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The application of shipping freight derivatives for evading risk in the Capesize shipping market

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THE APPLICATION OF SHIPPING FREIGHT DERIVATIVES FOR EVADING RISK IN THE CAPESIZE SHIPPING MARKET

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Declaration

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

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

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Abstracts

Title of Research Paper: **The Application of Shipping Freight Derivatives for Evading Risk in the Capesize Shipping Market**

Degree: **MSc**

The dry bulk shipping market is close to a completely competitive market. In such a market, due to the influence of various factors such as supply-demand, politics and so on, the freight rates are constantly changing. With the huge volatility of freight and fuel prices in recent years, the shipping market participants are faced with various kinds of risks. In order to avoid risks, many of them choose shipping freight derivatives to hedge. Shipping freight derivatives mainly include Freight Future, Forward Freight Agreements and Options.

Within the dry bulk shipping market, the subsector of Capesize market has high volatility due to its huge size and low flexibility. This market is mainly related to the iron ore and coal transport where "China Factor" plays a considerable role. Under such a complex situation with the quite large new building tonnage of capesize to be delivered in the next few years and the current downturn dry bulk market, risk management strategies of domestic medium-sized shipowners would be very important. Therefore, the paper demonstrates that the freight rate risk is the most critical risk need to be avoided through the analysis of the market and its risks. The main steps for hedge consists of the forecast of market trend, the calculation of exposure in physical market and the certainty of appropriate derivatives and its position in hedge market. The aim of this paper is to give a specific operating strategy based on risk aversion in coming several years for Capesize.

KEYWORDS: BCI; AMRA Model; Shipping Freight Derivatives; Risk Management

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List of Abbreviations

ADF	Augmented Dicket – Fuller
ARMA	Autoregressive Moving Average
ARIMA	Autoregressive Integrated Moving Average Model
BCI	Baltic Capesize Index
BDI	Baltic Dry Index
BHMI	Baltic Handymax Index
BIFFEX	Baltic International Freight Futures Exchange
DWT	Dead Weight Tonnage
EBIT	Earnings Before Interest and Taxes
FFA	Forward Freight Agreement
GDP	Gross Domestic Product
OTC	Over The Counter
T/C	Time Charter
VLOC	Very Large Ore Carrie

Chapter 1 Introduction

1.1 Background and Aim of the Paper

The international shipping market is derived from the demand of international trade. Due to this feature, the shipping industry has the characteristics of passivity and dependence of shipping industry, especially the dry bulk shipping market. The dry bulk shipping market is close to a completely competitive market. In such a market, due to the influence of various factors such as supply-demand, politics and so on, the freight rates are constantly changing. The world dry bulk markets generally weakened in the year 2011, and the depression will be likely to last several years.

With the huge volatility of freight and fuel prices in recent years, the shipping market participants are faced with various kinds of risks. In order to avoid risks, market participants use a variety of risk management methods. Many of them choose the shipping freight derivatives to hedge. Shipping freight derivatives mainly include Freight Future, Forward Freight Agreements and Options. Although there are lots of articles involving the prediction of freight index and risk management, the research only concerned about one type of vessel's market is rare.

Within the dry bulk shipping market, the subsector of Capesize market has high volatility due to its huge size and low flexibility. Capesizes were trading below operating cost for a prolonged period (Drewry Maritime Research, 2011, p.1). The Capesize shipping market is mainly related to the iron ore and coal transport where "China Factor" plays a considerable role. China imports iron ore from Australia and

Brazil, which has been the key factor for the recover of capesize market. However, the expected recovery may be limited by the heavy pressure from the side of supply. According to the report of Clarkson (“Dry Bulk Trade Outlook”, 2011, pp.2-3), the trend of world iron ore transport will go to “steady” in 2012 while the trend of coal transport will be “firm”. Additionally, the world capsize fleet in million DWT will be 276.4 in 2012 which is a 10% increase compared with the year 2011.

Under this complex and depress situation of the current dry bulk market, risk management strategies of domestic medium-sized shipowners would be very important. Thus, the paper illustrates that the freight rate risk is the most important risk need to be avoided through the analysis of the market and its risks. And according to those former theses often pay more attention on the application of FFAs within the risk management, this paper tries to compare and contrast the applications of FFAs and Freight Options. The aim of this thesis is to demonstrate the main steps of hedging and give a specific operating strategy to domestic Capesize’s shipowners in coming several years.

The main steps for hedge consists of the forecast of market trend, the calculation of exposure in physical market and the certainty of appropriate derivatives and its position in hedge market. So the article has 7 parts to contain those 4 steps. The fist part summarizes the background information such as aim, review and methodology. The second one introduces and analyzes features and types of Capesize shipping market and its risks. The third part is the forecast section. The ARMA model is used to analyze and predict the trend of BCI in 2012. Then the next two parts introduce two different applications of shipping freight derivatives for the aim of hedging. The sixth part gives specific operating strategies to domestic Capesize’s shipowners (e.g. ROSCO Shipping) based on the combination of analysis and forecast above. The last part puts comprehensive conclusions and advices to the development of shipping derivatives in China.

1.2 Literature Review

There are various kinds of risks in the shipping industry. It is of great significant for shipping market participants to select the correct methods of risk aversion based on analysis of the characteristics of the shipping market and its risk.

1.2.1 Dry Bulk Freight Market and its Risk Management

Scholars have done a lot of research work related to the characteristics of dry bulk shipping market and its risk.

Zhang (2003, pp.13-14) believed that the international dry bulk market is influenced by the trend of world economy, international political environment and uncertainties. Stopford (2003, p.43) said there is a certain short-term cycle in shipping market, which is identified by 4 stages: a trough, a recovery, a peak, and a collapse. Ma (2009, pp.1-5) found every stage of shipping market has its relatively fixed characteristics. Yu (2010, pp.6-16) introduced some of the features of the dry bulk shipping market, including: relatively concentrated navigation routes; the cyclicity and seasonality; not fixed routes, schedules, ports of call and freight rates of dry bulk vessel that changed with the contract agreed.

Within the Capesize market, Zhang et.al.(2006, pp.12-16) analyzed the status quo and development trend of the world iron ore trade and its affecting factors. Liu (2011, pp.7-9) found that the Vale's purpose is to control the whole chain of steel industry through controlling production, transportation and sales of iron ore for the impacts from the construction and operation of the 400,000 DWT VLOCs in China's shipping market.

With regard to the risk of shipping market, Kavussanos(1996, pp.67-82) extended the ARCH class of models to investigate volatility in the spot and time charter markets of dry-bulk vessels and found: 1) volatility is higher in the sport charter market than the time charter market; and 2) the spot freight market is riskier for larger size vessels than smaller size. Qian (1999) analyzed the business risk in the shipping industry through 4 steps: understanding, identifying, evaluating and resolving. Kavussanos and Visvikis (2006, pp.27-31) summarized the sources of risk in the shipping industry: 1) Business risk; 2) Liquidity risk; 3) Default risk; 4) Financial risk; 5) Credit risk; 6) Market risk; 7) Political risk; 8) Technical and physical risk.

1.2.2 Forecasting of Dry Bulk Freight Rates

Baltic Dry Freight Index (BDI) is regarded as a barometer of the international dry bulk market trend. Since the BFI plays a critical warning role within the shipping industry, its predictions have been researched by scholars in-depth.

Hawdon (1978, pp.21-25) applied the econometrics for the analysis of the shipping market for the first time, to identify possible factors affecting ocean freight. Cullinane (1992, pp.91-114) used the ARMA model to do the short-term prediction of the BDI. Lv and Chen (2003, pp.1-4) extracted the long-term trend, cyclical and seasonal factors of BDI to establish the ARMA model and forecast. Kavussanos and Nomikos (2003) investigated the causal relationship between futures and spot prices in the freight futures market. Batchelor et. al. (2007, pp.101-114) tested the performance of popular time series models in predicting spot and forward rates on major seaborne freight routes; They found that, in predicting forward rates, the VECM is unhelpful, and ARIMA or VAR models forecast better. Du et. al. (2009, pp.77-80) considered BDI’s monthly average data as per unit, and analyzed the fluctuation variation of season and cycle; Through ADF tests, an ARMA forecasting model was proposed. Jiang (2010) selected BCI to be researched and find that wavelet analysis - ARMA model had a much high level of prediction accuracy.

1.2.3 Shipping Freight Derivatives

In the shipping market, the freight rates are often difficult to be predicted. In order to avoid this kind of risk, maritime freight derivatives came into being.

Kavussans and Visvikis (2006, pp.233-255) summarized the current study of using shipping derivatives products in the area of risk management in shipping. Zhang and Yang (2006, pp.36-37) gave a brief introduction on the definition and development of forward freight agreements, combined with Chinese companies on the risk management of the FFA. Duan (2007, pp.38-39) systematically introduced the FFAs and illustrate the way for shipowners or charterers to use forward freight agreements to hedge the freight rates. Zhao and Sha (2007, pp.10-11,15) presented that the Chinese steel companies should make use of FFA to reduce the actual price risk of spot market because of the characteristics that China's imports of iron ore sea transport are mostly accomplished by the spot market. Wu (2009, pp.72-75) introduced the types of maritime freight derivatives and focuses on how to use the ocean freight derivatives to avoid the risk under the financial crisis. McDonald (2009, pp.27-34) introduced the definition of option. Wang (2011, pp.31-33) outlined the status quo and the necessity of the development of shipping finance derivatives in China.

1.3 Methodology

The method of time series prediction is to deal with the trend forecasting target of a group of data by analyzing its time series. For statistics processing, Autoregressive Moving Average (ARMA) models, which also known as Box Jenkins models, are usually applied to autocorrelation time series data. It is a high precision short-term time series analysis methods. The basic idea is that some of the time series are a series of time-dependent random variables. A single value that constitutes the time series, although uncertainty, there is a certain regularity of whole series, can be approximatively described by the corresponding mathematical model.

Given a time series of data *Yt*, the ARMA model is a tool for understanding and, perhaps, predicting future values in this series. The model consists of two parts, an autoregressive (AR) part and a moving average (MA) part. The model is usually then referred to as the ARMA (*p,q*) model where *p* is the order of the autoregressive part and *q* is the order of the moving average part. For stationary random data sequence, usually using a time series model to model, it can be divided into the following model: autoregressive model (AR model), the moving average model (MA model), autoregressive moving average model (ARMA model), and autoregressive integrated moving average model (ARIMA model). These models can be modeled for different characteristics of stationary time series.

In general, after choosing *p* and *q*, ARMA models can be fitted by least squares regression to find the values of the parameters which minimize the error term. It is generally considered good practice to find the smallest values of *p* and *q* which provide an acceptable fit to the data. In order to find appropriate values of *p* and *q* in the ARMA (*p, q*) model, the mapping of the partial autocorrelation functions can contribute to the estimate of *p*, and analogously, the autocorrelation functions can be used for an estimate of *q*. Further information can be collected by considering the same functions for the residuals of a model fitted with an initial selection of *p* and *q*.

The process of build an ARMA model is explained below:

1) Stationarity test of a time series

Most of the time series we have encountered are non-stationary in practical situations. So, it is important to estimate whether the time series is stationary. The stability criteria of the time series is that: if the autocorrelation function of the time series is falling into the confidence interval tending to zero when $k > 3$, the time series is stationary; if the autocorrelation function falls outside the confidence interval more, the time series is not smooth.

2) Statistical analysis of the time series

Within the ARMA model, in order to do the parameter estimates and degree determination, the first thing to do is the statistical analysis of time series $\{y_t\}(t=1,2,\ldots,n)$, results are as follows:

The mean value of $\{y_t\}$: $\mu_y = \frac{1}{n}\sum_{t=1}^{n} Y_t$

The variance of $\{y_t\}$: $Var(Y_t) = \sigma_y^2 = \frac{1}{n}\sum_{t=1}^{n} (Y_t - \mu_y)^2$

The covariance of $\{y_t\}$: $Cov(Y_t, Y_{t+k}) = \frac{1}{n-k}(Y_t - \mu_y) \cdot (Y_{t+k} - \mu_y)$

The autocorrelation function of $\{y_t\}$: $\hat{\rho}_k = \frac{\sum_{t=1}^{n-k}(y_t - \bar{y})(y_{t+k} - \bar{y})}{\sum_{t=1}^{n}(y_t - \bar{y})^2}$, $\bar{y} = \sum_{t=1}^{n} y_t / n$

The partial autocorrelation function of $\{y_t\}$: $\hat{\varphi}_{kk} = \begin{cases} \hat{\rho}_1, k = 1 \\ \dfrac{\hat{\rho}_k - \sum_{j=1}^{k-1}\hat{\varphi}_{k-1,j} \cdot \hat{\rho}_{k-j}}{1 - \sum_{j=1}^{k-1}\hat{\varphi}_{k-1,j} \cdot \hat{\rho}_j}, k = 2,3,\ldots \end{cases}$

$\hat{\varphi}_{k,j} = \hat{\varphi}_{k-1,j} - \hat{\varphi}_{kk} \cdot \hat{\varphi}_{k-1,k-j}$. The calculation of partial autocorrelation function can be recursive obtained from the first value with the increasing of k.

We can use the autocorrelation function and partial autocorrelation function to identify the appropriate ARMA model together. The partial autocorrelation function can be used to conclude the degree of AR model initially, while the autocorrelation function can determine the degree of MA Model.

3) Model degree determination

It is critical to estimate parameters and determine the degree during the model identification. For ARMA model, we can use the truncation of sample's autocorrelation function $\{\hat{\rho}_k\}$ and partial autocorrelation function $\hat{\varphi}_{k.j}$ to determine the model degree as shown below:

① If $\{\hat{\rho}_k\}$ truncates at q, then p = 0 and the model is MA (q);

② If $\hat{\varphi}_{k.j}$ truncates at p, then q = 0 and the model is AR (p);

③If $\{\hat{\rho}_k\}$ and $\hat{\varphi}_{k.j}$ are both trailing, the model is ARMA (p, q). Normally, the degree (p, q) can not be obtained directly at that time. It needs to combine with other methods to identify and determine after passing the examination.

4) Parameter estimate and projections

Usually, the parameter estimate and projections are processed by the specialized statistical analysis software. This paper used Eviews 6 to do the data processing and forecasting.

Chapter 2

Analysis of Capesize's Shipping Market and its Risk

2.1 The Status Quo of Capesize Market

The vessel type of Capesize is mainly used to transport the massive amount of ore. As the subsector department of the dry bulk shipping market, the Capesize market is influenced by the situation of dry bulk shipping market firstly. Meanwhile, the global iron ore and coal seaborne trade conditions affect the Capesize market, too.

2.1.1 Dry Bulk Market

In 2011, the dry bulk market is attacked by two sides: a supply glut which already existed and the even more serious EU financial crisis. The global economy is in a prolonged recession and need a period of time to recover again. It is expected that world GDP (Figure 1) will grow by 3.2% in 2012 from 4% in 2011 and then by 4-5% for the next 3-4 years (Drewry Maritime Research, 2011, p.1). The picture of the international shipping industry is not bright, the situation may be go further worsen in 2012.

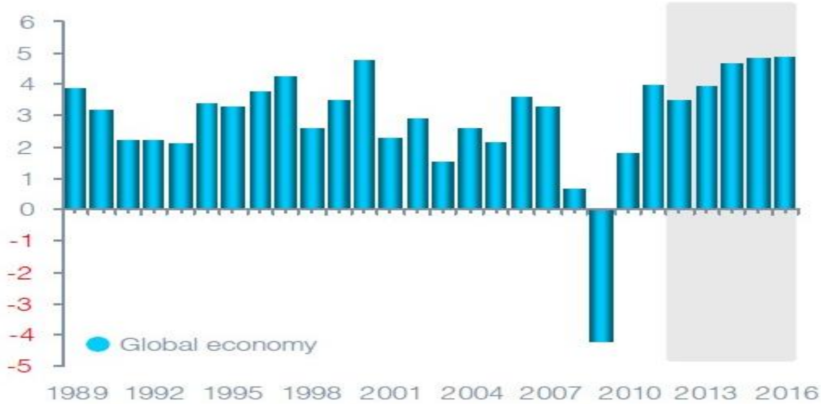


Figure 1 – GDP Growth Rate (% growth)

Source: IMF

Due to the dry bulk markets' weakness, the value of BDI fell significantly in the last several months. According to the BDI trend shown in Figure 2, the index was 1869 at the end of 2011, but just after 2 month, it dropped to only 703. That is mainly due to the serious oversupplied situation with a relative lack of new cargoes appearing at the same time that limited the stable development trend of freight rates. Huge fluctuation and ambiguous perspective are the status quo of the current freight market.

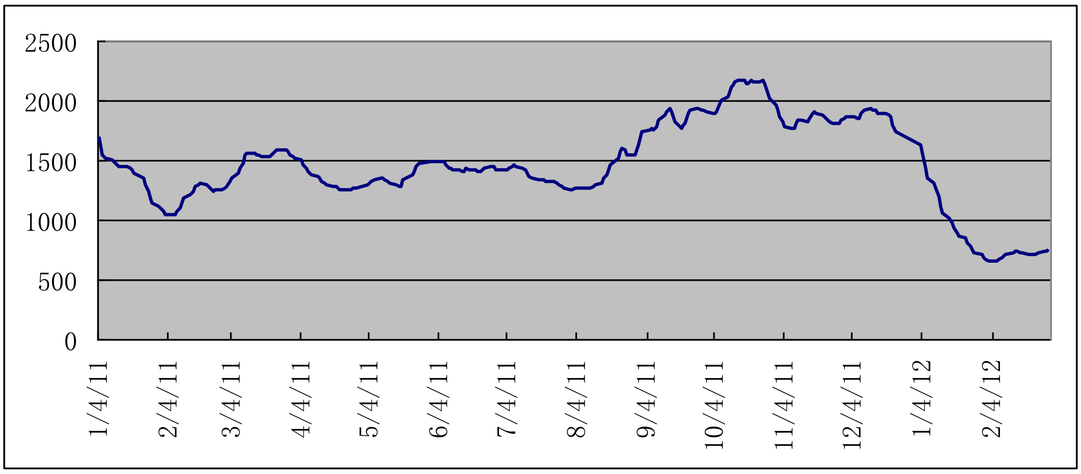


Figure 2 – BDI from Jan 2011 to Feb 2012

When it comes to the demand side, the growth in global demand is expected to be around 4% in 2012 and will not exceed 5% until after 2013 as the current global economic conditions will restrict any major improvement in trade (Drewry Maritime

Research, 2011, p.1). This leads to the gap between dry bulk supply and demand will still be huge in the foreseeable future, which can be observed by the Figure 3.

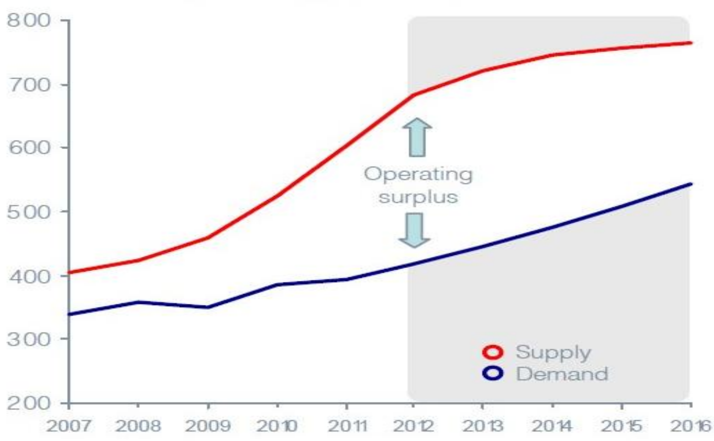


Figure 3 – Dry Bulk Supply / Demand Balance (million dwt)

2.1.2 Iron Ore Market

When speaking of the Capesize, what first comes to people is the iron ore transportation. Many iron and steel enterprises cut production in 2011, especially in Europe, because of the weaker demand and squeezed profit margins. Drewry predicted that the world economy falls into recession, there may be a significant slowdown in the global steel production in the near future (Drewry Maritime Research, 2011, p.2). However, on the contrary, those emerging economies such as India, China and Brazil will be likely to continue to boost steel demand growth In the next few years.

Definitely, the steel production condition of China will determine how the performance the dry bulk market will perform in the future. According to the data shown in Figure 4, the Construction boom in China once contributed to the record speed of production. But now, it seems to lose its power. This kind of slowdown will weaken the demand for iron ore dramatically. Due to most of the trading in the dry bulk industry in 2011 was related to steel production (Drewry Maritime Research, 2011, p.13). Although Chinese steel demand has a falling trend, it is still expected to stimulate the iron ore transport for more years.

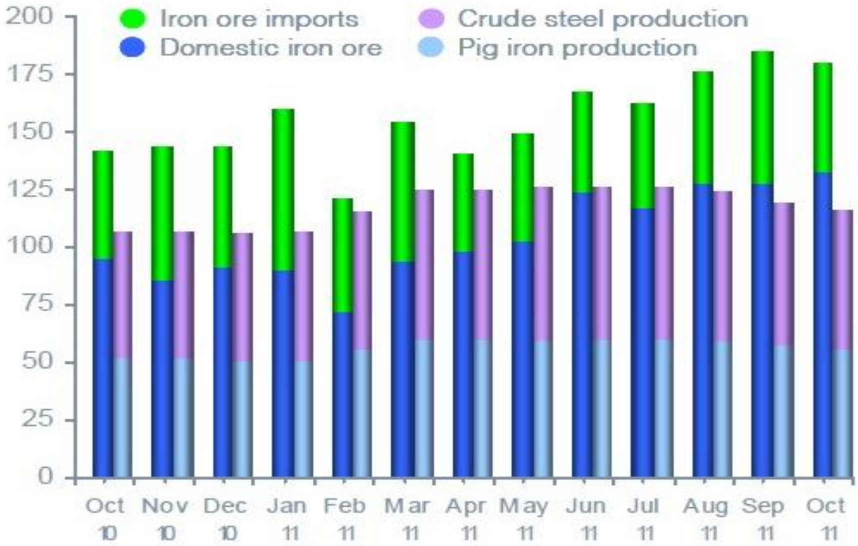


Figure 4 – China's Iron Ore Situation (million tonnes)
Source: TEX Report

Look around the iron ore seaborne trade condition of the whole world, as the Figure 5 shown, the total global iron ore trade in 2011 was 1045 million tones, down from 1048 million tons in 2010; Drewry forcasted a growth of over 7% is expected in the next five years, which will reach 150 million tons by the end of 2016 (Drewry Maritime Research, 2011, p.13).

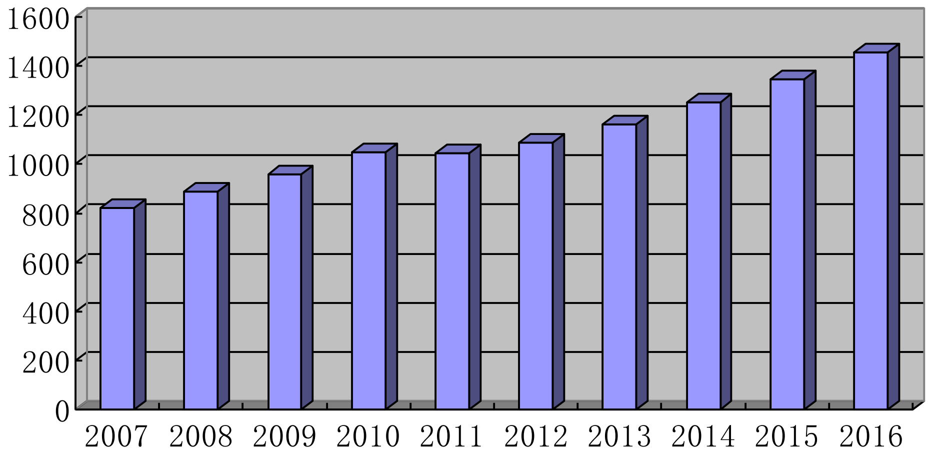


Figure 5 – Iron Ore Seaborne Trade (million tonnes)
Source: Drewry Maritime Research

2.1.3 Coal Market

Another main cargo source of the Capesize is the coal transportation. The global coal industry maintained a stable level in 2011. The total coal trade in 2011 is only slightly higher than in 2010, an increase of 0.7 million tons to 885.4 million tons (Drewry Maritime Research, 2011, p.14). The potential slowdown of the global steel production growth in 2012 mentioned above may also limit the development of coal trade, especially the coking coal trade. The forecast result of global seaborne coal imports by the Drewry is shown in Figure 6.

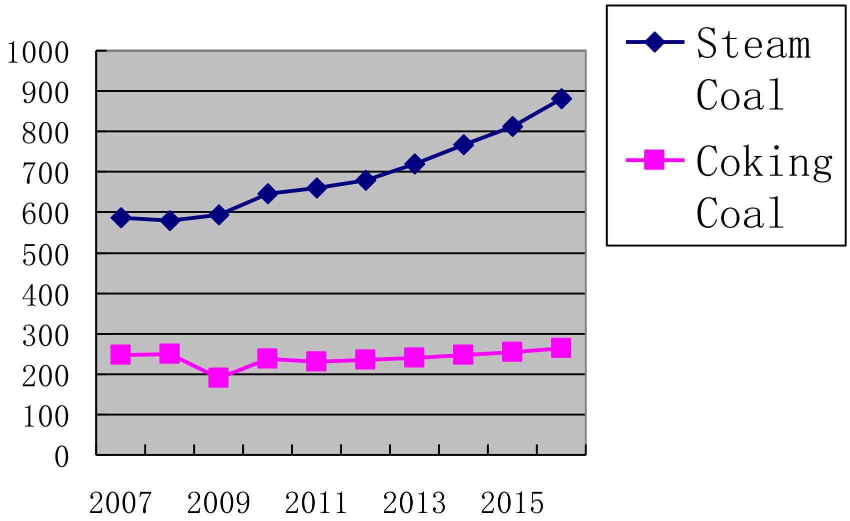


Figure 6 – Seaborne Coal Imports (million tons)
Source: Drewry Maritime Research

Based on the data of last several years, there were healthy conditions for both steam and coking coal trade in the last few years. Those developing countries usually play important roles within the coal market. Based on China's 12th five-year program, the plan of coal transport railways will reduce China's dependence on seaborne coal imports. On the other hand, India is sill the main force of the steam and coking coal imports. India is expected to import more coal in 2012, about 12% more than it imported in 2011, to meet its growing power-generation demand (Drewry Maritime Research, 2012, p.2). This may increase the need for large bulk carriers.

2.2 The Status Quo of Capesize Fleet

As we all known, the whole shipping industry is in a oversupply condition. Although the growth of bulk carrier availability is expected to slow to 10% in 2012 from 14% in 2011, the growth in demand is still expected to slow down from 5 % in 2011 to 3% in 2012 (“Dry Bulk Trade Outlook”, 2011, pp.3).

The Capesize fleets growth is about 18% in 2011, which is the largest growth of all the dry bulk sectors. In the year to date, 41.6 million dwt has been delivered into the fleet, some 41% of which is accounted for by vessels of between 170,000 and 179,999 dwt; another 29% of this volume is accounted for by vessels of 180,000-189,999 dwt ("Dry Bulk Trade Outlook", 2011, pp.15). According to the data from Clarkson, now the average age of Capesize fleet is 8.2 years. The global Capesize fleet is already young and abundant. In addition, Vale put its 4 million dwt VLOCs to transport from South America to China, which were refused to be accepted by the Chinese ports. The Table 1 below is shown the changes of Capesize / VLOC fleet in recent years. All those situations mentioned above will depress the freight rates of Capesize further.

Table 1 – Capesize / VLOC Fleet Changes ('000 dwt)

	Orderbook				Orders Placed				Deliveries				Demolition			
	Cape		VLOC		Cape		VLOC		Cape		VLOC		Cape		VLOC	
	No.	Dwt	No.	Dwt	No.	Dwt	No.	Dwt	No.	Dwt	No.	Dwt	No.	Dwt	No.	Dwt
2007	479	81921	106	27967	345	58261	52	14063	35	6192	20	4272	2	141	0	0
2008	652	109929	146	39951	179	29619	53	16753	28	4956	15	3633	10	1455	1	225
2009	610	102644	148	43170	58	10326	25	8518	92	16284	18	4829	8	1208	2	493
2010	316	52480	182	47964	47	7923	51	11362	187	32484	22	5527	55	8144	7	1561
2011*	265	44161	178	46152	40	6660	44	9826	196	33211	33	8883	51	7625	7	1561

* Provisional deliveries for 2011

Source: Drewry Maritime Research

The status quo of Capesize fleet influenced the vessel price of the cape. A 170,000 dwt newbuilding Capesize's price fell down to US$52.8 million in 2011. That is leading to a shrinking orderbook. Look forward to the next few years, the delivery of new vessels and limited order will alleviate the condition of over supply. On the other hand, the demolitions of Capesize led the scrapping activities in 2011. Last year, 51 capes and 7 VLOCs were scrapped. But, since the remaining fleets of Capesize are quite young, the scrapping activities are seem to decline in 2012.

2.3 The Sources of Risk in the Capesize Market

There are various kinds of risks in the shipping industry. With regard to the risk of shipping market, Kavussanos and Visvikis (2006, pp.27-31) summarized the sources of risk in the shipping industry: 1) Business risk; 2) Liquidity risk; 3) Default risk; 4) Financial risk; 5) Credit risk; 6) Market risk; 7) Political risk; 8) Technical and physical risk. This article applies this concept to the Capesize market and summarizes it from 3 aspects: operational risk, ownership risk and other risks.

2.3.1 Operational Risk

Operational risks due to the volatilities in Earnings before Interest and Taxes (EBIT) that may be caused by the changes in operating costs, voyage costs and freight rates. In voyage contracts, fluctuation in freight rates and bunker prices affects operating profits. In period time charter contracts, only fluctuation in freight rates affects the profits. Therefore, the bunker price fluctuation can be evaded by chartering period contracts or using bunker derivatives.

The shipping market is full of risks, especially the level of freight rate affects shipping companies' profits and competitiveness directly. Therefore, freight risk is the primary risk that be faced with shipping enterprises, the volatility of freight makes tremendous impact on shipping companies. To illustrate the freight rates risk, consider the BCI presented in Figure 7, which shows how freight rates in the Capesize sector have fluctuated between Jan 2011 and Feb 2012. The monthly BCI is 3516 by increased almost 13% in Dec 2011. But 2 months later, the index decreased by about 20% to an average 1468 (Drewry Maritime Research, 2012, p.6). Such great changes in freight rates, within short periods of time, mainly because freight rates depends on the daily balance of supply and demand of the freight services (Kavussanos & Visvikis, 2006, pp.27). When it comes to the influence caused by vessel size to the freight rates, the larger the vessels are, the higher volatility seems to show than that from the smaller ones. Although smaller vessels operate at higher unit costs, the volatilities of their prices and freight rates are lower when compared to larger ones. The Capesize vessel is the larger type within the dry bulk market, so its low flexibility brings high volatilities.

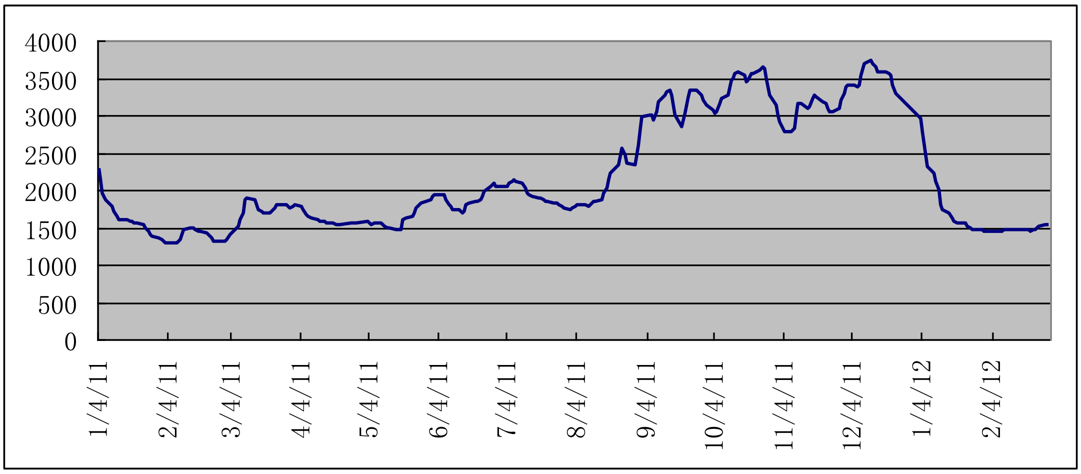


Figure 7 – BCI from Jan 2011 to Feb 2012

Volatility of freight rates are caused by cyclicity, seasonality and random shocks. Usually, for all the sizes of dry bulk carriers, the freight rates increase during the spring and autumn and drop sharply in the summer. Whether we focus on the summer decline or the winter rises, the degree of fluctuation can be eliminated when the duration of the contract increases. The main difference between the spot and time charter is that the voyage costs are not the shipowner's responsibility in t/c contracts. The voyage costs include fuel costs, broking commission, port charges, canal dues, tugs, etc. They are not as predictable as operating costs. Especially, fuel costs form the largest part of voyage costs, and are subject to the highest fluctuations. Thus, the longer the duration of contracts, the lower freight rates risk the shipowners are faced, which can be observed by the Table 2.

Table 2 – Capesize / VLOC Rates

	Spot Earnings ($/pd)				**Trip Rates ($pd)**				**1yr Period ($pd)**	
	RBay -ARA	**Pt Bol -ARA**	**Brz-China**	**WAus-China**	**Sing-Jap/ Australia rv**	**Cont/ Trans-Atlantic rv**	**Cont/-/ FE**	**FE/-/ Cont**	**Cape 150-170,000 dwt**	**VLOC 200,000+ dwt**
3Q10	5,400	23,600	32,800	21,800	23,300	26,100	43,400	10,000	38,200	38,700
4Q10	19,500	33,800	38,900	27,300	29,900	39,300	54,700	16,600	34,800	35,300
1Q11	-1,700	8,200	16,900	6,300	6,200	8,600	20,800	-1,700	18,300	18,800
2Q11	-3,500	7,500	15,600	7,000	7,100	8,000	20,400	-2,300	12,100	14,200
3Q11	-500	16,900	24,200	15,100	15,600	18,900	33,200	2,200	15,000	16,500
4Q11	8,100	23,200	36,200	25,600	12,900	32,800	50,800	18,800	20,000	20,500

Source: Drewry Maritime Research

2.3.2 Ownership Risk

Asset value (including its scrap value) risk is a large part of the fluctuations in the cash-flow for the shipowners. Shipping companies are sensitive to the changes of the ship price, not just because the ship value impacts on the balance sheet, but also because the decline of the price will directly affects the credit line and liquidated ability of shipowners. The large fluctuations in asset values can be observed in Table 3, which shows the price change of second-hand and newbuilding prices in the Capesize sector. We can find that Capesize 170,000 dwt newbuilding vessels were US$ 83.9 million in 2007, whose value one year later was US$97.3 million, then only to fall down to US$52.8 million in 2011.

Table 3 – Asset Value of Capesize / VLOC

	Newbuilding Prices (US $m)		Secondhand Values (US $m)		Scrap Prices ($/ldt)			
	Capesize	VLOC	Capesize	Capesize	India		China	
	170,000 dwt	200,000 dwt	150,000 dwt 10 yrs	170,000 dwt 5 yrs	10-25,000 ldt	25,000 ldt	10-25,000 ldt	25,000 ldt
2007	83.9	87.1	74.6	105.7	445	425	280	250
2008	97.3	101.2	82.3	123.2	510	480	310	280
2009	69.0	71.8	31.8	47.3	275	295	251	257
2010	55.1	63.3	30.9	48.4	491	504	442	452
2011	52.8	60.6	27.9	45.1	487	498	413	427

Source: Drewry Maritime Research

Therefore, it is extremely important to decide the timing of purchasing or selling the vessel. However, the ownership risk can be avoided by vessel leasing or selling and purchasing derivatives.

2.3.3 Other Risks

There are also several kinds of other risks during the operating of Capesize, especially the financial and physical risks.. These risks can be mainly classified into the following categories:

1) Foreign Exchange Rate Risk – as income in international business is in US$ while costs are in domestic currency. Maybe the way to manage exchange rate risk is trying to use the same kind of currency within the trade.
2) Interest Rate Risk - arising from changes in interest rates. Since the shipping companies are capital-intensive industries, this kind of risk will influence the capital charges associated with debt finance. However, it can be evaded by the

use of SWAP.

3) Counterparty Risk – due to the non-performance of counterparties. For shipping companies, most of the trades are negotiated between parties. Despite which kind of trade contract, the both sides are always exposed under the counterparty risks. Accidents and losses – those kinds of risks can be covered by various insurance contracts.
4) Pure Risk – mainly refers to the collision, accident, oil spill risk and so on. Usually, the long sailing distance of the carriage of goods by sea is affected by so many kinds of force majeure and artificial accidents. Typically, the shipping companies against these risks through the purchase of insurance.

Summary

Based on the analysis above, it can be concluded that the risk derived from the fluctuant freight rates is the most critical risk must be managed. There are several strategies for shipowners to evade that risk. For example, dry-docking the vessel in seasons that rates are low; using period contracts in order to reduce risks. However, those strategies are useful but may be proved expensive, non existent or inflexible. Thus, the use of derivatives for risk management in shipping is cheaper, more flexible. Freight Derivatives such as Freight Futures, Forward Freight Agreement and Freight Options have been used to hedge freight risks.

Chapter 3 Analysis and Forecast of BCI Trend

Baltic freight index is a barometer of the international shipping market. It plays an important role for shipping companies and investors to do the decision-making. BDI consists of three kinds of freight index with different vessel types. They are BCI (Capesize), BPI (Panamax) and BHMI (Handymax). BCI consists of 2 China routes – C3 (Tubarao / Beilun and Baoshan) and C5 (W Australia / Beilun – Baoshan), while BPI and BHMI do not have. Chinese steel enterprises mainly use Capesize ship to import iron ore, so the BCI's ups and downs are directly related to the transport costs. Therefore, this article selects BCI to be studied.

BCI is composed of 6 voyage charter routes and 4 time charter routes and calculated by their own weights. Those routes and their weights are shown in the table below.

Table 4 – Composition of BCI

Routes	DWT	Cargo	Description	Weights
C2	160,000	Iron Ore	Tubarao/Rotterdam	10%
C3	150,000	Iron Ore	Tubarao/Beilun and Baoshan	15%
C4	150,000	Coal	Richards Bay/Rotterdam	5%
C5	150,000	Iron Ore	W Australia/Beilun-Baoshan	15%
C7	150,000	Coal	Bolivar/Rotterdam	5%
C8_03	172,000	T/C	Gibraltar/Hamburg trans-Atlantic round voyage	10%
C9_03	172,000	T/C	Continent/Mediterranean trip Far East	5%
C10_03	172,000	T/C	Nopac round voyage	20%
C11_03	172,000	T/C	China/Japan trip Mediterranean/Continent	5%
C12	150,000	Coal	Gladstone/Rotterdam	10%

Source: Clarkson

3.1 Trend Analysis

This paper has selected 96 monthly date of BCI during the period from January 2004 to December 2011 to do the study. The sample data is shown in Table 5. The average value of those data is 5513, and the standard deviation is 3504. Within the 96 monthly data, the maximum is 16808 in May 2008 and the minimum is 1028 in November 2008. BCI is extremely volatile since 2003, which is essentially because of the imbalance between the capacity supply and demand. After 2003, with the increasing in China's iron ore imports and short supply, BCI began to rise and reached 16808 in May 2008. Then, due to the economic crisis, the whole global dry bulk shipping market got a sharp decline.

Table 5 – BCI Monthly Data from Jan 2004 to Dec 2011

	2004	2005	2006	2007	2008	2009	2010	2011
Jan	7599	6054	2976	6226	9669	1776	4041	1653
Feb	7247	6318	3645	6320	9780	3179	3367	1375
Mar	6231	6023	3681	7237	11252	2442	3591	1682
Apr	5325	6347	3346	8363	12066	2206	3286	1608
May	4296	5066	3095	9192	16808	3725	4626	1602
Jun	3911	3078	3389	7616	15815	7226	3793	1876
Jul	5109	2943	3987	8439	13221	5628	1969	1941
Aug	5951	3004	5134	9736	11665	4400	2987	2054
Sep	5565	4000	5347	11833	6741	3232	3609	3128
Oct	5992	4694	5411	14855	2490	4163	4163	3391
Nov	7426	4366	5734	15171	1028	6618	3656	3065
Dec	7649	3490	5872	14634	1172	5296	2711	3516

Source: Clarkson

Within the fluctuation of BCI, there are usually some regularities – long-term trend, seasonality and cyclicity. The analysis for those factors is stated as follow:

1) Long-term trend

Based on the observation of 96 monthly data, the long-term trend of the BCI is rising. However, the random factors also inflected the index sharply at the same time. Those changes are quite irregular, mainly because they are result from some random and unexpected events, such as natural climate, political events, international trade policy, trade structure, exchange rate fluctuations, etc.

2) Seasonality

The international dry bulk shipping market is affected by seasonal factors, except several years, mostly the dry bulk freight drops sharply in the summer and goes high during the spring and the winter. This is mainly caused by the difference of shipping costs and seaworthiness in different seasons, as well as the different seasonal demand for large amount of dry bulk cargos like coal and grain. Although the development of modern technology reduces the effect of climate to the coal and iron ore mining, the effect still exists. So in general, the freight rate increase within the cold and windy winter and decreases in the summer.

The Figure 8 shows the data of the sample by separate year. From the figure, it can be seen that the BCI usually is low during the mid of the whole year and high during the spring and winter.

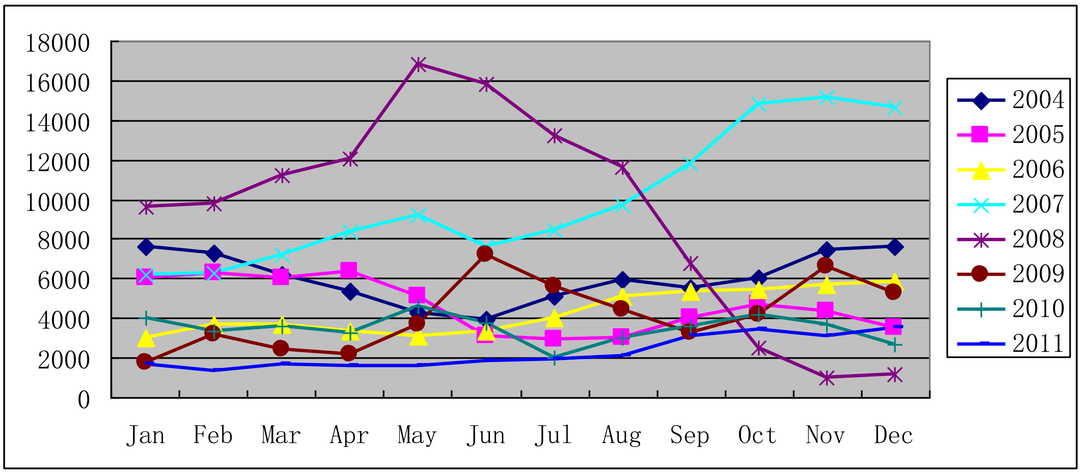


Figure 8 – BCI Trend by Separate Year

3) Cyclicity

The development of world economy has its cyclicity, as well as the supply and demand of shipping market. In tight market, the demand of international dry bulk shipping freight services increases sharply, which incurred the supply of capacity rising correspondingly. While the depressed market comes, the total situation will be opposite. However, the supply change cycle of vessel capacity has a significant time lag compared to the economic cycle. The supply – demand cycle will go round and round, usually the average cycle period is 5-10 years (Ma, 2009, p.2), which can be found through certain half century in the shipping market.

3.2 Data Processing

The data in the Table 5 was initially processed and plotted as a line chart, as shown, the sequence has a significant growth trend, and includes 12 months of seasonal fluctuations.

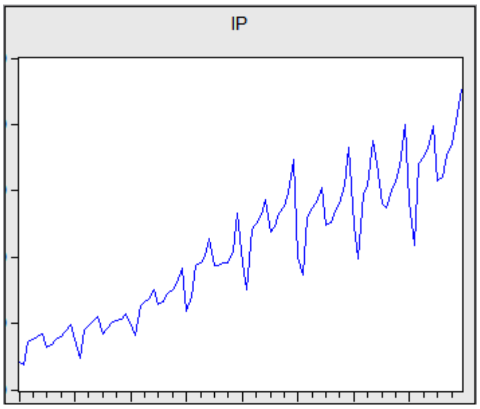


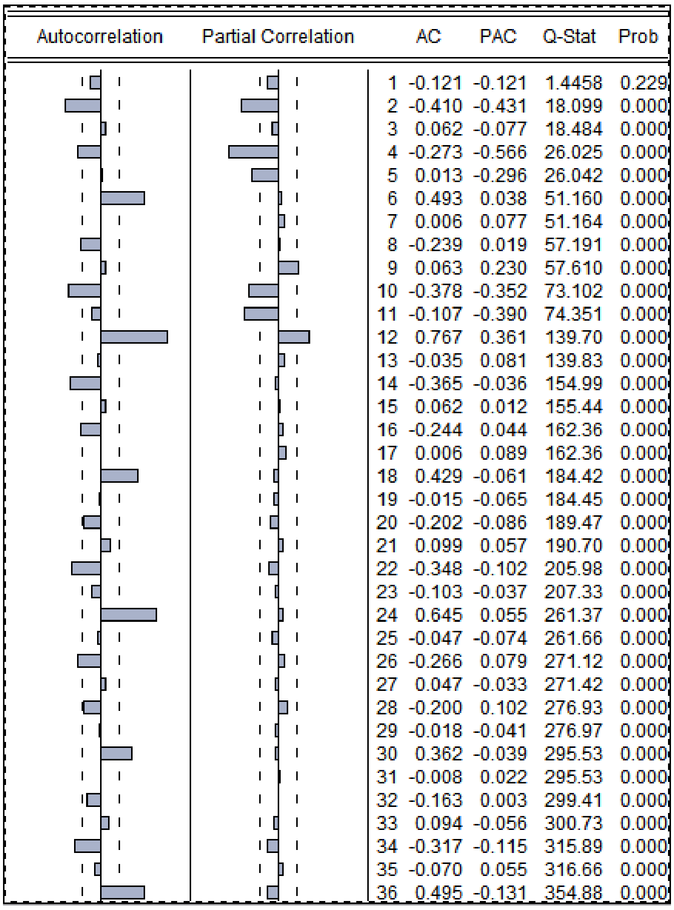
Figure 9 – Line Chart of the Sample

In order to determine whether the sample data has stationarity, it needs to do the stationarity test. Here we use the ADF (Augmented Dicket – Fuller) test. Only stable data can build the model. Through the ADF test, we can find the sequence is not stable as shown in Figure 10.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.874	0.874	75.614	0.000
		2	0.775	0.048	135.70	0.000
		3	0.757	0.299	193.70	0.000
		4	0.733	0.040	248.70	0.000
		5	0.763	0.360	308.93	0.000
		6	0.794	0.145	374.89	0.000
		7	0.712	-0.285	428.45	0.000
		8	0.637	-0.075	471.79	0.000
		9	0.604	-0.081	511.24	0.000
		10	0.565	-0.083	546.19	0.000
		11	0.617	0.315	588.34	0.000
		12	0.671	0.163	638.81	0.000
		13	0.570	-0.365	675.63	0.000
		14	0.480	-0.113	702.04	0.000
		15	0.463	0.106	726.92	0.000
		16	0.440	0.013	749.73	0.000
		17	0.463	-0.060	775.31	0.000
		18	0.485	-0.013	803.72	0.000
		19	0.413	-0.002	824.60	0.000
		20	0.337	-0.104	838.68	0.000
		21	0.309	0.064	850.66	0.000
		22	0.267	-0.087	859.75	0.000
		23	0.301	0.011	871.43	0.000
		24	0.342	0.049	886.74	0.000
		25	0.252	-0.104	895.18	0.000
		26	0.177	0.021	899.39	0.000
		27	0.157	-0.057	902.75	0.000
		28	0.133	0.019	905.21	0.000
		29	0.143	-0.098	908.09	0.000
		30	0.159	-0.019	911.70	0.000
		31	0.098	0.045	913.09	0.000
		32	0.046	0.045	913.40	0.000
		33	0.021	-0.044	913.46	0.000
		34	-0.014	-0.020	913.50	0.000
		35	0.013	0.007	913.52	0.000
		36	0.052	0.052	913.94	0.000

Figure 10 – Autocorrelation of the Original Sample

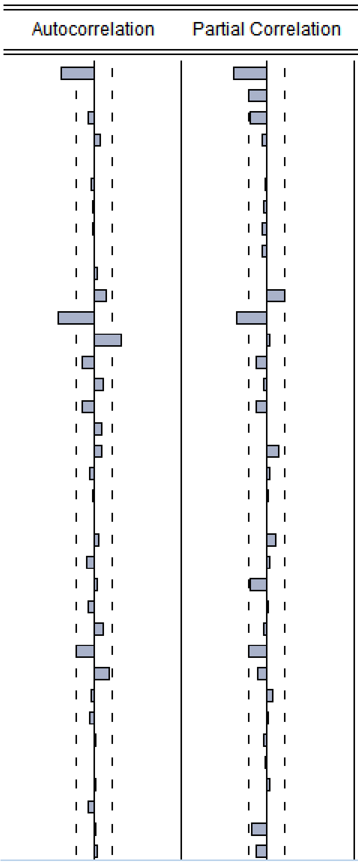
In order to eliminate the trend and reduce the volatility of the sequence at the same time, the first degree natural logarithms difference is done to the time series by period. The sequence after difference is called *ilip* and its Autocorrelation – Partial Autocorrelation is shown in the Figure 11 as follow. From the figure, the autocorrelation function began to be convergence and the trend of the sequence is basically eliminated. But when k = 12, the sample's autocorrelation coefficient and partial correlation coefficient is certainly not equal zero, indicating that the seasonality still exists.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.121	-0.121	1.4458	0.229
		2	-0.410	-0.431	18.099	0.000
		3	0.062	-0.077	18.484	0.000
		4	-0.273	-0.566	26.025	0.000
		5	0.013	-0.296	26.042	0.000
		6	0.493	0.038	51.160	0.000
		7	0.006	0.077	51.164	0.000
		8	-0.239	0.019	57.191	0.000
		9	0.063	0.230	57.610	0.000
		10	-0.378	-0.352	73.102	0.000
		11	-0.107	-0.390	74.351	0.000
		12	0.767	0.361	139.70	0.000
		13	-0.035	0.081	139.83	0.000
		14	-0.365	-0.036	154.99	0.000
		15	0.062	0.012	155.44	0.000
		16	-0.244	0.044	162.36	0.000
		17	0.006	0.089	162.36	0.000
		18	0.429	-0.061	184.42	0.000
		19	-0.015	-0.065	184.45	0.000
		20	-0.202	-0.086	189.47	0.000
		21	0.099	0.057	190.70	0.000
		22	-0.348	-0.102	205.98	0.000
		23	-0.103	-0.037	207.33	0.000
		24	0.645	0.055	261.37	0.000
		25	-0.047	-0.074	261.66	0.000
		26	-0.266	0.079	271.12	0.000
		27	0.047	-0.033	271.42	0.000
		28	-0.200	0.102	276.93	0.000
		29	-0.018	-0.041	276.97	0.000
		30	0.362	-0.039	295.53	0.000
		31	-0.008	0.022	295.53	0.000
		32	-0.163	0.003	299.41	0.000
		33	0.094	-0.056	300.73	0.000
		34	-0.317	-0.115	315.89	0.000
		35	-0.070	0.055	316.66	0.000
		36	0.495	-0.131	354.88	0.000

Figure 11 – Autocorrelation and Partial Autocorrelation of the Sample *ilip*

Therefore, the time sires still needs further processing. Do the seasonal difference to the sequence *ilip* and obtain a new sequence *silip*. Draw autocorrelation - partial autocorrelation analysis diagram in Figure 12. With regards to the figure, we can find both 2 coefficients fall into the interval, so the sequence trend has been basically eliminated. But the value of k = 12 is still higher which means the seasonality is still obvious.



	AC	PAC	Q-Stat	Prob
1	-0.409	-0.409	14.389	0.000
2	-0.004	-0.205	14.390	0.001
3	-0.075	-0.202	14.888	0.002
4	0.078	-0.060	15.430	0.004
5	0.007	0.000	15.435	0.009
6	-0.030	-0.024	15.515	0.017
7	-0.013	-0.030	15.530	0.030
8	-0.017	-0.053	15.559	0.049
9	0.006	-0.050	15.562	0.077
10	0.034	0.007	15.676	0.109
11	0.145	0.215	17.735	0.088
12	-0.440	-0.358	36.965	0.000
13	0.322	0.025	47.408	0.000
14	-0.150	-0.127	49.707	0.000
15	0.104	-0.048	50.833	0.000
16	-0.144	-0.133	53.006	0.000
17	0.098	0.000	54.034	0.000
18	0.090	0.135	54.920	0.000
19	-0.064	0.031	55.376	0.000
20	-0.014	0.010	55.397	0.000
21	0.007	-0.008	55.402	0.000
22	0.061	0.114	55.829	0.000
23	-0.085	0.030	56.677	0.000
24	0.035	-0.196	56.821	0.000
25	-0.072	0.009	57.444	0.000
26	0.111	-0.036	58.968	0.000
27	-0.207	-0.229	64.370	0.000
28	0.183	-0.112	68.657	0.000
29	-0.042	0.066	68.891	0.000
30	-0.050	0.016	69.227	0.000
31	0.024	-0.032	69.303	0.000
32	-0.008	-0.014	69.312	0.000
33	0.017	0.027	69.350	0.000
34	-0.074	-0.006	70.149	0.000
35	0.017	-0.182	70.191	0.000
36	0.037	-0.139	70.393	0.001

Figure 12 – Autocorrelation and Partial Autocorrelation of the Sample *silip*

Do the zero test to the sequence *silip*, we can obtain the mean of the sequence is -0.0020 while the mean error is 0.0037. That means the sequence can be used to establish the ARMA model directly. Through the second degree examination, the seasonality of sequence was not been significantly improved, so the first order seasonal difference is enough.

For test the predict result, the twelve values of year 2011 are chosen to be the observations for evaluating the prediction accuracy. The modeling sample is the period from January 2004 to December 2010.

3.3 ARMA Model Building

Based on the previous data processing, the ARMA model can be established by $d = 1$ and $D = 1$. Here we choose the ARIMA ($p. d. q$) $(P, D, Q)^s$ model. Observe the sequence *silip*'s diagram, as shown in Figure 4, $p = 2$ or $p = 3$ is more appropriate while $q = 1$. After a synthetically consideration, the choices of the combinations (p, q) are: ($3, 1$), ($4, 0$), ($2, 1$) and ($3, 0$). Besides, when $k = 12$, the sample's autocorrelation coefficient and partial correlation coefficient is certainly not equal zero, so $P = Q = 1$. In order to do the direct prediction of the original sequence y conveniently, EViews provides check operators $d(y, n, s) = (1 - B)^n (1 - B^s)$.

Firstly, establish the model ARIMA ($3. 1. 1$) $(1, 1, 1)^{12}$, the model parameter estimates and related test results are shown in Figure 13. Those items need to be compared with the other 3 models.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	-0.036857	0.360552	-0.102224	0.9189
AR(2)	-0.111177	0.200058	-0.555725	0.5804
AR(3)	-0.146734	0.164895	-0.889866	0.3770
SAR(12)	0.071978	0.120728	0.596202	0.5532
MA(1)	-0.460337	0.353437	-1.302457	0.1976
SMA(12)	-0.904183	0.034487	-26.21785	0.0000
R-squared	0.585352	Mean dependent var		-0.000914
Adjusted R-squared	0.551913	S.D. dependent var		0.067569
S.E. of regression	0.045230	Akaike info criterion		-3.269995
Sum squared resid	0.126839	Schwarz criterion		-3.074156
Log likelihood	117.1798	Hannan-Quinn criter.		-3.192397
Durbin-Watson stat	2.034658			
Inverted AR Roots	.80	.70+.40i	.70-.40i	.40+.70i
	.40-.70i	.22-.52i	.22+.52i	.00+.80i
	-.00-.80i	-.40+.70i	-.40-.70i	-.47
	-.70-.40i	-.70+.40i	-.80	
Inverted MA Roots	.99	.86-.50i	.86+.50i	.50-.86i
	.50+.86i	.46	.00+.99i	-.00-.99i
	-.50+.86i	-.50-.86i	-.86+.50i	-.86-.50i
	-.99			

Figure 13 – Model Parameter Estimates and Related Test Results

Figure 14 is a line chart of the model predictions compared with the actual observations, the prediction accuracy MAPE (Mean Absolute Percentage) for this model is 2.37. Do the same processing to build the models ARIMA ($3. 1. 0$) $(1, 1, 1)^{12}$, ARIMA (*2. 1. 1*) $(1, 1, 1)^{12}$ and ARIMA (*4. 1. 0*) $(1, 1, 1)^{12}$. The results show that the fitting effect of ARIMA (*2. 1. 1*) $(1, 1, 1)^{12}$ is not as good as the other three models, so it is not taken in consideration

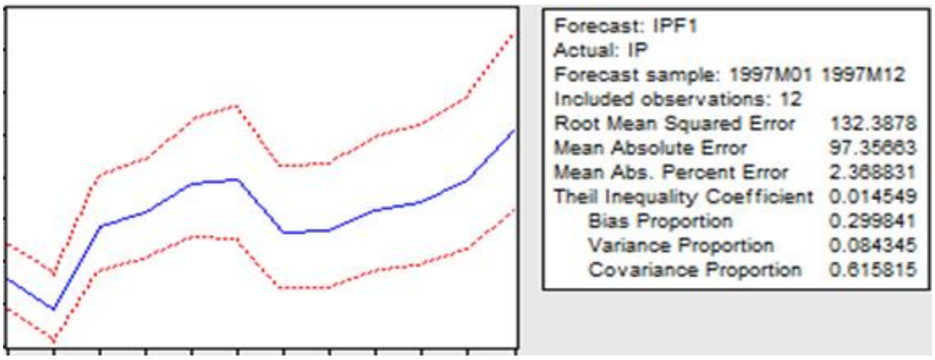


Figure 14 – Model Predictions Compared with the Actual Observations

3.4 Forecast Results

After the calculation, the selected 3 models all set reasonably. Those residual sequence's probability of the white noise test are all larger than 0.98. Compared with the other 2 models, the model ARIMA (*3. 1. 0*) $(1, 1, 1)^{12}$ has the lower AIC and SC values. Based on the comprehensively compare, this paper use the model ARIMA (*3. 1. 0*) $(1, 1, 1)^{12}$ to forecast the BCI monthly indices of the whole year 2012. The forecast results are shown in Table 6.

Table 6 – Forecast Results for 2012

2012.01-06	1206.483	1362.926	1693.718	1540.571	1564.650	1647.034
2012.07-12	1876.016	1939.830	1237.009	1371.510	1679.616	1320.593

Chapter 4

Application of Forward Freight Agreements (FFAs)

Shipping is a derived demand from the international trade, which is always influenced by various kinds of international affairs. In order to evade the fluctuated freight rates, the shipping freight derivatives came into being. Baltic freight index futures (BIFFEX), freight forward agreements (FFA) and freight options have appeared one by one. Once BIFFEX is popular within the shipping market, but due to its low efficiency and liquidity for hedging, BIFFEX eventually exited the market in 2002. Nowadays, it is commonly to use FFAs and Freight Options.

FFA refers to that both the buyer and the seller agree to set a long-term freight agreement related to a specific ship type and route. The agreement also provides a specified quantity and quality of a cargo at a certain price and a specified future date. The two sides agreed at a future point in time, received or paid the freight difference between the contract price and the official freight rates index of Baltic Shipping Exchange. There are 24 routes for the dry bulk FFA trading. The main method to trade FFAs is a directly transaction by client – client, also known as OTC.

4.1 Characteristics of FFAs

The FFA is “derivative" to the underlying freight services, as although the specified freight services of the agreement may be not provided or bought in the actual, the difference between the market price and contract price determine whether the contracts holders earn or loss. Besides, FFA contracts are not standardized. Those terms that related to the size of contract, such as expiration time and settlement price, are available to be negotiated by 2 sides.

In essence, FFA is a tool of freight risk management. Usually, there are 4 kinds of FFA market participants: shipowners, traders, manufacturers and financial companies. Those 4 participants are playing 3 roles – hedger, speculator or arbitrageur. This paper is focusing on the role of hedgers, who are interested in reducing a price risk by either transferring it to another hedger with an opposite position in the market, or to a party who willing to accept and trade the risk (Kavussanos and Visvikis, 2006, p.82).

FFA can fully demonstrate its advantages in the tramp shipping market:

1) Foresight – in fact, FFA is one kind of financial investment activities, its price can reflect the prediction of supply and demand in the shipping market.

2) Flexibility – FFA can be traded freely and repeatedly. It is free to change the market position according to the needs of traders.

3) Security – FFA do a grate help to diversify freight risk and compliance responsibilities.

4) Globalism – as one kind of financial investment activity, the FFA transaction is not limited by region.

Although forward contracts have those advantages, there still have risks. The contract involves a settlement which means the net cash must outflow from one counterparty and inflow to the opponents. So, this may be incurred credit risk that the loss party does not fulfill its obligations. In order to solve this potential problem, the cleaning – house is used to clear the FFAs.

4.2 Market Positions with Forward Contracts

FFAs are used to protect the increasing (decreasing) market price for the participants. The strategy of using FFA to hedge is to buy (sell) future contracts of a considerable quantity of that in the spot market, but with the opposite direction so as to sell (buy) the future contracts sometime in the future to compensate for the actural price risk broght by the changing price in the spot market

In general, the main market positions of derivatives products are long (buy derivatives) and short (sell derivatives):

1) Long – forwards contracts can be used to protect against the loss arising from a price increase of a "commodity", that means this participant need to buy the commodity in the future.
2) Short – forwards contracts also can be used to protect against the loss from a decline of the “commodity” price. This kind of market position usually belongs to the commodity owners. Within the shipping industry, the trade “commodity” is the freight services. Thus, the shipowners often choose to sell the futures.

4.3 Hedging Strategies of the Shipowner with Forward Contracts

Due to the most thing concerned by shipowners is the possibility of the freight rates decreasing. Therefore, the shipowners’ position in Forward Contracts is usually long in the spot and short in futures. Assume that a shipowner is worried about the freight rates may reduce in the future, he decided to lock the current price by hedging in the FFA market. He can sell the FFA contracts at the high price now and buy them back at the low price in the futures. The difference between the two prices will offset his losses from the spot market. If the freight rates increase actually, the situation is with the order reversed – the income from tangible market will offset the loss from the paper market.

To illustrate the hedging strategies of shipowner, here we give an example of Capesize voyage charter. Assume that in early May 2006, a shippnwer will have a vessel (160,000 dwt) open in Tubarao for a trip to Rotterdam at the end of August. The shipowner decided to sell an August 2006 BCI Route 2 (Tubarao / Rotterdam) FFA contract at the current price.

The freight rate of C2 was $ 52.78 / ton on May 13th 2008. The shipowner and the contract buyer agree a cargo size of 160,000 tons at the price on $ 53 / ton. The settlement price is the average of the C2, for 7 business days prior to and including the settlement date – Aug 26th 2008.

Aug 26th 2008, the rate of C2 fell to $ 35.72 / ton. The shipowners lost freight revenue $ 2,729,600 (= $ 52.78 / ton * 160,000 tons - $ 35.72 / ton * 160,000 tons). In the forward market, the settlement price is $ 35, so the shipowner gained $ 2,880,000 (= $ 53 / ton * 160,000 tons - $ 35 / ton * 160,000 tons). The overall net gian for shipowner was $ 150,400, reaching the hedging purposes. In addition, the owner must pay to the broker 0.25% commission of $ 7200. The payoffs are shown in the Figure 15 (Blue solid line – Short Futures; Pink dotted line – Long Spot Position).

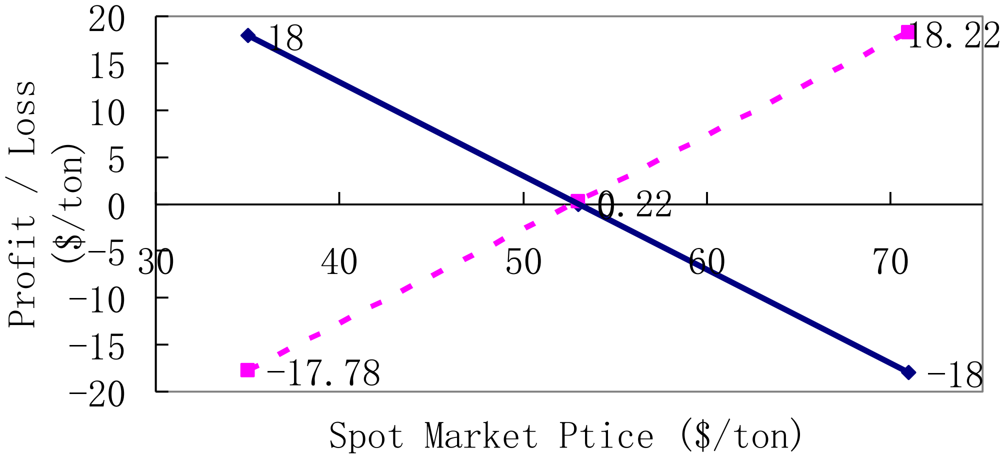


Figure 15 – Short Futures Payoffs

Chapter 5 Application of Freight Options Contracts

The freight option is a kind of option which its holder has the right to buy or sell a certain number of subject matter at agreed price up until or on the specified date. The option contract gives the right, but not the obligation. The price to get this right is paid by the option buyer to the option writer as a premium. The freight option is a combination of options and freight market, which makes the right of forward freight as the trading commodity.

5.1 Options Contracts Payoffs

There are two categories of options – Call option and Put option. Both of them have two sides - the buyer is the option holder while the seller is the option writer.

The call option gives its holder the right to purchase a certain amount of an underlying commodity at a certain price and certain date in the future. Suppose *St* is the spot price of the underlying commodity at time *t*, *X* is strike price and *c* is the premium of the call option. The payoff for the call option holder is calculated by [Max (*St* – *X, 0*) – *c*], while [- Max (*St* – *X*, *0*) + *c*] is for the option seller writer. Let *X* = $45 and *c* = $10, the payoffs of call option are shown in Figure 16 (the blue solid line shows the payoffs of call holder; the pink dotted line shows the payoffs of call writer). Observed by the Figure 16, when *St* > $45, the option is exercised. The holder's profit (= *St* - $55 - $10) is paid by the option writer. When the *St* < $45, the holder will not exercise the option and he will lost the premium $10, which is the writer's profit.

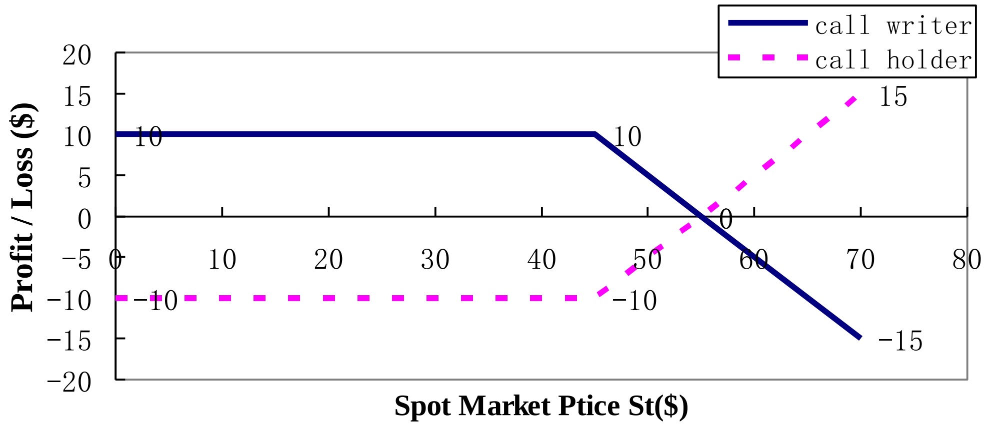


Figure 16 – Call Option Payoffs

On the other hand, the put option gives its holder the right to sell the related commodity at its exercise price. The function of the put option holder's profit, including the put option premium p, is [- Max (*X* – *St, 0*) - *p*] while it is calculated as [- Max (*X* – *St, 0*) + *p*] for the put option writer. In the same way, let the *X* = $45 and the *p* = $10, the put option payoffs are shown in Figure 17 (the blue solid line shows the payoffs of put writer; the pink dotted line shows the payoffs of put holder). If the *St* < $45, the holder will exercise the option and gain the profit (= $45 - *St* - $10) that paid by the writer. When the spot price is bigger than $55, the option will not be exercised and the writer can gain the profit of premium.

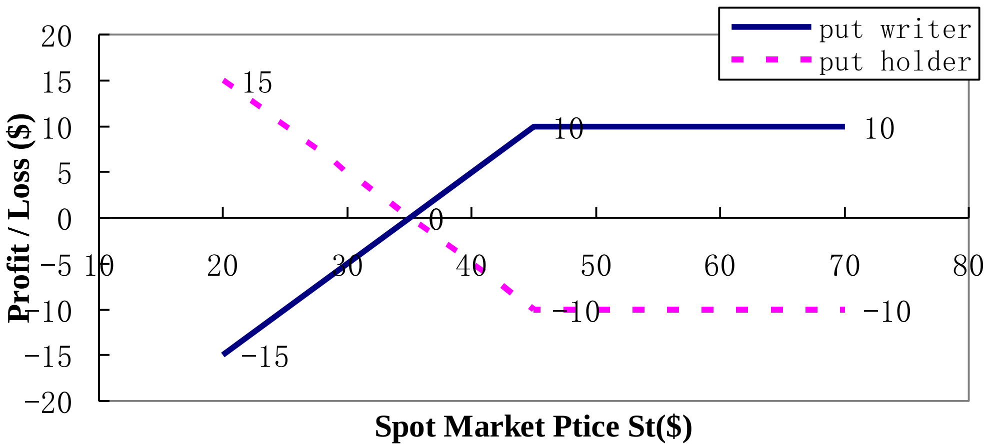


Figure 17 – Put Option Payoffs

Based on those two figures, we can clearly find that this game is a zero-sum, which means the seller's gain (loss) is the buyer's loss (gain) – the summary of the payoffs is zero.

5.2 Options Strategies of the Shipowner for Freight Hedging

The shipowners are the party wish to sell their freight services in the future. Thus they usually use derivatives to protect against the potential price decreasing. There are two ways of using option to hedge: Long put – buying a protective put; and Short call – buying a coverd call. Here we illustrate the strategy of Long put in detailed.

Long put is hedging the long positions in physical markets. Assume that a shipowner predicts a lower future freight rates compared to today's rate $45 / ton. In order to hedge against the freight risk and earn profit from the possibility of price increasing synchronously, he decide to by a put option exercised two months later at the strike price $45 / ton.

Two months later, if the spot price (the green solid thin line – Long Physical) falls below the exercise price $45, the shipowner has a loss in the physical market but the put option is exercised. The payoff (the pink dotted line – payoff of the Long Put option) is $45 – *St*, so the shipowner just makes a total loss of the option premium (shown by the left part of the blue solid heavy line). If the spot price increases to a higher level than $45, the option is not exercised and the shipowner make a profit in physical market. The total freight income at this situation is reflected by the right part of the blue solid heavy line in Figure 18.

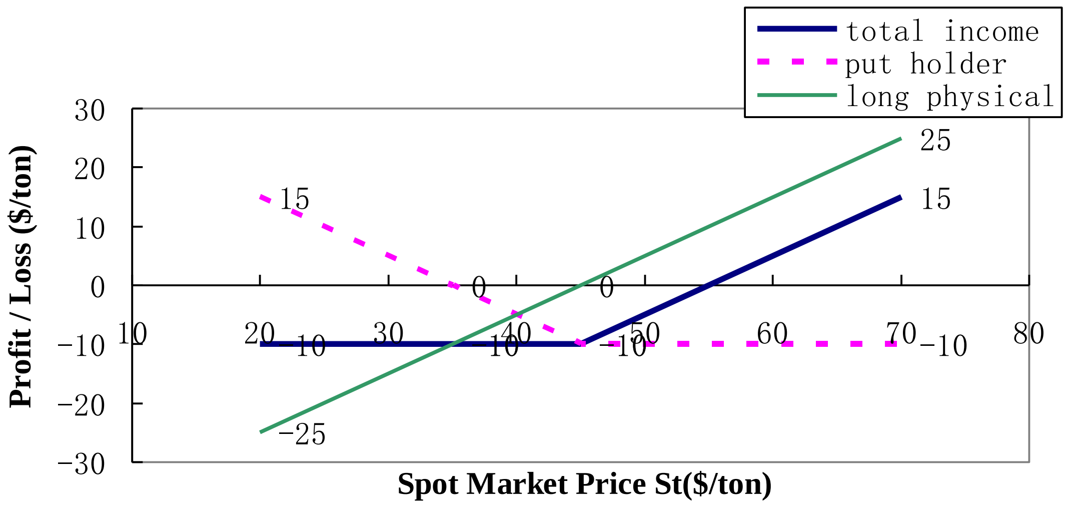


Figure 18 – The Hedging Position of the Shipowner

5.3 Hedging with Options vs. Hedging with FFAs

Combined with FFAs and Freight Options, there are three choices for the shipowners to hedge against the freight rates decline by using freight derivatives. Based on the Figure 19, there is going to demonstrate the difference between hedging with FFAs and Freight Options:

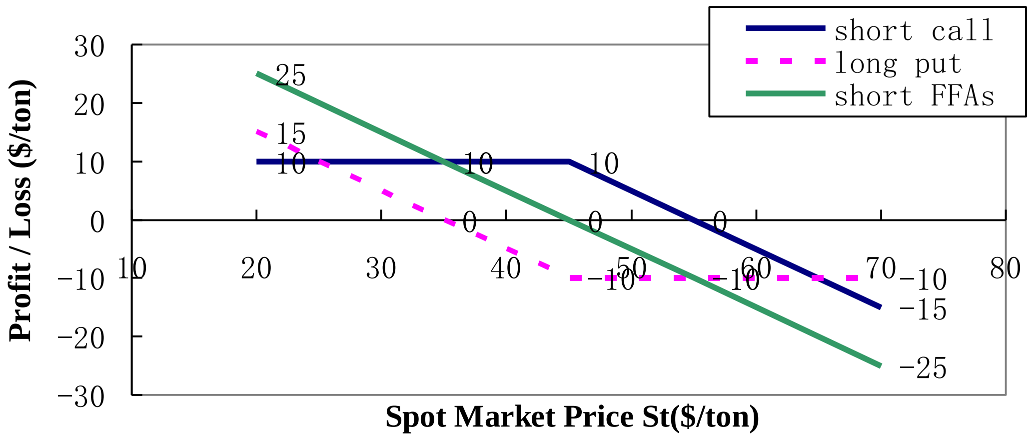


Figure 19 – The Hedging Position: Options vs. FFAs

1) Short FFAs (green solid line)

As shown in the green solid line in Figure 19, the FFA contracts have both unlimited potential profit and loss. Thus the FFAs can minimize the risk of price fluctuation, its profit /loss only depends on the difference between spot price and contract price.

2) Long Put (pink dotted line)

If the shipowner is looking forward to a unlimited potential profit but a limited potential loss, buying the Put Freight Option is a good idea. Because of the right to not exercise the option, the shipowner's loss is protected by the premium. Compared with the options, the FFA costs noting initially, so its potential loss also can not be limited by such insurance.

3) Short Call (blue solid line)

As shown in the figure, writing a call option, which will have a limited gain equal to the premium of the option if the freight rates go down. On the contrary, if the spot prices increase, the shipowner who wrote the call option will suffer an unlimited loss. That seems not beneficial to the shipowner. Use the example again, suppose the exercise price *X* is $45 / ton and the premium p of the option is $10, then the payoffs of both kinds of options are shown in the Table 7. The conclusion we can make from the data that when the spot price is change within the range from *X-2p* to *X+2p*, the total freight income of short call is better than its of long put. That means if the shipowner forecast the freight rates will change within this range, he should choose the Short Call Options to lock a profit of the premium.

Table 7 – The Payoffs: Short Call vs. Short Put

The Exercise Price X = $45 / ton; The Premium p = $10 / ton											
Spot Price ($/ton)	20	25	30	35	40	45	50	55	60	65	70
Physical Market ($/ton)	-25	-20	-15	-10	-5	0	5	10	15	20	25
Short Call ($/ton)	10	10	10	10	10	10	5	0	-5	-10	-15
Total Income (Short Call) ($/ton)	-15	-10	-5	0	5	10	10	10	10	10	10
Long Put ($/ton)	15	10	5	0	-5	-10	-10	-10	-10	-10	-10
Total Income (Long Put) ($/ton)	-10	-10	-10	-10	-10	-10	-5	0	5	10	15

Chapter 6

Risk-averse Strategy for Capesize's Shipowners

6.1 Brief Introduction of R Company and its Capesize

Rosco Ocean Shipping Co., Ltd. was established in October 2009, which mainly engages in international dry bulk cargo transportation and is a wholly-owned subsidiary of Sanhe Hopeful Grain & Oil Group. Currently Rosco has a fleet of eleven bulk carriers most of which are Panamax vessels, with a total capacity of nearly 1 million tons deadweight. The average age of the fleet is 3.7 years. Meanwhile Rosco has sea routes covering more than one thousand ports in over one hundred countries and regions all around the world and transports goods including iron ore, coal, grain, etc. In the first half of 2013, the scale of the fleet is expected to reach seventeen bulk carriers, with a capacity of nearly 1.5 million tons.

There is a 2-year-old Capesize – Rocso Maple within the Rocso's fleet. The basic information of the vessel is shown in the Table 8. Since the Rosco Maple put into operation in 2010, the mainly contract type of this Capesize is the short – term time charter. Rosco Maple is used to transport the coal and iron ore, especially the iron ore transportation. The past two years, Rosco Maple has navigated through many main iron ore routes, such as Indonesia - China, Australia – China and South America - Far East.

Table 8 – Vessel Information

Name	Rosco Maple
Year	2010
Flag	Hong Kong
Dead Weight	181,383
Operational Speed	16 Knots (Ballast); 14.6 Knots (Loaded)

Source: Internal Data

6.2 The Short – term Strategy

The status quo of today's shipping market is not optimistic. The whole international shipping market began to go depressed since the end of last year. The year 2012 is certainly a tough year for R company to operate its Capesize vessel carefully. Up to now, the Rosco Maple finished its first voyage from Hedland (Australian Port) to China for iron ore transportation. Now it is under the voyage from Peru to China, also for iron ore shipment.

Combined with the forecast result in Chapter Three (Figure 20) and the actual four-month BCI data in 2012 (Figure 21), we can find the level of Capesize price is quite low and decrease sharply at the beginning of 2012. When during the period from Feb to May, the index maintained a quite stable level around 1500. Usually the freight rates of dry bulk go down in the summer. But since the recent several years are not the common times. According to the Drewry's freight forecast (Table 9) and the ARMA model result, there is a high probability that the freight rates of Capesize will increase during this special summer. Due to those complex conditions, here gives several strategies below for short-term risk management.

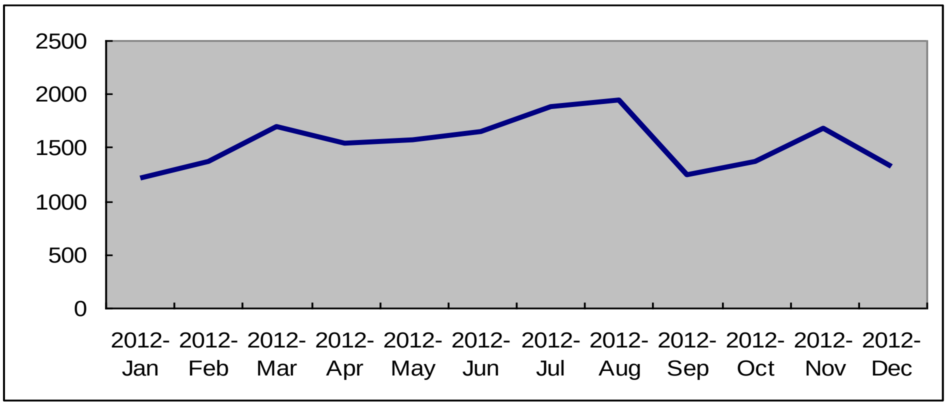


Figure 20 – The Forecast Results of ARMA Model

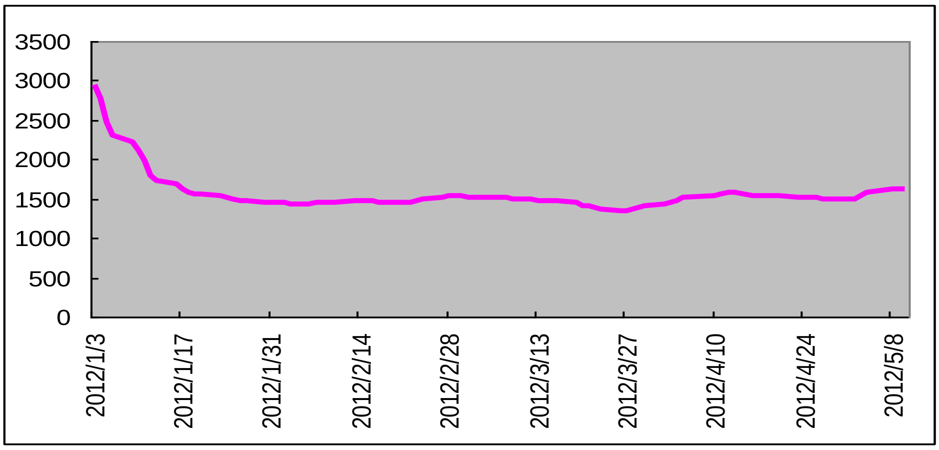


Figure 21 – BCI Daily Data from Jan 2012 to Apr 2012

Table 9 – The Forecast of Capesize / VLOC Quaterly Rates

	Spot Earnings ($/pd)				**Trip Rates ($pd)**				**1yr Period ($pd)**	
	RBay -ARA	**Pt Bol -ARA**	**Brz-China**	**W Aus-China**	**Sing-Jap/ Australia rv**	**Cont/ Trans-Atlantic rv**	**Cont/-/ FE**	**FE/-/ Cont**	**Cape 150-170,000 dwt**	**VLOC 200,000+ dwt**
1Q12	9,000	15,000	19,000	17,000	13,000	18,000	20,000	14,000	17,000	17,400
2Q12	15,000	16,000	20,000	18,000	14,000	19,000	20,500	15,000	17,500	17,900
3Q12	17,000	17,500	20,400	18,400	16,000	19,400	21,000	16,500	17,900	18,300
4Q12	18,500	19,000	20,800	19,500	18,600	20,000	21,000	18,800	18,200	18,700
1Q13	18,900	19,400	21,200	19,900	19,000	20,400	21,400	19,200	18,600	19,000
2Q13	19,200	19,800	21,600	20,300	19,400	20,800	22,000	19,600	19,000	19,400

Source: Drewry Maritime Research

1) Jan 2012 – March 2012

The 1st voyage of Hedland – China started at Jan 16th and finished at Mar 15th. The freight rate was $ 8.9 / ton, which was agreed several days before the beginning of voyage. As mentioned above, the dry bulk freight started to decrease sharply at the ending of the year 2011. For this voyage charter, the ideal way to hedge against the drop of rate is to sell a December 2011 BCI Route 5 (W Australia / Beilun – Baoshan, iron ore, 150,000 dwt) FFA at the freight level round $13[1]. Since the average C5 freight rate of 7 business days prior to and including Jan 16th is $8.5[2], the payoff $675,000 (= 13 * 150,000 – 8.5 * 150,000) can make up the loss from rate decreasing.

2) March 2012 – June 2012

The 2nd voyage (Peru to China, iron ore) Rosco Maple has is similar to the BCI Route 3 (Tubarao/Beilun and Baoshan), but based on the analysis before, the freight level seems to quite stable. If the R company was afraid that the change of the freight level on this route, to write a call freight rates might be a good choice. Maybe the range of freight fluctuation could be setted at $15-25[3]. As long as the rate change within this range, the shipowner can earn the premium of the call option.

3) The Second Half of 2012

Considered that it is quite difficult to predict the real trend of Capesize rates in this summer, the safe strategy is to look forward a 3 - month or 6 - month time charter contracts and use a Long Put freight options to hedge against the freight fluctuation at the same times. The short period time charter can maintain a stable income during the rest of the year while the Long put options can provide an unlimited profit if the freight rates increase as the forecast. If the freight rates follow the common seasonal

[1] The average value of C5 in Dec 2011 was $12.65.

[2] 6-Jan-12: $9.58; 9-Jan-12: $9.32; 10-Jan-12: $ 8.92; 11-Jan-12: $8.63; 12-Jan-12: $7.85; 13-Jan-12: $7.72; 16-Jan-12: $7.68.

[3] The average value of C3: Jan 2012 - $21.14; Feb 2012 - $19.81; Mar 2012 - $20.05.

regularity that decrease in summer, the option can also use to limit company's loss by the premium.

6.3 The Long – term Strategy

The global shipping market has its cyclicity, According to the Stopford's (2003, pp.42-68) summary, the average cycle of about 5 – 10 years can be found through certain half century in the shipping market. Now the whole market is suffering the process from the stage of "collapse" to "trough". Based on the yearly freight level forecast from Drewry (Table 10), the rates will be still depressed in the next one or two years.

Table 10 – The Forecast of Capesize / VLOC Yearly Rates

	Spot Earnings ($/pd)				Trip Rates ($pd)				1yr Period ($pd)	
	RBay -ARA	**Pt Bol -ARA**	**Brz-China**	**W Aus-China**	**Sing-Jap/ Australia rv**	**Cont/ Trans-Atlantic rv**	**Cont/-/ FE**	**FE/-/ Cont**	**Cape 150-170,000 dwt**	**VLOC 200,000+ dwt**
2011	600	13,950	23,225	13,500	10,450	17,075	31,300	4,250	16,350	17,500
2012	14,875	16,875	20,050	18,225	15,400	19,100	20,625	16,075	17,650	18,075
2013	19,400	20,000	21,900	20,500	19,500	21,000	22,200	19,800	19,100	19,600
2014	21,200	21,800	23,800	22,300	21,300	22,900	24,200	21,500	20,900	21,400
2015	23,100	23,700	26,000	24,300	23,200	25,000	26,400	23,500	22,700	23,300
2016	25,200	25,900	28,300	26,500	25,300	27,200	28,700	25,600	24,800	25,400

Source: Drewry Maritime Research

As we all known, the volatility is lower with the duration of contract rises. In Mar 2012, there was a charterer who wanted to charter the Rosco Maple with a 2-year time charter at the freight rate $16750 / day. Due to the whole Capesize sector in March was much complicated, the business did not come to a deal. However, if there is a long-term time charter contract at the rate round $20000 / day and the date of redelivery is set to 2014, it is obviously considerable to make a deal. Then, when the

Capesize sector begins to recover in 2014, the R company can go on to choose voyage contracts to operate the Rosco Maple.

6.4 The Potential Problems and Countermeasures of Freight Derivatives

Although select the freight derivatives to do the freight rates risk aversion is the first choice for shipping companies, the use of freight derivatives also has its potential risks and problems.

First of all, the freight derivatives have a high level of hedging effectiveness, but sometimes, it maybe not able to make a deal, especially under a downturn market. The freight derivative trading is based on the contrary forecast trend of the future by both sides. There is possible that when most of participants have the similar prediction for a specific route of a specific cargo within one period of times, it is quite difficult for the shipowner to find a counter party who is willing to undertake the risk at this specific time.

In the meantime, because of the character of OTC, the credit risk from the trading parties exists all the times. This kind of risk is generally reflected on the situation that one of two sides does not fulfill the commitment which leads to the losses for another party, or the settlement risk caused by one party’s unavailability of paying on time. However, whether it is the paper market or not, as long as the transaction exists, the credit risk has always existed. This requires shipping companies involved choose reliable counterparties with strength and credibility. For Rosco company, those iron ore importers who have large amounts and long-term demand of iron ore import are good choice to hedge with, eg. Baosteel.

Since speaking to the counterparty credit risk of non-compliance may lead participants to suffer financial loss, the financial risks incurred by the freight derivatives have to be noticed, too. Although just a small number of Chinese shipping companies involved in derivatives trading, but those number of cases that suffered huge losses are not low. Those financial losses are often due to the excessive speculation. Derivative trading needs the market participants to ensure a flexible and stable cash flow, which is a financial burden for many middle size shipowners. Moreover, the route of the actual operation of the spot market is far more than the freight derivatives trading routes available. Not every single actual route of specific ship and cargo could find a matching option to hedge. The various kinds of factors affect the the final hedging result.

In summary, the critical key to use the freight derivatives to manage freight rates risks accurately is to certain the initial goal of hedging clearly. The shipowners must maintain the correct track not to go the speculative way, and at the same time, apply the theory of optimal hedge ratios in order to avoid blindly input. The theory of optimal hedge ratios is based on the correlation analysis between the actual spot price and future price. The optimal hedge ratio h^* is expressed by the function below, σ_S means the standard deviation of spot price change; σ_F means the standard deviation of futures price change; and ρ_{SF} means the correlation coefficient between two kinds of prices' change. The shipowners should use this function to hedge the actual exposure risks.

$$h^* = \rho_{SF} \frac{\sigma_S}{\sigma_F}$$

Chapter 7 Conclusion

Recently, the "China factor" has a very huge impact on the international dry bulk shipping market. On the other hand, due to the lacking the awareness of risk management, only few Chinese enterprises participate in the forward freight market. Contrast to the large share of trade in the spot market, the influence of Chinese shipping companies in paper market is very limited. Most of Chinese trade enterprises and shipping companies are the price takers of the freight rates. It is essential for Chinese shipping companies to understand the rules of the forward freight market and be able to use them effectively in today's international shipping market. That is the right way to avoid risks by using the trade in paper market and increase the companies' competitiveness synchronously.

In addition, Chinese shipping derivatives are being developed. In the first half of 2012, Shanghai Shipping Exchange will publish the international dry bulk freight index, which means the Chinese dry bulk shipowners can trade their shipping derivatives domestically in the near future. Therefore, domestic shipowners should learn to use the freight derivatives in the risk management as soon as possible.

List of Bibliography

Batchelor, R. et. al. (2007). Forecasting spot and forward prices in the international freight market. *International Journal of Forecasting, 23*(2007), 101-114.

Cariou, P. (2011). *Finance & Investment Appraisal*. Unpublished lecture handout, World Maritime University, Malmo, Sweden.

Chou, M. T. and Huang, B. C. (2010). An analysis of the relationship between forward freight agreements and steel price index: An application of the vector ARMA model. *African Journal of Business Management, 4*(6): 1149-1154.

Clarkson Research Services Ltd. (2011). *Dry bulk trade outlook, December 2011*. London: Author.

Cullinane, K. (1992). A short-term adoptive forecasting model for BIFFEX speculation: A Box-Jenkins approach. *Maritime Policy & Management, 1992*(2): 91-114.

Drewry Maritime Research. (2011). *Dry bulk forecaster 3Q11*. London: Author.

Drewry Maritime Research. (2012). *Dry bulk forecaster 4Q11*. London: Author.

Drewry Maritime Research. (2012). *Dry bulk insight 2012-01*. London: Author.

Drewry Maritime Research. (2012). *Dry bulk insight 2012-02*. London: Author.

Drewry Maritime Research. (2012). *Dry bulk insight 2012-03*. London: Author.

Duan, G. D. (2007). Risk management in dry bulk market and the freight derivatives of FFA. *Chinese Shipping*, 2007(1), 38-39.

Dong, X. Y. (2011). *Research on the management method of operation risk in S shipping company*. Unpublished master's thesis, Hefei University of Technology, Hefei, China.

Du, Z. X. et. al. (2009). Forecasting model of Baltic dry index and its application. *Journal of DMU, 2009*(8): 77-80.

Engle, R. E. (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of UK inflation. *Econometrica*, *50*.

Hawdon. (1978). Tanker freight rates in the short and the long run. *Applied Economics*, *9*:21-25.

Jiang, L. (2010). *Prediction of the Baltic Capesize Index*. Unpublished master's thesis, Dalian Maritime University, Dalian, China.

Kavussanos, M. G. (1996). Comparisons of Volatility in the dry-cargo ship sector: Spot versus time charters, and smaller versus larger vessels. *Journal of Transport Economics and Policy, 1996*(1), 67-82.

Kavussanos, M. G. (2011). *Business Risks in the Shipping Industry & Risk Management Strategies*. Unpublished lecture handout, World Maritime University, Malmo, Sweden.

Kavussanos, M. G. and Nomikos, N. K. (2003). *Price Discovery, Causality and Forecasting in the Freight Futures Market*. London: City University Business School.

Kavussanos, M. G. and Visvikis, I. D. (2006). *Derivatives and risk management in shipping*. United Kingdom: Witherby Seamanship International.

Kavussans, M.G. and Visvikis, I.D. (2006). Shipping freight derivatives: a survey of recent evidence. *Maritime Policy & Management*, 33(3), 233-255.

Koekebakkera, S. et. al. (2006). Pricing Freight Rate Options. *Transportation Research, 2006* (3).

Li, J. (2009). *Pricing and applications of FFA in dry bulk shipping market*. Unpublished master's thesis, Shanghai Jiaotong University, Shanghai, China.

Li, W. (2011). *The application of shipping derivatives in avoiding freight risks of shipping company*. Unpublished master's thesis, Dalian Maritime University, Dalian, China.

Liu, C. J. (2011). The challenges and coping strategies of Chinese dry bulk shipping market from the Vale's 40DWT VLOCs. *Shipping Managemen*t*, 33*(10), 7-9.

Liu, J. and Lu C. X. (2008). The analysis of prediction model of BDI. *Marine Technology, 2008*(5), 18-22.

Liu, J. Q. (2001). The market forecast of Capesize vessel. *World Shipping, 24*(1), 13-14.

Lv, J. and Chen, Q. H. (2003). The law of fluctuations of the shipping freight rates. *Journal of DMU, 2003*(2): 1-4.

Prokopczuk, Marcel. (2010). *Pricing and hedging in the freight futures market*. United Kingdom: International Capital Market Association.

Ma, S. (2009). The cycle theory of shipping market and the changes in current dry bulk market. *Shipping Management, 31*(11): 1-5.

Ma, S. (2011). *Maritime Economy*. Unpublished lecture handout, World Maritime University, Malmo, Sweden.

McDonald, R. L. (2009). *Fundamentals of Derivatives Markets*: 27-34.

Nelson, D. B. (1990). ARCH models as diffusion approximations. *Journal of Econometrics,45*: 7-38.

Prokopczuk, M. (2010). *Pricing and Hedging in the Freight Futures Market*. ICMA Centre, University of Reading.

Qian, Z. R. (1999). The way to evade risks for shipping companies. *Chinese Shipping, 1999*(9).

She, Z. (2011). *The Research of Dry Bulk Companies Capacity Expansion and Operating Risk*. Unpublished master's thesis, Shanghai Maritime University, Shanghai, China.

Stopford, M. (2003). *Maritime Economics*, (2nd ed.). London: Taylor & Francis Group.

The Wikipedia web site gives information on Autoregressive-moving-average model (http://en.wikipedia.org/wiki/Autoregressive%E2%80%93moving-average_model)

Veenstra, A. W. and Franses, P. H. (1997). A co-integration approach to forecasting freight rates in the dry bulk shipping sector. T*ransportation Research, 31*(6): 447-458.

Wang, J. (2011). The development way of Chinese shipping financial derivatives product. *Shipping Managemen*t, 33(10), 31-33.

Wu, F. (2009). Application of shipping freight derivatives to evade risk under the financial crisis. *Pearl River Water Transport*, 2009(10), 72-75.

Yu, G. Y. and Zhu, Y. Q. (2009). Literature review of the research on forward freight agreements (FFA). *China Market*, 2009(15), 99-111.

Yu, J. (2010). *The assessment and risk aversion research of dry bulk freight volatility*. Unpublished master's thesis, Dalian Maritime University, Dalian, China.

Zeng, Z. S. (1999). The risks in the operation of international shipping enterprises. *Shipping Managemen*t.

Zhang, J. et. al. (2006). The application of FFA for risk management in shipping market. *World Shipping*, 29(5), 36-37.

Zhang, L. (2003). Analysis and countermeasures of international dry bulk market. *Port Economy*, *2003*, 13~14.

Zhang, M. Q. and Zhang, Y. F. (2010). World shipping market forecast and counter measures. *World Shipping, 2010, 33*(1), 44-46.

Zhang, M. X. et. al. (2006). Analysis and Forecast 0f World Iron Ore Shipping Market. *Metal Mine, 2006*(11), 12-16.

Zhao, H. Y. (2010). *The application of FFA for Evading Risk in the Dry Bulk Shipping market*. Unpublished master's thesis, Dalian Maritime University, Dalian, China.

Zhao, Y. J. and Sha, M. (2007). The application of FFA to reduce the market risk of iron ore transport. *Shipping Managemen*t, 29(12), 10-11,15.

Zhou, Y. O. (2011). The application of shipping freight derivatives FFA in the enterprises. *China Water Transport*, 2011(6), 18.

Zhou, Y. O. (2011). The application of shipping freight derivatives FFA in the enterprises. *China Water Transport*, 2011(6), 18.

Zhu, J. and Le, M. L. (2007) The time series modeling of BDI. *China Water Transport, 7*(8), 12-13.