5.452563
F-statistic	2.056543	Durbin-Watson stat	1.340376
Prob(F-statistic)	0.001277		

Table 6 Multiple Regression Test

Analysis: From this table, we are able to find that : the determined coefficient R-squared =0.968422, so if reflect that this regression model is highly significant. And the P=0.001277, so the regression model has passed the F test , which means the four dependent variable has the possibility of 0.001277 to make mistake in the production of significant independent variable.

So this result shows that 4 dependent variables have highly linear impact on CCFI.

4.3.2T test

From the Table 6 Multiple Regression Test. When significant level a= 0.05, The Prob of RBDI < 0.05. So this BDI pass the significant test.

4.3.3 chow point test

Chow Breakpoint Test: 2008M09
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 2003M04 2012M12

F-statistic	0.403063	Prob. F(5,107)	0.8458
Log likelihood ratio	2.183168	Prob. Chi-Square(5)	0.8233
Wald Statistic	2.015316	Prob. Chi-Square(5)	0.8470

Table 7 Chow Breakpoint Test

From this Chow forecast test. The Prob.F and Prob.Chi-Square is 0.8458,0.8233,0.8470, which means the difference between the forecast and real data is almost zero , so we can consider this regression model is stable.

4.3.4 The White Test

The White test is the vital method to test the heteroscedasticity of the model
In this test , we consider the e-square of dependent variable , and make the original independent —square and itself to establish a new linear regression model, and thought out the fitting analysis to check the exist of heteroscedasticity in the model.

Heteroskedasticity Test: White

F-statistic	0.660441	Prob. F(14,102)	0.8072
Obs*R-squared	9.724404	Prob. Chi-Square(14)	0.7820
Scaled explained SS	20.10203	Prob. Chi-Square(14)	0.1270

Table 8 White Test

Analysis: In the result of White Test , the Obs*R-squared is much more bigger than significant level of 0.1 ,0.05 or0.01, so the heteroskedasticity is impossible.

4.3.5 Correlation Test:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.622066	Prob. F(12,100)	0.0973
Obs*R-squared	19.06319	Prob. Chi-Square(12)	0.0870

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 03/07/13 Time: 17:22
Sample: 2003M04 2012M12
Included observations: 117
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030982	0.798871	0.038782	0.9691
RN	-0.018141	0.118987	-0.152464	0.8791
RBUNKER	0.013466	0.037798	0.356264	0.7224
RBDI	-0.009149	0.016002	-0.571718	0.5688
RF	-0.146912	0.954771	-0.153871	0.8780
RESID(-1)	0.323480	0.101143	3.198255	0.0019
RESID(-2)	0.018588	0.105967	0.175416	0.8611
RESID(-3)	0.080185	0.105887	0.757276	0.4507
RESID(-4)	-0.132110	0.106438	-1.241192	0.2174
RESID(-5)	0.106553	0.109765	0.970740	0.3340
RESID(-6)	0.033508	0.107631	0.311326	0.7562
RESID(-7)	-0.098216	0.107576	-0.912991	0.3634
RESID(-8)	-0.031201	0.108307	-0.288082	0.7739
RESID(-9)	-0.010305	0.108194	-0.095250	0.9243
RESID(-10)	-0.000225	0.109905	-0.002048	0.9984
RESID(-11)	-0.179225	0.109534	-1.636245	0.1049
RESID(-12)	0.003974	0.105356	0.037718	0.9700

R-squared	0.162933	Mean dependent var	1.21E-16
Adjusted R-squared	0.029003	S.D. dependent var	3.472720
S.E. of regression	3.421990	Akaike info criterion	5.431916
Sum squared resid	1171.002	Schwarz criterion	5.833258
Log likelihood	-300.7671	Hannan-Quinn criter.	5.594856
F-statistic	1.216549	Durbin-Watson stat	2.002332

Table 9 The Correlation Test

From the result of the LM test table , Prob .Chi- Square >0.01 , Prob .F> 0.05,

Also , the Durbin-Watsom stat = 2.002332

So DW= 2(1-p) =2.002332, p= -0.002332 , and we may get the conclusion that the

negative correlation is too small to be visible .

4.4 Analysis of the result of the Eviews

After we get the final result of the Eviews , we are able to see that , BDI has a huge influence among all the factors . So it is necessary for us to further analysis the correlation of the two vital Index in shipping .

Chapter 5 The Methodology of the VAR Model based on the result of Eviews

5.1 The process of the VAR model

5.1 .1 Methodology of VAR Model

The vector auto regressive (VAR) model has been a popular choice to describe macroeconomic time-series data. There are many reasons for that. Firstly, the VAR model is not only easy to estimate, but also gives a good fit to data. Moreover, the VAR model enables the researchers to combine short term and long term information in the data by taking advantage of the cointegration property

The VAR model is usually used for the prediction of time series and dynamic effect of the random disturbance of the variable system dynamic. In this model , each variable is treated equally without dividing into endogenous variables and exogenous variables.

5.1.2The relationship between CCFI and BDI

In the previous chapter , we already discussed the concept of CCFI and BDI in the details of formulation , sample choices and practical usage .So in this chapter , we are going to research the further relationship between these two index.

In the international shipping market , both CCFI and BDI enjoy a very vital reference role . In last few years , the shipping market turned to be fluctuation , the amplitude of freight rate is around thousand up and down ,especially in the 2008 , when the America subprime mortgage crisis evaluated into the global financial crisis, the shipping industry suffered huge lose in that period . The BDI went down from the highest point of 12000 in 2008.5 to 10000 even lower, in the meanwhile , CCFI fell to the ground just like plummeted. As a result , every related industry suffered huge losses because failed to find effective way to avoid risks . Thus , it has great significance when finding out the way of avoiding the risks by means of figuring out the regularity of its fluctuation and the correlation and difference between BDI and CCFI.

So in the following pages, first thing is to collect the data in the special period of economic crisis , and based on the result of Eviews Multiple linear regression , I ‘m gong to use VAR model and Granger Casualty Test to analysis the CCFI fluctuation features when comparing with BDI ,which is really useful practically when avoiding the freight rate risks.

5.1.3 Data collection and preparation

The original data collected in Eviews Is from 2003 to 2012; however ,the financial crisis broke out after 2008 and had a significant effect on the data string . As a result , I select the BDI and CCFI from 2009 to the end of 2012, which performed the situation during the after-crisis period in the shipping market.

From the above method tests we found that the variables other than BDI are all insignificant. As a result, the VAR model is introduced to analysis the relationship

between BDI and CCFI. Firstly, the BDI and CCFI statistics are transformed into monthly returns using simple return model:

$$Ri= [Pi-P(i-1)]/P(i-1)*100\% \ i=2,3,4,\ldots,n$$

	Mean	Median	Max	Min	SD	Kurtosis	Skewness	JB	P
BDI	0.02996	-0.00956	1.00663	-0.44409	0.26771	5.25036	1.11913	19.7281	0.00005
CCFI	0.00521	-0.00754	0.16635	-0.05000	0.04589	5.25075	1.54050	28.5100	0.00000

Table 10 The Normality and Statistics of BDI and CCFI

The Table 10 above shows some statistical information of BDI and CCFI. From the figure it can be seen that BDI has much higher return than CCFI. However, BDI has higher standard deviation than CCFI has which prove that dry bulk sector is more volatile than container sector. CCFI has a higher sleekness than that of BDI, which means that the number of months that CCFI has a lower return than mean is higher than that BDI has. In addition, the high JB value shows that CCFI does not apply for the normal distribution, which is a prominent characteristic of most stocks.

5.1.4 The Process of VAR model distinguished method

The result of the Granger Causality test is deeply influenced by the choice of lag length normally , the reason may be the stability of the tested sample or the length of the sample volume . Different lag choice will bring the different test results ,therefore, we regularly need to choose different lag length for testing in order to avoid the sample that has not correlation in the model test being the lag period.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	64.90307398	NA	9.42E-05	-3.594461	-3.505584	-3.563781
1	77.32365815	22.71193	5.83E-05	-4.075638	-3.809007*	-3.983597
2	82.86480724	9.499113	5.35E-05	-4.163703	-3.719318	-4.010302
3	83.93177793	1.707153	6.37E-05	-3.996102	-3.373962	-3.781339
4	89.20121223	7.828874	6.00E-05	-4.068641	-3.268747	-3.792518
5	89.69279274	0.674168	7.49E-05	-3.86816	-2.890512	-3.530676
6	97.83914448	10.24113	6.09E-05	-4.105094	-2.949693	-3.70625
7	101.6397768	4.34358	6.44E-05	-4.093702	-2.760546	-3.633496
8	121.6876738	20.62069*	2.73e-05*	-5.010724	-3.499815	-4.489158*
9	126.2753098	4.19441	2.87E-05	-5.044303	-3.35564	-4.461377
10	127.7804456	1.204109	3.70E-05	-4.90174	-3.035322	-4.257453
11	129.9286258	1.473038	4.78E-05	-4.795921	-2.75175	-4.090274
12	139.2450915	5.323695	4.32E-05	-5.099720*	-2.877794	-4.332711

Table 11 VAR lag order selection criteria

After many times tests , the final order number is 8 lag , this is the most suitable order number when considering the comprehensive information , the reason is: All the statics is smallest when the lag period tis 8 lag,which means the 8 lag is the smooth process, so table above shows that the eighth lag is most suitable for this VAR model through LR, HPE and FQ. As a result, we choose to add 8 lags into the VAR model.

5.1.5 The Granger Causality Test

Here is the effective method when testing the causality relationship between BDI and CCFI: (1) First to estimate the current level period that BDI can be explained by the hysteresis values

(2) Then verify whether the level of explanation could be improved by introducing the CCFI lag value .If answer is yes , we call the CCFI is the causality of BDI, the lag coefficient of CCFI has statistical significance .

(1) Unit Root Test

The process of the test is as follows: the prerequisite of the Granger Causality test is that the time series should share the stability , otherwise there may be occurred by the false regression problems.

So before the Granger Causality Test , we are supposed to hold the unit root test first for ensuring the stability of time series stationarity of all statistics.

CCFI		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.957284266	0.00361712
Test critical values:	1% level	-3.584743203	
	5% level	-2.928141763	
	10% level	-2.602225248	

Table 12 Unit Root Test(CCFI)

BDI		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.544	1.23E-06
Test critical values:	1% level	-3.585	
	5% level	-2.928	
	10% level	-2.602	

Table 13 Unit Root Test(BDI)

The tables above illustrate the result of CCFI and BDI respectively in terms of unit root test. It can be seen that the none-hypothesis are both rejected. It is quite clear that these two strings of data are all stationary and VAR model is valid under this circumstance. Also the difference series of the BDI and CCFI are smooth .

(2) **Granger Result test**

Dependent variable: RCCFI			
Excluded	Chi-sq	Df	Prob.
RBDI	9.213278439	8	0.324624892
All	9.213278439	8	0.324624892
Dependent variable: RBDI			
Excluded	Chi-sq	Df	Prob.
RCCFI	22.27753852	8	0.004426859
All	22.27753852	8	0.004426859

Table 14 Granger Causality Test

Table 14 illustrates the Granger Causality Result of CCFI and BDI. It can be seen that the P-value of CCFI to BDI is significant, which means that CCFI is a causality of BDI and thus implies that CCFI can affect BDI in terms of return. However, it is quite interesting to observe that the return of BDI cannot influence the return of CCFI.

5.2 The analysis of the result based on VAR Model.

(1) The unit root test shows the fact that: the market of BDI and CCFI has the relationship of balanced because their sequence of the result is quite smooth

(2)The Granger Casualty Test indicated that CCFI is the granger casualty of BDI ,while the BDI doesn't enjoy the same result ; so the yield rate of CCFI is helpful when we making the prediction of BDI yield rate , and the yield rate of BDI shares nothing with CCFI

(3)The result implies that CCFI is relatively more advanced and forward-looking index than BDI. Nevertheless, it is notable that BDI is widely applied index which includes 22 lines all over the worlds. Besides, there is FFA and other futures introduced as a derivative of BDI to hedge the risk. Since futures have forecasting ability over spot market, the BDI index would be affected by its derivatives and thus may also influence the result of this study.

(4)when we found out the result of VAR lag order selection criteria , we chose the 8 lag as the final lag number in the test , which means we are able to predict the future trend of the fluctuation risk that the shipping market bring to us , the shipping related experts can easily avoid the risks of the changeable shipping market ,

Chapter 6 .Conclusion

6.1 The final conclusion of the dissertation

(1)Eviews can be used to reflect the correlation in the same time by means of the cross-sectional data, While the Granger test is only used to determine the causality test based on the different time series data model according to the characteristics of itself, which means the causality level in cross-sectional can't be concluded by Granger Causality Test.

In my dissertation, firstly I try to find the correlation of each factors in the same time series, and select the most influencing factor to be tested by the VAR of Granger Causality Test, thus we are able to get the conclusion from both time series and cross-sectional sides , which makes the final result more convincible and more rigorous, and the result also reflect that the Eviews model and VAR model are proved each other and enhance the preciseness of each result , which is the innovation point of view in my dissertation.

(2)What should be noticed is that : The causality relationship that come from the Granger Causality Test is mainly meaningful on the statistical aspect ,but not quite convincible on the realistic causality .

We are able to take the advantage of the statistical result as the basement of realistic causality when we need references for testing ,but not the final depending factor when we decide the realistic causality of two things.

So in conclusion , the Granger Causality Test is not equal to the realistic causality ,

but the references value behind the test is huge than other test method.

So the causality relationship in statistic is vital and meaningful when we do the economics forecast and crises and risks evading .

(3)As the China shipping market going to be more perfect and integrated with the international shipping market, the CCFI plays a more and more important role in the shipping market and more obvious , the mainly usage of the CCFI can be summarized as:

The reflection of the price fluctuation in the export container market. CCFI own the ability that enable the ship company , agents, brokers and shippers to understand the supply and demand features of the market timely and provide the reference for the enterprise when making management decision.

The communication department is also access to know the shipping market through the freight index fluctuation situation , only by understanding the necessary market information of the current times , can the shipping related experts formulate the corresponding shipping policy and regulation

Providing the analysis method for the freight rate trade and get prepared for the price futures that Shanghai shipping exchange will hold .

(4) There is also some deficiency in the dissertation that remained for other people to discover : The statistical result of the VAR model is not the most reasonable way when clarifying the causality correlation with two different variables, and the statistic in Eviews is also fine adjustment to get the most reasonable result of regression.

6.2 The Practical Usage of CCFI

In this essay, the factors that influence the CCFI index are discussed and are

examined. Baltic Dry Index (BDI), Fleet development in containership sector, Containership New Building index, and Bunker price are chosen to be the variables. Firstly the multiple regression model is used to investigate how these variables explain the dependent variable (CCFI). However, the result shows that only BDI has significant impact on CCFI. As a result, in the second part, the VAR model is introduced to exam the relationship between BDI and CCFI. The result of Granger Causality Test illustrates that CCFI is a causality of BDI while BDI cannot cause CCFI. This implies that CCFI is more advanced than BDI in terms of return.

(1) So the study of freight index is really a effective way of avoiding the risks of fluctuation of freight rate , no matter the shippers ,ship owners or related shipping business men , they are all in favor of such regulation of fluctuation of one global freight rate ,the profit that they may get is more than the number that they see in the paper , the profit is hard expressed by word but being worthy in long run.

(2) also it do help to improve the current financial derivatives in such situation with many single composition and promote the development of the national financial innovation in one country .

(3) In the meanwhile , after we figuring out the regulatory rules of the CCFI, it also generate the effort of the supporting the shanghai to become the international shipping center and international finance center.

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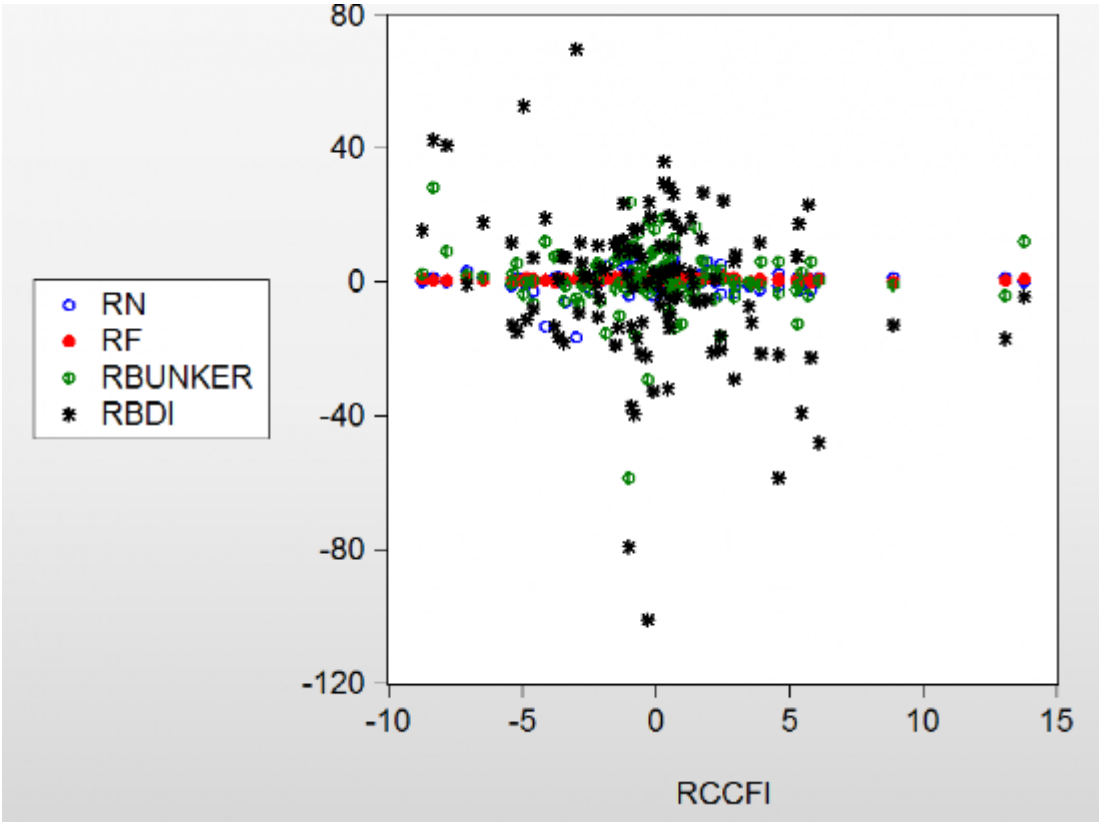
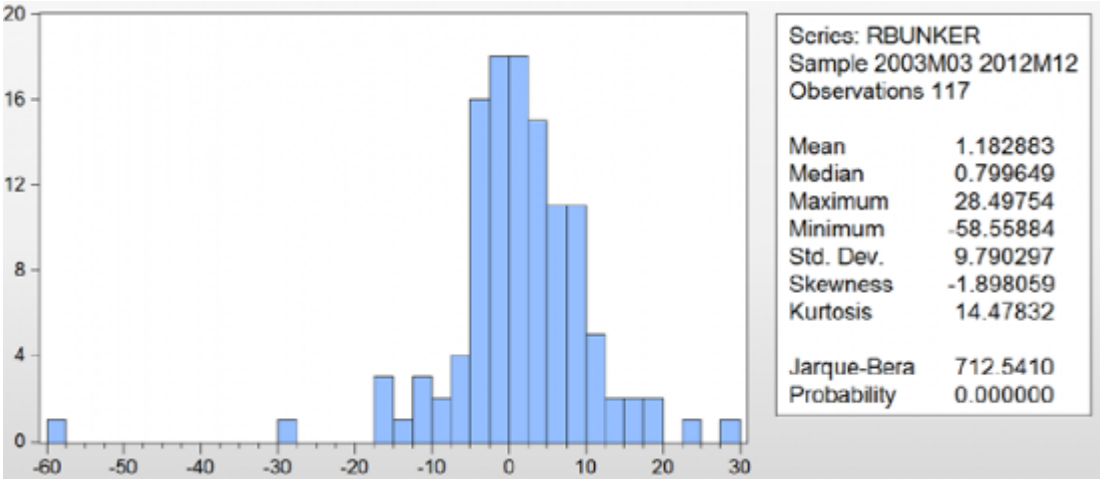
APPENDICES

Appendix I

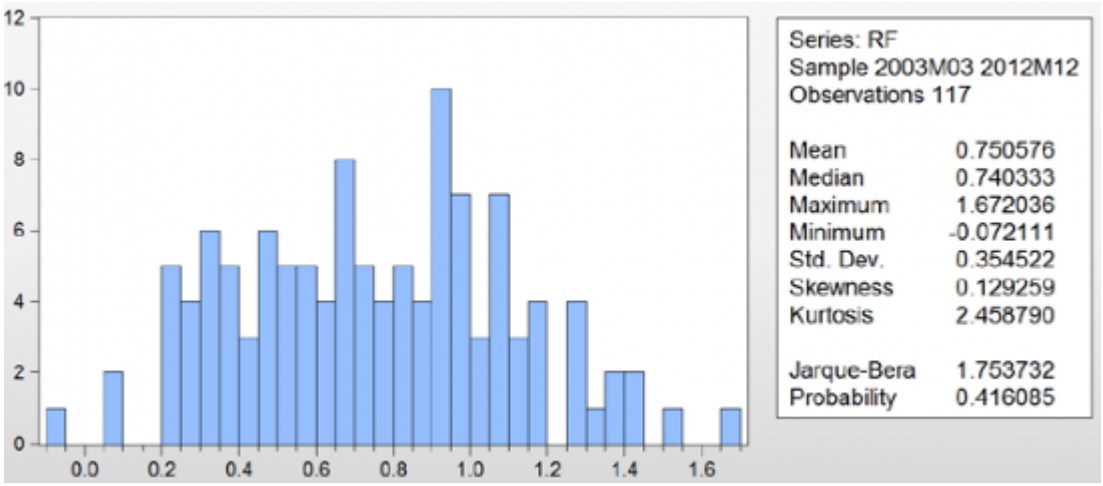
1. Variables scatter graph



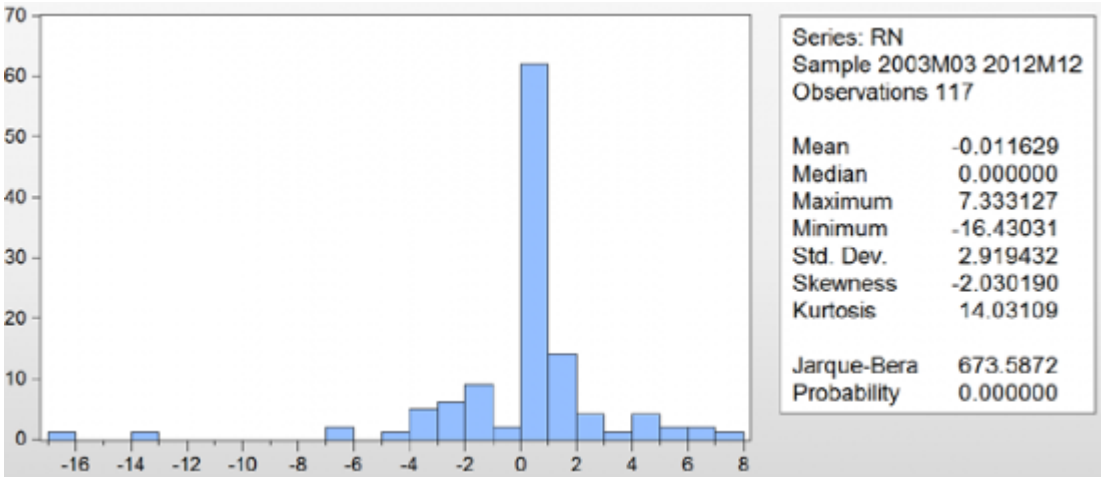
2. Rbunker descriptive statistics



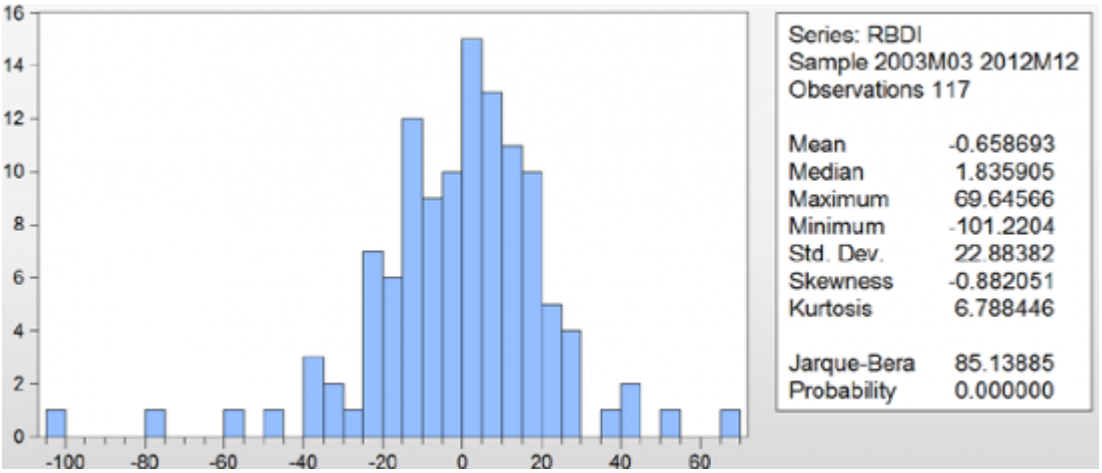
3. Rfleet development descriptive statistics



4. Rnew building descriptive statistics



5. RBDI descriptive statistics



Appendix II

1. Breusch-Godfrey test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.622066	Prob. F(12,100)	0.0973
Obs*R-squared	19.06319	Prob. Chi-Square(12)	0.0870

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 03/07/13 Time: 17:22
Sample: 2003M04 2012M12
Included observations: 117
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030982	0.798871	0.038782	0.9691
RN	-0.018141	0.118987	-0.152464	0.8791
RBUNKER	0.013466	0.037798	0.356264	0.7224
RBDI	-0.009149	0.016002	-0.571718	0.5688
RF	-0.146912	0.954771	-0.153871	0.8780
RESID(-1)	0.323480	0.101143	3.198255	0.0019
RESID(-2)	0.018588	0.105967	0.175416	0.8611
RESID(-3)	0.080185	0.105887	0.757276	0.4507
RESID(-4)	-0.132110	0.106438	-1.241192	0.2174
RESID(-5)	0.106553	0.109765	0.970740	0.3340
RESID(-6)	0.033508	0.107631	0.311326	0.7562
RESID(-7)	-0.098216	0.107576	-0.912991	0.3634
RESID(-8)	-0.031201	0.108307	-0.288082	0.7739
RESID(-9)	-0.010305	0.108194	-0.095250	0.9243
RESID(-10)	-0.000225	0.109905	-0.002048	0.9984
RESID(-11)	-0.179225	0.109534	-1.636245	0.1049
RESID(-12)	0.003974	0.105356	0.037718	0.9700

R-squared	0.162933	Mean dependent var	1.21E-16
Adjusted R-squared	0.029003	S.D. dependent var	3.472720
S.E. of regression	3.421990	Akaike info criterion	5.431916
Sum squared resid	1171.002	Schwarz criterion	5.833258
Log likelihood	-300.7671	Hannan-Quinn criter.	5.594856
F-statistic	1.216549	Durbin-Watson stat	2.002332
Prob(F-statistic)	0.268965		

2. White test

Heteroskedasticity Test: White

F-statistic	0.660441	Prob. F(14,102)	0.8072
Obs*R-squared	9.724404	Prob. Chi-Square(14)	0.7820
Scaled explained SS	20.10203	Prob. Chi-Square(14)	0.1270

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/07/13 Time: 17:20
Sample: 2003M04 2012M12
Included observations: 117

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.32507	11.29691	1.179532	0.2409
RN	-0.518400	2.866119	-0.180872	0.8568
RN^2	-0.343580	0.192538	-1.784479	0.0773
RN*RBUNKER	-0.046262	0.112838	-0.409984	0.6827
RN*RBDI	-0.096187	0.055731	-1.725918	0.0874
RN*RF	0.906075	4.061302	0.223100	0.8239
RBUNKER	1.428827	1.057915	1.350607	0.1798
RBUNKER^2	-0.006734	0.020424	-0.329690	0.7423
RBUNKER*RBDI	0.018563	0.016422	1.130376	0.2610
RBUNKER*RF	-1.762571	1.300041	-1.355781	0.1782
RBDI	-0.343663	0.342576	-1.003173	0.3182
RBDI^2	-0.003324	0.003556	-0.934650	0.3522
RBDI*RF	0.383197	0.470498	0.814451	0.4173
RF	21.91559	30.58029	0.716657	0.4752
RF^2	-22.30249	18.86745	-1.182062	0.2399

R-squared	0.083115	Mean dependent var	11.95671
Adjusted R-squared	-0.042732	S.D. dependent var	25.50626
S.E. of regression	26.04553	Akaike info criterion	9.476779
Sum squared resid	69193.71	Schwarz criterion	9.830903
Log likelihood	-539.3915	Hannan-Quinn criter.	9.620549
F-statistic	0.660441	Durbin-Watson stat	1.772274
Prob(F-statistic)	0.807236		