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WORLD MARITIME UNIVERSITY

Shanghai, China

**The Research On The Seasonal Volatility Of Dry
Bulk Market**

By

Yang Lei

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

INTERNATIONAL TRANSPORT AND LOGISTICS

2009

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DECLARATION

I certify that all the material in this dissertation 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): _____

Acknowledgement

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Abstract

The dry bulk cargo shipping is an important component of the international shipping which is considered to be a submarket known for the volatility and high risk due to the uncertainty caused by factors such as the global economy, government policy, pattern and volume of the global trade. In this highly competitive market, the fierce volatility has brought about great opportunities and risk for all the people involved in this market. One prominent case is the last dry bulk cycle which start since 2003, end in the second half of 2008. During this cycle, the BDI reached the peak since the birth of it and fell down to the bottom at 662 points. In this cycle, some player won while the others lost, actually the no. of the former outweighs the latter so much. So much research has been done in this field in order to find some guideline for all the participants.

This dissertation focus on the seasonal fluctuation of the freight rate in dry bulk shipping which is caused by many factors. They include but not confined to the global economy, the FFA market and the demand of the dry bulk shipping which is the seaborne trade of the dry bulk. Due to above reasons, we can find the seasonal characteristic in the freight rate. We will research this rate by some special mathematical method to find some special features in the seasonality.

Firstly, I will mainly introduce the dry bulk shipping market.

Then, I will analyze the two decisive facets of the dry bulk shipping: supply and demand.

Then I will analyze factors influencing the BDI which is the direct reflection of the

freight rate and the relationship between these factors and the seasonality.

Finally I will establish models to calculate the statistics to find out the basic features.

Keywords: dry bulk, seasonality, BDI, capsize,

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CHAPTER 1 Introduction of the paper

1.1 Background and meaning of the research

The dry bulk shipping market is considered to be one of the most volatile markets in the world since it is exposed to many unstable factors, such as the interest rate, the political situation and many other unpredictable factors. Unexpected changes and sharp movement in the freight rate may result in the substantial gain or loss in this market, most of the time, it is the great loss. Therefore, analyzing these movements carefully should be of vital importance for the people who are involved in this market and should be very essential when they make their decisions.

The freight is the reflection of the shipping market equilibrium or more strictly speaking, the freight rate is the point at which the shipping demand and supply meet each other. On the other hand, shipping is a kind of derived service of the international trade. Thus it means that all the factors which influence the international trade will exert influence on shipping as well. So let's consider the international trade through following factors which can be the critical part when analyzing the shipping as well:

Firstly, it is the production and consumption of the commodity to be transported.

Secondly, it depends on the global macro economic situation of which the international shipping can be an important hint. These macroeconomic variables are shown elsewhere to have random variations as well as deterministic seasonal components in most cases.

For both of above two considerations, normally, we can find one thing in common that is the seasonal fluctuation. Investigation of this seasonal volatility should be of great value to the ship owner and charter from the both of the economic and econometric point of view. For the economic consideration, revealing of the seasonal fluctuation should have practical meaning in owner and charter's strategies, tactical and budgeting policy. For the econometric consideration, it can be helpful for the academics to establish the due models to explore and forecast the possible fluctuation in future.

Due to the above practical meaning, I choose the above subject as my dissertation topic. In the end of my paper, I try to find (1) when the freight will increase and drop (2) whether the seasonal changes is asymmetric (3) what is the different character for different vessels in the seasonal volatility of the freight rate.

1.2 Literature review

The dry bulk shipping is one of the most important branches of the global shipping not only because the cargo it transports is of vital importance for the global economy but also it can mirror the global economy straightforwardly. Dry bulk shipping concerns the transportation of raw materials for heavy industry, like iron ore, coal. The demand for transportation is governed by the changes in world consumption of bulk commodities, as well as changes in the geographical demand

and supply pattern. (1) The demand for transportation in bulk shipping is therefore taken to be independent of freight rates. (2)

The most important and striking feature for the dry bulk shipping is its volatility which was supplemented and highlighted by the market cycles. All of these has well explained by Martin Stopford in his famous book *Maritime Economics*.

Early empirical studies of the bulk shipping markets are Tinbergen(1931) and (1934). These papers are a part of Tinbergen's major contribution to the development of business cycle theories, but are also seminal from the perspective of maritime economics.

Berg-Andreassen (1996) studies the dry bulk markets by investigating rate fluctuation from the Baltic Freight Index. Kavussanos and Nomikos (1999) investigate whether the BFI follow a random walk. The focus of these papers is to explore the unbiased hypothesis of the BIFFEX future prices.

Kavussanos (1996) studied the volatility in dry bulk freight rate, both spot and time charter rates. Rogers and Glen(1997) studied the cape size market and concluded that all routes the freight rates in level form are non-stationary, but for the first difference the unit-root hypothesis can be rejected.

Veenstra and Franses (1992) investigated the monthly rate for three capsize and three Panamax routes. They concluded that the freight rate follow random walks but are co-integrated.

Cheng and Wang (2004) applied Nelson's EGARCH model to explore the leverage effect in the presence of the international bulk shipping market. They conclude that the phenomenon of the asymmetric impact between past innovations and current volatility seems to be an intrinsic nature of this market.

Another direction of the dry bulk market research is focused on the FFA market which is used to hedge the market risk. By using the FFA, ship-owners and charters can secure the level of the future income or costs and thus reduce uncertainty and unforeseen volatility of the cash- flow.

In the market survey on the using of the FFA, Cullinane (1991), Dinwoodie and Morris (2003) pointed out that although FFA has been made a great development, some people haven't realized the function of it. Furthermore, most participants concern about the risk of payment default on settlement.

Kavussanos (2004) investigate the impact of FFA trading and the activities of speculator on spot market price volatility of the four route of BPI. The results suggest that 1)a stabilizing impact on the spot price volatility in all the routes 2)an impact on the asymmetry of volatility in routes 2 and 2A 3)substantially improve the quality and speed of information flowing in route 1,1A,and2 . Overall, the result suggests that the introduction of FFA contracts has not had a detrimental effect on the underlying spot market.

Kavussanos and visikis (2005) investigate the risk management function of the FFA market .They examine the effectiveness of time-varying hedge ratio in reducing freight rate risk for the four routes of BPI. Market agents will benefit from this result by developing appropriate hedge ratios for each route, thus control their freight risk more efficiently.

Kooeekbakker and adland (2004) investigate the forward freight rate dynamics by modeling them under a term-structure model Among their research , the time-charter rate was changed into forward freight rate .they used a Panamax 65,000 DWT vessel

under three different time-charter : six months , one year and three years . These data then was collected to establish a forward rate function using a smoothing algorithm in order to investigate the factors governing the dynamics of the FFA rate curve .The results of the research showed that the forward curve is bumped, with volatility reaching a peak for freight rates with roughly one year to maturity.

In the seasonality of dry bulk freight rate, Kavussanos and Alizadeh (2001) examine the seasonal fluctuation of dry bulk freight rates and compare them 1) across different size vessels 2) across freight contracts with different maturities 3) under different market conditions

Chapter 2 Dry bulk shipping market

2.1 main features of dry bulk shipping

Dry bulk shipping is the most important component of the international shipping which presents many prominent features. On the other hand, the dry bulk market is known for its pronounced volatility and cycle.

2.1.1 Derivative service of international trade

This is the most important and most fundamental characteristic of shipping. Due to the unbalanced allocation of the crude material and different productivity level, some countries have to import the crude materials to make products. All these give rise to the international dry bulk shipping. The factors which impact the international trade can affect the international shipping indeed. Normally we can find that when the global economy grows quickly and the international trade is very booming, surely the international shipping is prosperous, otherwise, shipping will have stagnancy or even retroversion. We can see clearly that shipping industry has synchronization with the global recession since last year. And another character the dry bulk shipping or shipping in line with the economy is that both of them are periodical. Or we can say, most of the time, in virtue of the global economic fluctuation, the shipping volatility is minimized. On the other hand, taking cognizance of this rule can be helpful to analyze the demand side of shipping for

the people who are involved in this industry.

2.1.2 Unbalanced service

Since the different allocation of the crude materials and the compared advantage among the countries, trading in the bulk cargo between different countries is integrant. Countries like Australia are rich at iron ore and coal should be the net exporter, on the other hand countries like Japan which is devoid of crude material are always the net importer, owing to this trait, we can find that dry bulk shipping is much more unbalanced than liner shipping. For instance, usually we can find the workable vessel close to Australia if we want to transport

Panamax size of iron ore from Australia to Far East is hard to find, since few bulk vessels carry cargo from else where to Australia, so the means to handle is always to ballast a panamax from Far East or America to Australia. This is a typical case of the unbalance of the dry bulk shipping. So in dry bulk shipping and tramp shipping, the chartering arrangement of vessels is critical for every company, since the ballasting is so normal in this area. And still more this feature of dry bulk shipping is another encouragement of the building of larger and larger ships because this feature can assist the company to achieve the economy of scale.

2.1.3 Periodical industry

This is another important and distinguished characteristic of dry bulk shipping or for shipping.

A cycle was defined as an interval of time during which one sequence of a regularly recurring sequence of events is completed. And it creates endless

problems for the people involved in this industry.

The average cycle length of 6.6 years over the period 1947-2000 was 17 percents less than the 7.6 years average between 1872 and 1936. This certainly gives credibility to the shipping folk law that shipping cycles last seven years.

Dry bulk shipping is kind of perfect competition market; the basic method to analyze it is the law of demand and supply model. A change in the relative demand and supply of ships leads to a shortage or surplus of tonnage, which can trigger the increasing or the decreasing immediately. When the supply exceeds the demand, the freight rate will fall down accordingly, while if the demand outstrips the supply, the freight rate will increase which leads the dry bulk market to be a very profitable market. When the former situation happens, the surplus tonnage especially the over age vessels that have a poor operating cost and bunker consumption will go to be scrapped. When the latter situation happen, more and more investment will rush into this market, which can be spent on the building of new vessels or the new shipyard, then the global fleet can be enhanced in one or two years , by the result of which the demand and the supply meet an equilibrium then. This is the basic mechanism the shipping cycle can experience. Or we can say that shipping cycles are a manifestation of fluctuation in supply and demand and freight rate are highly sensitive to quite small movements in either of these variables.

On the demand side, the driving force is, since shipping is a kind of derivative service of international trade, the global business cycle which has direct reflection on the international trade. Another factor can influence the demand side should be the random accidents, such as the 1973 oil crisis or the closure of the Suez Canal

in 1956. Currently, we can find that the main reason which caused and drove this shipping crisis started in the second half of last year is the shortage of the shipping demand, which means the seaborne trade is so stagnant.

On the supply side, the outstanding influence is the investment cycle, a major component of which is the time lay between ordering a new ship and taking delivering, as ship owners struggle to match investment to the essentially unpredictable demand cycles.

2.1.4 Perfect competition market

One of the important features of any market is the degree of competition prevailing in the market. The dry bulk shipping can be identified as the perfect competition market where individual participants can't influence the market price. The price can only be determined by all the participants. Dry bulk shipping has below characters which make the dry bulk market a typical perfect competition market.

a) no barriers to entry and exit

For the dry bulk shipping, it is relatively easy to enter as long as the investor can afford initial investment to buy a vessel. This is especially evident for the expansion of the industry for the past 50 years .during this time , many private investors have been attracted to the shipping business , especially the dry bulk sector , due to the profitability of this market , which , at least at certain times , has been higher compared to other sectors of the economy.(see stopford, page 71) This leads much money to rush into this market . Normally, most of the ship owners in the dry bulk shipping are small scale, like the standard Greek ship owners.

At the same time, it is very easy for the owners to exit this market easily due to their scale by liquidating the company or selling off their vessels.

b) Number of market participants

It is well known that in a perfect competition market that the number of the participants should be unlimited. In the dry bulk shipping, the number of the participants can't be described unlimited, but it should be very large. Since dry bulk is a kind of tramp shipping, its operation is very flexible compared with liner shipping. This decides that small-scale owner who even just own one vessel can have a successful operation in this market.

On the other hand, the number of charters, in the form of traders, operators or shipping agencies, is large enough to prevent this market is monopolized by the limited players.

c) The homogeneity of the product

An important condition, which should be satisfied for perfect competition to prevail in the market, must be homogeneous. For the dry bulk shipping, the product which is the transport service can fully tally with this request, since the standard product offered by the ship owners is to move the large volume of dry bulk cargo from one place to another safely and timely. Further more, this homogeneity is intensified by the fact that the cargo transported by bulk vessels is low value and can meet the requirement "one commodity, one ship". There, as long as there are enough participants in the market, the shipper just looks for the owner who can provide them more competitive services, which are cheaper, faster and safer.

d) Efficient information dissemination

Efficient information dissemination is a necessary condition for the existence of perfect competition in a market.

In the dry bulk shipping, we have the professional institutions, such as Baltic exchange, the Lloyd's maritime information service as well as other professional ship brokers who can provide the up-to-date information. All these enable the ship owners to make their decision timely. And recent advance in technology have improved the industry information dissemination. Base on these facts, we can see that the dry bulk is very transparent market which makes so many owners and charters benefit from this feature.

e) Mobility of ships and competition

As Zannetos mentioned, an important factor which contributes to the existence of perfect competition condition in international shipping, is the fact that the assets that provide the service is mobile. This mobility can allow the owner to move their vessels to another route which make them earn more revenue very easily and can eliminate the unbalance between different routes. On the other hand, we can say that it is the mobility that prevent a small number of the market participants control or monopolize the due market or route, in the end to make the perfect competition available.

The preceding discussion indicates that the dry bulk market satisfies all the conditions of perfect competition market.

2.2 Introduction of the main bulk cargo

Dry bulk cargo is the large volume cargo that needn't to be bagged, and can be shipped directly into the holds. Currently, the main components of dry bulk cargo

is iron ore , coal , grain ,bauxite and phosphate ore .there are some other kind of bulk cargo which don't take so much market share , such as cement ,timber, fertilizer and so on .

Most of this dry bulk cargo is of great importance to the social development and construction. For example, iron ore is the crude material of the steel industry; steel is the material for so many kinds of heavy industry, like the car industry, the ship-building industry and some other important kind. For coal, besides playing important role in the steel industry, it is the main crude material to make electricity .Grain is the necessity of the food industry and is an intrinsic need of our daily life. The bauxite is the crude material to aluminum industry. Phosphate is an essential material of the fertilizer industry. From the above, we can see that the dry bulk cargo plays an extremely important role in the development of the macro economy. That's why so many banks especially investment banks consider the BDI as one of the most important and leading reflection of the global economic situation. Following will give a brief introduction of these five main bulk cargos.

2.2.1 Iron ore

The transport of iron ore accounts for the largest part of dry bulk shipping.

Normally, the transport of iron ore is determined by the cargo volume and the distance between the iron ore exploiting place and the steel factories. After 70es of last century, Japan and Western Europe were the main importing countries. Because at that time Japan and western European countries did well in the ship building , car industry and so on .When it enters into the 21 century, china replaced Japan as the 1st iron ore importer since china invest so much on its infrastructure construction.

2.2.2 Coal

Coal is the second largest volume dry bulk cargo. It can be basically divided into two types: the steam coal and the artificial coal, the former is used to generate electricity while the latter is to do the steel-making. These two functions decide the cargo flow. The steam coal will go to the developed countries that have more energy consumption. The artificial coal will go to the states which can have large capacity of steel production. So the main routes of coal transport are from Australia, North America and southern Africa to Japan, Far east, Europe and Med.

2.2.3 Grain

This kind of cargo mainly includes wheat, rice, and corn, which is mainly for the consumption of the human beings and animals. Usually, transport of grain can begin after it has been harvested. So the prominent feature of this kind of transport is the seasonality and instability. The main exporting countries comprise America, Canada, South America and Australia while the main importing countries consist of Africa, Japan and India.

2.2.4 Bauxite and phosphate

The bauxite is the main crude material of the smelting of aluminum. The main route is from Australia, Africa to Europe and America.

Phosphate is the raw material of the fertilizer, the main route of transporting is Morocco, America, The Near east and Red sea to East Asia and West Europe.

2.2.5 Other minor bulk cargo

This minor bulk cargo includes sugar, cement, timber, salt, fertilizer and steel. All of this minor bulk cargo can account one third of the total bulk cargo volume.

2.3 Routes of dry bulk shipping

2.3.1 Pacific routes

2.3.1.1 From Far East to west coast of North America

This route has a seasonal change which should be via north in summer and south in winter to avoid the fog and storm in pacific. This route has the largest cargo volume

2.3.1.2 From Far East to Caribbean Sea and the east coast of north America

For this route, the vessels not only pass the pacific sea but also have to pass the Panama Canal; this leads this route to be a very long route. Normally, the Honolulu in the Hawaiian I Islands is the most important place for replenishing the vessels sailing in this route. This route is one of the largest volume routes in the pacific sea routes.

2.3.1.3 From Far East to the west coast of South America

This is a very long route too, vessels have to replenish the bunker and spare in the replenishing ports.

2.3.1.4 from Far East to Australian and New Zealand

This route is mainly for the transport of iron ore and coal from Australia to Far

East. This route isn't so long and always close to the main land.

2.3.1.5 From East china to South east china

This area is combination of developed and developing countries , so the inter trade is very thriving .The outstanding feature of this route is it is not so long but trade is flourishing and developed so quickly.

2.3.1.5 From Far East to North India, Med and North West Europe

For the dry bulk shipping, this route is mainly for transport of the steam coal. Vessels have to pass the Malacca channel, if to the Med and North west Europe, vessels have to pass the Suez Canal as well.

2.3.2 Indian routes

2.3.2.1 From Australia to Persian Gulf or Mid East or From Australia via Suez Canal, Med to West Europe

2.3.2.2 from South Africa to Far East

This route is mainly for the transport of coal from South Africa to Far East. Richards's bay is one of the largest coal ports in the world

2.3.3 Atlantic sea routes

2.3.3.1 From the North West Europe to the east coast of the North America

This route links two of the most developed areas in the world, so the cargo volume is very huge.

2.3.3.2 From the North West Europe to Med, Mid East, Far East

2.3.3.3 From the south North America via Cape of Good Hope to Far East

This route is mainly for the transport of the iron ore from Brazil to Far East.

Chapter 3 The latest development in tonnage constitution

3.1 The constitution of the dry bulk fleet

The dry bulk vessels is the tools we use to do the transport, it is necessary to do some research on the variation of the fleet structure.

Table 3.1 The constitution of the new building order up to December, 2008

	99	00	01	02	03	04	05	06	07	08
cape	31	33	35	34	36	35	36	36	37	38
pmx	19	20	20	21	21	22	23	23	24	25
hmx	14	13	15	15	16	16	17	19	18	20
hdy	36	34	30	29	27	27	24	22	21	17

*All the number means the percentage of the individual size accounts in the total new building tonnage

* Source: Clarkson research studies December, 2008

From the above table, we can find some characters of the variation of the fleet structure as follow:

a) The total tonnage is increasing.

From the size, we can see that for the passed ten years, the total number has increased from 266.1 million DWT to 391.7 million DWT, increased 47%. The number of vessels has been increased from 5413 to 6670, increased 23.2 percents. Except the handy vessels, the other bulk vessels are increasing dramatically. From the size, we can see that the cape, panamax, handymax is increasing 62%, 81%, 69 %.

b) The size of vessel is increasingly larger and larger

From the table, we can find that the variations of the percentages different vessels are taking.

The percentage of the handy fell down from 30% in 1997 to the 19.3% in 2007 .meanwhile the percentages of the other three kinds of vessels are increasing. The tonnage of cape size increased from 30% to 49%, who replaced the handy as the main size in the dry bulk shipping .Panamax vessels increased from 23% to 40 %. The handymax increased from 17% to 20%. From the other hand , we can see from the average tonnage of each vessel the fact that the dry bulk vessels is becoming larger and larger ,which has increased from 49159 DWT in 1998 to 58726 DWT in 2007. Many factors brought on this trend, one of the leading reasons should the economy of scale which now is prevailing in the shipping world. Another important reason should be the specialization of shipping. Now the shipping word can basically be set off into three types, one is the container shipping, which has conquered most of the market share of the general cargo vessels and is one of the key innovations that improve the efficiency of the maritime logistic so largely. The other two is the dry bulk shipping and the fluid bulk shipping which the dominating role is taken by tanker shipping. Due to the specialization, the loading and discharging efficiency has been dramatically

increased in line with the development of the ports infrastructure. Surely, this trend will continue to last, which can be recognized from the definition of cape size given by dreary shipping consultant.

Table 3.2 The percentages of different size for the different age up to December, 2008

	0-4 years	5-8 years	10-14 years	15-19 years	More than 20 years
cape	30	22	31	39	16
Pmx	31	36	24	24	17
hmx	27	26	28	19	17
Hdy	12	16	17	18	50

*All the number means the percentage of the individual size accounts in the total tonnage

* Source: Clarkson research studies December, 2008

We can find another character of dry bulk vessels that is they are becoming younger and younger.

The vessels less than 4 years old occupies 27%, the vessels between 5-9 years old accounts for 18% and vessels between 10-14 years old takes 18%. All these three 3 kinds of size, which normally we can define as young vessels, occupy 63% totally. On the other hand, the vessels that is older than 14 years old takes the rest 37%. There is another standing-out feature when we analyze the age constitution

that is the over aged vessels should be more centralized in the small vessels, especially the small handy where the over aged vessel take 63%, much higher than other vessel size.

We can conclude that the larger and younger ships now the mainstream of the dry bulk vessels since they have better operating cost, are easier to achieve the economy of scale

3.2 Some factors influencing the tonnage supply

3.2.1 The tonnage of the new building and demolition

The vessel should be demolished when the vessel is so old which can result in the poor performance in the operating cost or can't tally with some regulatory requirements. For example, single deck tanker will have compulsory demolition or has conversion into dry bulk carrier which now is the most prevailing way to handle this. On the other hand, this can change the tonnage contracture accordingly since most of the tankers are large size such as VLCC. We can get the net tonnage by using the delivery tonnage minus the demolishing tonnage.

3.2.2 Congestion

This is another vital factor that can change the tonnage structure during short period especially when the market is very booming or the port facilities is poor. Congestion can reduce utilization and turnover rate of the vessels, as a matter of fact, this equals to reduce the amount of the vessels, which is to reduce the supply of the shipping.

Normally, when the amount of the vessels in the port exceed the capacity of the port can handle, congestion of the port can come into being. To some extent, congestion of ports can alter the supply of shipping, which should exert great influence on the freight rates. Congestion can't change the trend of increasing or decreasing, but can exaggerate this trend. From below table, we can find that the time of port congestion has the same trend with the up and down trend of the freight rates. They have the interaction between each other.

3.2.3 Technical barrier

Dry bulk vessels have 4 basic types, which have their own technical characters, routes, cargo. This can confine the due tonnages for the due business; it is not very easy for one size to enter into the market of another size. Another factor I want to mention is the ship manning.

This is another decisive factor when considering vessel's technical barrier. The seafarer and other employees are the vessel's operator or manager , the quality of whom will determine the rate the new building vessels put into the market. But it is not very easy to find adequate seafarers during the limited time.

Chapter 4 Research on the fluctuation of the freight rate in dry bulk shipping

4.1 Main introduction of dry bulk freight rate index

4.1.1 The category and working method of BDI index

There are so many indexes to reflect the fluctuation of the shipping world. Some of them belong to the container domains, some of them are about the dry bulk. Now BDI is the most prevailing index in the real world which can be considered as the weatherglass of the dry bulk shipping and the global economy. It is a number issued by the Baltic-exchange on the daily basis whose ingredients comprise the BCI,BPI,BSI,BHI which are reflection of the

Cape, Panamax, Supermax, handy's freight rate or hire respectively. For the passed many years, BDI gave veracious guidance on the dry bulk freight rate and it is the most important consulting statistics when people want to charter in or out vessels.

For the BDI, It is made in a exponential floating method. Baltic exchange choose the typical routes that have either important meaning in the cargo volume or the freight rates as the stylebook, then multiply the hire or freight in each route with the converting constant, eventually, plus each other, herewith, we get the daily

index. Below is the constitution of BCI, BPI, BSI, BHI respectively, contents include the size of the vessels, the routes and the percents the due route takes when calculating the respectively index.

Table 4.1 Baltic Capesize Index (BCI) composition, 2006

	Vessel			
routes	size	cargo	route description	weights
C2	160,000	Iron ore	Tubarao (Brazil) to Rotterdam	10%
C3	150,000	Iron ore	Turabao/Beilun and Baoshan (China)	15%
C4	150,000	Coal	Richards Bay (S. Africa) to Rotterdam	5%
C5	150,000	Iron ore	W. Australia/Beilun-Baoshan	15%
C7	150,000	Coal	Bolivar (Columbia)/Rotterdam	5%
C8	172,000	T/C	Delivery Gibraltar–Hamburg range, 5–15 days Ahead of the index date, transatlantic round voyage duration 30–45 days, Redelivery Gibraltar–Hamburg range	10%
C9	172,000	T/C	Delivery ARA or passing Passero, 5–15 daysahead of the index date, redelivery China–Japanrange, duration about 65 days	5%
C10	172,000	T/C	Delivery China–Japan range, 5–15 days ahead of the index date, round voyage duration30–40 days, redelivery China–Japan range	20%
C11	172,000	T/C	Delivery China–Japan range, 5–15 days ahead of the index date, redelivery ARA or passing Passero, duration about 65 days	5%
C12	150,000	Coal	Gladston (Australia) to Rotterdam	10%

Source: Baltic Exchange

*Route C1, which involved a 120,000 dwt vessel carrying coal from Hampton Roads (US) to Rotterdam (The Netherlands) was introduced on 1 March 1999, but Ceased being published on

Table 4.2 Baltic Panamax Index (BPI) composition, 2006

	vessel			
routes	Size(dwt)	Cargo	Route description	weights
P1	55,000	Light grain	1–2 safe berths/anchorages US Gulf (Mississippi River not above Baton Rouge) to ARA	10%
P1A	74,000	T/C	Transatlantic (including east coast of South America) round of 45/60 days on the basis of delivery and redelivery Skaw–Gibraltar range	20%
P2	54,000	HSS	1–2 safe berths/anchorages US Gulf (Mississippi River not above Baton Rouge)/1 no combo port to South Japan	12.5%
P2A	74,000	T/C	Basis delivery Skaw–Gibraltar range, for a trip to the Far East, redelivery Taiwan–Japan range, duration 60–65 days	12.5%
P3	54,000	HSS	1 port US North Pacific/1 no combo port to South Japan	10%
P3A	74,000	T/C	Transpacific round of 35/50 days either via Australia or Pacific (but not including short rounds such as Vostochny (Russia)/Japan), delivery and redelivery Japan/South Korea range	20%
P4	74,000	T/C	Delivery Japan/South Korea range for a trip via US West Coast—British Columbia range, redelivery Skaw–Gibraltar range, duration 50/60 days	15%

Source: Baltic Exchange

*The vessel size is measured by its carrying capacity (dwt—deadweight tones) and includes the effective cargo, bunkers, lubricants, water, food rations, crew and any passengers.

*Each shipping route is given an individual weighting to reflect its importance in the world-wide freight market.

*Routes P1A, P2A, and P3A refer to time-charter (T/C) contracts, while P1, P2, P3 and P4 refer to voyage contracts.

*HSS stands for heavy grain, soya and sorghum.

Table 4.3 Baltic Supramax Index (BSI) composition, 2006

	Vessel		
Routes	Size(dwt)	Routes description	Weights
S1A	52,000	Delivery Antwerp–Skaw range for a trip of 60–65 days redelivery Singapore–Japan range including China 5% commission total. Laycan (laydays canceling) 5–10 days in advance	12.5%
S1B	52,000	Delivery passing Canakkale (Turkey) for a trip of 50–55 days redelivery Singapore–Japan range including China 5% commission total. Laycan 5–10 days in advance	12.5%
S2	52,000	Delivery South Korea–Japan range for 1 Australian or trans Pacific round voyage, for 35–40 days trip, redelivery South Korea/Japan range 5% commission total. Laycan 5–10 days in advance	25%
S3	52,000	Delivery South Korea–Japan range for a trip of 60–65 days redelivery Gibraltar–Skaw range 5% commission total. Laycan 5–10 days in advance	25%
S4	52,000	Delivery Gibraltar–Skaw range for one trans-Atlantic round voyage of 45–50 days, redelivery Gibraltar–Skaw range, 5% commission. Laycan 5–10 days in advance	25%

Source: Baltic Exchange

* Supramax vessels carry bulk cargos, grain and coal.

* Laycan refers to the time interval into which the vessel must be in port ready to pick

Table 4.4 Baltic Handymax Index(BHI) composition,2006

	Vessel		
Routes	Size(dwt)	Route description	Weights
HM1A	45,500	Delivery Antwerp–Skaw range for a trip about 60–65	12.5%

		days redelivery Singapore–Japan range including China	
HM1B	45,500	Delivery passing Canakkale for a trip about 50–55 days redelivery Singapore–Japan range including China	12.5%
HM2	45,500	Delivery South Korea/Japan for 1 Australian or trans Pacific round voyage, one laden leg, redelivery South Korea–Japan range	25%
HM3	45,500	Delivery South Korea–Japan range for a trip about 60–65 days redelivery Gibraltar–Skaw range	25%
HM4A	45,500	Delivery Antwerp–Skaw range for a trip about 30–35 days Redelivery US Gulf	12.5%
HM4B	45,500	Delivery US Gulf for a trip about 30–35 days redelivery Skaw–Passero	12.5%

Source: Baltic Exchange

*. Handymax vessels carry bulk cargos, grain and coal.

4.2 Normal factors influencing the BDI

From above introduction, according to its calculating method, we can see BDI is a good reflection of the real market hire or freight rate, so research on the factors which can influence it are of meaning to all the participants in this industry. Especially when the quantity of FFA trading expand so dramatically which can have price discovery function , the research on this subject should have more realistic meaning.

4.2.1 The demand and supply of dry bulk shipping

Although as above mentioned that the future product do some have role in the price of the spot market , which has been proved theoretically, the most important factor

which influence the index should be the demand and supply , and this also provide a fundamental method to analyze the shipping market .

For the demand side, I can conclude three main factors which influence the shipping demand.

The demand of international shipping start with the world trade, so close scrutiny of the latest trends and leading indicators for the global economy provide significant meanings for the demands international shipping industry.

1) seaborne commodity trades

Here, the discussion of the function of the seaborne commodity trade will fall into two parts, short-term and long-term.

An important cause of short term volatility is the seasonality of some trade .many agricultural countries are subject to seasonal variations caused by harvests, notably grain and citrus fruits. Seasonality has a disproportionate effect on the spot market. Transport of seasonal agricultural commodities is difficult to plan, so shippers of these commodities rely heavily on the spot charter market to meet their tonnage requirements.

Long-term trends in commodity trade are best identified by studying the economic characteristic of the industry which produce and consume the traded commodities.

A third factor to consider is the relocation of processing can have a direct effect on the volume of cargo shipped by sea and the type of ship required. Sometimes, processing does not actually reduce the volume of cargo but changes the shipping

requirement.

2) Average haul and ton miles

The demand for sea transport depends on the distance over which the cargo is shipped. A ton of oil transported from Middle East to Western Europe via cape generates two or three times as much demands for sea transport as the same tonnage shipped from Middle East to Singapore. To take account of average haul, it is usual to measure sea transport demand in terms of ton miles, which can be defined as the tonnage of cargo shipped, multiplied by the average distance over which it is transported.

The effect of changing the average haul on ship demand has been dramatically illustrated several times in recent years by the closure of the Suez canal, which increased the average distance by sea from the Arabian Gulf to Europe from 6,000 miles to 11,000 miles.

Usually, analyzing changes in the average haul of a commodity trade can be extremely complex, requiring information in the form of detailed trade matrices, but very often the key issue is simply the balance between long haul and short haul supplies.

From the supply side, we can find some factors which can influence it , they are the fleet productivity , the shipbuilding productivity and the freight rate .

Although the fleet is fixed in size, the productivity with which the ships are used adds an element of flexibility. The productivity of fleet of ships measured in ton miles per

DWT depends on four main factors, speed , deadweight utilization , loaded days at sea and port time.

Firstly, the time a vessel takes on a voyage is determined by the speed. Clarkson research shows that even in a very good market condition, vessel's average speed is less than the designed speed owing to the operational factors.

Secondly, the port time plays an important role in the productivity equation among which the port congestion is the most critical one.

Thirdly the dead weight utilization refers to the cargo capacity loss owing to the bunkers, constants and stores etc. which prevent the full loading being carried.

Finally, the full vessel's time is divided into two basic types, the loaded days at sea and unproductive days such as the in ballast, port time and off-hire. A reduction in unproductive time allows an increase in loaded days at sea. Nowadays, the specialization in shipping increases the ballast time of the vessel since the vessel can not adjust themselves easily to different cargoes. Although on the other hand specialization is the only way to the economy of scale.

In the end, the supply of dry bulk shipping can be influenced by the freight rated absolutely. This is the ultimate regulator which the market uses to motivate decision-makers to adjust capacity in the short term.

Further more, the size of the global fleet is determined by ship-owners who respond to the freight rates by scrapping, new building and adjusting the performance of the fleet. Although the order book provides a guide to the size of the global fleet twelve to

eighteen months ahead, future ordering and scrapping are influenced by market sentiment and are very unpredictable.

The freight rate is the point when the demand and supply reach the equilibrium. When either of them changes, then demand and supply will react to each other, the former equilibrium will be broken and new equilibrium will reach, this is the basic mechanism that the dry bulk market is working. It has clearly showed this rule in the up and down of the market in 2008. At the first half of last year, the demand was very strong, since large share of the demand was driven by Chinese and Indian iron ore demand which benefit from the global economic booming. On the other hand, due to congestion and the limited capacity of ship yard, the increasing of supply is limited; this induced that the demand and supply can't meet at a point for a long time, accordingly, the freight rate increased accordingly. That's the main reason BDI reached its record high level since its introduction in 1985, reaching 11,793 points. But just half a year later, the index dropped by 94 percents, to 663 pints, the lowest since 1986. This made every owner and operator suffer great loss although they have made some other remedying tactics, for example, laying up vessels, reduced the vessel's speed in order to reduce the bunker consumption. Many owners survive while more went bankrupt. The leading reason was the reduction of letters of credit because the financial crisis makes the bank weird and more cautions, which were not willing to issue. This prevents the cargo to be bought and sold, consequently there is no cargo to be transported and lead to the huge dropping in the demand side.

Freight is the link between supply and demand. It stipulates ship owners to provide more tonnage when the freight rate is rising. It will have the opposite effect when the rate falls down. We looked in detail that the dynamics of the mechanism that timescale is important in reaching an equilibrium price.

4.2.2 The increasing of the cost

The shipping cost can be basically divided into three types, the financial cost, and the operating cost. The voyage cost. For the passed ten years, all of these three costs increased a lot. Below, I will analyze four parts of the shipping cost, which should be more important and take more accounts compared with other parts.

Raw materials will only be transported from distant sources if the cost of shipping operation can be reduced to an acceptable level. Actually, over the last century, improved efficiency, bigger vessels and more effective organization of the shipping industry has brought about a steady reduction in transport cost, but this is far from enough.

a) Bunker

This is the main part of the vessel's cost and increased a lot these years as result of the increasing price of the crude oil.

Obviously, cost will increase which result in the increasing of the freight rates accordingly if the bunker price is increasing. According to SSY research, if the bunker increases 2 dollars per tonnage, the average freight rate will be promoted by 0.2 dollar per tonnage. Another research showed that if the bunker price fluctuate 1 dollar, for round voyage of Atlantic or Pacific, the freight rate can change 0.05 dollar accordingly.

3) Managing cost

This mainly comprise the manning cost and the managing cost.

Currently, owners, especially small-scale ones, like to outsource vessel's management, while they can just focus on the commercial operation. This trend leads to the existence of specialized ship management companies, like v-ships. But these years, the manning cost is increasingly huge, because the number of experienced and qualified seafarers is dropping off, and the high technical vessels like large container vessels, VLCC, LPG, LNG, the time spent on the training of the seafarers from a fresh to an experienced one should be very long. The shipping industry now is in urgent huge demand of senior seafarers. On the other hand, this lead to the expense on the manning of the vessels is very huge now. Now most of the seafarers working onboard should be from developing countries, this is an efficient way for the owners or the management companies to reduce their operating cost, which is partly a consequence of the fact that the seafarers are not willing to work on board.

3) Cost on purchasing or building vessels

Since these years, the price of steel, which takes the largest part of the building expense, is always increasing; the new vessel's price is increasing accordingly. Another factor we have to take into account is that when the shipping market is booming, more money wants to enter into this industry, nowadays, this kind of investment is but mainly not confined to buy second-hand vessel or new build vessels. When those money rushes into this market, the vessels' price can be increased sharply. Last year, when the market was very good, the orders the Chinese shipyards had got can make them at full working capacity to 2011, although later part of these order had been cancelled.

4) Port charges and canal charges

In order to achieve the economy of scale, in the dry bulk shipping, there is still the hub-spoke system, which causes the hub ports to invest more on their infrastructure and facilities to increase the loading and discharging rate. Eventually, these expenses will be shared by these vessels through the increasing of port dues.

Benefiting from the booming, Panama and Egypt increased the canal charges too.

From all the above four kinds of cost, we can see that the cost for the ship owner is increasing, correspondingly, the break -even point will be increased. So the only method owner can take is to increase the freight rate.

4.2.3 FFA

FFA, the abbreviation of the freight forward agreement, now is a very popular and dangerous phrase and plays an increasingly important role on the fluctuation of the dry bulk freight rate.

Shipping is capital intensive, seasonal, cyclical and volatile industry, especially for the latter two characteristics , they are not only proved theoretically but also happened several times .Furthermore , the shipping is a kind of derivative service ,.since if there is no booming of the international trade , shipping will not have property either. That's why we say shipping is exposed to the international trade, political and economical environment. All the above leads shipping to be one of the most volatile industries in the world.

All the risk the shipping will encounter include the market risk , strategic risk , credit risk , financial risk , operational risk , legal risk, organizational risk, sovereign risk among which the market risk is the most important and easier to be measured and controlled, especially after the availability of shipping derivatives. Derivative is a kind of tools which was firstly used in finance. But during the passed 20 years, it has been more and more prevailingly used in shipping .It includes the freight futures, forward freight futures (FFA) and freight option contracts among which the FFA is most popular now. The main function of the above shipping derivatives is to hedge the risk caused by the uncertainty of the market.

For FFA, it is broadly defined by the Baltic exchange taking a position in the future market as a substitute for a forward cash transaction .It is a principal-to-principal over the counter derivative product the value of which derives from the freight rates traded in Baltic exchange. The trader of FFA especially the shipping companies can benefit so much from it whose advantages include but not confined to

- 1) A good tool to manage risk
- 2) Easy to fix and close out positions
- 3) Price discovery
- 4) No physical performance
- 5) No restriction to physical performance
- 6) No re-letting of the ships to the other parties as in the spot market
- 7) Easily understood and quickly trade

Due to the above, FFA market is increasingly important and attracting. It has been predicted that trading volume will reach 3,500,000 LOT in 2012 which should be huge amount and at the peak of the FFA trade in 2007 and 2008; its value was more than the spot market which sounds incredible.

The high volatility of freight rates in the shipping industry is proving particularly attractive to non-shipping players looking to become involved in shipping markets, without physically exposing themselves to operating the assets: the vessels. Some brokers said that freight derivatives have been turned over as much in a month as they used to in a year. It seems likely that both charters and ship owners will increasingly need to safeguard their profit against the volatile freight rate market since the shipping market becomes more and more familiar with hedging and risk management techniques.

Currently, there are four kinds of players in the FFA market.

a) The bulk carriers

The bulk carriers provide the transport service; they are intrinsic participants of the FFA market, like Norden in Denmark, Oldendorff in Germany, Imc in Singapore and Panocean in Korea. These three years, Chinese ship owners are much more involved in this market.

b) Commodity traders

The large commodity traders, since they did well in the future market, will participate in this market inevitably. The four largest traders, like ADM, Bunge, Cargill, Louis Dreyfus, are the main players of this market as well.

c) Investment bank

Since the passed 5 years were the golden time of dry bulk shipping, most of dry bulk carriers won enormous benefit which makes many investment banks interested in this market. Whereas, most of these kinds of banks don't want to buy the vessel that is the asset investment and all these assets can't be handled timely. so the FFA , a kind of paper market, should be more of interest to these investors. It is not so surprised that we find the name of investment banks like Morgan Stanley. The function of this is to echo with their investment in the FFA market.

d) Huge manufacturers

For the three biggest manufacturers of iron ore, like CVRD, BHP Billiton, Rio tito , transport should be another critical think they have to consider when sell their iron ore with CIF contract.. To secure the transport cost should the most serious problem they have to address when encountering one of the most volatile market—dry bulk shipping market.

But on the other hand, the big players make gambling at this market. The customary tactics they make is to charter in many vessels at the sensitive time and change the market supply demand status artificially. An impressive case , TMT , Taiwan dry bulk carrier, one of the largest FFA traders, chartered in 10 cape size vessel at the same time, then make them lay up which cause the due index increase hugely. Because, normally, most of the cape size vessels are used to carry out the COA contract so the number of the spot cape size vessel is limited.

It has been proved that FFA has price discovery and risk management function theoretically and practically, whereas since the future market is always the heaven of gambling, this can exaggerate the risk in the investment of FFA. Since the trading of

FFA contracts is through broker, and most of the time, the details should be kept top private and confidential. Then it is very difficult to assess the exact winning and loss, but we can see the case that COSCO suffered a great loss of 4.2 billion RMB that FFA market is not always a safeguard for the players if the investment on FFA deviates from the original functions of FFA.

4.2.4 Global economy

Undoubtedly, the most important sole influence on ship demand is the world economy, since it generates most of the demand for sea transport through either the import raw materials for manufacturing industry, or the trade in manufactured products. There are three aspects in the global economy that can influence the shipping market demand for the sea transport.

Firstly, it is the business cycle which lays the foundation for the freight cycles. Since the world industrial production produce most of the demand for commodities traded by sea, so when the global economy has its own business cycles, it means that all the product traded and shipped will have the same cycle with the global business cycle if we don't take the shipping supply, which is the supply of the new-building tonnage, into consideration.

Secondly, the trade elasticity can exert important influence on the internal shipping. The trade elasticity is the percentage growth of sea trade divided by the percentage growth in industrial production. Normally, there are two reasons why the trade elasticity of individual regions will change. The first is the balance of demand to available local resources of food and raw materials is likely to change over time. Another reason is that the mix of countries generating industrial growth many change

new countries emerge or others decline in importance.

4.2.5 Political disturbance

The singular feature of political developments as far as the shipping market is concerned is that when they occur they are inclined to bring about a sudden and unexpected change in demand.

Events of political disturbance don't necessarily impact directly on ship demand, but their consequences are significant.

The research showed that the regularity with which political events have turned the shipping market on its head is quite striking.

- 1) The Korean War, which started in early 1950. Although cargo associated directly with the war was mainly transported by ships of the USA reserve fleet, political uncertainty sparked off a stock building boom in Western countries.
- 2) The Suez crisis and nationalization of the Suez canal by the Egyptian government in July 1956, Oil tankers trading were diverted round the cape and this created a sudden increase in ship demand
- 3) The six day war between Israel and Egypt in May 1967 resulted in the closure of the Canal. European oil imports were diverted round the cape.
- 4) The closure of the tapeline oil pipeline between Saudi Arabia and Mediterranean in 1970 redirected crude oil previously shipped through the pipeline around the cape
- 5) The nationalization of Libyan oil assets in August 1973 resulted in the oil companies turning to the more distant Middle East producers for oil supplies
- 6) The Yom Kippur War in October 1973 and the OPEC production cut-back

- triggered the collapse of the tanker market. The associated price rise had the effect on the world economy and the shipping market that was to last more than a decade
- 7) The 1979 Iran revolution and the temporary cessation of Iranian oil exports precipitated a major increase in the price of crude oil , with significant repercussions for the world economy and the shipping market
 - 8) The 1990 Gulf War which resulted in the closure of the Dortyol pipeline and a phase of short term oil stock building. Both increased tanker demand.

Sometimes, the accident, especially the political events or the war, can influence the shipping world greatly. The closing of Suez Canal which leads to the rate of tanker flied and make the VLCC come into being is a standard case that the accident influence the real shipping world. Platou (1970) comments as follow:

The year 1957 shows how almost impossible it is to predict the future of the shipping industry. The forecasts made at the end of 1956 by leading shipping personalities were fairly optimistic. Nobody seemed to expect the recession which subsequently occurred, a depression which must be considered the worst since the middle thirties. From sky high rates at the end of 1956 they fell throughout 1957 to what can only be termed an almost rock bottom level. There were few people, if any, who imagined that, with small changes, it would run out to be a ten year depression only relieved by a second and more lasting closure of the Suez Canal in 1967.

4.3 The relationship between this factors and seasonality

We analyzed five main factors which can possible influence the BDI, the relationship between the demand and supply, the increasing cost, the FFA, the global economy and the political disturbance. Through them, we can find that demand, FFA and the global economy have the seasonal characteristics.

For the demand, some of the cargo's transporting has the seasonal demand. For example, the grain in us gulf, it can just be transported after the harvesting.

For the FFA market, it is the same situation. Since FFA is a kind of future based on the BDI, while on the other hand, due to the seasonality of BDI, so the FFA must have the seasonal characteristic indeed. But since the leverage effect and price discovery functions of the FFA, it can exaggerate the seasonal fluctuation to some extent.

For the global economy, all the macroeconomic variables are shown elsewhere to have random variations as well as seasonal constitution. Trade figures in several commodities are also shown to be seasonal. So for the global economy, it have seasonal characteristic to some extent as well, since some components of it has this characteristic.

From above, it has been found that the factors which can influence the BDI which is the reflection of the freight rate have the seasonal characteristic, so this decides that the freight rate must have the seasonal characteristic.

Chapter 5 the influence of seasonality on the dry bulk shipping freight rates

For the above chapters, we analyze the main factors that can influence the dry bulk freight rate. Here we begin to talk the subject of this paper, seasonality.

Every experienced shipping man can have this feeling in common that the freight rates not only in dry bulk shipping but also in other sectors can have seasonal fluctuation. We want to explore this through the three subsidiary markets: the cape size, the panamax size, the handy size, their one-year time charter hire and their three-year time charter hire and try to conclude this seasonality which can make decision maker in the dry bulk shipping benefit so much from this.

5.1 The statistical feature of dry bulk freight rates

For the analysis, the data of the monthly freight were got from ISL. The monthly hire of the one-year time charter and the three-year time charter were got from Clarksons. But all the number is the average of all the fixtures made during that month.

Table 5.1 Features of the statistics in voyage freight rate, one year time charter hire

Three years time charter hire

VOYAGE FREIGHT RATE			
	CAPE	PANAMAX	HANDY
MEAN	4.96	5.25	5.13
S.D.	0.52	0.45	0.36
COEFFICIENT OF VARIATION	10.04	8.47	7.23
SKEWNESS	-0.13	-0.53	-0.40
KURTOSIS	1.25	0.42	-0.86
ARCH(12)	56	113	178
L-B(12)	1154	1368	1752
J-B	43	12.5	14.3

HIRE FOR ONE –YEAR TIME CHARTER			
	CAPE	PANAMAX	HANDY
MEAN	9.31	9.05	8.64
S.D.	0.52	0.43	0.35
COEFFICIENT OF VARIATION	4.92	4.39	4.04
SKEWNESS	-0.48	-0.52	-0.56
KURTOSIS	-1.08	-1.13	-1.26
ARCH(12)	548	614	892
L-B(12)	1464	1658	1783
J-B	16.9	20.3	23.4

HIRE FOR THREE YEARS TIME-CHARTER			
	CAPE	PANAMAX	HANDY
MEAN	9.35	9.26	8.80
S.D.	0.31	0.29	0.30
COEFFICIENT OF VARIATION	3.43	3.19	3.42
SKEWNESS	-0.54	-0.62	-0.79
KURTOSIS	-0.85	-1.06	-0.56
ARCH(12)	412	882	398
L-B(12)	1358	1655	1786
J-B	15.4	22.3	23.8

The above tables give the statistic features of the monthly freight rate, one-year time charter hire and three-year time charter hire , from which , we can find two prominent

features:

1) For the voyage freight rate, we can find that the rate of larger vessels is less than that of the small vessels. While for the time charter hire, its calculation is based on one day, so definitely the hire of larger vessels should be more than the smaller vessels. But if we convert the time charter hire into the voyage freight rate, we can still find the rule that the average freight rate of the larger vessels should be less than that of the larger vessel.

This is the economy of scale in the shipping industry which encourages the emerging of larger and larger vessels in every subsidiary markets, such as VLCC for the tanker market and VLOC for the dry bulk market.

2) The distribution features of different size vessels for different period is the same: SKEWNESS shows a tend to the left while negative KURTOSIS is flat or fat or on the other hand, the only exceptional showed in the voyage freight of cape size vessel indicates that the distribution of this serial is narrow KURTOSIS. The statistics in the last three lines indicates that the statistics shows a feature that is self-correlation, normal distribution and heteroscedasticity.

3) The coefficient variation has positive relationship with the vessel's size if we don't consider the period of the time charter; it is that the larger the vessel is, the extent of the fluctuation should be more serious. This can be easily explained as follow:

For the smaller vessels, it is more convenient for them to change their routes and cargo in order to accustom to the fluctuation of the dry bulk shipping market while for the larger vessels, especially for cape size vessels, their routes and their cargo are so stable

that any change in the demand or supply of this due market can result in serious fluctuation.

4) The coefficient variation has a negative relationship with the period of the time charter if the vessel's size is the same; it means the fluctuation of the time charter hire is more less when the period of the time charter is longer. The time charter hire is always the expectation of the future market, or we can explain that the time charter hire of the long period should be the average level of the daily hire in owner's mind.

So when the period is longer, we can find that the average hire which is the time charter hire should be more stable.

5.2 The establishment of the model of seasonality in dry bulk shipping

After finding the basic characteristics of the freight rates and hire in the dry bulk market, this part is trying to establish the seasonal model for them in order to find the seasonality. The first step is to get the logarithm and the difference of the statistics due to which is to convert the curve trend into the linear trend.

Then the model can be established as follow:

$$\Delta X_t = \beta_0 + \sum_{i=2}^{12} \beta_i Q_{it} + \varepsilon_t \quad (5.1)$$

$$Q_{it} = D_{it} - D_{1t} \quad (i=2,3, \dots, 12, \text{ here } D_{1t}, D_{2t} \dots \text{ are the monthly dummies}) \quad (5.2)$$

$$\beta_1 = -(\beta_2 + \beta_3 + \dots + \beta_{12}) \quad (5.3)$$

$$Se(\beta_1) = \left\{ \sum_{i=2}^{12} Var(\beta_i) + 2 \sum_{i=2}^{12} \sum_{j=2}^{12} Cov(\beta_i \beta_j) \right\} \quad (5.4)$$

$$\Delta xt = \sum_{i=2}^{12} \beta_{1,i}(d1,tQ1t) + \sum_{i=2}^{12} \beta_{2,i}(d2,tQ_i,t) + \beta_{1,0}d1,t + \beta_{2,0}d2,t + \varepsilon \quad (5.5)$$

β_0 is a constant,

β_i is a factor that reflect the extent of the monthly fluctuation in the form of growth rate.

ε is a white noise error item

When I enter all the statistics, we can get below results:

Monthly freight rate				
Month	Coefficient	Cape size	Panamax	Handy
Constant	β_0	-0.01	-0.01	-0.01
		(0.07)	(-0.21)	(-0.37)
JAN	β_1	0.032	-0.054	-0.004
		(1.04)	(-0.96)	(-0.23)
FEB	β_2	-0.044	0.048	0.006
		(-0.92)	(1.26)	(0.36)
MAR	β_3	0.021	0.086	0.043
		(0.32)	(2.64)	(1.73)
APR	β_4	0.152	-0.008	0.032
		(2.57)	(-0.26)	(2.12)
MAY	β_5	-0.009	0.011	0.023
		(-0.20)	(0.35)	(1.12)
JUN	β_6	-0.073	-0.012	-0.040
		(-2.18)	(-3.96)	(-1.88)
JUL	β_7	-0.182	-0.113	-0.098

		(-3.24)	(-3.65)	(-4.16)
AUG	β_8	0.024	-0.002	-0.009
		(0.28)	(-0.03)	(-0.42)
SEP	β_9	0.158	-0.004	0.013
		(1.48)	(-0.05)	(0.56)
OCT	β_{10}	-0.041	0.095	0.024
		(-1.06)	(2.64)	(0.87)
NOV	β_{11}	0.021	0.054	0.099
		(0.32)	(1.92)	(0.43)
DEC	β_{12}	-0.052	-0.013	-0.003
		(-1.47)	(-0.27)	(0.14)
	Wald-test	55.76	63.06	52.78
		(0.00)	(0.00)	(0.00)
	L-B(1)	7.520	4.897	3.851
		(0.006)	(0.027)	(0.051)
	L-B(12)	3.43	37.88	10.52
		(0.002)	(0.000)	(0.589)
	ARCH(12)	1.72	4.06	0.92
		(0.064)	(0.000)	(0.549)
	WHITE-TEST	2.210	0.104	0.006
		(0.138)	(0.720)	(0.948)
	J-B	1.92	226.8	1009
		(0.386)	(0.000)	(0.000)

Hire for one year time charter				
Month	Coefficient	Capsize	Panamax	Handy
Constant	β_0	-0.003	-0.002	-0.001
		(-0.27)	(-0.28)	(-0.22)

JAN	β_1	-0.002	0.020	0.013
		(-0.19)	(1.24)	(0.78)
FEB	β_2	-0.030	-0.002	-0.004
		(-1.56)	(-0.000)	(-0.47)
MAR	β_3	0.030	0.023	0.029
		(1.90)	(1.53)	(3.07)
APR	β_4	0.026	0.007	0.025
		(1.21)	(0.44)	(2.08)
MAY	β_5	-0.006	0.024	0.006
		(-0.30)	(2.12)	(0.51)
JUN	β_6	-0.042	-0.043	-0.039
		(-2.80)	(-3.20)	(-4.51)
JUL	β_7	-0.042	-0.056	-0.045
		(-2.08)	(-3.87)	(-4.50)
AUG	β_8	0.020	0.013	-0.007
		(1.21)	(1.17)	(-0.77)
SEP	β_9	0.036	0.002	0.008
		(1.58)	(0.23)	(0.64)
OCT	β_{10}	-0.001	-0.006	0.009
		(-0.03)	(-0.56)	(1.17)
NOV	β_{11}	0.019	0.012	0.006
		(0.96)	(0.92)	(0.63)
DEC	β_{12}	-0.011	0.002	-0.002
		(-0.76)	(0.17)	(-0.23)
	WALD-TEST	33.45	56.36	54.77
		(0.000)	(0.000)	(0.000)
	L-B(1)	34.49	28.3	28.49

		(0.000)	(0.000)	(0.000)
	L-B(12)	65.49	59.07	58.49
		(0.000)	(0.000)	(0.000)
	ARCH(12)	0.68	2.02	0.80
		(0.763)	(0.025)	(0.626)
	WHITE TEST	2.209	0.103	0.005
	J-B	1.89	226.9	1009

HIRE FOR THREE YEAR CHARTER				
Month	Coefficient	Capesize	Panamax	Handysize
	β_0	-0.002	-0.002	-0.001
		(-0.31)	(-0.29)	(-0.20)
JAN	β_1	-0.009	0.012	0.013
		(-0.97)	(1.45)	(1.00)
FEB	β_2	-0.024	-0.003	-0.016
		(-1.27)	(-0.41)	(-0.04)
MAR	β_3	0.023	0.021	0.005
		(2.12)	(2.10)	(0.48)
APR	β_4	0.009	0.004	-0.001
		(0.56)	(0.41)	(-0.004)
MAY	β_5	0.001	0.013	0.040
		(0.08)	(1.63)	(1.25)
JUN	β_6	-0.021	-0.021	-0.030
		(-1.85)	(-2.40)	(-2.25)
JUL	β_7	-0.021	-0.022	-0.019
		(-1.68)	(-3.18)	(-3.12)
AUG	β_8	0.029	0.008	0.018
		(1.85)	(0.77)	(1.19)

SEP	β_9	0.028	0.007	0.009
		(2.18)	(0.87)	(1.29)
OCT	β_{10}	0.001	-0.021	0.001
		(0.009)	(-2.56)	(0.25)
NOV	β_{11}	-0.006	-0.006	-0.014
		(-0.37)	(-0.63)	(-1.35)
DEC	β_{12}	-0.12	0.008	-0.009
		(-1.21)	(1.15)	(-1.25)
	Wald-test	45.61	67.36	26.03
		(0.000)	(0.000)	(0.006)
	L-B(1)	25.88	37.11	4.492
		(0.000)	(0.000)	(0.034)
	L-B(12)	39.88	108.4	
		(0.000)	(0.000)	(0.042)
	ARCH(12)	0.72	2.15	4.76
		(0.731)	(0.016)	(0.000)
	WHITE-TEST	0.005	0.212	6.729
		(0.942)	(0.645)	(0.013)
	J-B	5884	29.88	68
		(0.000)	(0.000)	(0.000)

5.3 The analysis of these results

5.3.1 The analysis of the spot market freight rate

We can find clearly that β_i , $i=1,2,\dots,12$, is much more or less than the average level, β_0 , especially cape in April increased 15.38%, the panamax increase 8.6% in March while the seasonal increasing of the freight rate in handy in March and April are 4.35% and 3.3%. The increasing of the freight rate for these months

can be explained as follow:

- 1) March and May are the months when , in Japan, is the end of one financial year .This can lead many companies to import cargo more concentrated during this time and results in the great increasing which changes the supply-demand equilibrium and promote the freight rate correspondingly. At the same time , it is the harvest time for the southern hemisphere , which mainly is Australia and Argentina , hence, this can increase the shipping demand in Panamax and handy especially the latter in March and April that are the prevailing size in the shipping of grain.

Panamax experience an increasing in October and September which is the direct consequence of the exporting of the grain in US Gulf, as above mentioned, panamas is the leading size used to ship the grain especially in US Gulf where the port facilities are good enough for the loading and discharging.

For the above statistics, another prominent feature should be that the voyage freight rate during summer time is falling down. This can be interpreted that during the summer time, the main industrialized countries abate their industrial production due to the high temperature.

5.3.2 The analysis for the one-year time charter hires

It shows from the statistics that for the one year time charter hire , it increase 5.5% in May for the handy size while panamax has an increasing of 2.4 % in May and Cape has an increasing of 3% in March.

For the increasing of handy size, we can still find that the shipping demand from the grain is the driver, but for the Panamax and Cape, it seems that these two sizes

don't suffer the same influence. The main reason should be that for the one year time charter, charter doesn't want to use large vessels that seems to be a little risky for them which comes from their uncertainty in the cargo volume, the destination and the high storing cost. For the storing cost, it accounts for a large part of the whole logistic cost which will be exaggerated when the port can't transfer them timely. Another important reason should be for many exporting countries of grain, their port conditions such as draft and the port handling facilities can't meet the requirements of the panamax and cape vessels that are labeled with the large load and discharge rate.

During summer time, we can find the one year time charter hire fall 8.4%, 9.7% and 8.4% respectively. The first reason has been mentioned above that is the abatement in the industrial production due to the high temperature in summer. The other cause is the time charter hire has the inevitable synchronous fluctuation with the current and expected voyage freight rate, so during June and July, when the voyage freight rates fall down, the time charter rate will fall down accordingly. But another outstanding trait in the fluctuation of the hire is that the extent it falls down is much more serious than that of the increasing.

5.3.3 Analysis for the three year time charter hires

The three year time charter hire has the same rule with one year time: Both of them has a seasonal increasing in spring while having a seasonal falling down in summer. (Cape, Supramax and Handy have the 2.3%, 2.1% and 1.8% increasing percentage and have 4.2% 4.3% 4.9% decreasing percentage respectively). The decreasing rate is half of that of one year time charter rate, this can prove another rule discussed in 5.1 which is the longer the period is, the hire should be more

stable. Another characteristic is that, during August and October , there is an increasing of 5.7% , because these three months are the normal time for the Chinese , Japanese and Korean steel mills to negotiate the COA contract with Brazil and Australia which is carried out mostly by capsize or renew their long term imports(iron ore or coal) and the associated contracts.

Chapter 6 Conclusion

This dissertation provides empirical evidence on issues relating to the seasonal behavior of freight rates in dry bulk shipping. The magnitude and pattern of seasonal fluctuations is measured and compared across freight rates for different size vessels as well as contract durations. More over, the seasonal behavior of freight rates is examined and compared under different market conditions.

Overall the seasonal movement of dry bulk time-charter rate suggests that, on average, the level of the freight rate increase in a certain months (March and April). After realizing this, Owner and charter can take advantage to this rule very well: owner can charter out their vessels in March or April while charter can charter in vessel in June or July. On the other hand, these regular seasonal fluctuations indicates that, if the cleaning and repositioning cost permits, sometimes combined ship owner can stitch between different markets to counteract the negative effect of the seasonal fluctuation in dry bulk shipping market.

There is another feature that the extent of the rate fluctuation in dry bulk market is in line with the size and the duration of the contract. We can clearly find that the fluctuation in the spot market are much more pronounced than that of the three year time charter and one year time charter . Let us take one year time charter for example: the hire of it is the expectations of the forthcoming one year which have

consider many factors where the seasonal fluctuation has been incorporated to some extent. Further more, the spot rate is more than the period rate since most of the time owner has to worry about the period of the unemployment which is the disadvantage compared to the time charter.

The higher seasonal fluctuation of the spot freight rate can be further explained that the time charter (more than one year) is a kind of strategy which is preferred by the industrial carriers. Since the period time charter can't only meet their requirement of the tonnage demand but also can secure the cost at a relative stable level over a long period. For the latter advantage, it is highly appreciated by the steel mills which can make them more convenient when pricing their products. Then they can use the spot market as a supplementing to meet their volatile tonnage demand. Therefore, they will enter the spot market at a certain time which will exaggerate the fluctuation of the spot market.

I conclude the research results as follow:

- (1) The levels of freight rates for different sizes of dry bulk shipping increase during spring and autumn
- (2) Spot rate seasonality is much more serious for freight rates of larger tonnage than smaller tonnage
- (3) Seasonal changes are asymmetric; its rising is less serious in all sectors compared to falls.

In the shipping industry volatilities in freight rates and ship prices are considerable compared with other sectors of the world economy. Unexpected changes and sharp movements in the dry bulk freight rates, over the short period, prevent the decision making progress and on the other hand provide enough opportunities for all the

participants to suffer the great loss or win the great gain. Therefore, comprehending and analyzing rules of these movements in the dry bulk market is essential for decision makers.

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