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**WORLD MARITIME UNIVERSITY**

Shanghai, China



**EMPIRICAL ANALYSIS ON THE EFFECT OF  
THE FORWARD FREIGHT AGREEMENT IN  
DRY BULK BASED ON ROUTE C3 AND C5**

By

**LI GANG**

**China**

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

**MASTER OF SCIENCE**

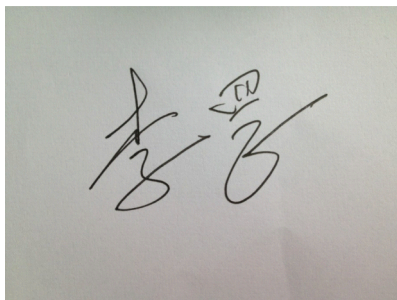
**ITL**

2012

## **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.

A photograph of a handwritten signature in black ink on a light-colored surface. The signature consists of two Chinese characters, '李' (Li) and '旭' (Xu), written in a cursive style.

2012-06-09

### **Supervised by**

Professor Xu Dazhen  
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## Abstracts

Title of Research Paper: **EMPIRICAL ANALYSIS ON THE EFFECT OF THE FORWARD FREIGHT AGREEMENT IN DRY BULK BASED ON ROUTE C3 AND C5**

Degree: **MSc**

The fluctuation of freight in dry bulk shipping brings a serious risk for all participator in dry bulk shipping industry. After the financial crisis in the later of 2008, the BDI index drops from about 10,000 to only around 700. This kind of unpredictable fluctuation gives huge pressure on the companies in shipping industry.

The forward freight agreement is the most active freight risk management tool in financial derivatives. Route C3 and C5 are the most important iron ore routes for China. The main task of this dissertation is to analyse the price discovery function and hedging function of freight forward agreement with econometric methods.

The result shows there is a strong relationship between spot price and FFA price. paper find there is a cointegration relation between spot price and FFA price. The price discovery function displays FFA price have a strong introduction effect on spot price. Future price will close to spot price when the future contract is closing to the settlement date. The effect of hedging in all six kinds of FFA contracts in routes C3 and C5 are really close. Because there is fewer variables in voyage charter contract than the time charter contract. Thus the effect of hedging in FFA voyage charter is good.

Based on the result from the empirical analysis, the dissertation discusses the effect of freight forward agreement and shows the necessity of Chinese companies to join the FFA market and gives some suggestions. The results of this dissertation will provide the theoretical support to the FFA market participants and can be a reference for Chinese companies if they want to join the FFA market in route C3 and C5.

**Key word:** freight forward agreement, hedging, price discovery, C3 route, C5 route

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## **List of Abbreviations**

ADF	Augmented Dickey-Fuller
BIFFEX	Baltic International Freight Futures Exchange
CE	Cointegration Equation
IMAREX	The International Maritime Exchange
OLS	Ordinary Least Squares
SSEFC	Shanghai Shipping Freight Exchange Co. LTD
SSY	SIMPSON SPENCE& YOUNG Broker Company
Std. Dev.	Standard Deviation
t-statistics	Trace statistics

## Chapter 1 Introduction

### 1.1 Background and Problem Definition

Shipping industry is a cyclical industry especially in dry bulk market. The dry bulk shipping market is also nearly a perfect competitive market. Thus the freight rate of dry bulk market is fluctuating all the time. We use Baltic dry index(BDI) to instead of the former Baltic freight index(BFI) to show the freight rate of dry bulk market. We can analyse the trend of dry bulk market by using BDI, then we can understand the situation of dry bulk market. We can see the trend of BDI in last four years in figure 1, as you can see BDI changes a lot and fluctuate all the time. This will cause high risk for shipping company. So risk management is necessary for shipping company.

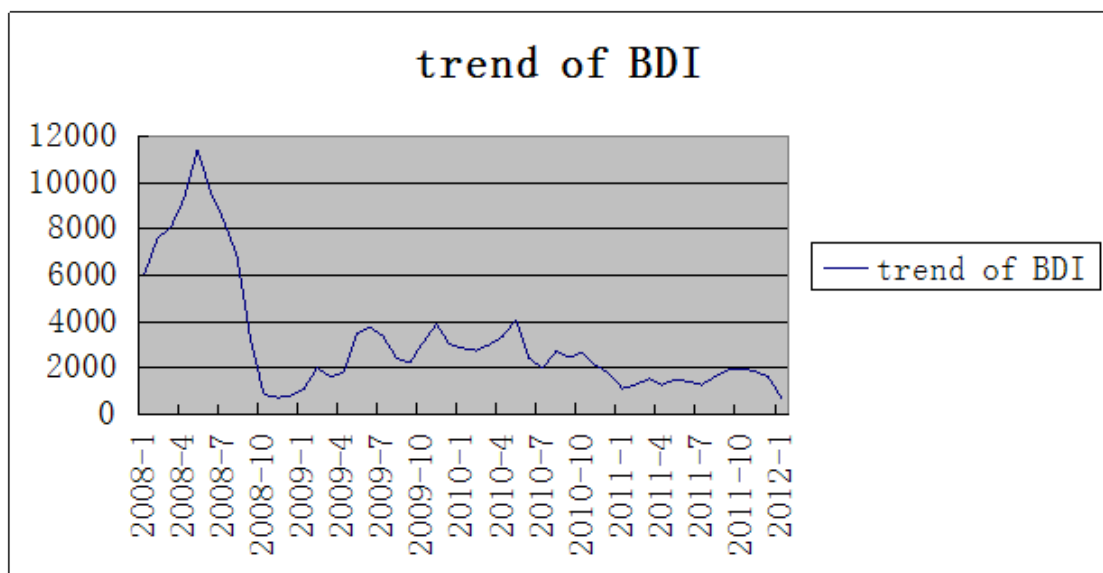


Figure 1 the trend of BDI from 2008-1 to 2012-1

Source : website of [value500.com/BDI.asp](http://value500.com/BDI.asp)

We have three steps of risk management which are fleet split operation, index floating method and freight derivatives. Nowadays freight derivatives become the major solution of risk management in many shipping companies. There are three kinds of freight derivatives which are Baltic International Freight Futures Exchange(BIFFEX), Forward Freight Agreement(FFA) and freight option.

Many shipping companies join FFA market because FFA has hedging and speculation functions. Ship owner can use FFA market to avoid risks and even make money from FFA market. However From present IMAREX report we know market volumes is generally decreasing in dry FFA clearing. As competition in the dry FFA market has driven clearing fees down, revenues are down year-on-year from dry FFA's even the increased volumes. In general the market continue to be slow due to overcapacity in the underlying physical market.(IMAREX annual report ,2011)

China act an important role in the dry bulk market because of its need of iron ore and coal. So some Chinese shipping companies join the FFA market. However Chinese shipping companies lost lots of money in FFA market because they have less professional knowledge about FFA market. The most famous case is COSCO lost nearly four billion in the FFA market at the end of 2008. After that people in China are interested in FFA market and want to know more about FFA. However after COSCO event lots of Chinese shipping companies quit from FFA market and centre government also give orders to state owned enterprise to avoid FFA and be careful to join the FFA market. The good news is since the shipping industry is recovering, Shanghai gives the twelfth five-year plan about shipping industry. An important part of this plan is developing freight derivatives. For instance Shanghai Shipping Freight Exchange Co. LTD(SSEFC) is operating very well and it gives Chinese shipping companies a good stage to operate freight derivatives.

We know Chinese shipping companies should join the FFA market. The question is how to make sure they will not lose money and avoid the risk in a perfect competitive

market. As we all know iron ore is the major import product in China. So i will focus on the two important iron ore routes in FFA which are C3 and C5 to show Chinese shipping companies should join the FFA market to have the initiative in the dry bulk market.

## **1.2 Literature review**

- Price discovery function

Foreign professors have done this researches for many years. Hoffman(1932) gives the oldest idea about price discovery. He thinks the price discovery function means future price can show the trend of spot price. Future price has better response ability to new information than spot price. (Hoffman,1932) Batchelor, Alizadeh and Visvikis(2007) use ARIMA, VAR, VECM, S-VECM models to illustrate the dangers of forecasting with equilibrium correction models when the underlying market structure is evolving, and coefficient estimates conflict with sensible priors. At the same time we learn that forward rate do help to forecast spot rate and VECM can forecast spot rate accurately, however ARIMA is good at forecast forward rate. (Batchelor, Alizadeh and Visvikis,2007, p.101-114) Kavussanos, Visvikis and Menachof(2004) use different kinds of forward rate to forecast spot rate and compare the quality of forecasting. Result of the paper is the longer the forward time the worse quality of forecasting. (Kavussanos, Visvikis and Menachof, 2004, p.241-266) Kavussanos, Visvikis and Batchelor(2004) The purpose of this paper is to investigate the impact of the introduction of forward freight Agreement(FFA) trading on spot market price volatility in two panamax Atlantic (1 and 1A) and two panamax Pacific(2 and 2A) trading routes of the dry-bulk shipping industry. The results suggest that the onset of FFA trading: (a) decreased spot price volatility in all investigated routes, (b) has had an impact on the asymmetry of volatility in Pacific routes, and (c) substantially improved the quality and speed of information flow in three out of the

four investigated routes. After introducing control variables, that may affect price volatility, the results indicate that only in voyage routes may the reduction in volatility be a direct consequence of FFA trading. It seems that the introduction of FFA trading has not had a detrimental effect on the spot market, with an improvement in the way information is transmitted into spot prices following the onset of FFA trading. (Kavussanos, Visvikis and Batchelor, 2004, p.273-296) Toda and Phillips(1993) illustrate the application of Granger causality test. (Toda and Phillips, 1993, p.1367-1393)

Chinese professors also have done lots of researches in last several years. Zong Beihua, Shao Boyang(2008) use the 4T/C of BPI to study the effect of FFA to the volatility of spot rate. The result shows FFA can make the spot market stable before 2003 and the volatility of spot price increase with the development of the forward freight market. Meanwhile the market information efficiency decrease and the attenuation of volatility becomes weaker. (Zong Beihua, Shao Boyang, 2008, vol.31) Zhu Jian(2007) study the hedge function and price discovery function of FFA with econometric methods. (Zhu Jian, 2007) Li Jun, Lu Chunxia(2008) use Johansen cointegration method to analyse forward rate and spot rate based on two routes which are BCI T/C average and BPI T/C average. Paper find out FFA market in these two market have high risk. Paper also find out that the Latter route is suit for hedge and the former route is suit for speculation. (Li Jun, Lu Chunxia, 2008, vol.8) Gong Xiaoxing, Lv Jin and Wang Rao(2010) to analyze the relationship between forward freight agreement ( FFA) and spot freight in shipping market, vector autoregressive model (VAR) was built combined with multiple economic variables , and model validation was carried out by Granger test . Impulse analysis and variance decomposition were respectively applied to analyzing three Panamax lines including T/C , P2A and P3A. Empirical results show that the proposed model is feasible. FFA and sudden changes in economic information have continuing impact on spot freight market but the latter has time lag in response to above variables. (Gong Xiaoxing, Lv

Jin and Wang Rao, 2010, vol.36) Wu Peijian, Den Guishi and Tian Wei(2008) the paper from the perspective of managing freight risk, this paper analyses the cointegration relationship between forward rate and spot rate by using the method of economics and constructs an error correction model which can be used to forecast the price of freight and price for FFA market. (Wu Peijian, Den Guishi and Tian Wei, 2008, vol.22) Xiao Yiming(2009) use econometric methods to study empirically the effectiveness of the optimal hedging in the forward freight market by using a typical route as an example. The result shows that the correlation coefficient between forward rate and spot rate is high. Forward rate is playing a guiding role to lead spot rate to change. (Xiao Yiming, 2009)

- Hedging function

Keynes and Hicks both British economist give the earliest theory about hedge. Hedge is a way to avoid the freight risk in spot market. It can transfer the freight risk in spot market. Purpose is protecting the profit. The operation of hedge is buying same quantity but opposite direction future contract in future market. It use the profit in one market to fill the lost in another market. Working(1960) has a research on basis risk. Hedger can transfer the basis risk to the other party by a contract. He thinks hedger can earn money from the basis. It makes hedge become a behaviour of speculation. (Working, 1960, p.431-459) Kavussanos, Visvikis(2004) use methods of OLS, VECM, SURE-VECM, VECM-GARCH and VECM-GARCH-X to calculate the static ratio and dynamic ratio of FFA. The paper also use minimum variance of hedge ratio to find out the efficiency of hedge by internal and external sample. Result is there is a different in the efficiency of hedge in each route. Transatlantic route is better than transpacific route on the efficiency of hedge. (Kavussanos, Visvikis, 2004)

Chinese professors have done lots of researches on hedging function. Zhu Yiqiu, Chen Fen(2005) give general introduction of hedge function of FFA. (Zhu Yiqiu, Chen Fen, 2005, vol.28) Zhang Jian, Yang Yongzhi(2006) analyse the volatility of dry bulk

shipping market, introduce FFA and its situation in the dry bulk transport market and give some advise to Chinese shipping companies. (Zhang Jian, Yang Yongzhi, 2006, vol.29) Duan Guodong(2007) introduce the three steps of risk management and current situation of FFA. Then he uses an example shows how to hedge by using FFA. (Duan Guodong, 2007, p.38-39)Yang Liu(2007) point out that most of charterer use forward market to forecast spot rate. The paper also gives us the detriment of focus on using FFA to speculate and gives opinion to the parties in the shipping market of China to focus on using FFA to hedge rather than speculation. (Yang Liu, 2007, p.48-49) Zhu Jian(2007) use Ederington's way to calculate the hedge ratio and get the result of the efficiency of hedge by using FFA in the routes of BPI T/C average and C4. The paper find out the route C4 is higher than BPI T/C average in the hedge ratio. (Zhu Jian, 2007)Xiao Yiming(2009)Paper use minimum variance hedging model and bring in Kendall's rank correlation model, Copula model and GED-GARCH model to estimate the ratio of forward rate and spot rate after hedging in use of BCI, BPI, BSI three routes, and moreover, the result of estimating hedging are satisfactory. Finally by comparing the time series between before and after hedging the price, through analysing the hedging effectiveness, it can be concluded that using the Tail Dependence to calculate the rate sequence of return after hedging has a smaller mean and variance, and its fluctuations are much more moderate than before hedging, so it prove hedging function is very effective. (Xiao Yiming, 2009) Zhao Haiyang(2010) introduce how to forecast BDI accurately to help hedging by using FFA and how to hedge by comparing successful example and failure examples. Result is we should use FFA to hedge when we have an accurate forecast of market. (Zhao Haiyang, 2010) Zhang Jian(2009) shows how to hedge by using P2A route and compare the difference between hedging and speculation. (Zhang Jian, 2009)Bao Xu, Sun Axun(2008) show the routes in FFA market, the current situation of FFA and use example to illustrate how to hedge by using FFA. (Bao Xu, Sun Axun, 2008) Zhou Yangou(2011) introduce the freight derivatives, application of FFA in shipping companies and also use an example to display how to hedge by using FFA. (Zhou Yangou, 2011) Sheng Wuchen,



Wang Xiaoming and Zeng Qiugen(2010) estimate minimum hedging ratio by using B-VAR, ECM and EC-GARCH based on 4 routes of BCI T/C average, BPI T/C average, P2A and P3A. Result shows ECM and B-VAR get highest hedge ratio and best hedging efficiency. P2A and P3A have higher hedging efficiency than the other two routes. (Sheng Wuchen, Wang Xiaoming and Zeng Qiugen, 2010) Xi Bei, Yu Siqing(2011) analyse hedging strategy from risk management aspect. Use Fundamental Analysis and technical analysis to find the right way to operate hedging. (Xi Bei, Yu Siqing, 2011, vol.33) Zhang Haiyang(2010) take two busy routes for example to research the optimal hedging ratio. After introduction the Kendall model, the CoPula model and the GARCH model, we come to the optimal result by using the minimum variance hedging model. (Zhang Haiyang, 2010)

- Speculation and others

Zhao Haiyang(2010) use an example to show how to speculate by using FFA. (Zhao Haiyang, 2010) Zhang Haiyang(2009) introduce three ways to earn profit from FFA market. (Zhang Haiyang, 2009, vol.31) Xi Bei, Yu Siqing(2011) introduce speculation strategy basically. (Xi Bei, Yu Siqing, 2011, vol.33)

Yuan Rongxin, Xi Pei(2011) introduce the transaction process. (Yuan Rongxin, Xi Pei, 2011) Xing Dan(2011) illustrate how Chinese companies facing FFA market and the future of FFA market. (Xing Dan, 2011)

As I know from the literature review there is no article analyse the C3 and C5 which are two most important routes for China in dry bulk market. Only few of articles consider speculation function of FFA market. During the financial crisis some banks join the FFA market, not much articles consider the function of FFA during financial crisis and other problem like impact of enhance speculation function to the FFA market.

### **1.3 The framework of the paper and methodology used**

This paper will do empirical analysis of the functions of FFA especially focus on price discovery and hedging functions. From this empirical analysis we can know the efficiency of FFA in these two routes. paper will choose C3 and C5 to be the sample and it can be a reference for Chinese companies if they want to join the FFA market of these two routes. The paper will also illustrate it is necessary for Chinese shipping companies join the FFA market and give them some recommendations.

This paper has five chapters. First chapter is introduction, i will introduce the background, result of literature review, the framework of the paper and methodology used. Second chapter is general introduction of FFA, in this chapter i will give reader a basic idea of FFA. Third chapter is empirical analysis, this chapter is the main part of the paper. I will do all the calculations in this part. Fourth chapter is result of empirical analysis and revelation. This part is also important , i will give a result in this part After calculations and connect with Chinese shipping companies to explain the reason why they should join FFA market and give some own recommendations. Last part is conclusion, give an overview of paper and emphasize the result of the paper.

This paper will use some econometrics methods and apply time series analysis. This paper will use correlation analysis, ADF test, cointegration test and Granger causality test in the software of EVIEWS to analyse the price discovery function. This article will also analyse the hedging ratio and the effect of hedging in these two routes to analyse the hedging function by the formulas proposed by Johnson and Ederington.

## **Chapter 2 General introduction of the Forward Freight Agreement market**

### **2.1 Overview of the Forward Freight Agreement**

Forward Freight Agreement which is also well known as FFA means an agreement made by two counterparties. This agreement should cover some main terms which are the agreed route, the day, month and year of settlement, contract quantity and the contract rate at which differences will be settled. One party will receive money from the other party or pay money to the other party within five days following the settlement date. (Kavussanos & Visvikis, 2011, pa.16) The settlement is decided by the freight index of Baltic Exchange on the settlement date and the freight agreed in the agreement.

Forward Freight Agreement is presented by Clarkson in the end of 1991. Two famous European shipowner which are Bocimar and Burwain operated first FFA trade in 1992. FFA got great developing after 2005. FFA attracted more shipowner like TMT, OCEANBULK and banks like CITIBANK, MORGAN STANLEY to join in this market. It made a huge change of FFA. There were 1.65 million agreements made and the market value of FFA was 57 billion in 2005 compared to 23 billion in 2004. Nowadays FFA market has already take two-thirds of the whole shipping market and physical market only take one-third of the whole market.

There are four main participants in the FFA market. They are shipowner, trader, producer and financial institution. It shows these four parties clearly in the table 1.

Table 1 main participants of FFA market

Shipowner	Shipping companies and operators who are dealing with international dry bulk shipping. For example: KLAVENESS from Norway, NAVIOS/OCEANBULK from Greece.
Trader	Companies who are dealing with dry bulk import and export.
Producer	Companies who are producing different dry bulk commodities. For example: three biggest iron ore supplier Rio tinto, BHP billiton and CVRD.
Financial institution	Banks, hedge fund and hedge funds. For example: MORGAN STANLEY

Source: Zhou Yangou,(2011), Application of freight derivative FFA in shipping company, China Water Transportation,2011(6)

At the same time i should introduce the routes of dry bulk FFA market. There are four types of routes which are capesize, panamax, supramax and handysize. Dry bulk FFA market has 24 Baltic dry bulk routes which are 10 capesize routes, 7 panamax routes, 5 supramax routes and 2 trial routes. Here are some main routes published by Baltic Exchange in the table 2.

Table 2 routes published by Baltic Exchange

Type of ship	Routes	Tonnage
Capesize	C3 Tubarao-Beilun/Baoshan	150000mt
	C4 Richards Bay-Rotterdam	150000mt
	C5 Australia-Beilun/Baoshan West	150000mt

	C7 Bolivar-Rotterdam	150000mt
	BCI T/C Average	4 T/C routes Average
Panamax	P2A SKAW/GIB-Far East	74000mt
	P3A Pacific R/V	74000mt
	BPI T/C Average	4 T/C routes Average
Supramax	BSI T/C Average	5 T/C routes Average
Handysize	BHI T/C Average	T/C Average

Source: Bao Xu, Sun Axun,(2008), Discussion of FFA, China Logistics and Purchase, 2008(23)

Nowadays the International Maritime Exchange(IMAREX-NOS), London Clearing House Limited(LCH), Singapore Exchange(SGX) and the New York Mercantile Exchange(NYMEX) are the famous stage to deal with FFA settlement.

## **2.2 Functions of the Forward Freight Agreement**

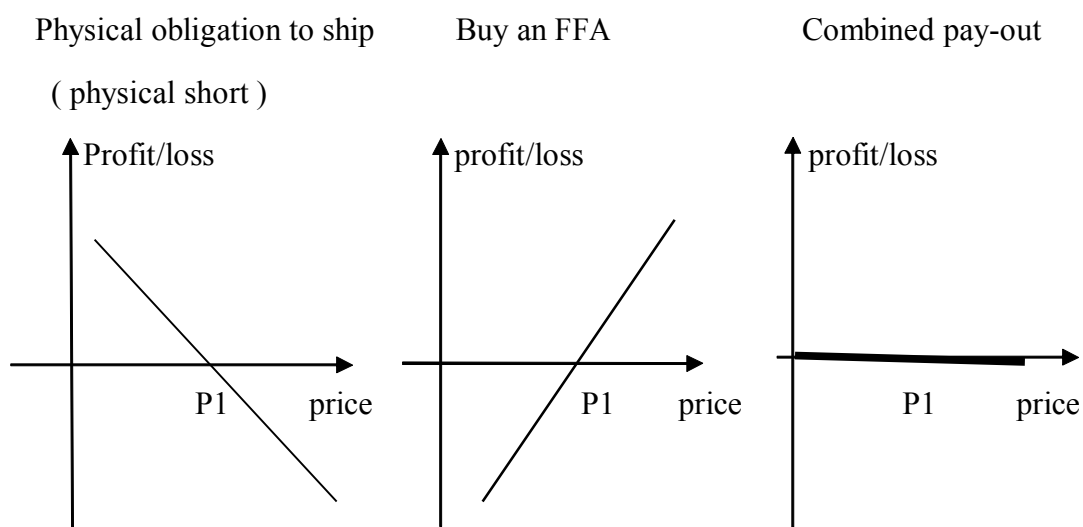
FFA has four kinds of functions which are price discovery, hedging, speculation and market developing.

### **1. Price discovery**

As i mentioned at chapter 1, shipping industry is a perfect competitive market. Therefore the freight rate of spot market will change all the time. Shipowner or shipper always suffer lost because of wrong estimation of the trend of freight rate. The participants of FFA are doing business in different area in dry bulk shipping. So they are familiar with dry bulk shipping and they have their own information, experience and judgement of market. All of these will display on the FFA price. Otherwise the operation of FFA market is fair. Every price of new deal will show on the screen of each exchange house. It helps to make correct future price. That's the reason why FFA has price discovery function to show the trend of freight.

## 2. Hedging

The original purpose of FFA is to avoid the risk caused by the fluctuation of freight. We use hedging to combine profit and loss to stay at a stable level. It can be understood easily by the figure 2.



P1: expected freight rate to be paid for cargo shipment

fixed rate of the FFA bought

Figure 2 hedging physical shipment obligations by buying an FFA

Source: Kavussanos & Visvikis, 2011, Theory and Practice of Shipping Derivatives, Risk Books, pa.98

Figure shows that hedging means buy(sell) future contract with same quantity in physical market but opposite trade direction. Then at a specific date in the future contract owner sell(buy) the future contract to fill the loss in the spot market caused by the fluctuation of freight. On shipowners side, the purpose of using hedging is protecting profit. Shipowners buy or sell future contract according to their estimation for the market. Then they can use it to protect profit. The hedging ratio is higher than BIFFEX.

### 3. Speculation

In 2007 a company named TMT earned 3 billion in FFA market by speculation. It means people in FFA market can earn more money according to their forecast of market. Speculator buy more future contracts When they think the market will goes up and sell more future contracts when they think the market will goes down. It shows the biggest different between hedging and speculation that is the purpose. Hedging means people use FFA to protect their profit. But speculation means people use FFA to earn money. Just like earn money from stock market. However it is not every FFA deal all can avoid the risk, most people use FFA to remove the risk to others who are willing to take it. The people who want to take risk is speculator.

### 4. market developing

This is some my personal idea about FFA. FFA market is helpful to avoid the risk of freight fluctuation. But it needs professional knowledge and skilled operators. At the same time FFA has price discovery function. FFA market can show the trend of spot market Although the price of FFA market can be changed by somebodies' will. So FFA market means a lot to physical market.

## **2.3 Transaction of the Forward Freight Agreement**

Nowadays there are two kinds of transactions of FFA which are over-the-counter (OTC) and cleared market. OTC means two counterparties make an agreement based on the credit. Cleared market has a organized house for trading and use standardized contract. All deals are finished through a clearing house. The table down below make a comparison of both types of transactions.

Table 3 comparison of OTC and cleared market

	OTC	Cleared market
Trading fee	Commission for brokers	Commission for brokers and clearing fee
Capital cost	no	stated commission
Credit risk	High	Zero (because of clearing house)
Effect of cash flow	medium	low
Frequency of utilization	Leading in FFA trade	Getting popular

Source: result of own research

The table 3 shows cleared market is getting popular because of its advantages. The cleared FFA market suffered no defaults while lots of bilateral counterparties were forced to renegotiate their contracts during the latest financial crisis.

There are two kinds of contracts in OTC. The first one FFABA contract is made by Forward Freight Agreement Brokers' Association (FFABA). This one is always used by the member of FFABA. The second one ISDA contract is made by International Swaps And Derivatives Association (ISDA). This one is always used by big shipping companies or banks. In cleared market there are 75% deals use FFABA contract and 25% deals use ISDA contract.

Each exchange house will provide its own contract in cleared market. IMAREX-NOS is known as the best exchange house. So the FFA contract of IMAREX-NOS is used often.

There are four settlement mechanisms in FFA market:

1. The settlement price is the average price of contract routes published in Baltic exchange house at each settlement period.



2. There are two kinds of settlement period according to character of routes. First is T/C average routes, the settlement period of this is 30 days. Settlement price is the average price of all index in the trading month. Second is single route, the settlement period of this is 7 days. Settlement price is the average price of all index in 7 days before the settlement date.

3. Settlement price should all be paid at settlement date and it should be received in five days.

4. Settlement price is equal to fixed price minus floating price, then it times contract quantities.

## **Chapter 3 Empirical analysis**

### **3.1 Data collection and description**

All the data collected in this paper come from the iron ore report of SIMPSON SPENCE & YOUNG (SSY). All the data is the transaction price in FFA market. Time charter FFA contract is divided by quarters and voyage charter FFA contract is separated by months. This dissertation focuses on two iron ore routes which are very important to China.

The transaction item of C3 and C5 are one month FFA contract, two months FFA contract and three months FFA contract. The data start from April 9<sup>th</sup> in 2010 to March 30<sup>th</sup> in 2012. There are 440 observations for both C3 and C5.

### **3.2 Function of price discovery**

#### **3.2.1 Correlation analysis**

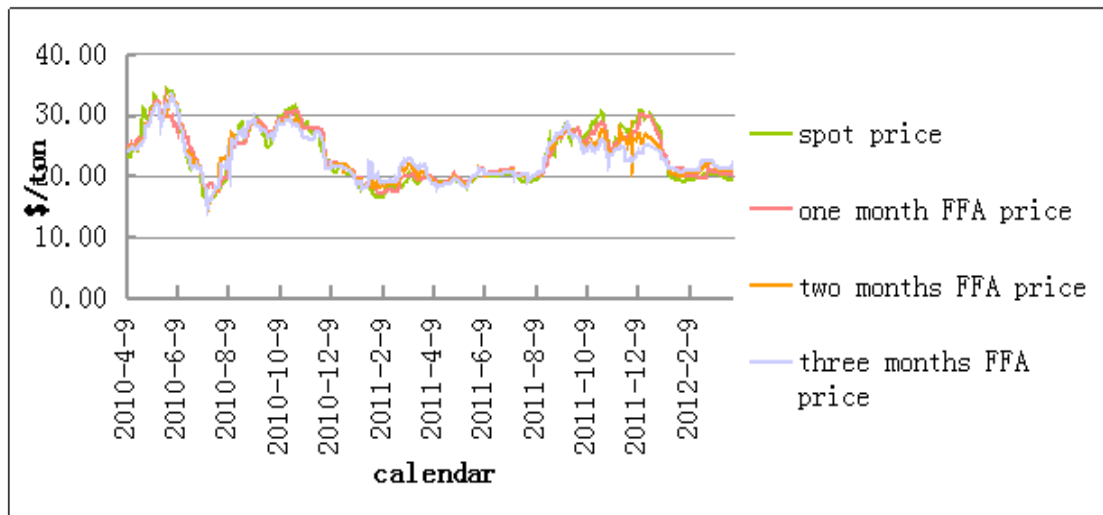


Figure 3 Trend map of spot price and FFA price in C3

Source: result of own research based on the data from SSY

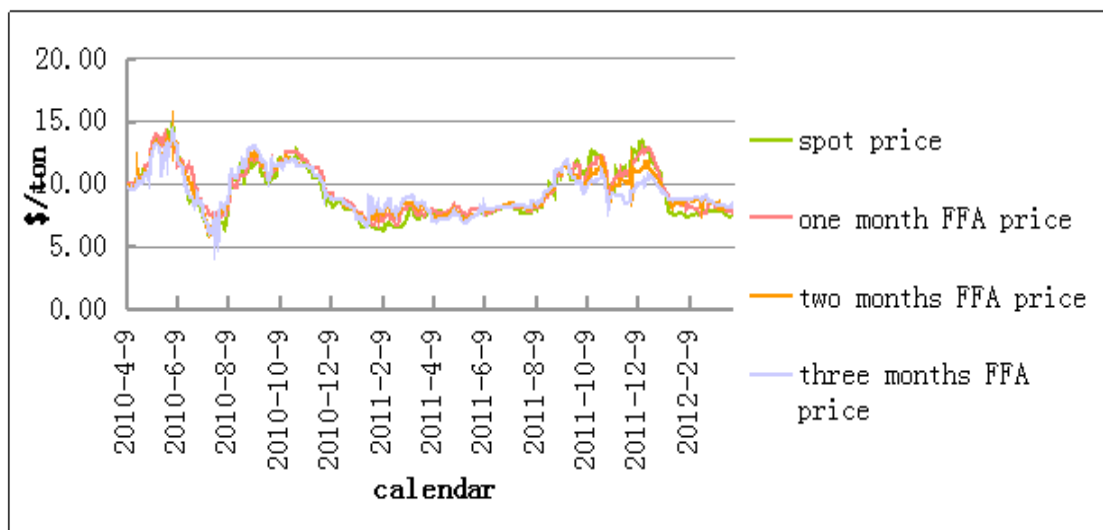


Figure 4 Trend map of spot price and FFA price in C5

Source: result of own research based on the data from SSY

we can see the trend of spot price and FFA price is similar in the figure3 and figure4. We can give an initial judgement that there is a strong connection between spot price and FFA price. We can also use correlation analysis to judge the connection between spot price and FFA price. The table 4 and table 5 shows the correlation coefficient of spot price and FFA price in route C3 and C5.

Table 4 Correlation matrix of spot price and FFA price in C3

	Spot price	One month FFA price	Two months FFA price	Three months FFA price
Spot price	1	0.9663697567	0.9567724914	0.9134061989
One month FFA price	0.9663697567	1	0.9491561723	0.9055326759
Two months FFA price	0.9567724914	0.9491561723	1	0.9727112454
Three months FFA price	0.9134061989	0.9055326759	0.9727112454	1

Source: own calculation based on the data from SSY

Table 5 Correlation matrix of spot price and FFA price in C5

	Spot price	One month FFA price	Two months FFA price	Three months FFA price
Spot price	1	0.9649550895	0.9449213452	0.8678794964
One month FFA price	0.9649550895	1	0.9507070213	0.8759974487
Two months FFA price	0.9449213452	0.9507070213	1	0.9654068791
Three months FFA price	0.8678794964	0.8759974487	0.9654068791	1

Source: own calculation based on the data from SSY

From the charts we can see the correlation coefficient of one month FFA price is highest in both two charts. The correlation coefficient of two months FFA price and three months FFA price is getting lower when the settlement date getting later. It

means the connection of spot price and future price will be weak if the settlement date of future contract is far from present date. The correlation coefficient of spot price and FFA price is high in these two routes is because the target of FFA is freight. Freight do not need to be stored or transported so it has no capital cost to hold a FFA contract. The other thing should be noticed is the correlation coefficient between FFA price is high. It might because spot price and FFA price can be affected by same reasons.

### 3.2.2 Stationarity of time series analysis

This paper need to check the stationarity of time series before we do the cointegration test and granger causality test. There are several ways to check the stationarity of time series. Autocorrelation analysis and unit root test are the most common way to solve this problem. This paper will uses unit root test by the help of EVIEWS. It has two types of unit root test in EVIEWS which are Dickey-Fuller(DF), Augmented DF(ADF)and Phillips-Perron test. ADF will be used in the dissertation.

We should know what is ADF basically before we use it. First is a example based on the situation of AR(1).

$$y_t = \mu + \rho y_{t-1} + \varepsilon_t \quad (3-1)$$

In this formula  $\mu$  and  $\rho$  are parameters.  $\varepsilon_t$  is the error term. If  $-1 < \rho < 1$ , series y will be a stationary time series. If  $\rho = 1$  then series y will be a nonstationary time series. Thus if we want to check a stationary time series then we should make sure  $\rho < 1$ . So we make two assumptions:  $H_0 : \rho = 1$   $H_1 : \rho < 1$

If we minus  $y_{t-1}$  at both side of formula, we will get the formula below:

$$\Delta y_t = \mu + \gamma y_{t-1} + \varepsilon_t \quad (3-2)$$

In this formula  $\gamma = \rho - 1$

So we can change our assumptions to

$$\begin{cases} H_0 : \gamma = 0 \\ H_1 : \gamma < 0 \end{cases}$$

So unit root test change to a t test for  $\gamma$ . We can use Ordinary Least Squares(OLS) to calculate formula (3-2) to get estimate of  $\gamma$  and statistic of t. We can consult the DF list, if the absolute value of t is higher than DF or critical value of t, then we can refuse the assumption of  $\gamma = 0$ . So the time series is stable. On the opposite situation we can not refuse the assumption. So the time series is unstable.

The above introduction is the basic DF test. It only be worked on the situation of AR(1) which means  $\rho = 1$

If the error term  $\varepsilon_t$  is autocorrelation, then we will use ADF to solve this kind of problem. The operation of ADF is to give the lagged difference of dependent variable y on the right side of regression equation. The equation changes to this:

$$\Delta y_t = \mu + \gamma y_{t-1} + \varepsilon_t + \delta_1 \Delta y_{t-1} + \dots + \delta_{p-1} \Delta y_{t-p} \quad (3-3)$$

It will also check the assumptions:

$$\begin{cases} H_0 : \gamma = 0 \\ H_1 : \gamma < 0 \end{cases}$$

ADF will use the same critical value like DF.

Stationarity of time series is necessary for time series analysis by econometrics methods. If the time series is not stable we can use difference to make the time series stable. In this dissertation we have to make the time series to be stable before we can do other analysis.

Table 6 Result of ADF test before 1<sup>st</sup> difference

Spot price in C3	T-statistics	-0.617995	Spot price in C5	T-statistics	-0.707861
	Probability	0.4493		Probability	0.4098
	1% level	-2.570277		1% level	-2.570277
	5% level	-1.941551		5% level	-1.941551
	10% level	-1.616212		10% level	-1.616212
One month FFA price in C3	T-statistics	-0.600913	One month FFA price in C5	T-statistics	-0.608120
	Probability	0.4567		Probability	0.4536
	1% level	-2.570277		1% level	-2.570277
	5% level	-1.941551		5% level	-1.941551
	10% level	-1.616212		10% level	-1.626212
Two months FFA price in C3	T-statistics	-0.503157	Two months FFA price in C5	T-statistics	-0.588431
	Probability	0.4981		Probability	0.4621
	1% level	-2.570264		1% level	-2.570264
	5% level	-1.941550		5% level	-1.941550
	10% level	-1.616213		10% level	-1.616213
Three months FFA price in C3	T-statistics	-0.469626	Three months FFA price in C5	T-statistics	-0.543742
	Probability	0.5118		Probability	0.4812
	1% level	-2.570277		1% level	-2.570264
	5% level	-1.941551		5% level	-1.941550
	10% level	-1.616212		10% level	-1.616213

Source: own calculation based on the data from SSY

We can see all the absolute value of t-statistics in table 6 is lower than the absolute value of each level. So we can not reject the original assumption and all the time series are not stable. So we do the 1<sup>st</sup> difference in the table 7.

Table 7 Result of ADF test after 1<sup>st</sup> difference

Spot price in C3	T-statistics	-10.36412	Spot price in C5	T-statistics	-13.30753
	Probability	0		Probability	0
	1% level	-3.445127		1% level	-3.445127
	5% level	-2.867949		5% level	-2.867949
	10% level	-2.570248		10% level	-2.570248
One month FFA price in C3	T-statistics	-17.30348	One month FFA price in C5	T-statistics	-16.99854
	Probability	0		Probability	0
	1% level	-3.445127		1% level	-3.445127
	5% level	-2.867949		5% level	-2.867949
	10% level	-2.570248		10% level	-2.570248
Two months FFA price in C3	T-statistics	-18.66494	Two months FFA price in C5	T-statistics	-19.81969
	Probability	0		Probability	0
	1% level	-3.445127		1% level	-3.445127
	5% level	-2.867949		5% level	-2.867949
	10% level	-2.570248		10% level	-2.570248
Three months FFA price in C3	T-statistics	-17.67551	Three months FFA price in C5	T-statistics	-18.83383
	Probability	0		Probability	0
	1% level	-3.445127		1% level	-3.445127
	5% level	-2.867949		5% level	-2.867969
	10% level	-2.570248		10% level	-2.570248

Source: own calculation based on the data from SSY

We can see all t-statistics is lower than the level in table 7. So we reject the original assumption. All time series are stable after 1<sup>st</sup> difference and they can be used to do cointegration test now.



### 3.2.3 Cointegration test

The cointegration test in this dissertation only has two variables. So paper will focus on introducing the theory of Engel-Granger(EG) or Augmented Engel-Ganger(AEG).

We should use OLS to estimate the cointegration parameter vector and assume there is a relation between two variables which are integrated of order.

$$y_t = k x_t + u_t, u_t \sim I(0) \quad (3-4)$$

The long term balance between two variables should be:

$$y_t = k x_t$$

Then we can get this formula by OLS:

$$y_t = \hat{k} x_t + \hat{u}_t \quad (3-5)$$

$\hat{k}$  is the least-square estimation of cointegration parameter  $k$ .  $\hat{u}_t$  is the least-square estimation of error term  $u_t$ .

According to the definition of cointegration, if there is cointegration between two time series, then the non-equilibrium error term of time series will be stable. On the other hand the non-equilibrium error term should be integrated for order. According to this idea, the unit root test for non-equilibrium error term can check the time series whether cointegration. If there is a root of unity, the series will be unstable and the cointegration is not existing. However if there is no root of unity, the series will be stable and the cointegration is existing.

In the part of Stationarity of time series analysis we find out that all the time series are stable. So we can calculate the result of cointegration test in EVIEWS. The result of cointegration test is displayed in the table 8 and table 9.

Table 8 Results of Cointegration test in C3

C3	Spot price and one month FFA contract		Spot price and two months FFA contract		Spot price and three months FFA contract	
Hypothesized No. Of CE	T-statistics	5% critical level	T-statistics	5% critical level	T-statistics	5% critical level
None	63.78604	25.87211	39.77517	25.87211	27.16115	25.87211
At most 1	5.872687	12.51798	5.733706	12.51798	5.801901	12.51798

Source: own calculation based on the data from SSY

Table 9 Results of cointegration test in C5

C5	Spot price and one month FFA contract		Spot price and two months FFA contract		Spot price and three months FFA contract	
Hypothesized No. Of CE	T-statistics	5% critical level	T-statistics	5% critical level	T-statistics	5% critical level
None	57.29877	25.87211	26.58523	25.87211	26.72308	25.87211
At most 1	6.022767	12.51798	5.431347	12.51798	5.280736	12.51798

Source: own calculation based on the data from SSY

T-statistics and 5% critical level are listed in the table 8 and table 9. According to the theory of cointegration test, if the T-statistics is bigger than the 5% critical value, then we reject the assumption. If the T-statistics is smaller than the 5% critical value, then we accept the assumption. Here use the cointegration test of Spot price and one month FFA contract in C3 as an example to explain the result of cointegration test. First assumption is there is no cointegration equation between two time series. The result of cointegration test shows the trace statistics is bigger than the 5% critical value. So we reject this assumption and it means there is a cointegration equation between two time series. Second assumption is there is only one and at most one cointegration equation

between two time series. The result of cointegration test shows the trace statistics is smaller than the 5% critical value. So we accept this assumption . After all we believe there is only one cointegration equation between the spot price and one month FFA contract. The connection of these two time series is stable.

Other results of cointegration test can use the same way to analyse. From the results we can see there is only one cointegration equation between spot price and future price. This result means the trend of spot price and the trend of future price will keep a long term stability.

### **3.2.4 Granger causality test**

The Granger (1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. Y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant. Note that two-way causation is frequently the case; x Granger causes y and y Granger causes x.(EViews6 users guide)

EViews runs bivariate regressions of the form in equation 3-6 and equation 3-7.

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \dots + \beta_l x_{t-l} \quad (3-6)$$

$$x_t = \varphi_0 + \varphi_1 x_{t-1} + \dots + \varphi_l x_{t-l} + \gamma_1 y_{t-1} + \dots + \gamma_l y_{t-l} \quad (3-7)$$

For all possible pairs of (x,y) series in the group. The reported F-statistic are the Wald statistics for the joint hypothesis:

$$\beta_1 = \beta_2 = \dots = \beta_l = 0 \quad \gamma_1 = \gamma_2 = \dots = \gamma_l = 0$$

The null hypothesis is that x does not Granger-cause y in the first regression and that y does not Granger-cause x in second regression.(EViews6 users guide)

The results of Granger causality test are listed in table 10 and table 11.

Table 10 Results of Granger causality test in C3

Null Hypothesis	Observations	F- statistic	Probability
Spot price does not Granger cause one month FFA price	436	13.1654	3.E-06
One month FFA price does not Granger cause spot price	436	34.1933	2.E-14
Spot price does not Granger cause two months FFA price	436	12.9907	3.E-06
Two months FFA price does not Granger cause spot price	436	23.2755	3.E-10
Spot price does not Granger cause three months FFA price	436	5.26612	0.0055
Three months FFA price does not Granger cause spot price	436	24.1594	1.E-10

Source: own calculation based on the data from SSY

Table 11 Results of Granger causality test in C5

Null Hypothesis	Observations	F- statistic	Probability
Spot price does not Granger cause one month FFA price	436	13.6351	2.E-06
One month FFA price does not Granger cause spot price	436	19.7395	6.E-09
Spot price does not Granger cause two months FFA price	436	3.71352	0.0252
Two months FFA price does not Granger cause spot price	436	22.5323	5.E-10

Spot price does not Granger cause three months FFA price	436	5.05533	0.0068
Three months FFA price does not Granger cause spot price	436	19.8919	5.E-09

Source: own calculation based on the data from SSY

Paper uses one month FFA price and spot price in C3 as an example to analyse the results of Granger causality test. The probability is 3.E-06 when the null hypothesis is Spot price does not Granger cause one month FFA price. The probability is 2.E-14 when the null hypothesis is One month FFA price does not Granger cause spot price. The probability of the second null hypothesis is lower than the first one. So we can not reject the hypothesis that Spot price does not Granger cause one month FFA price but we do reject the hypothesis that One month FFA price does not Granger cause spot price. Therefore it means one month FFA price has a effect on spot price and spot price has not much effect on one month FFA price.

After analyse all results we find that in C3 one month FFA price, two months FFA price and three months FFA price all have effect on spot price and this kind of effect is getting weaker when the settlement date of FFA contract is getting later. At the same time the effect of spot price is getting stronger. In C5 the effect of one month FFA price, two months FFA price and three months FFA price keep in a similar level. Spot price have bigger effect on two months FFA price and three months FFA price in C5. In a word one month FFA price, two months FFA price and three months FFA price all have strong effect on spot price. It proves that the price discovery function of FFA is exist and the price discovery function has strong effect on spot price.

### 3.3 Function of hedging

#### 3.3.1 Basis analysis

Basis means spot price minus future price. Basis is highly related to hedging. If the basis at the start of hedging is same as the basis at the end of hedging, then we will have a perfect hedging and hedger can protect his profit. However in reality spot price and future price have different fluctuation rate even they might have similar trend. At the same time future price has different fluctuate rate in different kinds of future contract. Thus it is hard to have a perfect hedging. It means each participator in FFA market should know the change of basis in each future contract and choose the best future contract. We can see the trend map of basis in all six kinds of future contracts in figure5 and figure 6.

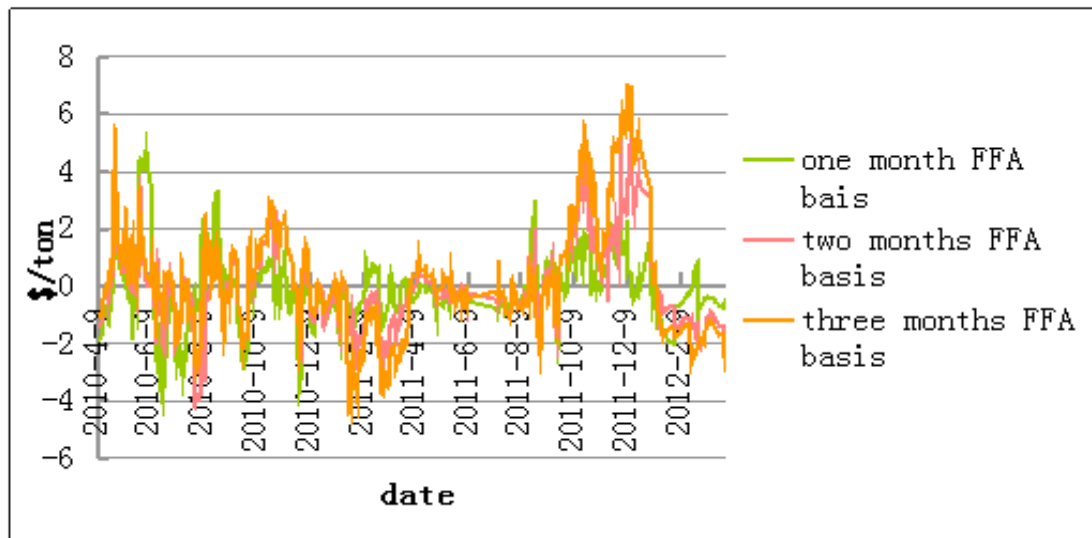


Figure 5 Trend map of basis in route C3

Source: result of own research based on the data from SSY

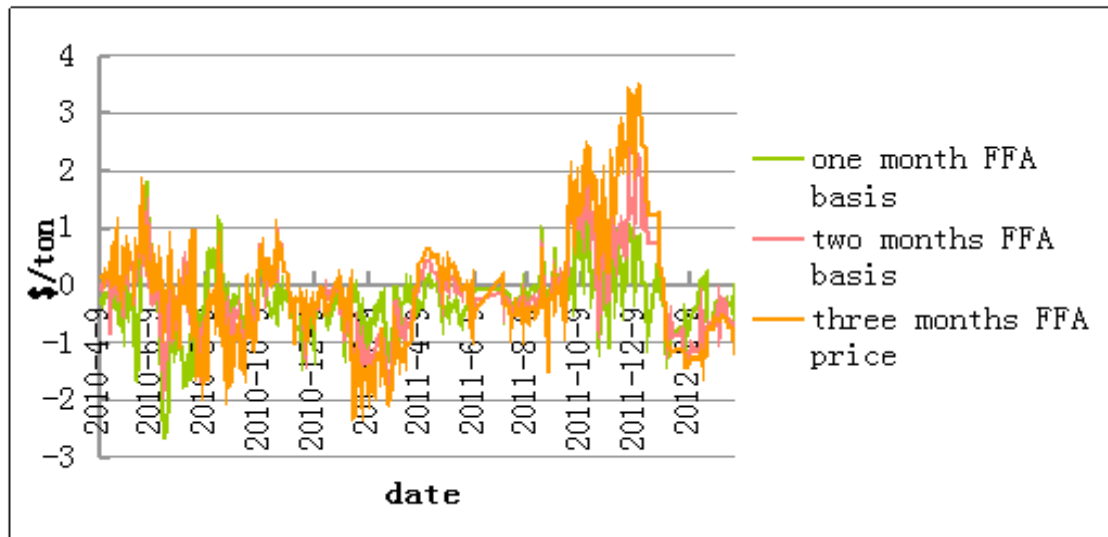


Figure 6 Trend map of basis in route C5

Source: result of own research based on the data from SSY

In the figures we can find out all six kinds of future contracts have a similar trend and the basis fluctuate under zero. It because the spot market suffered a great lose in financial crisis in the later of 2008. The spot market has not recovered from the financial crisis and we find out it in the trend of BDI. So the basis always fluctuating down below zero.

Table 10 Descriptive statistics of basis in C3

Basis of C3	One month FFA	Two months FFA	Three months FFA
Mean	-0.087011	0.063057	0.254381
Median	-0.26	-0.125	0
Maximum	4.92	5.29	6.98
Minimum	-3.81	-4.23	-4.4
Std. Dev.	1.294364	1.555449	2.057682
Skewness	0.801384	0.596647	0.862126
Kurtosis	5.696655	3.978792	3.849986
Jarque-bera	179.5948	43.47121	67.44331
Probability	0	0	0

Observations	438	438	438
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Source: own calculation based on the data from SSY

Table 11 Descriptive statistics of basis in C5

Basis of C5	One month FFA	Two months FFA	Three months FFA
Mean	-0.297329	-0.161484	-0.063196
Median	-0.29	-0.235	-0.19
Maximum	1.49	2.56	3.46
Minimum	-2.65	-1.85	-2.32
Std. Dev.	0.575842	0.744908	1.065648
Skewness	-0.282140	0.611360	0.902405
Kurtosis	5.308670	3.665834	3.951735
Jarque-bera	103.0827	35.37538	75.97727
Probability	0	0	0
Observations	438	438	438

Source: own calculation based on the data from SSY

In these two tables we can see the mean is getting smaller and Std. Dev. is getting bigger by the future contract is closing to the settlement date. Cost-of-Carry theory believes future price will close to spot price when the future contract is closing to the settlement date. At this point of time the basis risk will be low. The result of descriptive statistics of basis is same as the Cost-of Carry theory.

### **3.3.2 Hedging ratio analysis**

At first this paper will use an example to show the operation of hedging. Assumption is a shipowner want to hedge the freight of 10,000 mt wheat in three month at a route of capesize. It because the shipowner believes the freight will be higher than the freight at present. If the optimal hedge ratio of this route is 0.8 and each future



contract takes 1000 mt, the shipowner will need to buy  $0.8 \times \frac{10000}{1000} = 8$  future contracts to hedge the risk of freight fluctuation perfectly.

Now we need to know to calculate the optimal hedge ratio. Here is the formula of optimal hedge ration.

$$h = \rho_{SF} \frac{\sigma_S}{\sigma_F} \tag{3-8}$$

$\Delta S$ : Spot price change equal with the hedging period

$\Delta F$ : Future price change equal with the hedging period

$\sigma_S$ : Standard deviation  $\Delta S$

$\sigma_F$ : Standard deviation  $\Delta F$

$\rho_{SF}$ : Correlation coefficient  $\Delta S, \Delta F$

$h$ : hedge ratio which minimises the variance of the hedged position

So we know the optimal hedge ratio is decided by standard deviation of  $\Delta S$ ,  $\Delta F$  and the correlation coefficient of them.

The effect of hedge can be calculated by the formula which is proposed by Ederington.

$$e = \frac{Var(S_t) - Var(F_t)}{Var(S_t)} \tag{3-9}$$

This formula can be used to analyse the result of hedging and the result of not hedging.

We can see the effect of hedging in all six kinds of FFA contracts in the table 8.

Table 12 Effect of hedging by different FFA contracts

	One month FFA in C3	Two months FFA in C3	Three months FFA in C3	One month FFA in C5	Two months FFA in C5	Three months FFA in C5
$\sigma_S$	0.597199 68996	0.597199 68996	0.597199 68996	0.321890 64644	0.321890 64644	0.321890 64644

$\sigma_F$	0.611116 87159	0.689201 44762	0.672037 98511	0.304164 22636	0.361140 33803	0.361719 59591
$\rho_{SF}$	0.406478 32986	0.416762 10397	0.409334 29274	0.468546 34604	0.506697 32443	0.451794 09362
Optimal hedge ratio	0.397221 45444	0.361128 37565	0.363750 7375	0.495852 80959	0.451628 11277	0.402047 04002
Variance before hedging	0.356647 46968	0.356647 46968	0.356647 46968	0.103613 58827	0.103613 58827	0.103613 58827
Variance after hedging	0.373463 83075	0.474998 6354	0.451635 05343	0.092515 876598	0.130422 34375	0.130841 06607
Effect of hedging	-0.04715 1213711	-0.33184 355919	-0.26633 466327	0.107106 72081	-0.25873 78348	-0.26277 902594

Source: own calculation based on the data from SSY

As we can see from the table 8 the effect of hedging in all six kinds of FFA contracts is really close. The negative number in the result is because the spot price is lower than the future price in most of observations. So the variance of spot price is lower than the variance of future price. According to the formula it is the reason why there are negative numbers in the result. We can see the FFA voyage charter contract is good for hedging. It is because voyage charter contract is running on the specific route. So there is fewer variables in voyage charter contract than the time charter contract. Thus the effect of hedging in FFA voyage charter is good.

## **Chapter 4 Result of Empirical Analysis and Revelation**

### **4.1 Effect of the Forward Freight Agreement market**

We can see the benefits of FFA but it still has some disadvantages. This paper will try to analyze it based the result of empirical analysis.

Advantages:

1. From empirical analysis we can say FFA is a developed financial derivative which do not need real shipments and ships. It gives participants ability to have both advantages in spot market and future market. They can use each market to help the other because of the strong link between them.
2. Speculators and arbitrageurs can earn profit from FFA. As we can see from the empirical analysis, FFA has a great ability in price discovery. So if somebody can learn this function well. Then he can use FFA to manage risks and also get a chance to get extra profit. Meanwhile people do not need to do details about risk management but sign a contract. It can save lots of time.
3. BIFFEX may have different fluctuation rate in future market and spot market. FFA do not have this kind of problem because of its effective price discovery function.
4. Both parties in FFA market can choose to do business in OTC. So they do not need to go to the exchange house and pay the margin to the clearing house. It saves lots of capital cost. At the same time it gives participants flexibility. Both parties can make a deal based on an agreement and all specific items can be discussed.
5. After the future contract is done, both parties should show his real identity and each party has right to cancel the contract in a short time.

Disadvantages:

1. As i mention in the introduction of FFA, OTC has a significant problem and no one can ignore it. Credit risk is the most serious problem of OTC. In OTC, parties are doing business directly. It will cost lots of time and money to find out the information about the other man's reputation. In most cases, you have no choice but go to the arbitration or the court when you are facing problems.
2. FFA is still using the main routes in settlement. It brings a problem that if the route in the contract is different from the main routes, few people will sign it.
3. FFA has some unknown problems. For example: the other can not perform the contract because of his company has already go broke. The other party want to cancel the contract before the settlement date.
4. The leverage effect can make participator of FFA market lose more money.

#### **4.2 Necessity of China join the Forward Freight Agreement market**

COSCO which is the biggest shipping company in China suffered a huge lost in FFA market in 2008. I think this incident is the reason why Chinese shipping companies start operating carefully when they want to join the FFA market. Actually many Chinese shipping companies quit from FFA market and only few of state owned enterprises are allowed to join the FFA market.

This situation is caused by several reasons. First reason is the huge lost of state owned enterprises. This shakes confidence of all Chinese shipping companies and makes them feel puzzled. The rest of Chinese shipping companies don not know whether they should join the FFA market or keep away from it. Second reason is the state government gives order to state owned shipping companies that they can not join the FFA market unless they have the permission from state government. As we all know all big shipping companies in China are state owned companies. So this order means

some Chinese shipping companies have to quit from FFA market even they want to join it. Third reason is Chinese shipping companies are junior in FFA market. They don not have enough professional knowledges about FFA market. Thus they almost become the one who takes the risk in every future contract. Fourth reason is the financial crisis. The terrible market situation makes some shipping companies don not have time and money to challenge the FFA market.

In my opinion Chinese shipping companies should join the FFA market even we are facing the problems which are listed above. Here is three reasons which i list below:

- 1) China is playing an important role in world economy also in shipping industry. Chinese dry bulk shipping companies are taking higher market share in world dry bulk shipping. However many Chinese shipping companies suffer quite big lost which is caused by the fluctuation of freight. It is because Chinese shipping companies are doing original shipping business and they do not care about the future market. As we can see from empirical analysis FFA has price discovery function and it can show the trend of freight in spot market. Foreign shipping companies can use it to remove the risk. However Chinese shipping companies have no way to avoid the risk but accept it. Therefore it is necessary to learn and use FFA market to avoid the risk of freight fluctuation.
- 2) The fluctuation of freight in dry bulk market is not only affect the shipping companies but also the relevant companies in the country. For instance the steel companies will affect by the freight fluctuation easily. It because they need ships to import iron ore from other country especially in China. If Chinese shipping companies take both advantages in spot market and FFA market, it will help China to become the authority in dry bulk shipping even in the shipping industry. It can generate the China economy.
- 3) Nowadays China only focus on the spot market which limit the development of shipping industry in China. FFA market can lead the shipping industry in China to get higher level and use the functions of FFA market to fix the insufficient in spot

market. The another important thing is the price discovery function of FFA market can help shipping companies to optimize the allocation of resources. This can improve the competitiveness of the shipping company and help them to survive from the competitive market.

Chinese shipping companies have to learn the rule and the operation of FFA market. FFA is not only a tool of risk management but also a way to beat your competitor.

In a word Chinese shipping companies should join the FFA market as soon as possible.

### **4.3 Recommendations of Chinese companies join the Forward Freight Agreement market**

1. It will be necessary to have a good spot market environment to develop the FFA market. Spot market is a lower level than FFA market but it is still the foundation of FFA market. We have lots of means to improve the spot market. Here i list some of them. First is to complete the law system of spot market. Each market all need rules to control it. Second is to build some shipping center like Shanghai and try to use the shipping center to motivate the region economy. Third is to record the freight price and index in some routes to prepare to join the FFA market.
2. China need its own exchange house and clearing house. It will make Chinese companies join FFA market much easier. For instance, SSEFC is operating very well and tring to join the future market with the government support. The other important thing is make connection between FFA market and financial institution. Financial institution has enough experience to deal with derivatives. Thus this kind of relationship can accelerate the development of FFA market in China.

3. China should enhance cooperation and communication with foreign famous exchange house like IMAREX-NOS. China should accept successful experience from foreign countries based on China only has few exchange houses. Government should be a significant role to build a market system and encourage more companies to join this market.
  
4. China should educate more qualified personnels to help Chinese companies running on the right way. On the other hand authority should help Chinese companies to understand the purpose of join FFA market. As we learned from this dissertation we know FFA has hedging function and speculation function. We can calculate the effect of hedging before we use FFA to avoid the risk. However we have nothing to do but wish the market go the right way what we want it to go, if we only use FFA to speculate. Speculating just like gambling. It is the reason why so many companies suffered huge lost during financial crisis. We should focus on the purpose of avoid risk.

## **Chapter 5 conclusion**

This dissertation analyse the efficiency of FFA based on empirical analysis of two important iron ore routes C3 and C5. The result of empirical analysis shows the hedging function still need to be perfected and participator of FFA still need to learn more about hedging. On the other side the price discovery function is strong. The future price lead the trend of spot price.

Here is the detail result of my empirical analysis.

1. There is a strong relationship between spot price and FFA price. The future price of different FFA contract also have strong connection.
2. After check the stationarity of time series analysis, paper find that all series are integrated of order time series and all time series can be used for cointegration test. The cointegration test shows there is only one cointegration equation between spot price and future price. This result means the trend of spot price and the trend of future price will keep a long term stability.
3. The result of Granger causality test displays FFA price have a strong effect on spot price and it will lead the trend of spot price. It proves that the price discovery function of FFA is exist and the price discovery function has strong effect on spot price.
4. The basis always be negative value because of the spot market is still weak. It proves future price will close to spot price when the future contract is closing to the settlement date. At this point of time the basis risk will be low.
5. The effect of hedging in all six kinds of FFA contracts is really close. Because there is fewer variables in voyage charter contract than the time charter contract.



Thus the effect of hedging in FFA voyage charter is good.

In chapter four the paper discuss the result of empirical analysis and show the effect of FFA by discuss the advantages and disadvantages. Then it shows the necessity of Chinese shipping companies join the FFA and gives some reasonable advises.

This dissertation has already discussed lots about FFA. But it can be better if it can discuss some other aspects of FFA. For example we can discuss more relationship between spot price and FFA price during financial crisis and the effect of financial crisis. We also can discuss more about speculation function of FFA. As we know FFA is a kind of financial derivative. So it has leverage ability. It can be used to hedge the risk and also can be used to speculate and arbitrage.

## Reference

Batchelor, Alizadeh, Visvikis,(2007), Forecasting spot and forward prices in the international freight market, *International Journal of Forecasting*, 2007(23), 101-114

Bao Xu, Sun Axun,(2008), Discussion of FFA, *China Logistics and Purchase*, 2008(23)

Duan Guodong,(2007), Development of risk management and freight derivatives FFA in dry bulk shipping market, *China Water Transportation*,2007(1), 38-39

EViews6 users guide, software introduction of EViews 6.0

Gong Xiaoxing, Lv Jin, Wang Rao,(2010), Relationship between forward freight and spot freight in shipping market, *Journal of Dalian Maritime University*, 2010, Vol.36(1)

Hoffman , G.Wright,(1932), Future Trading Upon Organized Commodity Markets in the United States , *Philadelphia: University of Pennsylvania*

Hiro Y. Toda,Peter C.B.Phillips, (1993) Vector Autoregressions and Causality: Theoretical Overview and Simulation Study, *Econometrica*, Vol 61,No.6,P1367-1393

IMAREX annual report, (2011), (<http://www.imarexgroup.com/> )

Li Jun, Lu Chunxia, (2008), Application of cointegration test and pricing in freight forward market of international dry bulk shipping, *China Water Transport*, 2008, Vol.8(7)

Kavussanos, Visvikis, Menachof, (2004), The unbiasedness hypothesis in the forward freight market : evidence from cointegration test, *Review of Derivatives Research*, 2004(7),241-266

Kavussanos, Visvikis, Batchelor, (2004), Over-the-counter forward contracts and spot price volatility in shipping, *Transportation Research Part E*, 2004(40), 273-296

Kavussanos, Visvikis,(2004), The hedge performance of over-the-counter forward shipping freight markets, *Izmir: 14<sup>th</sup> International Association of Maritime Economists(LAME) Conference Proceeding*,2004

Kavussanos & Visvikis, (2011), Theory and Practice of Shipping Derivatives, *risk books*, pa.16,98

Sheng Wuchen, Wang Xiaoming, Zeng Qiugen,(2010), Research of hedging efficiency of FFA in dry bulk shipping, *Friends of Accounting*,2010(13)

Working H.,(1962), New Concepts Concerning Futures Markets and Prices, *American Economic Reviews*, 52,P431—459

Wu Peijian, Den Guishi, Tian Wei,(2008), Research on freight risk management based on FFA, *Soft Technology*,2008, Vol.22(9)

Xiao Yiming,(2009), Empirical analysis on the validity of hedge of the shipping price market in dry bulk shipping, *Dalian Maritime University*,2009

Xing Dan,(2011), How to deal with the temptation and conquest of FFA, *China Ship Survey*,2011(11)

Xi Bei, Yu Siqing,(2011), Application of forward freight agreement, *Shipping Management, 2011*, Vol.33(1)

Yuan Rongxin, Xi Pei,(2011), Analysis of FFA transaction process, *HLJ Foreign Economic Relations and Trade, 2011*(6)

Yang Liu,(2007), Relationship between FFA market and spot market in dry bulk, *Maritime China,2007*(3),48-49

Zong Beihua, Shao Boyang,(2008), Influence of forward freight market on spot price volatility, *Navigation of China, 2008*,Vol.31(2)

Zhu Jian, (2007), Empirical analysis on the functions of the freight forward agreement market in international dry bulk shipping, *Shanghai Jiao Tong University, 2007*

Zhu Yiqiu, Chen Fen,(2005), Study and innovation on freight-keeping market of sea transportation, *Journal of SSSRI,2005*, Vol.28(1)

Zhang Jian, Yang Yongzhi,(2006), Application of FFA in shipping market risk management, *World Shipping, 2006*, Vol.29(5)

Zhao Haiyang,(2010), The application of FFA for evading risk in the dry bulk shipping market, *Dalian Maritime University, 2010*

Zhang Jian,(2009), How to operate FFA successfully? *China Ship Survey, 2009*(7)

Zhou Yangou,(2011), Application of freight derivative FFA in shipping company, *China Water Transportation,2011*(6)

Zhang Haiyang,(2010), The research on application of forward freight agreements used in hedging and profit model in shipping company, *Dalian Maritime University*,2010

Zhang Haiyang,(2009), Create profit model of FFA, *Shipping Management*,2009, VOL.31(8)

## Appendix I : original data of spot price and FFA price in C3 and C5

date	route C3 \$/ton			
	spot price	one month FFA price	two months FFA price	three months FFA price
2010-4-9	23.33	25.25	24.75	24.25
2010-4-12	23.20	25.00	24.50	24.25
2010-4-13	23.56	25.25	24.75	24.50
2010-4-14	24.05	25.50	25.00	24.75
2010-4-15	24.48	25.25	24.75	24.75
2010-4-19	24.58	25.25	24.70	24.50
2010-4-20	24.47	25.75	25.00	24.50
2010-4-21	24.68	26.00	25.00	24.50
2010-4-22	25.02	25.50	24.75	24.50
2010-4-23	25.56	26.25	25.50	25.25
2010-4-26	26.05	26.00	25.50	25.25
2010-4-27	29.62	26.25	26.00	25.75
2010-4-28	31.23	26.50	26.00	25.75
2010-4-29	31.17	26.25	26.00	25.75
2010-4-30	29.94	28.75	28.50	28.25
2010-5-4	29.41	28.75	28.50	28.25
2010-5-5	29.33	28.75	28.50	28.50
2010-5-6	29.98	29.50	29.25	29.00
2010-5-7	31.27	30.50	30.00	29.75
2010-5-10	31.75	31.50	31.00	30.75
2010-5-11	33.33	32.00	31.50	31.25
2010-5-13	33.01	32.50	32.00	31.75
2010-5-14	32.12	32.50	32.00	32.00
2010-5-17	31.64	32.25	31.75	31.50
2010-5-18	30.80	32.00	30.50	30.00
2010-5-19	29.89	29.00	28.50	28.25
2010-5-20	29.53	29.50	29.00	28.75
2010-5-21	30.08	29.75	29.25	29.25
2010-5-24	31.20	32.00	31.50	31.25
2010-5-25	34.02	30.25	31.50	31.75
2010-5-26	34.40	30.00	31.75	31.50
2010-5-27	34.19	29.75	31.00	31.75
2010-5-28	33.83	29.75	32.00	31.70
2010-6-1	34.09	30.00	33.50	33.25
2010-6-2	33.82	29.50	33.25	33.00
2010-6-3	33.20	28.50	33.00	32.75
2010-6-4	32.54	28.25	32.50	32.25
2010-6-7	31.76	28.00	31.75	31.50
2010-6-8	31.06	27.50	31.00	30.90
2010-6-9	31.00	29.25	30.50	30.25

2010-6-10	30.32	29.00	29.50	29.25
2010-6-11	28.77	28.75	28.50	28.25
2010-6-14	26.42	28.25	27.75	27.50
2010-6-15	25.60	28.00	26.00	26.00
2010-6-16	24.88	26.50	24.25	24.50
2010-6-17	24.22	26.50	24.25	24.00
2010-6-18	23.29	26.50	24.25	23.50
2010-6-21	22.69	26.50	23.75	23.25
2010-6-22	21.83	24.50	23.50	23.00
2010-6-23	21.29	24.50	23.50	22.50
2010-6-24	21.23	24.50	23.50	21.50
2010-6-25	21.89	24.50	23.50	21.50
2010-6-28	22.05	23.25	21.80	21.75
2010-6-29	22.13	23.00	21.75	21.70
2010-6-30	22.26	23.00	22.40	22.00
2010-7-1	21.89	22.50	22.10	21.50
2010-7-2	21.65	22.00	21.75	21.25
2010-7-5	21.05	21.75	21.50	21.50
2010-7-6	19.79	21.75	21.50	21.60
2010-7-7	18.29	19.75	19.50	20.00
2010-7-8	17.19	19.75	19.00	19.00
2010-7-9	16.83	18.75	18.50	18.75
2010-7-12	16.20	18.25	17.80	18.00
2010-7-13	15.74	18.25	16.70	15.25
2010-7-14	15.44	18.25	15.75	16.00
2010-7-15	15.60	18.75	15.25	15.50
2010-7-16	15.93	18.75	15.75	16.00
2010-7-19	16.27	18.75	16.40	16.50
2010-7-20	16.66	18.25	17.10	17.25
2010-7-21	17.03	18.25	17.30	17.25
2010-7-22	17.00	18.25	17.50	17.80
2010-7-23	17.43	18.25	17.70	18.40
2010-7-26	17.47	17.75	18.00	18.25
2010-7-27	17.47	17.75	18.00	18.25
2010-7-28	18.05	18.25	22.25	19.50
2010-7-29	18.77	19.50	23.00	20.90
2010-7-30	18.98	19.50	23.00	22.00
2010-8-2	19.01	19.75	23.00	21.70
2010-8-3	19.21	19.75	23.00	21.50
2010-8-4	19.46	19.75	23.25	21.50
2010-8-5	20.34	19.75	23.25	21.50
2010-8-6	21.47	19.75	23.25	23.00
2010-8-9	22.35	22.25	23.75	20.50
2010-8-10	23.85	24.25	26.50	22.50

2010-8-11	26.42	24.75	27.00	24.50
2010-8-12	26.52	24.75	26.75	26.00
2010-8-16	26.47	25.25	26.50	25.25
2010-8-17	26.55	25.50	26.50	26.50
2010-8-18	26.69	25.50	26.50	26.50
2010-8-19	27.19	25.75	27.00	27.00
2010-8-20	28.33	25.50	27.25	27.25
2010-8-23	28.77	25.50	27.25	27.25
2010-8-24	28.78	25.50	27.50	27.50
2010-8-25	27.49	25.50	26.50	26.50
2010-8-26	26.57	25.50	26.50	26.50
2010-8-27	26.75	25.50	26.50	26.50
2010-8-31	27.02	27.25	28.00	28.75
2010-9-1	27.69	28.25	28.50	28.50
2010-9-2	28.57	28.50	28.75	28.75
2010-9-3	28.85	28.50	28.75	29.00
2010-9-6	28.79	28.75	28.80	29.00
2010-9-7	28.89	29.25	29.25	29.50
2010-9-8	29.42	29.25	28.80	28.50
2010-9-9	29.45	29.25	28.70	28.40
2010-9-10	29.51	29.25	28.50	28.20
2010-9-13	29.37	29.25	28.50	28.25
2010-9-14	29.16	29.00	28.25	28.00
2010-9-15	28.52	28.75	28.00	27.75
2010-9-16	27.89	28.50	27.75	27.50
2010-9-17	27.04	28.50	27.75	27.75
2010-9-20	26.37	28.25	27.50	27.50
2010-9-21	25.76	28.00	27.25	27.25
2010-9-22	24.84	27.50	27.00	27.00
2010-9-23	24.73	27.50	26.75	26.50
2010-9-24	24.84	27.50	26.75	26.50
2010-9-27	25.27	27.50	27.00	27.00
2010-9-28	27.15	27.25	26.75	26.70
2010-9-29	27.34	26.50	26.25	26.00
2010-9-30	27.50	26.50	26.25	26.00
2010-10-1	27.83	27.75	27.25	27.00
2010-10-4	28.21	28.75	28.25	28.00
2010-10-5	29.21	29.25	29.00	28.75
2010-10-7	29.68	29.50	29.00	29.00
2010-10-8	29.84	29.50	28.75	28.50
2010-10-11	29.60	29.25	28.75	28.50
2010-10-12	29.77	29.50	29.00	28.75
2010-10-14	30.69	30.00	29.25	29.00
2010-10-15	30.97	30.50	29.50	29.25



2010-10-18	31.06	30.50	29.50	29.25
2010-10-19	31.03	30.50	29.50	29.25
2010-10-20	31.12	30.50	29.50	29.50
2010-10-21	31.16	30.25	29.25	29.25
2010-10-22	31.45	30.50	29.00	28.50
2010-10-25	31.53	30.75	29.25	28.75
2010-10-26	31.61	30.75	29.50	28.75
2010-10-27	31.29	30.75	29.25	28.50
2010-10-28	30.35	30.60	29.10	28.25
2010-10-29	30.00	30.60	29.00	28.25
2010-11-1	29.80	29.75	27.75	27.75
2010-11-2	29.27	29.50	27.50	27.50
2010-11-3	28.74	29.25	27.25	27.25
2010-11-4	28.68	28.00	26.50	26.50
2010-11-5	28.64	28.00	26.50	26.50
2010-11-8	28.70	28.25	26.50	26.50
2010-11-9	28.87	28.00	26.50	26.50
2010-11-11	27.92	28.00	26.00	26.00
2010-11-12	27.44	28.00	26.00	26.00
2010-11-15	27.07	28.00	26.00	26.00
2010-11-16	27.11	28.00	26.00	26.00
2010-11-17	27.34	27.50	26.25	26.25
2010-11-18	27.40	27.50	26.75	26.75
2010-11-19	27.45	28.00	27.50	27.50
2010-11-22	27.55	28.00	27.50	27.50
2010-11-23	27.39	28.00	27.50	27.50
2010-11-24	26.59	27.75	26.75	26.75
2010-11-25	25.19	27.75	26.50	26.50
2010-11-26	24.21	27.75	26.50	26.50
2010-11-29	23.52	26.50	26.00	25.00
2010-11-30	22.44	22.25	21.50	21.25
2010-12-1	22.41	22.25	21.50	21.25
2010-12-3	22.73	22.25	21.50	21.25
2010-12-6	22.71	22.50	21.75	21.50
2010-12-7	22.09	22.25	22.00	22.00
2010-12-8	21.54	22.25	22.00	21.50
2010-12-9	21.09	22.25	22.00	21.75
2010-12-10	20.87	22.40	22.00	21.75
2010-12-13	20.75	22.40	22.00	21.75
2010-12-14	20.85	21.75	22.00	21.75
2010-12-15	21.16	21.75	22.00	21.75
2010-12-16	21.65	22.00	22.00	21.75
2010-12-17	21.88	22.00	22.00	21.75
2010-12-20	21.67	21.85	22.00	21.75

2010-12-21	21.42	21.75	21.75	21.75
2010-12-22	21.06	21.75	21.25	21.50
2010-12-23	20.76	22.00	22.00	21.50
2010-12-24	20.61	22.00	22.00	21.50
2011-1-4	20.22	20.75	20.50	20.25
2011-1-5	19.68	20.00	19.75	19.55
2011-1-6	19.04	19.25	19.00	18.80
2011-1-7	18.57	19.00	18.75	18.55
2011-1-10	18.23	19.75	19.50	19.25
2011-1-11	18.02	19.75	19.50	19.25
2011-1-12	17.85	19.75	19.50	19.25
2011-1-13	18.13	18.50	18.25	18.00
2011-1-14	18.32	18.50	18.25	18.00
2011-1-17	18.38	18.75	18.50	18.25
2011-1-18	18.30	18.75	18.50	18.25
2011-1-19	18.15	18.75	18.50	18.25
2011-1-20	18.13	18.75	18.50	18.25
2011-1-21	18.10	18.75	19.75	22.50
2011-1-24	17.99	18.60	19.50	22.25
2011-1-25	17.60	18.50	19.25	22.00
2011-1-26	17.30	18.50	18.25	19.75
2011-1-27	16.96	18.50	18.25	19.75
2011-2-1	16.59	17.40	19.25	20.50
2011-2-2	16.56	17.40	18.35	19.50
2011-2-3	16.59	17.40	18.35	19.50
2011-2-4	16.66	17.25	18.50	19.00
2011-2-7	16.65	17.15	18.75	19.25
2011-2-8	16.73	17.15	18.75	19.25
2011-2-9	17.22	17.50	18.50	19.00
2011-2-10	17.64	17.50	18.75	19.25
2011-2-11	18.28	17.50	18.75	19.25
2011-2-14	18.25	18.00	18.75	19.25
2011-2-15	18.35	18.00	18.75	19.25
2011-2-16	18.37	18.00	19.00	19.50
2011-2-17	18.48	18.00	19.00	19.50
2011-2-18	18.52	17.75	18.75	19.25
2011-2-21	18.48	17.75	18.75	19.25
2011-2-22	18.38	17.75	19.25	19.75
2011-2-23	18.25	17.75	18.75	19.25
2011-2-24	18.18	17.75	19.00	19.50
2011-2-25	18.25	17.75	19.00	19.50
2011-2-28	18.27	19.75	21.00	22.00
2011-3-3	18.69	20.00	21.50	22.50
2011-3-4	18.90	20.00	21.00	22.00

2011-3-7	19.18	20.00	21.50	22.50
2011-3-8	19.48	20.25	21.50	22.50
2011-3-9	19.89	20.25	22.00	23.00
2011-3-10	20.53	20.25	22.00	23.00
2011-3-11	20.69	20.25	22.00	23.00
2011-3-14	20.44	20.38	21.50	22.50
2011-3-15	19.96	20.25	21.00	22.00
2011-3-16	19.41	20.25	21.00	22.00
2011-3-17	19.15	20.00	21.00	22.00
2011-3-21	18.89	19.50	19.90	21.20
2011-3-22	19.02	19.50	20.25	21.50
2011-3-23	19.51	19.50	20.65	21.90
2011-3-25	19.86	19.65	20.60	21.80
2011-3-28	19.93	19.65	20.60	22.00
2011-3-29	19.91	19.80	20.50	21.80
2011-3-31	19.74	20.25	20.00	21.00
2011-4-1	19.77	20.25	20.00	20.00
2011-4-4	19.74	20.00	19.75	19.50
2011-4-6	19.39	19.90	19.50	19.00
2011-4-7	19.27	19.75	19.30	18.90
2011-4-11	19.15	19.50	19.00	18.80
2011-4-12	19.05	19.25	18.40	18.00
2011-4-13	19.04	19.00	18.60	18.20
2011-4-14	19.07	19.00	18.70	18.40
2011-4-15	19.05	19.00	18.70	18.50
2011-4-18	19.04	19.00	18.70	18.50
2011-4-19	19.02	19.00	18.70	18.50
2011-4-20	19.11	19.00	18.70	18.50
2011-4-21	19.08	19.25	18.90	18.70
2011-4-26	19.05	19.20	18.90	18.70
2011-4-27	19.38	19.50	19.20	19.00
2011-4-28	19.43	19.50	19.20	19.00
2011-5-3	19.44	20.50	20.00	19.80
2011-5-4	19.36	20.00	19.80	19.50
2011-5-6	19.29	19.90	19.70	19.40
2011-5-9	19.18	19.85	19.60	19.20
2011-5-10	19.08	19.50	19.20	18.80
2011-5-11	18.99	19.50	19.20	18.80
2011-5-12	18.89	19.25	19.00	18.60
2011-5-13	18.80	19.25	19.00	18.60
2011-5-16	18.49	19.00	18.80	18.30
2011-5-17	18.28	19.00	18.80	18.30
2011-5-18	18.17	19.00	18.70	18.30
2011-5-19	19.24	19.25	19.00	18.70

2011-5-23	19.27	19.75	19.50	19.75
2011-5-24	19.30	19.90	19.75	20.00
2011-5-25	19.38	19.90	19.75	20.00
2011-5-26	19.52	20.00	19.90	20.10
2011-5-27	19.76	20.00	20.00	20.10
2011-5-31	20.47	20.50	20.50	20.60
2011-6-1	20.75	21.25	21.25	21.30
2011-6-2	20.88	21.25	21.00	21.20
2011-6-3	20.99	21.25	21.00	21.20
2011-6-6	20.91	21.25	21.00	21.00
2011-6-7	20.39	21.00	20.95	21.00
2011-6-8	19.98	20.50	20.20	20.40
2011-7-11	20.54	21.30	21.00	20.70
2011-7-12	20.40	21.30	21.00	20.70
2011-7-13	20.25	20.50	20.30	20.00
2011-7-14	20.13	20.40	20.40	20.50
2011-7-18	19.81	20.40	20.20	20.00
2011-7-19	19.69	20.40	20.20	20.00
2011-7-20	19.56	20.40	20.20	20.00
2011-7-21	19.39	20.00	20.10	20.20
2011-7-22	19.32	20.00	20.20	20.30
2011-7-25	19.27	20.00	20.20	20.30
2011-7-26	19.29	20.00	20.30	20.40
2011-7-27	19.45	20.00	20.20	20.30
2011-7-28	19.43	20.00	20.20	20.30
2011-7-29	19.38	19.60	19.40	19.20
2011-8-1	19.34	19.70	19.70	19.50
2011-8-2	19.30	19.70	19.70	19.70
2011-8-3	19.36	20.00	20.00	20.00
2011-8-4	19.45	20.00	20.10	20.20
2011-8-5	19.53	20.00	20.10	20.20
2011-8-8	19.57	20.00	20.20	20.30
2011-8-9	19.51	20.00	20.20	20.30
2011-8-10	19.72	20.00	20.20	20.30
2011-8-11	19.95	20.15	20.40	20.60
2011-8-12	20.14	20.15	20.40	20.60
2011-8-15	20.22	20.30	20.60	20.80
2011-8-16	20.66	20.55	20.85	21.00
2011-8-17	21.34	20.60	20.90	21.10
2011-8-18	22.35	21.60	22.50	22.80
2011-8-19	23.19	21.50	22.50	22.70
2011-8-22	24.35	22.00	24.00	24.50
2011-8-23	25.24	23.50	24.50	25.00
2011-8-24	25.84	23.50	24.50	25.50

2011-8-25	24.45	23.50	24.50	25.50
2011-8-30	23.64	24.85	25.00	26.00
2011-8-31	24.94	25.75	26.00	26.50
2011-9-1	26.02	26.75	26.70	26.70
2011-9-2	27.07	27.00	27.10	27.10
2011-9-5	27.15	26.50	26.80	27.00
2011-9-6	26.98	26.75	27.00	27.20
2011-9-7	26.48	26.50	26.70	26.90
2011-9-8	27.18	26.50	26.70	26.90
2011-9-9	27.86	27.00	27.30	27.60
2011-9-12	28.40	27.50	27.80	28.10
2011-9-13	28.86	27.75	28.00	28.40
2011-9-14	28.82	28.00	28.50	28.90
2011-9-15	28.16	28.00	28.50	28.90
2011-9-16	26.77	28.00	27.50	27.00
2011-9-19	25.69	27.75	27.50	27.00
2011-9-20	26.92	27.25	26.50	26.50
2011-9-21	27.15	27.25	26.50	26.50
2011-9-22	27.62	27.50	26.75	26.75
2011-9-23	27.75	27.50	26.75	26.70
2011-9-26	27.59	27.75	26.50	26.50
2011-9-27	27.66	28.00	26.50	26.50
2011-9-29	27.27	27.50	26.00	26.00
2011-9-30	26.82	26.00	25.75	25.75
2011-10-3	26.28	25.25	24.25	23.75
2011-10-4	26.11	25.25	24.25	23.75
2011-10-5	26.53	25.50	25.00	24.50
2011-10-6	26.82	25.75	24.75	24.25
2011-10-7	26.95	25.75	24.75	24.25
2011-10-10	27.07	26.50	25.25	24.75
2011-10-11	27.62	26.75	25.50	25.00
2011-10-12	28.38	27.00	25.50	25.00
2011-10-13	28.50	27.25	25.75	25.25
2011-10-14	28.87	27.25	25.25	24.25
2011-10-17	28.87	27.15	25.00	24.00
2011-10-18	28.72	28.00	25.50	24.50
2011-10-19	29.34	28.25	25.50	24.50
2011-10-20	29.84	28.25	25.50	24.50
2011-10-21	29.89	28.50	25.75	24.75
2011-10-24	30.11	28.75	27.50	26.00
2011-10-25	30.64	29.00	27.60	26.10
2011-10-26	30.46	28.90	27.50	26.00
2011-10-27	29.57	28.75	27.25	25.75
2011-10-28	28.71	28.75	27.25	25.75

2011-10-31	27.34	27.00	25.50	23.75
2011-11-1	26.44	26.00	25.00	23.25
2011-11-2	25.15	25.25	24.00	22.25
2011-11-3	24.60	24.50	23.50	23.50
2011-11-4	24.40	24.50	23.50	23.50
2011-11-7	24.30	24.50	23.75	23.50
2011-11-8	24.64	24.75	24.25	24.00
2011-11-11	26.29	25.65	24.75	24.50
2011-11-14	26.10	25.75	24.75	24.50
2011-11-15	26.46	25.75	25.00	24.50
2011-11-16	27.65	26.50	27.50	25.00
2011-11-17	28.46	26.35	27.25	25.00
2011-11-18	28.38	26.25	27.00	25.00
2011-11-21	27.94	26.50	26.00	24.75
2011-11-22	27.79	26.50	26.00	22.75
2011-11-23	27.70	26.50	25.75	22.75
2011-11-24	27.49	26.50	25.75	22.75
2011-11-25	27.48	26.60	25.25	22.75
2011-11-28	27.55	26.90	26.50	22.50
2011-11-29	27.94	27.00	27.25	23.00
2011-11-30	28.29	26.00	23.00	22.75
2011-12-1	28.65	27.25	26.25	22.75
2011-12-2	28.84	27.25	26.25	22.75
2011-12-5	28.90	27.50	26.00	23.50
2011-12-6	29.06	27.75	26.25	23.75
2011-12-7	29.42	28.50	26.75	24.00
2011-12-8	30.10	28.50	27.00	24.25
2011-12-9	30.73	30.25	27.00	23.75
2011-12-12	30.72	30.25	25.50	23.75
2011-12-13	30.43	30.25	25.50	23.75
2011-12-14	29.89	30.25	26.25	24.50
2011-12-15	29.50	30.00	26.75	25.25
2011-12-16	29.55	30.00	27.00	25.25
2011-12-19	29.93	30.00	26.50	25.25
2011-12-20	29.99	30.00	26.50	25.25
2011-12-21	30.24	30.00	26.40	25.00
2011-12-22	29.92	30.00	26.40	25.00
2012-1-3	27.58	26.00	24.50	24.10
2012-1-4	25.79	25.50	24.25	23.00
2012-1-5	24.08	24.25	23.25	23.00
2012-1-6	23.31	24.00	23.00	23.00
2012-1-9	23.09	23.25	22.75	22.50
2012-1-10	22.70	23.25	22.65	22.65
2012-1-11	21.93	23.00	22.00	22.00

2012-1-12	20.80	21.75	21.50	21.50
2012-1-13	20.25	21.50	21.25	21.25
2012-1-16	20.06	21.25	20.50	21.50
2012-1-17	19.89	21.25	20.50	21.50
2012-1-18	19.76	21.25	20.50	21.50
2012-1-19	19.59	21.25	20.50	21.25
2012-1-27	19.33	21.30	20.00	20.75
2012-1-30	19.27	21.25	20.00	20.75
2012-1-31	19.25	20.00	20.75	21.00
2012-2-1	19.28	20.00	20.75	21.00
2012-2-2	19.38	20.10	20.85	21.10
2012-2-3	19.42	20.10	20.85	21.10
2012-2-6	19.47	20.15	20.85	21.10
2012-2-7	19.53	20.15	20.85	21.10
2012-2-8	19.57	20.15	20.85	21.10
2012-2-9	19.61	20.15	20.80	21.10
2012-2-10	19.61	20.15	20.85	21.10
2012-2-13	19.64	20.00	20.75	21.00
2012-2-14	19.68	20.00	20.75	21.00
2012-2-15	19.65	20.00	20.75	21.00
2012-2-16	19.65	20.00	20.75	21.00
2012-2-17	19.65	19.90	20.75	21.00
2012-2-20	19.65	19.75	21.00	22.25
2012-2-21	19.77	19.80	21.00	22.25
2012-2-23	20.25	19.80	21.75	22.75
2012-2-24	20.47	19.80	21.75	22.75
2012-2-27	20.61	19.80	21.85	22.75
2012-2-28	20.69	21.65	22.75	22.75
2012-2-29	20.68	21.30	22.75	22.50
2012-3-1	20.60	21.30	22.75	22.50
2012-3-5	20.50	21.00	22.25	22.50
2012-3-6	20.44	20.85	22.00	22.00
2012-3-7	20.40	20.80	21.90	21.90
2012-3-8	20.38	20.75	21.50	21.75
2012-3-9	20.34	20.70	21.40	21.70
2012-3-12	20.29	20.70	21.25	21.50
2012-3-13	20.22	20.60	21.10	21.40
2012-3-16	20.06	20.45	21.10	21.40
2012-3-19	19.88	20.45	21.10	21.40
2012-3-21	19.72	20.30	21.00	21.30
2012-3-22	19.64	20.30	21.00	21.30
2012-3-23	19.60	20.30	21.00	21.30
2012-3-27	19.58	20.30	20.95	21.25
2012-3-28	19.59	20.20	21.30	21.85

2012-3-29	19.72	20.30	21.75	22.20
2012-3-30	19.91	20.30	21.75	22.20



route C5 \$/ton

date	spot price	one month FFA price	two months FFA price	three months FFA price
2010-4-9	9.90	10.25	10.00	9.75
2010-4-12	9.78	10.00	9.75	9.65
2010-4-13	9.72	10.00	9.75	9.60
2010-4-14	9.82	10.00	9.80	9.75
2010-4-15	9.85	10.00	9.80	9.60
2010-4-19	9.85	10.00	9.75	9.70
2010-4-20	9.98	10.25	10.00	9.80
2010-4-21	10.47	10.50	11.00	10.20
2010-4-22	10.38	10.50	10.25	10.00
2010-4-23	10.19	10.50	10.40	10.20
2010-4-26	10.13	10.50	10.25	10.10
2010-4-27	10.95	10.50	10.50	10.20
2010-4-28	11.15	10.75	10.60	10.30
2010-4-29	10.98	10.75	10.80	10.60
2010-4-30	10.85	11.50	11.10	10.80
2010-5-4	10.79	11.50	11.00	11.00
2010-5-5	10.89	11.50	10.75	10.50
2010-5-6	11.26	12.00	11.50	11.00
2010-5-7	12.49	12.75	12.25	12.00
2010-5-10	13.05	13.50	12.95	12.75
2010-5-11	13.65	13.75	13.15	13.00
2010-5-13	13.78	14.00	13.35	13.25
2010-5-14	13.60	14.00	13.30	13.20
2010-5-17	13.36	13.75	13.00	13.00
2010-5-18	12.73	13.50	12.70	12.75
2010-5-19	12.13	13.00	12.20	12.00
2010-5-20	11.63	13.25	11.20	11.00
2010-5-21	11.86	13.50	11.40	11.30
2010-5-24	12.91	14.00	12.40	12.30
2010-5-25	14.09	13.00	13.50	13.20
2010-5-26	14.18	13.00	13.60	13.25
2010-5-27	13.79	12.75	12.50	12.25
2010-5-28	13.63	12.75	13.20	13.00
2010-6-1	14.41	13.25	13.70	13.50
2010-6-2	14.74	13.25	14.30	14.20
2010-6-3	14.25	13.00	13.05	13.95
2010-6-4	13.72	12.75	13.50	13.40
2010-6-7	13.00	12.50	13.30	13.10
2010-6-8	12.08	11.75	12.40	12.20
2010-6-9	12.19	12.00	11.90	11.70

2010-6-10	12.13	12.00	11.90	11.70
2010-6-11	11.96	12.00	11.80	11.60
2010-6-14	11.40	11.75	11.55	11.35
2010-6-15	11.18	11.50	11.40	11.00
2010-6-16	10.36	11.00	10.50	10.00
2010-6-17	10.09	11.00	10.50	10.00
2010-6-18	9.60	11.00	10.50	9.50
2010-6-21	8.85	11.50	10.50	9.50
2010-6-22	8.61	11.25	10.00	9.00
2010-6-23	8.70	11.25	10.00	9.00
2010-6-24	8.82	11.25	10.00	9.00
2010-6-25	8.88	11.25	10.00	9.00
2010-6-28	8.84	9.75	8.50	8.25
2010-6-29	8.81	9.75	8.60	8.40
2010-6-30	8.72	9.75	8.90	8.60
2010-7-1	8.41	9.50	9.10	9.00
2010-7-2	8.32	9.00	8.70	8.50
2010-7-5	8.17	8.75	8.50	8.60
2010-7-6	7.89	8.75	8.40	8.25
2010-7-7	7.70	8.25	8.00	8.10
2010-7-8	7.44	8.25	7.80	8.20
2010-7-9	7.30	8.25	7.60	7.25
2010-7-12	6.87	8.10	6.90	7.00
2010-7-13	6.65	8.10	6.50	6.90
2010-7-14	6.00	7.75	6.10	6.30
2010-7-15	6.01	7.75	6.10	6.30
2010-7-16	6.16	7.50	5.90	6.10
2010-7-19	6.19	7.50	6.40	6.50
2010-7-20	6.58	7.75	7.10	6.75
2010-7-21	6.45	7.75	7.00	6.50
2010-7-22	6.15	7.75	6.80	5.50
2010-7-23	6.17	7.75	6.40	6.80
2010-7-26	6.14	7.00	6.90	5.50
2010-7-27	6.14	7.00	6.90	6.50
2010-7-28	6.75	7.25	7.75	8.00
2010-7-29	6.97	7.50	7.75	8.50
2010-7-30	7.00	7.50	7.75	8.50
2010-8-2	6.90	7.50	8.00	8.20
2010-8-3	6.53	7.50	8.00	8.00
2010-8-4	6.82	7.50	8.00	8.50
2010-8-5	7.02	8.00	8.25	8.50
2010-8-6	7.62	8.00	8.25	8.50

2010-8-9	9.01	8.75	9.50	9.50
2010-8-10	9.41	10.00	10.75	10.75
2010-8-11	10.49	10.25	11.00	11.00
2010-8-12	10.60	10.00	10.75	10.75
2010-8-16	10.26	9.75	10.50	10.50
2010-8-17	10.33	9.75	10.50	10.50
2010-8-18	10.29	9.75	10.50	10.50
2010-8-19	10.47	10.50	11.00	11.00
2010-8-20	11.06	10.75	11.25	11.25
2010-8-23	11.85	10.75	11.25	11.25
2010-8-24	11.81	10.75	11.75	11.75
2010-8-25	10.65	10.75	11.50	11.50
2010-8-26	10.33	10.75	11.25	11.25
2010-8-27	10.80	10.75	11.25	11.25
2010-8-31	11.01	11.50	12.00	12.75
2010-9-1	11.25	12.00	12.25	12.75
2010-9-2	12.05	12.25	12.50	12.90
2010-9-3	11.92	12.25	12.50	12.90
2010-9-6	11.42	12.00	12.20	13.00
2010-9-7	11.52	12.25	12.50	13.00
2010-9-8	11.97	12.25	12.50	13.00
2010-9-9	11.81	12.00	12.25	12.75
2010-9-10	11.79	12.00	12.25	12.75
2010-9-13	11.74	12.00	12.25	12.50
2010-9-14	11.55	11.75	12.00	12.25
2010-9-15	11.04	11.50	11.75	12.00
2010-9-16	10.78	11.50	11.75	12.00
2010-9-17	10.70	11.50	11.50	11.75
2010-9-20	10.59	11.25	11.50	11.75
2010-9-21	10.14	11.00	11.25	11.50
2010-9-22	10.05	10.50	10.75	11.00
2010-9-23	10.09	10.50	10.75	10.75
2010-9-24	10.16	10.75	10.50	10.25
2010-9-27	10.41	10.75	11.00	11.00
2010-9-28	11.00	11.50	11.50	11.75
2010-9-29	10.81	11.00	11.25	11.50
2010-9-30	10.54	11.00	11.25	11.50
2010-10-1	10.54	11.10	11.35	11.60
2010-10-4	10.67	11.25	11.25	11.50
2010-10-5	11.58	11.50	11.50	11.70
2010-10-7	12.08	11.75	11.75	11.70
2010-10-8	12.08	11.75	11.50	11.50
2010-10-11	11.95	11.75	11.50	11.25

2010-10-12	11.85	11.75	11.50	11.50
2010-10-14	12.08	12.25	12.00	12.00
2010-10-15	12.14	12.50	12.25	12.00
2010-10-18	12.17	12.50	12.00	11.75
2010-10-19	12.12	12.50	12.00	11.75
2010-10-20	12.04	12.50	12.00	12.00
2010-10-21	11.99	12.50	12.00	12.00
2010-10-22	12.02	12.50	12.00	12.00
2010-10-25	12.10	12.50	12.00	12.00
2010-10-26	12.25	12.50	12.00	11.75
2010-10-27	12.55	12.50	11.75	11.75
2010-10-28	12.08	12.50	11.75	11.50
2010-10-29	12.25	12.50	11.75	11.50
2010-11-1	12.14	12.25	11.50	11.50
2010-11-2	12.01	12.25	11.50	11.50
2010-11-3	11.89	12.00	11.50	11.50
2010-11-4	11.76	12.00	11.50	11.50
2010-11-5	11.76	12.00	11.50	11.50
2010-11-8	11.71	11.85	11.50	11.50
2010-11-9	11.55	11.75	11.40	11.40
2010-11-11	11.08	11.50	11.40	11.40
2010-11-12	11.01	11.25	11.25	11.25
2010-11-15	10.81	11.25	11.25	11.25
2010-11-16	10.57	11.25	11.25	11.25
2010-11-17	10.53	11.25	10.75	10.75
2010-11-18	10.54	11.25	10.75	10.75
2010-11-19	10.53	11.25	10.75	10.75
2010-11-22	10.48	11.25	10.75	10.75
2010-11-23	10.41	11.25	10.75	10.75
2010-11-24	10.32	11.00	10.50	10.50
2010-11-25	10.03	11.00	10.25	10.25
2010-11-26	9.72	11.00	10.25	10.25
2010-11-29	9.14	10.25	10.25	10.00
2010-11-30	8.60	9.25	9.00	9.00
2010-12-1	8.50	9.35	9.15	9.25
2010-12-3	8.76	9.35	9.15	9.15
2010-12-6	8.74	9.25	9.05	9.00
2010-12-7	8.53	9.25	9.00	9.00
2010-12-8	8.38	9.25	8.75	8.75
2010-12-9	8.22	9.25	8.75	8.75
2010-12-10	8.38	8.75	8.75	8.75
2010-12-13	8.40	8.75	8.80	8.75
2010-12-14	8.56	8.75	8.80	8.75
2010-12-15	8.70	8.75	8.80	8.75

2010-12-16	8.72	8.75	8.75	8.75
2010-12-17	8.73	8.75	8.75	8.75
2010-12-20	8.49	8.75	8.75	8.75
2010-12-21	8.36	8.75	8.65	8.75
2010-12-22	8.18	8.50	8.25	8.50
2010-12-23	8.11	8.75	8.25	8.50
2010-12-24	8.05	8.75	8.25	8.50
2011-1-4	8.10	8.25	8.00	8.00
2011-1-5	7.81	8.00	7.80	7.70
2011-1-6	7.54	7.90	7.70	7.60
2011-1-7	7.34	7.65	7.35	7.25
2011-1-10	7.19	7.75	7.50	7.35
2011-1-11	6.86	7.75	7.50	7.35
2011-1-12	6.70	7.75	7.50	7.35
2011-1-13	6.64	7.40	7.30	7.10
2011-1-14	6.54	7.40	7.30	7.10
2011-1-17	6.53	7.25	7.05	6.95
2011-1-18	6.55	7.00	6.90	6.60
2011-1-19	6.66	7.00	6.90	6.60
2011-1-20	6.71	7.00	6.90	6.60
2011-1-21	6.73	7.00	8.50	9.05
2011-1-24	6.73	7.00	8.35	9.00
2011-1-25	6.69	6.75	8.25	8.75
2011-1-26	6.60	6.75	7.25	7.75
2011-1-27	6.54	6.75	7.25	7.75
2011-2-1	6.49	7.25	8.00	8.50
2011-2-2	6.46	7.00	7.50	8.00
2011-2-3	6.40	7.25	7.75	7.90
2011-2-4	6.42	7.50	7.75	8.00
2011-2-7	6.34	7.00	7.50	7.80
2011-2-8	6.36	7.00	7.50	7.80
2011-2-9	6.49	7.50	8.10	8.30
2011-2-10	6.73	7.50	8.10	8.30
2011-2-11	6.77	7.50	8.10	8.30
2011-2-14	6.93	7.50	8.75	8.80
2011-2-15	6.90	7.50	8.75	8.80
2011-2-16	6.80	7.25	7.90	8.10
2011-2-17	6.73	7.25	7.80	8.00
2011-2-18	6.70	7.25	7.65	7.90
2011-2-21	6.63	7.00	7.50	7.80
2011-2-22	6.57	6.75	7.45	8.00
2011-2-23	6.54	6.75	7.40	7.60

2011-2-24	6.56	6.75	7.60	7.90
2011-2-25	6.59	6.75	7.60	7.90
2011-2-28	6.58	7.70	8.00	8.20
2011-3-3	6.77	8.00	8.50	8.80
2011-3-4	6.82	8.00	8.50	8.80
2011-3-7	7.16	8.00	8.50	8.90
2011-3-8	7.41	8.25	8.50	8.95
2011-3-9	7.75	8.25	8.50	8.90
2011-3-10	8.22	8.25	8.50	8.90
2011-3-11	8.23	8.25	8.50	9.00
2011-3-14	8.06	8.35	8.50	9.10
2011-3-15	7.79	8.35	8.45	8.90
2011-3-16	7.58	8.35	8.45	8.90
2011-3-17	7.37	7.75	8.25	8.60
2011-3-21	7.23	7.50	7.90	8.30
2011-3-22	7.29	7.50	8.25	8.50
2011-3-23	7.50	7.50	8.25	8.50
2011-3-25	7.58	7.75	8.25	8.60
2011-3-28	7.52	7.50	8.25	8.50
2011-3-29	7.36	7.60	8.00	8.25
2011-3-31	7.47	7.85	7.80	8.00
2011-4-1	7.69	7.85	7.80	7.80
2011-4-4	7.71	7.90	7.85	7.80
2011-4-6	7.57	8.00	7.60	7.30
2011-4-7	7.50	7.90	7.40	7.10
2011-4-11	7.53	7.90	7.40	7.10
2011-4-12	7.53	7.75	7.20	7.00
2011-4-13	7.63	7.75	7.30	7.10
2011-4-14	7.80	7.75	7.40	7.20
2011-4-15	7.82	7.75	7.40	7.20
2011-4-18	7.82	7.65	7.40	7.20
2011-4-19	7.77	7.65	7.35	7.15
2011-4-20	7.75	7.65	7.40	7.20
2011-4-21	7.74	7.75	7.50	7.25
2011-4-26	7.83	7.80	7.60	7.30
2011-4-27	7.86	7.90	7.70	7.40
2011-4-28	7.88	7.90	7.70	7.40
2011-5-3	7.85	8.40	8.10	7.90
2011-5-4	7.80	8.15	7.70	7.50
2011-5-6	7.64	8.15	7.70	7.50
2011-5-9	7.61	8.15	7.70	7.50
2011-5-10	7.51	7.90	7.40	7.20

2011-5-11	7.42	7.90	7.40	7.20
2011-5-12	7.37	7.75	7.20	7.00
2011-5-13	7.33	7.75	7.20	7.00
2011-5-16	7.28	7.60	7.10	6.90
2011-5-17	7.21	7.50	7.20	7.00
2011-5-18	7.18	7.50	7.25	7.00
2011-5-19	7.23	7.50	7.25	7.00
2011-5-23	7.36	8.00	7.50	7.30
2011-5-24	7.37	8.00	7.50	7.40
2011-5-25	7.33	8.00	7.50	7.40
2011-5-26	7.42	8.00	7.50	7.50
2011-5-27	7.53	8.00	7.60	7.60
2011-5-31	7.63	8.00	7.60	7.60
2011-6-1	7.77	8.10	7.80	7.80
2011-6-2	7.83	8.00	8.00	8.00
2011-6-3	7.78	8.00	8.10	8.20
2011-6-6	7.74	8.00	7.90	7.80
2011-6-7	7.57	7.75	8.15	8.25
2011-6-8	7.54	7.60	7.80	8.00
2011-7-11	8.43	8.50	8.55	8.25
2011-7-12	8.15	8.50	8.50	8.40
2011-7-13	8.01	8.15	8.25	8.35
2011-7-14	8.03	8.15	8.25	8.35
2011-7-18	7.98	8.15	8.25	8.35
2011-7-19	7.96	8.20	8.25	8.40
2011-7-20	7.75	8.20	8.25	8.40
2011-7-21	7.78	8.10	8.20	8.30
2011-7-22	7.77	8.10	8.20	8.30
2011-7-25	7.77	8.10	8.20	8.30
2011-7-26	7.75	8.00	8.10	8.10
2011-7-27	7.76	8.00	8.15	8.15
2011-7-28	7.71	8.00	8.15	8.15
2011-7-29	7.68	7.90	8.00	8.10
2011-8-1	7.64	7.90	8.10	8.20
2011-8-2	7.78	7.90	8.10	8.20
2011-8-3	7.92	8.25	8.40	8.60
2011-8-4	8.15	8.25	8.40	8.60
2011-8-5	8.06	8.25	8.40	8.60
2011-8-8	7.95	8.15	8.35	8.55
2011-8-9	7.92	8.15	8.35	8.55
2011-8-10	8.03	8.15	8.35	8.45
2011-8-11	8.16	8.25	8.40	8.60
2011-8-12	8.18	8.25	8.40	8.60

2011-8-15	8.22	8.25	8.40	8.60
2011-8-16	8.43	8.50	8.65	8.95
2011-8-17	8.61	8.70	8.90	9.10
2011-8-18	8.78	8.85	9.10	9.30
2011-8-19	8.96	9.00	9.30	9.40
2011-8-22	9.05	9.00	9.20	9.40
2011-8-23	9.47	9.25	9.50	9.65
2011-8-24	9.97	9.25	9.50	9.65
2011-8-25	9.75	9.25	9.50	9.70
2011-8-30	9.11	9.60	9.70	9.90
2011-8-31	9.83	10.50	11.00	11.00
2011-9-1	10.73	11.00	11.00	11.00
2011-9-2	11.05	11.10	11.20	11.20
2011-9-5	10.98	11.00	11.20	11.20
2011-9-6	10.90	10.75	10.90	11.10
2011-9-7	10.69	10.75	10.80	11.00
2011-9-8	11.06	10.75	10.90	11.00
2011-9-9	11.56	11.50	11.50	11.60
2011-9-12	11.74	11.75	11.75	11.80
2011-9-13	11.67	11.50	11.60	11.70
2011-9-14	11.71	11.50	11.80	11.90
2011-9-15	11.54	11.50	11.70	11.80
2011-9-16	10.92	11.00	11.00	11.00
2011-9-19	10.37	11.00	10.80	11.00
2011-9-20	10.39	11.00	10.75	10.50
2011-9-21	10.58	11.00	10.75	10.50
2011-9-22	11.47	11.50	10.75	10.50
2011-9-23	11.74	11.40	10.75	10.50
2011-9-26	11.86	11.60	10.25	10.00
2011-9-27	11.71	11.50	10.50	10.00
2011-9-29	11.28	11.50	10.25	10.25
2011-9-30	11.12	10.25	10.25	10.25
2011-10-3	10.96	10.00	9.50	9.25
2011-10-4	10.76	10.00	9.50	9.25
2011-10-5	10.74	10.25	9.75	9.50
2011-10-6	10.99	10.50	10.00	9.75
2011-10-7	11.20	10.50	10.00	9.75
2011-10-10	11.42	11.25	10.50	10.00
2011-10-11	12.30	11.50	10.75	10.25
2011-10-12	12.14	11.50	10.50	10.25
2011-10-13	12.46	11.60	11.00	10.30
2011-10-14	12.65	11.60	10.90	10.20
2011-10-17	12.55	11.60	10.85	10.15
2011-10-18	12.03	11.60	10.85	10.15



2011-10-19	12.04	12.10	11.10	10.40
2011-10-20	12.35	12.10	11.10	10.40
2011-10-21	12.32	12.10	11.10	10.40
2011-10-24	12.32	12.25	11.50	10.50
2011-10-25	12.27	12.25	12.00	11.00
2011-10-26	12.13	12.25	11.75	10.75
2011-10-27	11.71	11.80	11.50	10.50
2011-10-28	10.91	11.80	11.50	10.50
2011-10-31	10.59	11.00	10.25	9.25
2011-11-1	10.12	10.00	9.50	8.75
2011-11-2	10.02	9.75	9.00	8.25
2011-11-3	9.76	9.30	8.60	8.95
2011-11-4	9.60	9.30	8.60	8.95
2011-11-7	9.48	10.00	9.75	9.25
2011-11-8	9.49	10.25	9.75	9.25
2011-11-11	11.15	10.50	10.00	9.10
2011-11-14	10.74	10.75	9.85	9.10
2011-11-15	10.52	10.75	9.85	9.10
2011-11-16	10.89	11.00	10.40	9.15
2011-11-17	11.06	10.50	10.35	9.15
2011-11-18	11.23	10.50	10.35	9.15
2011-11-21	11.31	11.00	10.25	8.55
2011-11-22	11.36	11.00	10.25	8.55
2011-11-23	10.93	11.00	10.00	8.55
2011-11-24	10.72	11.00	10.00	8.55
2011-11-25	10.83	10.75	10.00	8.55
2011-11-28	11.05	11.00	10.50	8.60
2011-11-29	11.78	11.00	11.20	9.50
2011-11-30	12.31	11.25	9.75	9.50
2011-12-1	12.78	11.75	11.25	9.40
2011-12-2	12.76	11.75	11.25	9.40
2011-12-5	12.53	11.90	11.00	9.90
2011-12-6	12.38	12.15	11.00	9.90
2011-12-7	12.16	12.20	11.00	10.00
2011-12-8	12.42	12.25	11.00	10.00
2011-12-9	13.33	12.50	11.00	10.00
2011-12-12	13.46	12.60	11.25	10.00
2011-12-13	13.37	12.85	11.25	10.00
2011-12-14	13.22	12.75	11.25	10.25
2011-12-15	12.77	12.60	11.25	10.00
2011-12-16	12.75	12.70	11.75	10.30
2011-12-19	12.72	12.70	11.75	10.30
2011-12-20	12.65	12.90	11.25	10.75
2011-12-21	12.33	12.80	11.20	10.70

2011-12-22	11.94	12.80	11.20	10.70
2012-1-3	10.90	10.50	10.15	9.65
2012-1-4	10.56	10.25	10.00	9.50
2012-1-5	9.81	9.90	9.50	9.50
2012-1-6	9.58	9.80	9.30	9.30
2012-1-9	9.33	9.50	9.30	9.30
2012-1-10	8.92	9.25	9.20	9.20
2012-1-11	8.63	9.25	9.00	9.00
2012-1-12	7.85	9.00	8.75	8.75
2012-1-13	7.73	9.00	8.75	8.75
2012-1-16	7.68	8.75	8.25	8.75
2012-1-17	7.63	8.50	8.15	8.70
2012-1-18	7.58	8.50	8.30	8.75
2012-1-19	7.60	8.50	8.50	8.75
2012-1-27	7.65	8.40	8.50	8.75
2012-1-30	7.63	8.35	8.40	8.75
2012-1-31	7.61	8.40	8.75	8.75
2012-2-1	7.61	8.40	8.75	8.75
2012-2-2	7.54	8.50	8.75	8.85
2012-2-3	7.43	8.00	8.75	8.85
2012-2-6	7.44	8.25	8.75	8.85
2012-2-7	7.48	8.25	8.75	8.85
2012-2-8	7.52	8.20	8.75	8.85
2012-2-9	7.58	8.15	8.65	8.85
2012-2-10	7.59	8.15	8.60	8.85
2012-2-13	7.61	8.00	8.75	8.90
2012-2-14	7.63	8.00	8.75	8.90
2012-2-15	7.63	8.00	8.75	8.90
2012-2-16	7.61	8.00	8.75	8.90
2012-2-17	7.61	7.85	8.75	8.90
2012-2-20	7.61	7.60	8.65	8.80
2012-2-21	7.61	7.70	8.00	8.75
2012-2-23	7.63	7.70	8.75	9.00
2012-2-24	7.83	7.70	8.75	9.00
2012-2-27	7.90	7.70	8.85	9.10
2012-2-28	7.92	8.55	8.65	8.75
2012-2-29	7.91	8.60	8.55	8.65
2012-3-1	7.91	8.60	8.55	8.65
2012-3-5	7.90	8.60	8.55	8.65
2012-3-6	7.90	8.50	8.55	8.50

2012-3-7	7.89	8.30	8.50	8.45
2012-3-8	7.81	8.10	8.50	8.40
2012-3-9	7.82	8.10	8.50	8.40
2012-3-12	7.80	8.10	8.10	8.40
2012-3-13	7.78	8.10	8.50	8.40
2012-3-16	7.78	8.10	8.00	8.30
2012-3-19	7.76	8.10	8.00	8.30
2012-3-21	7.56	7.80	8.10	8.20
2012-3-22	7.52	7.80	8.10	8.20
2012-3-23	7.47	7.80	8.10	8.20
2012-3-27	7.46	7.80	8.10	8.20
2012-3-28	7.50	7.75	8.25	8.40
2012-3-29	7.56	8.10	8.40	8.55
2012-3-30	7.70	8.10	8.40	8.55