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The impact of WTI and the ordering of crude tankers on tanker spot freight rate

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The impact of WTI and the ordering of crude tankers on tanker spot freight rate

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Declaration

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

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

XU JIAJIA

2018.06.30.

Abstract

The world trade has developed at a continuously fast speed recently years, shipping transportation gradually plays an indispensable role as the intermediate link of trade. Crude oil, needless to say, is the largest commodity traded in the world, so that as the transport carriers, tanker market has been paid more attention to.

The financial crisis in 2008 has caused great recession in shipping industry, and the results can be seen from the drop of major shipping indexes. The tanker freight market has been affected by the market factors as well, which WTI and new crude orders can be regarded as the demand &supply factors that influence the fluctuations of the freight rate. Before the crisis, the industry experienced a booming period, and undergone a low level of development after that. To have a clear comparison, it is needed to exclude the recession period and compare the effects on different type's tankers in the research. The tanker freight rate will take BDTI (Baltic Dirty Tanker Index) as reference, and the research will apply the VECM (Vector Error Correction Model) and dynamic relationship analysis to analyze the impacts of two factors specifically in a certain period of time on changes of spot freight rate. Two factors have the same trend with freight rate after crisis, which is different from the results before crisis.

Finally, the suggestion for the marketers is to be concerned with Asia countries development and US policy changes..

KEYWORDS: Tanker freight rate, crude oil, BDTI, crude tanker orders, VECM.

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Chapter 1 Introduction

1.1   Backgrounds of research

As a driving force of global development in economy, crude oil is in the unshakable position and always regarded as a powerful resource to stabilize the world economic landscape. No country can do without the various products produced by crude oil, so that the oil trade is derived from the need of international trade of this limited commodity. For the security and cost concerns, the way of transportation is mainly by tanker shipping.

The world economy is full of volatility, so as the trade does. Affected deeply by these two factors, shipping market also fluctuates all the time. As one of the major shipping markets, the frequent fluctuations in the tanker market are inevitable. Depending on the data, before the financial crisis happened in 2008, the huge demand for crude oil drove the tanker market to the highest point, which kept BDTI (Baltic Dirty Tanker Index, which concludes the market price information) over 1000 points. After the entire market collapsed, BDTI was down to even 500 points, and the excess demand was replaced by oversupply, which decreased the freight rate. As has been mentioned, the recession has heavily hit the world market, as we all know that the economy is much closely related with each other in today's business, so the domino effect happens and it has started from the American market. The US has the strongest currency for its powerful position, which the crude oil is dollar-denominated. Not only that, America ranks the first place of import of crude oil in the world, at the same time, the US consumption of crude oil is huge, showed by statistics, in 2016, 19.63 million barrels has been consumed every day. International crude oil prices are usually the U.S. crude futures prices. When the global demand plunged, especially America, the oversupply condition in crude market was worse than ever which the price dropped under 40 dollars per barrel at that time. What bothered the market more was the new orders of tankers on the way, which made the 9% growth of capacity more difficult to digest. Driven by two parts----demand and supply, the tanker freight rate decreased about 60%.

The tanker market is mainly controlled by the world demand & supply; of course, because of the precious nature of oil, it can be influenced by the change of economy

development and politics as well. As the special commodity for tanker transportation, the fluctuations of crude oil price have direct impacts on world trade. The spot freight rate can be considered to be an integrated reflection of the condition of these reasons. It is necessary to study the impacts of changes of crude oil prices and new order quantity on tanker spot freight rate as well as on different tanker types in the market. Obviously, the economic factor has done great damage to the market, in order to more directly observe the relationship among factors before and after the financial crisis, some related data will be eliminated from the study.

1.2   Literature review

Researches on tanker market and crude oil

In researches about tanker market, Adland R., Cullinane K. (2004) studied the non-linear dynamics of spot freight rate, what they have found was that (1) when the level of freight rate goes up, the tanker freight rate fluctuates more. (2) Tanker service couldn't be traded, which showed that it also could not be treated as a second-hand commodity. (3) Tanker market is an approximately perfect competitive market, and the spot freight rate reflects service prices. In addition, they put forward that some elements which can be predictable in spot freight rate would perform like the efficient market on account of the blocked information in market. However, Wan (2010) supported the view that the international crude oil and tanker freight market does not conform to the hypothesis of an effective market due to the irrationality of market investors, the necessary transaction cost in the market as well as the lagging reaction of investors to the market change.

Speaking of the volatility spillovers in tanker market, Tsouknidis D.A. (2016) considered that they had become more violent since the crisis happened. When the volatility spillovers are at a low level and lacking of some external shocks, the spillovers of tanker freight markets decrease. Considering on the vessels' types, as larger vessels are engaged in a riskier market, they reveal the highest volatility than the smaller ones. Furthermore, Wayne K. Talley (2011) thought that freight rates were influenced by the vessel's type, which included its deadweight, vessel age, and transport routes.

Despite of differentiation in vessel's types, the fluctuations in tanker market still have seasonal changes depending on this specific commodity. Kavussanos, Alizadeh-M (2001) discovered the seasonal rates change more obviously during the recovering market, vice versa. This is consistent with the market cycle, which fluctuates with the elasticity of supply. Javier Poblacion (2015) has supplemented that from the freight rates perspective, in winter and spring, they are higher than the other two seasons.

Turning to crude oil market, Silvério and Szklo (2012) studied the contribution relationship in oil price market, in other words, futures market helps the price discovery process of spot market, but the spot price would not follow the futures price. García-Carranco, Bory-Reyes, Balankin (2016) found that crude oil volatility dynamics was completely different during various price development. Mo, Nie, Jiang (2017) paid attention to the dynamic relationship between crude oil and US dollars, they claimed that there was a long time negatively dependence and fractional co-integration in two markets. WTI (West Texas Intermediate) Crude Oil, for the strong demand of American market, its futures price is regarded as one of the mainstream benchmarks in world. In WTI futures market, Alizadeh and Nomikos (2004) suggested that transportation costs should be the gap between spot and futures price of crude oil. Zheng and Lan's research in 2015 indicated that the crude oil price market was oligopolistic for that the price was regulated by a few countries. So that the oil freight rate had more fluctuations than regulated price in oil market. Not to mention that tanker market is full of uncertainties, raised by Sun, Tang, Yang, etc. (2014), the uncertainties are mainly connected with the changes of the oil market and the demand & supply situation in short and long term. Ladislav Kristoufek (2018) focused on the efficiency of crude oil market through a series of updated data, what revealed in the paper was that at least in the long term before the financial crisis started, the market could be regarded to be efficient. And the change of WTI didn't show more inefficiency during the periods that the whole shipping market was inefficient.

How the demand in crude oil affects its price is another topic to study. Wang and Sun (2017) proved that the demand was inelastic to the oil price volatility, and the most crucial factor to fluctuate oil price is economic behavior. Miao, Wang, etc.(2017) have found

demand had some positive impacts on the price.

Researches on impact of economic behaviors

The authors, Miao and Wang, etc.(2017) found that American monetary policy could be exhibited by the changes of interest rates and currency, which could have effects on crude oil prices.

Considering financial crisis factor, Wang S.Y., Pan J.J. and Yu S.Q. (2015) have studied on what impacts of crude oil price and the change of economy will influence the international tanker freight rate. They studied the connections between demand and supply factor in tanker market, and found that the actions of capital market create fluctuations in tanker market. The financial crisis is not all negative to the market, financial liberalization is improved, but, the regulation isn't strictly, by Hlaing, Kakinaka (2017).

As a capital-intensive industry, managing the financial part of shipping market is vital. Ahrends, Drobetz and Nomikos (2018) indicated that other companies which also had a strong desire to capital or assets didn't have such high cash reserves like shipping companies, which could be contributed to enlarge the marginal value of cash to overcome the scarce situation of capital supply, especially the external support. So, they become much more cautiously when they handle related matters. Alexandridis, Sahoo, Song and Visvikis (2018) pointed out that the shipping market was vulnerable to the sharply changeable fluctuations in freight rate department; therefore, hedging and diversifying some of the related risks become the main way to avoid or transfer risk. Kavussanos and Tsouknidis (2014) confirmed that the shipping bond was affected by the volatility in stock market, earnings from freight rate, etc. Drobetz, Haller, Meier (2016) focused on how financing activities influence the shipping market during and after the crisis. Alizadeh, Huang, Dellen (2015) have showed a regime switching model for a significant improvement in the performance of the hedge in shipping market.

1.3   The framework and contents of research

  The framework of this dissertation is:

Chapter1 The background and structure of the research.	Chapter3 Analysis of the influence of WTI and the ordering of crude tankers on tanker spot freight rate based on co-integration analysis and VECM.
Chapter2 The overview of tanker freight &new building market and analysis of factors affecting tanker spot freight rate.	Chapter4 Analysis of impacts of WTI and new crude tanker orders on the spot freight rate of three routes of VLCC.
Chapter5 Conclusion of research & suggestion for the markerters.	

The contents of this research are:

1. Make the statement of the feature and mechanism of tanker freight market and tanker new building market in order to roundly analyze the demand and supply of tanker market. Discover what related factors that affect the tanker spot freight market as well as the different impacts.

2. The analysis of demand & supply impacts on tanker spot freight rate and discussing the function of main factors to study what development of tanker market and the relationship among these factors before and after recession. In different market circumstances, before 2008and after 2009, how the changes of market behaviors of new tanker orders have impacted on tanker transport is totally different.

3. Mainly study on the relationship among crude oil price, new tanker order quantity and tanker spot freight fluctuations by correlation and regression analysis. In the dissertation the author will take BDTI index as the criterion of the spot freight rate of tankers, WTI index reflects the crude oil price changes and the data of new building tanker order quantity into the regression models. Use the co-integration analysis to test and verify the specific model as well as correct the defects of the design of the model or selection of data.

4. After the analysis of the overall relationship influence of the market, the study will separately focus on the particular type of tanker vessel----VLCC to see what impacts will be related with this type of vessel, through the research, to make the comparison based on

the results of the analysis.

5.   Based on the conclusion obtained, the related recommendations will be given to the marketers to contribute to the decision-making.

Chapter 2 An overview of crude tanker market

2.1 The analysis of crude tanker market

Tanker market varies from the other two main markets in the industry, container & dry bulk market, for that the commodities, especially crude oil, are relatively simple and centralized. Owing to the characteristic of the cargo, tanker market is vulnerable to the internal and external risks, which causes frequent alteration in the business. The risks mentioned can appear in political, economic or natural aspects depending on the development of world oil trade, after all, the crude oil is one of the most precious and limited resources for whole world to scramble for. What can obviously reflect these effects of risks in time is tanker freight market, and for crude oil trade, there is a weatherglass in market that relatively shows the real fluctuations------ BDTI (Baltic Dirty Tanker Index).

Baltic international tanker's daily freight index firstly issued by Baltic Exchange in 1998, the initial point was set at 1000 based on the weighted sum of 7 routes selected, as time developed, to adapt the rising demand of world oil trade, the index separated two parts----refined petroleum and crude oil. In the light of data, crude oil accounts for about 30% of the traded cargo today, as the feedback of the market; BDTI is a comprehensive indicator and applied in 2001. The components of BDTI are made up of the same weight of the freight of several routes included. The 17 companies, which are authoritative and have a good reputation, consist of the assessment group; they collect the newest transaction information in shipping industry to analyze the level of freight rates or daily rents of variable types of tankers. If there is an absent freight rate, the freight rates of others will be taken as references. Of course, the maximum and minimum data will be excluded to ensure the accuracy. The average daily rent levels of the route, separately multiplied with the conversion constant, then add the index of each route together; the result is BDTI of the day. Along with the development of the shipping market, up to now, BDTI covers 17 routes in the calculation as follows:

Baltic exchange dirty tanker index (BDTI) routes			
Route	Route description	Size mt	Indicative routes
TD1	ME Gulf to US Gulf	280000mt	Ras Tanura to LOOP
TD2	ME Gulf to Singapore	260000mt	Ras Tanura to Singapore
TD3	ME Gulf to Japan	260000mt	Ras Tanura to Chiba
TD4	W Africa to US Gulf	260000mt	O.S Bonny to Loop
TD5	W Africa to USAC	130000mt	O.S Bonny to Philadelphia
TD6	Black Sea / Med	135000mt	Novorossiyk to Augusta
TD7	North Sea to Cont	80000mt	Sullom Voe to Wilhelmshaven
TD8	Kuwait - Singapore(Crude/DPP Heat 135F)	80000mt	Mena al Ahmadi to Singapore
TD9	Caribs to US Gulf	70000mt	Puerto la Cruz to Corpus Christi
TD10	Caribs to USCA - Double hull vessel	50000mt	Aruba to New York
TD11	Cross Med	80000mt	Banias to Lavera
TD12	ARA to US Gulf	55000mt	Antwerp to Houston
TD14	SE Asia to EC Australia	80000mt	Seria to Sydney
TD15	West Africa to China	260000mt	Zaffiro and Bonny to Ninqbo
TD16	Black Sea to Mediterranean	30000mt	Odessa to Augusta
TD17	Baltic Sea to Cont or Britain	100000mt	Primorsk to Wilhelmshaven
TD18	Baltic Sea to Cont or Britain	30000mt	Tallinn to Rotterdam

Figure 2.1.1 BDTI routes

Source: www.clarksons.net/portal

From the vessels types' perspective, BDTI also classifies by the size of these tankers, there are VLCC index, Suezmax index, Aframax and Panamax index. Among the routes in Figure2.1.1, mainly pivotal in the market are TD3, TD5 and TD7. These routes separately represent three kinds of tanker types and three geographically important routes. TD3 is for giant tanker, which carries cargo from Middle East to Far East; Suezmax tankers is applied to TD5, the oil will be carried from Africa to America; TD7 is used Aframax tanker, the route design is from North Sea to the continent of Europe. The top ranking countries of the crude oil trade in the world are distributed among destinations of the three routes above.
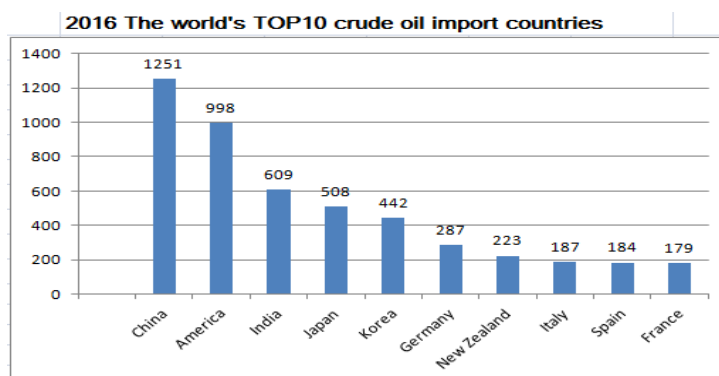
Figure 2.1.2 Top 10 countries of importing crude oil

Source: www.cnki.com

The Figure 2.1.2 shows the rank of top 10 countries in importing crude oil in 2016, there are four Asian countries in the top 5, which accounts for more than 57% of the total amount of top 10 countries, for such huge demand, so that TD3 is at the primary position and giant tankers are used in this route. The US is always in the front rank in oil trade, as

the figure illustrated, the demand of USA is almost equal to the overall needs of the remaining five countries, which are most of European countries. Based on the amount of trade, these three routes are much more important to the world crude oil trade as well as the tanker market operation.

In spite of the considerations of basic demand & supply for crude oil, the future changes in tanker freight market may come from the other three parts: first is the economic and political environment of the world. This is the basis of the formation of a healthy world trade, which also contributes to the tanker market because it is a high risky industry and easily affected. Second is the cost of equipments and automation. The costs come from the growing price of updated vessels, fuel price and electronic operation management. There will be fewer employees on board in the future, and automation will gradually take their places. Third one is the natural factor, which affects the navigation or the supply of crude oil in certain period. The Figure 2.1.3 is the changes of BDTI from August of 1998 to December of 2017.
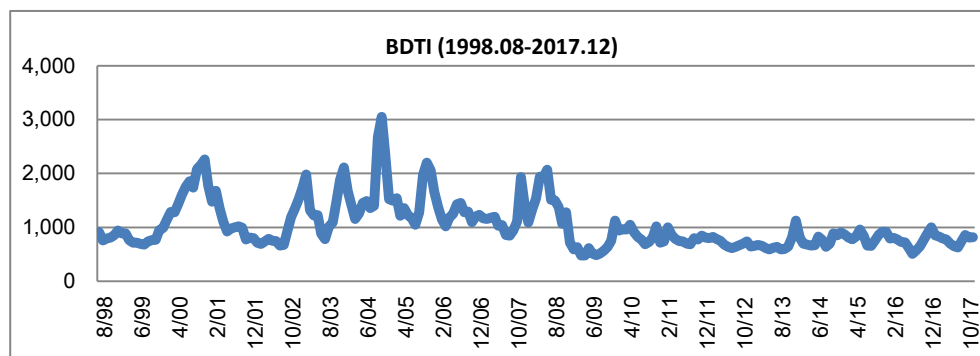
Figure 2.1.3 BDTI Data (1998.08-2017.12)
Source: www.clarksons.net/portal

As we can see from the Figure 2.1.3that the market has been dragged from the high level since 2001, this was the glide of America economy due to the Iraq War. During 2003-2008, the BDTI was at an active situation, even touched over 3000 points, which meant the prosperity of tanker market; however, after the economic shock happened in 2008, the index dropped rapidly, in a long time up till now, it was almost all below 1000 points and could not break around 1500 points. Tanker market has been greatly affected by the crisis and fluctuated in a small range since 2009, which shows that the market still doesn't have a clear sign of recovery.

2.2 An overview of crude tanker new building market

The four main types of tankers in market:

(1) VLCC/ULCC (Very Large / Ultra Large Crude oil Carrier)

As their names, this kind of tankers can carry more than 300, 000 tons of cargo, and they can serve for long distance routes, just like TD3, to meet the large demand of the market. Expect this, due to the poor market right now, to centralize the capacity is a way to save cost for operation, so that these huge tankers have the reason to be build.

(2) Suezmax Crude oil Carrier

The vessel deadweight is about 120, 000~ 200, 000 tons, the upper limit constrains to the navigable condition of the Suez Canal. The transportation routes are mainly through West Africa to US, West Africa to Mediterranean Sea, etc.

(3) Aframax Crude oil Carrier

To operate in an economic way, the capacity of the tanker will be controlled in 80, 000~ 100, 000 tons, the routes include North Sea to Cont, Middle East to Far East, etc.

(4) Panamax Crude oil Carrier

This is a kind of small vessels of 60, 000~ 80, 000 tons, due to the limitation of Panama Canal, the routes operated in a short distance, such as Far East to Japan or to India.

The features of tanker newbuilding market

The tanker newbuilding market has some similarities with tanker freight market, they are all with high risks and capital-intensive. What different from the other market is that, firstly, a new ship built needs a long time of return of investment, and there are more uncertainties during the construction, maybe from the investment part, maybe from the updated design or even the lack of materials, these problems will lengthen the period. It's very common that when the ship is delivered, the market environment has changed a lot; the investment cannot be returned and the investors will have another loss. Secondly, building a ship is not like produce products on a production line, the vessel is of unique design required by the customer. The cost is much higher than any other industry for the

large size and sophisticated structure inside. To cope with the personal requirements, there is a need to sign the contract to reserve the ship, obviously this also includes risks. For example, the price contracted in advance cannot fit the market price when the ship is build. There is a choice of abandoning the ship for investors, so that the cost may go even higher. Thirdly, the world is much related so as to the newbuilding market. To construct a tanker may be involved many countries for the world supply chain of materials and other political factors. The world grand environment including economy, politics and even the ocean factor affects the process of construction, the cooperation seems important too.

The fluctuations in tanker newbuilding market

The market volatilities come from the following parts:

(1) The world economy and crude oil trade

The progress of the world economy derived crude oil trade, with the needs of the development of emerging countries like China, India at the beginning of this century, demand of crude oil went up; this promoted oil trade and created new orders to carry more oil to meet the increasing needs. During the low tide of shipping market, the abandon rate of tankers increased and the orders were reduced because of the consideration of oversupply problem. The world trade and economy environment have great impacts on the demand of new tankers.

(2) The politics and war factors

The tanker is needed to obey the law of its place of registration. With some restrictions on behalf of political needs, the construction of tanker may be affected. And there exists regional wars, which would block the normal navigation through some routes, such as the closure of the Suez Canal in the late 60s of the last century as a result of the war. Owing to the special commodity, a war for oil will also cause great troubles to the oil price changes and new orders of tankers.

From the nations' part, some policies will support the trade or newbuilding industry, so that there might be some kind of economic subsidies and the amount of new orders is added. However, in the long term, the balance of the market and the increase of the ship

price will be damaged.

(3)The resource feature

It's a common sense that crude oil is a finite resource, although people are always chasing after it, they still try to find something that can replace it like the research and application of electric cars. And considering of environment protection, the demand for LNG vessels may be more popular in the future than the vessels for crude oil.

The interaction of first two aspects above mainly causes the fluctuations in tanker newbuilding market.

2.3 Factors affecting tanker spot freight rate fluctuations

(1) Changes in crude oil price

In the 70s of the last century, the crude oil production was mainly controlled by the members of OPEC, who decided the world major production amount of crude oil. In other words, they had the power to set their criterion from the supply part, which had great impacts on the coordination of the oil market so as the ultimate right of decision on price. In 80s, the share of non OPEC countries production increased, which weakened OPEC's pricing power and shortened the fluctuation range. At the same time, spot trading, forward contracts and futures trading developed. And since this century, futures transactions have become the leading force of the oil pricing. Normally, the crude futures is commonly priced in dollar, one of the mainstream index is WTI, West Texas Intermediate（Crude Oil）, which is one of the global benchmark for crude oil futures pricing owing to the strong demand and economic position of US. But once the war or financial crisis happens, the crude oil price may have a violent fluctuation than ever. As the carried cargo, the price changes in cargo will affect its trade, so as the crude oil.
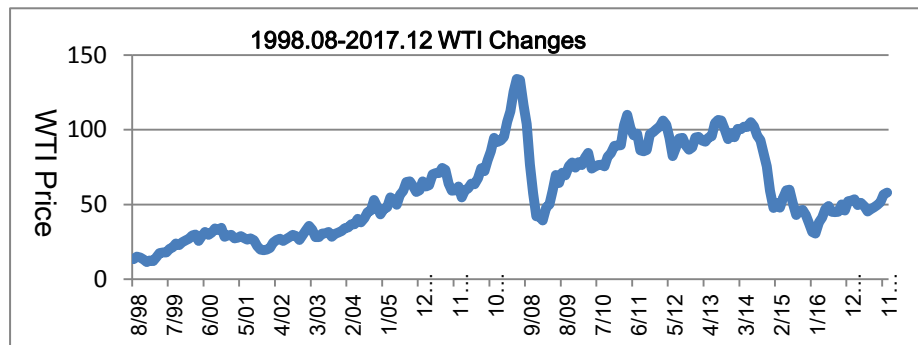
Figure 2.3.1WTI Changes (1998.08-2017.12)

Source: www.cn.investing.com

What shows in the Figue2.3.1 is the change of WTI price from 1998 to 2017. From about the first 10 years, in general, crude oil prices were in an upward growth and peaked around in the middle of 2008 over $ 140 per barrel, which was more than the doubled price in end of 2017. At beginning of 2009, the crude oil price dropped from the high peak without normal fluctuation because of the global financial crisis. From the late of 2009 to the beginning of 2015, the price had a recovery, after this, it went down again, even broke $ 40 per barrel, the market didn't see a recovery and still in the doldrums, the crude oil price couldn't turn back to the high peak and slide further.

(2) Demand & supply condition in the market

Fluctuations in world economy

The power of economy can be showed in all aspects, especially in this capital-intensive shipping industry. The level of economic development decides the market demand, not only the demand for crude oil but also the enough capital that can be put in investment to promote the fleet and new vessels. The reasons for the entry of capital are: firstly, to seek more profit from the tanker business by expanding the supply. The other is to maintain the operation of fleet as well as the business. When the economy crumbles, there will be a break in the capital chain so that the freight rate will quickly go down.

The orderbook of new tankers

The oversupply problems have continued to today since the breakdown of world economy. The tanker freight rate reflects the demand & supply of the market to certain extent. When the market cannot digest the supply of tankers' capacity, the freight rate

would decrease, vice versa. Hence, the orderbook, the supply of new tankers, is useful for research of the market situation and its effects on tanker freight rate fluctuations. The orderbook represents the contact in advance, which has a certain lag until new vessels are put into use. So that if there is a space for getting profit, there must be more tankers and more numbers of orderbook; when these orders turn into new ships that are ready for operation, a contraction of demand will lead to a rapid drop in spot freight rate. If tanker market is well for trade but there are not enough ships, the lag of new tankers will push the spot rate up in a short time.

The two factors, economy and tanker orderbook, reflect the demand and supply power that push and pull the freight rate in tanker freight market, which is the fundamental reason for fluctuations in freight rate.

(3) Management cost of enterprises

The increase of the management cost come from fixed investment, maintenance fee of technical equipment, employee fee and fuel etc. This is a component of cost of the freight rate that cannot be replaced, which raises freight rate and the transportation fee from a long-term trend.

2.4 Summary

In summary, tanker market is full of risks and controlled by the input of capital investment. BDTI can represent the changes of the tanker freight market as well as the freight rate of different routes. The trend of BDTI is jointly affected by the world economy, politics, natural factors and the growing cost of equipments, including electronic operation fee due to the automation. The financial crisis really caused trouble in many aspects in tanker freight market and newbuilding market. Expect this reason, the volatility of newbuilding market also restricts to the politics and war factors, and the substitute for crude oil in the future will reduce new tanker contracts. The spot freight rate in tanker market is influenced by the demand& supply factors from inside. Demand comes from the impetus of economy, which promotes the world trade. From the supply perspective, new tankers have a period of time before being put into use, which causes the

violent fluctuations in spot freight rate. The management cost is another factor that shipping companies need to take into consideration, the cost is the basis of freight pricing and it has a growth trend that will increase the freight rate from long-term view.

Chapter 3 Analysis of WTI & ordering of crude tanker impacts on tanker spot freight rate

3.1 Data selection and meaning

1. Crude oil price data

The crude oil futures traded based on the WTI: the intermediate crude oil produced in West Texas, is the benchmark oil of the US crude oil futures in NYFE, which is one of the most mainstream crude oil price in world market for that it has the largest crude futures transaction volume as well as the strong demand of U.S. To study what implications crude oil futures price have on the spot freight rate, the WTI data is chosen, and data is composed of average value of every month from August of 1998 to December of 2017. Firstly, there is an apparent view of the changes of futures price during almost the past nineteen years as Figure 2.2.1 indicated, which also showed in diagram that the collapsed economy brought the steepest decline of crude oil price. To analyze the different results before and after this factor, it is needed to remove partial interference data to ensure the accuracy of comparisons.
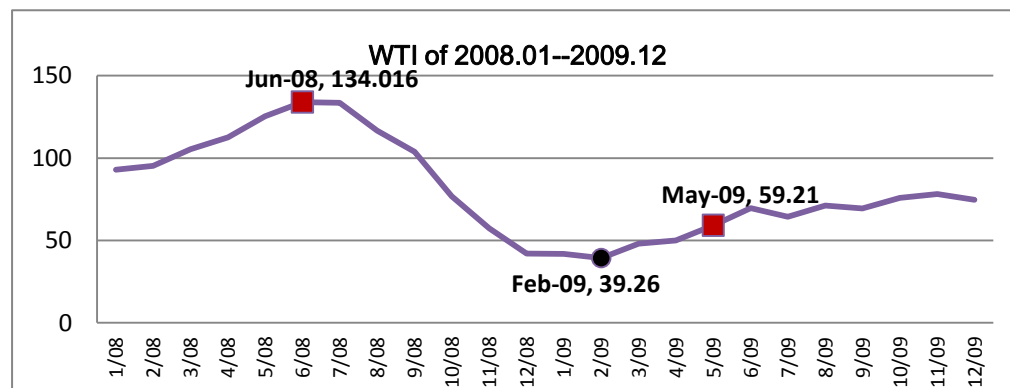
Figure 3.1.1 WTI Data (2008.01-2009.12)
Source: www.cn.investing.com

The change of WTI trend visible in Figure 3.1.1 is recorded from January of 2008 to December 2009. During the two years, the crude futures price had huge fluctuations, for instance, the highest point happened in June of 2008 at $134.016, but as the circular spot marking in the graph, the lowest value didn't reach a third of the maximal value. After have reached the bottom in February of 2009 since the market boomed, the price had a

recovery trend. Therefore, to eliminate the recession factor, the data from June of 2008 to May of 2009, namely the middle part between the two square points, will be excluded from analysis. And the two parts of data will be shown in the following figures, Figure 3.1.2, Figure 3.1.3 and Figure 3.1.4.
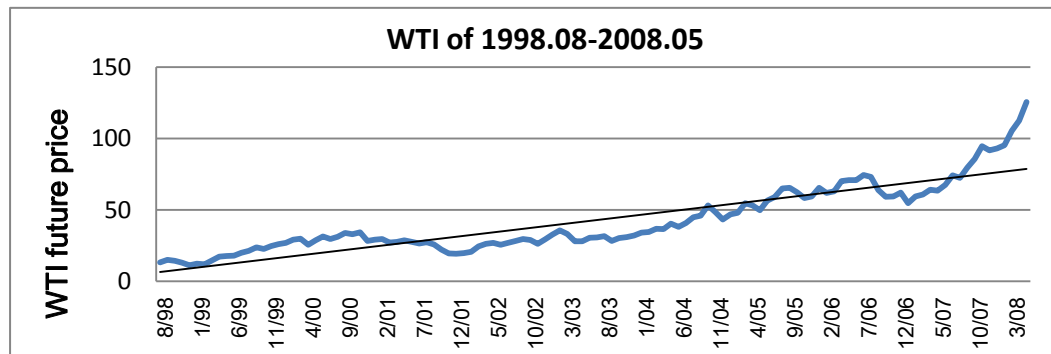
Figure 3.1.2 WTI Data (1998.08-2008.05)
Source: www.cn.investing.com
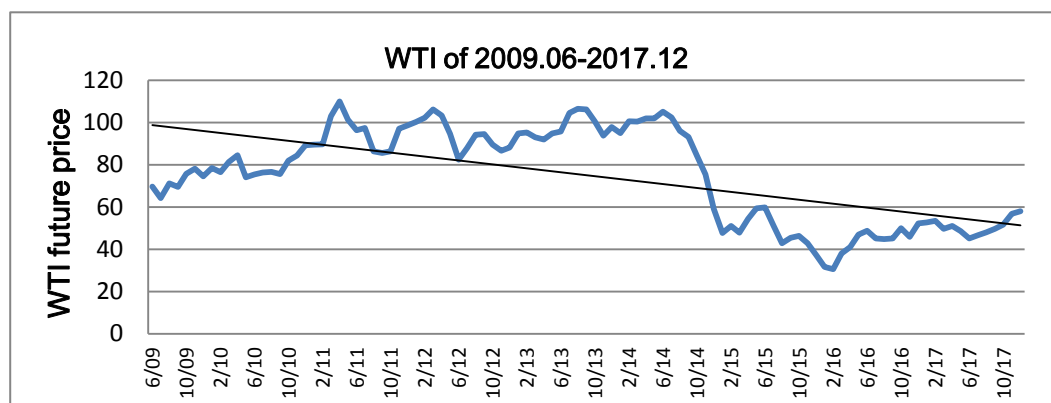
Figure 3.1.3 WTI Data (2009.06-2017.12)
Source: www.cn.investing.com
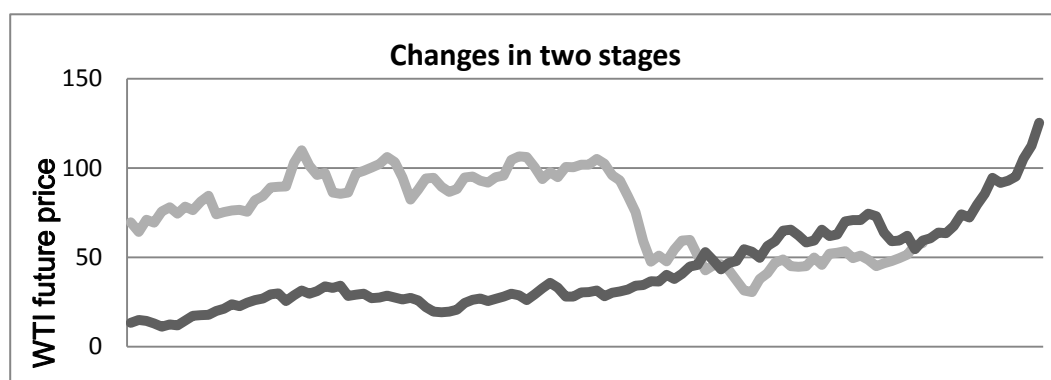
Figure 3.1.4 Changes in two stages
Source: www.cn.investing.com

The first two diagrams present specific graphics in different period; in Figure 3.1.2, the futures price shows a slowly rising trend and a lower level of price compared to the WTI

level in Figure 3.1.3, which has constant fluctuations in a certain price range and a negative trend line of crude price. The last one is the curve combination which clearly illustrates the market performance in two stages.

The curves in above charts reflect three stages of WTI development during 1998-2017. At the first stage, the relationship of world economy and trade was getting closer, on the other hand, anticipation of emerging countries in trade and their demand of national constructions, especially China, promoted the market, which led to the increase of crude oil price. The second stage manifested a depressed crude market with a sharp decline in price under the influence of economic problems, which wouldn't be needed in this research. In the later stage, the high peak seems to be untouchable, and there is still a downward trend after a certain fluctuations at a relatively high range of price.

2. BDTI data

BDTI data is selected from the same period as WTI data to fit the analysis, and the average monthly data within 12 months since June of 2008 will also be abandoned because it is the interference data which includes the information of the drastic drop in freight rates.
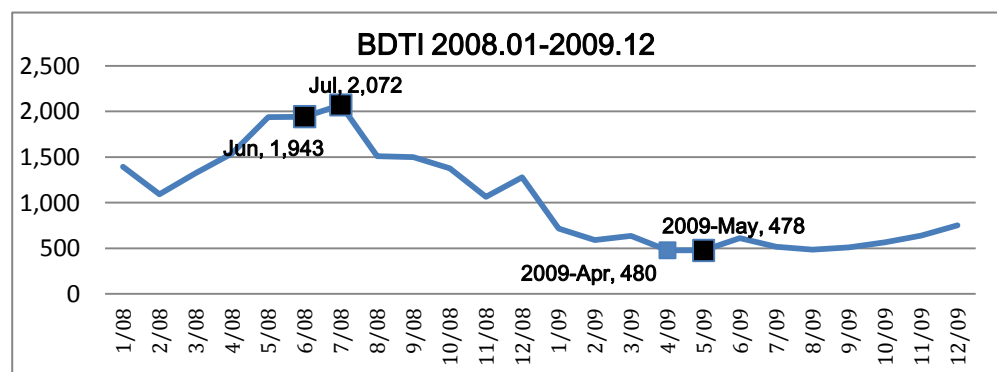
Figure 3.1.5 BDTI Data (2008.01-2009.12)
Source: www.clarksons.net/portal

The Figure 3.1.5 containing two years of data indicates that the undulation of BDTI during 2008 and 2009. The maximum value in above chart is the number of July, 2008, which has reached more than 2000 points due to the boom and the higher expectation of whole market. The minimum value appears in May of 2009, which is less than 500 points, which can be explained as the impact of economic damage and the lack of market confidence.
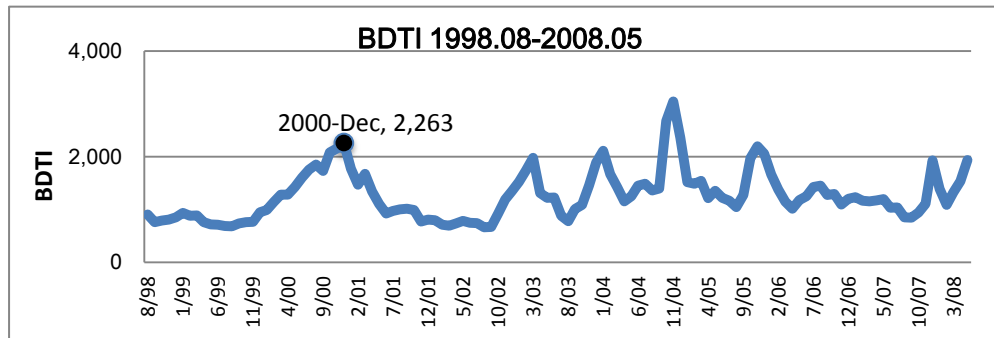
Figure 3.1.6 BDTI Data (1998.08-2008.05)

Source: www.clarksons.net/portal

The Figure 3.1.6 contains the information of BDTI changes from 1998 to 2008. It is illustrated by the figure that the tanker market has gradually recovered from the end of last century to the end of 2000 since Asian financial crisis occurred. After peaked at December of 2000, because of US economy facing the downside risks caused by '911' event, tanker freight went down in a period of time. From 2002 to 2006, there is an intense fluctuation in a short period of time, which is mainly caused by the changes in economic cycle. The expectation of the market has been in an upward trend since 2007, and has fluctuated in a high range before crisis happened.

The chain reaction caused by the collapse of the economy is a prolonged slump in tanker business shown as Figure 3.1.7, which the freight rate could rarely be over 1000 points in the past 8 years.
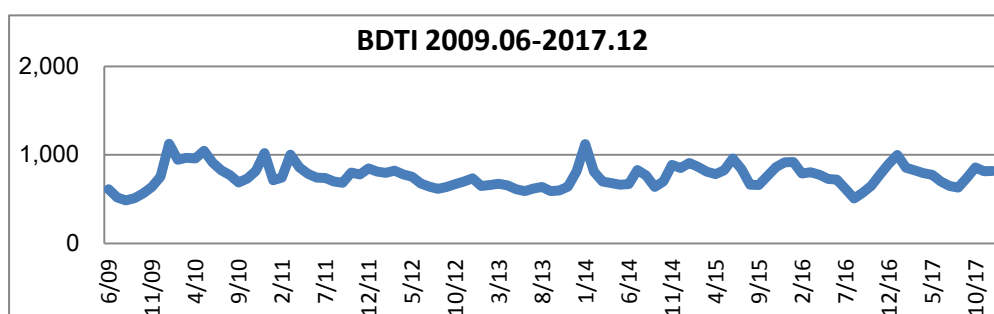
Figure 3.1.7 BDTI Data (2009.06-2017.12)

Source: www.clarksons.net/portal

The Figure 3.1.8 can reveal the gap between the two stages of the freight rate level, and the below one is the phenomenon of the market condition after crisis. Nowadays, global economic environment cannot compare with the former one and is still in a continued recovery.
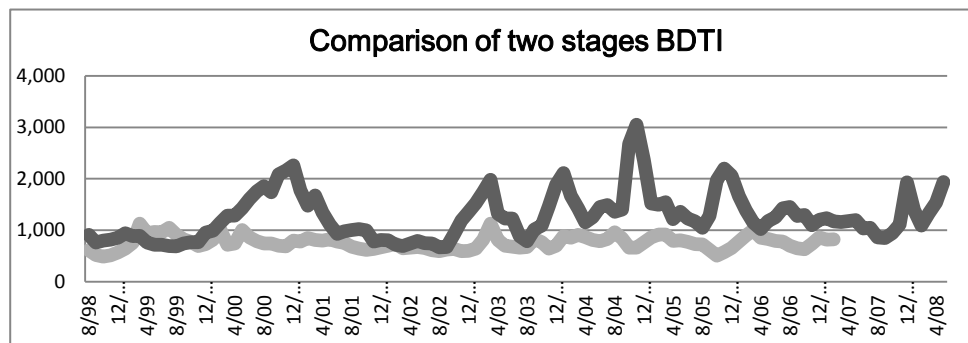
Figure 3.1.8 Comparison of two stages BDTI
Source: www.clarksons.net/portal

3. Crude tanker orderbook data

Orderbook number is decided by the industry demand and the market expectation. When the trend of tanker market seems to be positive, shipowner will enlarge the capacity to adapt to the increase demand of market; in case that market demand is soaring, which drives the freight rate up based on an insufficient supply situation, and the forecast of profit margin is still growing, there will be more orders for shipyards on account of shipowner's plan of earning profit.
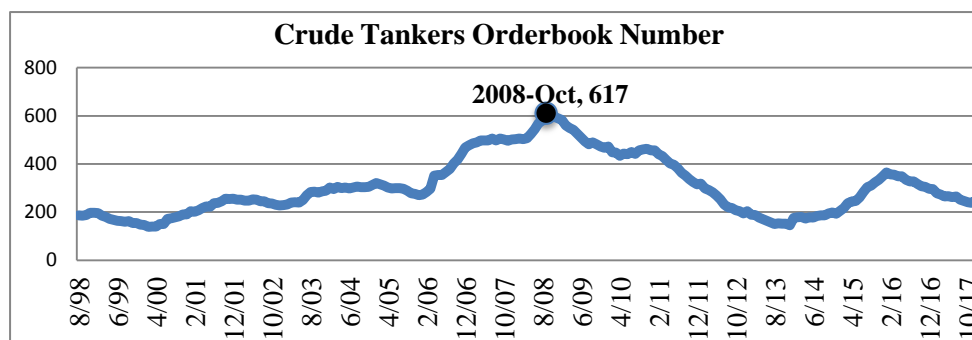
Figure 3.1.9 Crude Tankers Orderbook Number (1998-2017)
Source: www.clarksons.net/portal

The Figure 3.1.9 is the changes of crude tankers order numbers of every month from August of 1998 to the end of 2017. It can be seen from the chart that there is a significant increase during 2006 to 2008, which is a period of market boom that more crude tankers are needed. And the high peak appears in October, 2008; new orders of crude tankers are up to 617 just in one month, which proves how well the market performs and enough confidence in expectations for the continuous prosperity of the market. Owing to the breakdown of economy, market has undergone a recession so that the advanced supply cannot be totally put into market to meet the demand or update the old tankers, and the

market oversupply environment has caused new orders to be cut off and uncompleted tankers to be abandoned for financial problem, which can be shown as the sharp drop in the quantity of orders in the figure after crisis in 2008. From 2015 to 2016, crude tanker market has been in a healthier level of recovery in freight rate, but the market has still been threatened by the sudden drop in crude oil demand and surplus of tankers. After removing disturbed data, two parts data are shown as next figures, Figure 3.1.10 and Figure 3.1.11.
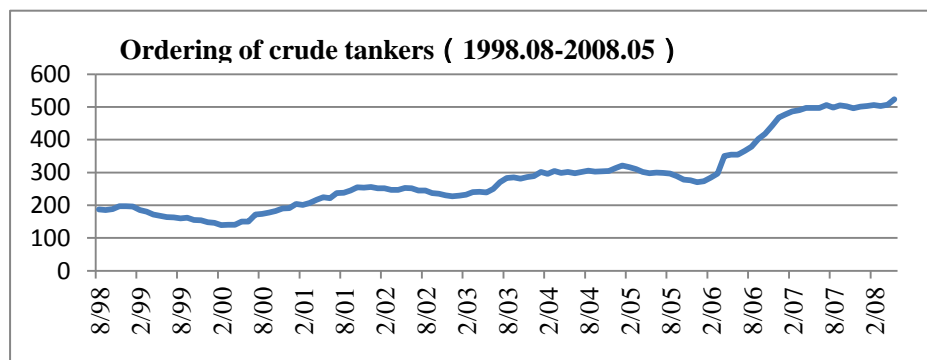
Figure 3.1.10 Ordering of crude tankers (before crisis)
Source: www.clarksons.net/portal
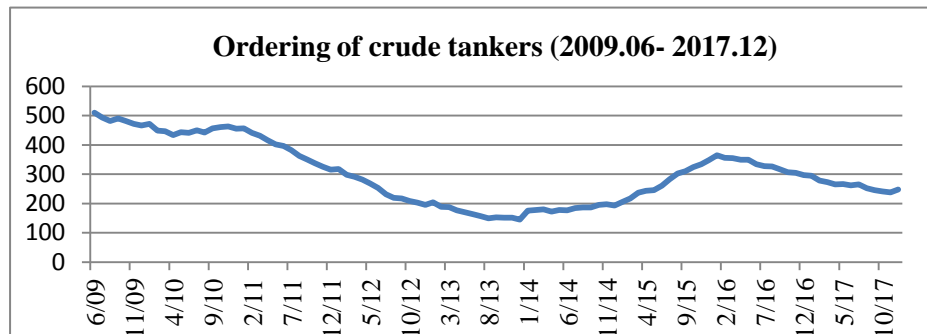
Figure 3.1.11 Ordering of crude tankers (after crisis)
Source: www.clarksons.net/portal

Like the crude oil futures market, the first chart reflects a positive trend, and there is a downward trend in second chart during the late period of financial crisis.

3.2 The co-integration analysis between WTI and new crude tanker orders

1. Analysis of the steadiness of the data

The selected data of BDTI, WTI and new orders are a sequence of numbers arranged in chronological order respectively, which can be called time series. How the internal

relationship is between variables is needed to find out by co-integration analysis, VECM model, impulse response functions and other methods. First is co-integration analysis, and one necessary requirement before this is to identify whether time series are stationary series, so the first step is to use Unit Root Test. If the result is proved to be stationary series, the cointegration equation(CE) can be build; if the sequence is unstable, there should be continued to test the first and second difference until the test results meet the requirements. If the sequences of variable original value passes the unit root test, the variables is called integrated of order zero; if the sequence of the first difference of variable is tested by the unit root, then the variable is called integrated of order one, and so on.

Firstly, it is needed to make a sequence diagram of each variable to observe whether the variable change trend shows a stationary sequence. The sequence diagrams are made by Eviews 9.0, and the data is divided by two parts of fluctuation situation before and after the financial crisis.
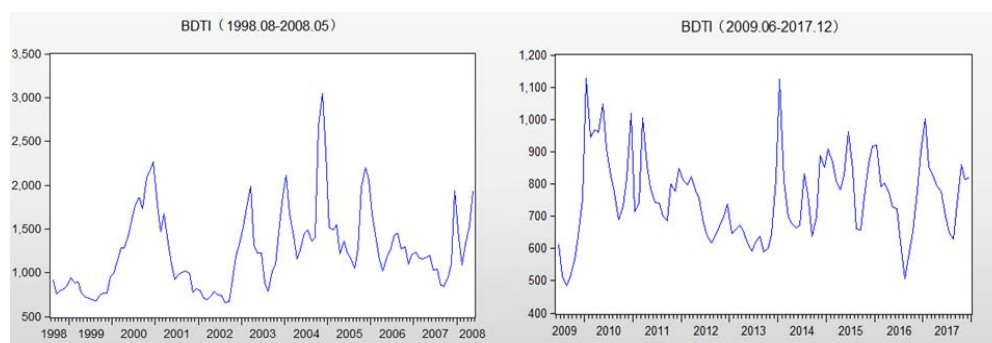
Figure 3.2.1 BDTI trends
Source: www.clarksons.net/portal
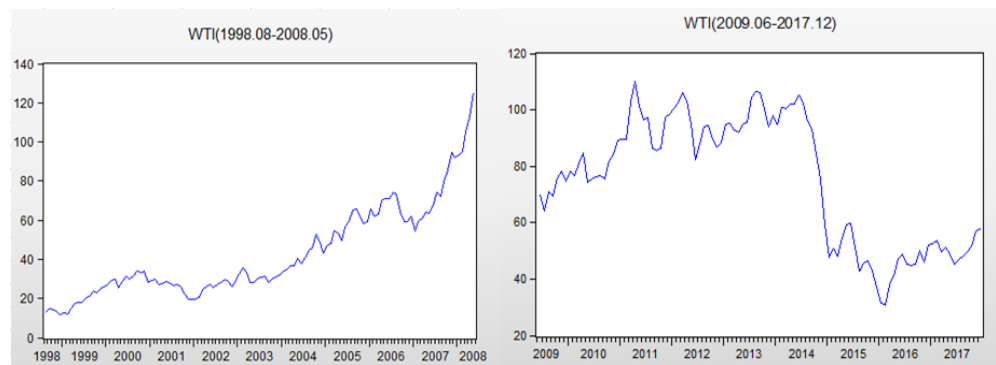
Figure 3.2.2 WTI trends
Source: www.clarksons.net/portal
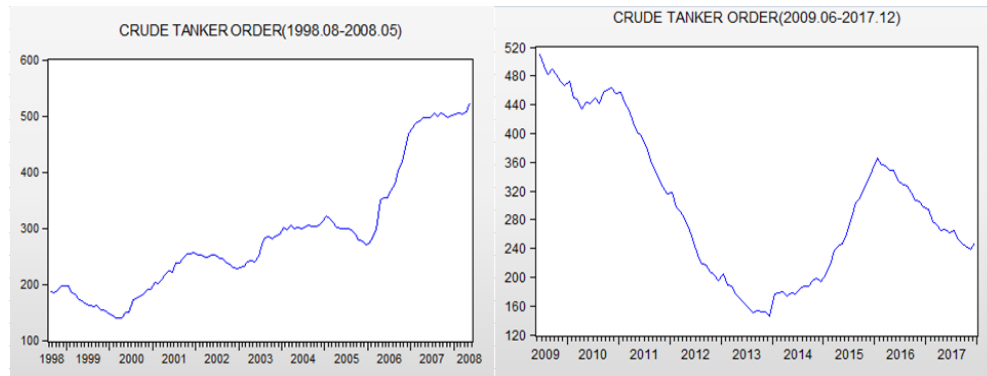
Figure 3.2.3 Crude tanker orders trends

Source: www.clarksons.net/portal

As we can see from three diagrams, there are different fluctuations in data during the period before and after the recession, and the changes are with a clear trend of growth or decline in Figure 3.2.2 and Figure 3.2.3, which cannot be regarded as a stationary time series that fluctuates around a constant. For BDTI series, there is no obvious trend to prove its stability, so next step is to make unit root test to examine the stability of each sequence. Before the test, it is needed to process the sequences by logarithmic transformation to convert the large spaced data to small spaced data as well as to reduce the influence of heteroscedasticity and volatility of series in the analysis.

2. Unit root test

Unit root test refers to whether there is a unit root in the sequence tested, if the unit root exists, the sequence is a non-stationary time series and the probability of a pseudo regression in analysis is high. The method for testing unit roots in this research is ADF (Augmented Dickey–Fuller) test, which the null hypothesis assumes the existence of unit root. First of all is ADF test of the original sequences which are logarithmic sequences during two different periods---before crisis and after crisis, just as the data selection has been mentioned above. In order to study the influence of the other two factors on BDTI of two parts, BDTI series, WTI and new order quantity sequence before crisis is respectively named as lny, lnx_1 and lnx_2; the other part of series is named as lny', lnx_1' and lnx_2'. In Eviews, there will be three options that need to be defined the in the test regression, which is Trend and intercept (constant term and trend item), Intercept (constant term) and None.
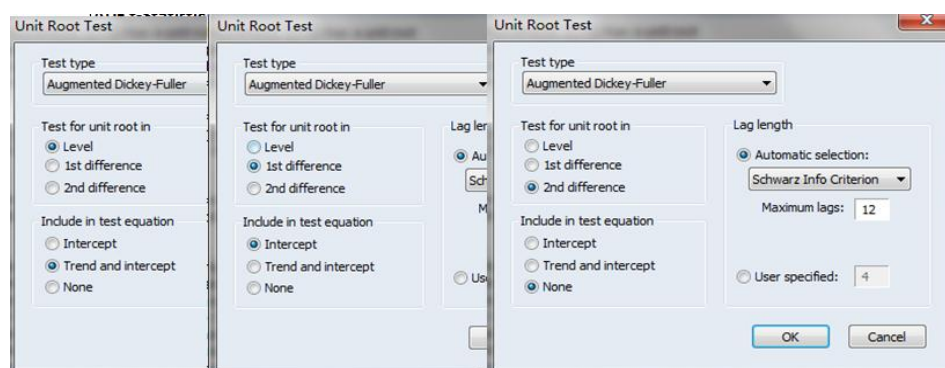
Figure 3.2.4 Choice of unit root test

Source: Eviews 9.0

In first step like Figure 3.2.4, for original sequence, we choose Trend and intercept option to test the significance of time trend under the Level condition. If the result cannot reject the original hypothesis, the first order difference should be continued and the Intercept option should be chosen; if the test is still unable to pass, the two order difference will be made and the None option is selected. These tests are all based on SIC principle. Generally, after second order difference, a stationary sequence can be got. The following tables show the ADF test results of three series before and after recession.

Table 3.2.1 ADF test results (before crisis)

Variable	Option	ADF t-Statistic	1% level	5% level	10% level	Prob.*
	Trend and intercept	-3.928024	-4.0391	-3.44902	-3.1497	0.0139
lny	Intercept	-8.369269	-3.4876	-2.88651	-2.5802	0
	Trend and intercept	-1.884905	-4.0384	-3.44868	-3.1495	0.656
lnx1	Intercept	-9.899319	-3.4876	-2.88651	-2.5802	0
	Trend and intercept	-3.030392	-4.0398	-3.44937	-3.1499	0.1286
lnx2	Intercept	-4.488368	-3.4881	-2.88673	-2.5803	0.0004

Source: www.clarksons.net/portal

Table 3.2.2 ADF test results (after crisis)

Variable	Option	ADF t-Statistic	1% level	5% level	10% level	Prob.*
lny'	Trend and intercept	-5.179871	-4.05145	-3.454919	-3.153171	0.0002

	Intercept	-8.598901	-3.497029	-2.890623	-2.582353	0
	None	-7.741707	-2.59091	-1.944445	-1.614392	0
	Trend and intercept	-2.503883	-4.05145	-3.454919	-3.153171	0.3258
	Intercept	-7.77156	-3.496346	-2.890327	-2.582196	0
lnx1'	None	-8.954796	-2.588772	-1.94414	-1.614575	0
	Trend and intercept	-1.989635	-4.054393	-3.456319	-3.153989	0.5994
	Intercept	-2.211308	-3.498439	-2.891234	-2.582678	0.2037
lnx2'	None	-10.75961	-2.588772	-1.94414	-1.614575	0

According to the principle of ADF test, when the value of the test statistic is less than the test critical value, the original hypothesis is rejected and the sequence is considered stable. And the P value indicates the appearance probability of the results of sample observations when the original hypothesis is true, in other words, the smaller the P value is, more reasons we can have to reject the original hypothesis.

What can be obtained from Table 3.2.1 is (1) For lny series of Trend and intercept option, t value is less than the critical value at 5% significant level; and there is 98.61% probability to accept no unit root, so the series can be regarded as stable at 5% significant level. (2) Under the Level condition, lnx_1 series has 65.6% possibility to accept the original hypothesis, and t value isn't significant even at 10% level, which means that the sequence is not stable. So that there should be first order difference with Intercept option, as the table shows, the t value is about -9.899, the null hypothesis is rejected, which proves no unit root in sequence at 1% significant level. (3) In the Level test, the t value of lnx_2 series is not seemed to be significant at each level although P value shows that there is only 12.86% possibility not to reject the hypothesis. After first order difference, the t value of -4.488 and P value is 0.0004, the series is significant at 1% level. To carry out the co-integration analysis, not only to pass the ADF Test, but also to ensure the same order of sequences. Although the lny sequence is proved to be stable, it is needed to make the

first order difference to keep the same order as lnx_1 and lnx_2 series. At this time, the t value is less than critical value of 1% significant level and to reject the existing of unit root at 100%, still to be a stationary sequence. To sum up, after first order difference, three sequences are stable at 1% significant level.

From the second table above, (1) lny' series is stable in Level option for the t value is less than any critical value, P value also proves to be significant at $0.0002 < 0.05$. For the later co-integration test, the sequence should be made first and second order difference to keeping the same order as other sequences; the result is significant at 5% level. (2) The results of Level test of lnx_1' and lnx_2' series cannot reject the null hypothesis because P value is over 0.05 and t value is higher than values at 1%, 5% and 10% level. After first order difference, the P values of lnx_1' series are zero and t value < critical value, which means that it can be regarded as significant in 5 % level. However, the result of lnx_2' series shows that it cannot be significant for that its P value is $0.2037 > 0.05$, there should be a second order difference. After test, the three series can be viewed as stable, P value and t value can fit the condition.

3. Johansen co-integration test based on VAR model

Since we have more than one variable in the analysis, there can be more than one co-integration relationship, and Johansen co-integration test is chosen to find whether the long term relationship exists among variables by using maximum likelihood estimation under a VAR system. To select an appropriate lag order, we should build a VAR model with sequences of lny, lnx_1 and lnx_2 as well as the series of y', x_1' and x_2' . At the beginning of estimate, we follow the default setting, which the lag intervals is set to be 2, the lag length is 8, and delete the constant term in Exogenous variables blank, what we can get are the values of criteria in the next Table 3.2.3 and Table 3.2.4.

Table 3.2.3 Different values of the criteria (before crisis)

Values of the criteria under lag different orders					
Lag	LogL	LR	FPE	AIC	SC	HQ
1	393.2323	NA	1.86E-07	-6.99E+00	**-6.765094***	-6.896424

2	410.968	33.53655	1.58E-07	-7.144873	-6.702976	**-6.965637***
3	420.2283	**17.00535***	**1.58e-07***	**-7.149606***	-6.486761	-6.880753
4	426.0084	10.29894	1.68E-07	-7.091061	-6.207267	-6.73259
5	429.3614	5.791629	1.86E-07	-6.988389	-5.883647	-6.5403
6	435.172	9.719498	1.98E-07	-6.9304	-5.604709	-6.392692
7	441.6095	10.4171	2.09E-07	-6.883809	-5.33717	-6.256484
8	446.6429	7.870363	2.26E-07	-6.811689	-5.044102	-6.094746

Table 3.2.4 Different values of the criteria (after crisis)

Values of the criteria under lag different orders					
Lag	LogL	LR	FPE	AIC	SC	HQ
1	358.3907	NA	1.28E-07	-7.355594	**-7.113647***	**-7.257829***
2	366.3051	14.82918	1.31E-07	-7.33274	-6.848847	-7.137211
3	380.0913	**24.96014***	**1.19e-07***	**-7.433500***	-6.707662	-7.140207
4	384.852	8.318775	1.30E-07	-7.344253	-6.376468	-6.953195
5	393.1441	13.96569	1.33E-07	-7.32935	-6.119619	-6.840528
6	398.5304	8.731407	1.44E-07	-7.253272	-5.801594	-6.666685
7	400.7766	3.499322	1.67E-07	-7.111086	-5.417462	-6.426735
8	408.5152	11.56721	1.74E-07	-7.084531	-5.148961	-6.302415

* The lag order of the selection of the corresponding criteria
Source: www.clarksons.net/portal

According to the selection principle, the lag order chosen mostly by above criteria is the one selected to fit the degree of freedom of VAR model; and based on the information of tables above indicated, the third lag order is determined by the data of two periods. After lag order is confirmed, it is very necessary to reestimate the model with new order. There will be an establishment of another VAR model of two parts, which is used to apply the cointegration test.

Speaking of the options represented in the Eviews, Johansen test gives five models to choose to test. The first class is that there is no definite trend in series, which is divided into two cases: model 1 is no certain term and trend term in CE (cointegration equation); the other one is trend term in CE. The second class indicates that there is linear trend among variables with certain term or with certain and trend term. The third one means that there is t^r in time series. According to the Pantula principle, the test starts from the most constrained model to the least constrained model until we find the most appropriate model, which can be the first one to deny the null hypothesis: H_0: There is no cointegration relationship. Due to Johansen test imposes vector constraints on unconstrained VAR model, so the actual lag order in the test should be the number of the chosen lag order of unconstrained VAR model minus one. After several tests by Eviews, we choose model 2 for first part, model 3 for second part, and test results are in the Table 3.2.5.

Table 3.2.5 Trace Test(before crisis)

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.133059	40.66171	35.19275	0.0116
At most 1 *	0.128132	24.24156	20.26184	0.0134
At most 2	0.07103	8.473026	9.164546	0.0675

Table 3.2.6 Trace Test(after crisis)

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.227251	32.77991	29.79707	0.022
At most 1	0.038989	6.999804	15.49471	0.5777
At most 2	0.029776	3.022811	3.841466	0.0821

As the Table3.2.5 illustrates, at 5 % significant level, there can be at most two cointegration relationships. The Trace Test is to rank the characteristic roots of the equation from the largest to the smallest, then add together started from one root to see if the sum value is zero, which is more accurate compared to other tests. It can be seen from the P value to observe the significance of the results. P value of None is 0.0116, which rejects the null hypothesis, in other words, admits that there must be one CE. So as to the second one: At most one means that there must have one CE but maybe no more than one. And the last result proves that there should be two relationships not over three because of this one fails to reject original hypothesis in the significant level of 5 %. It can be deduced from the test that there exists a long-term equilibrium relationship among BDTI, WTI and new orders of crude tankers. The expression of Normalized Cointegration Relationship is:

$$\ln y_t = 0.47232 \ln x_{1t} - 0.423651 \ln x_{2t} + c \qquad (3\text{-}1)$$

$$(0.21144) \qquad (0.29797)$$

In equation: t indicates the corresponding year, the number in brackets is the standard error of coefficients.

What shows in Table 3.2.6 is that there is at most one co-integration relationship among variables at 5% significant level, on account of that there is only one value, P value of None is less than 5%, which is 0.022 that can reject the original hypothesis. The long term equilibrium relationship among series exists. The Normalized Cointegration Relationship expression is:

$$\ln y_t' = 0.043422 \ln x_{1t}' + 0.172916 \ln x_{1t}' + c \qquad (3\text{-}2)$$

$$(0.08214) \qquad (0.07439)$$

In CE: t indicates the corresponding year, the number in brackets is the standard error of coefficients.

3.3 Analysis of VECM results based on two factors

However, tanker market is filled with uncertainties, and obviously, it cannot be a balance situation in short term among these factors. How to repair to the balance state as well as the exact expression of CE is used VECM model. The economic meaning of VECM:

when there is a long-term stable relationship, the short-term effect between independent variable and dependent variable is controlled by the long-term effect. If the short-term fluctuation is deviated from the long-term stable relationship, it will soon be brought back to the original track through the "amendment" mechanism------the error correction term. Then, a short-term model is established, which regards the error correction term as an explanatory variable and together with other variables that reflect short-term fluctuations. The results of the first VECM model which show two CEs:

Cointegration Eq1: $\ln y(-1) = -0.044714 \ln x_2(-1) + 6.8857$ $\hspace{2cm}$ (3-3)

Cointegration Eq2: $\ln x_1(-1) = 0.802288 \ln x_2(-1) - 1.713333$ $\hspace{2cm}$ (3-4)

And the Normalized Ccintegration Equation becomes:

$$\ln y(-1) = 0.47232 \ln x_1(-1) - 0.423651 \ln x_2(-1) + 7.694941 \hspace{1cm} (3-5)$$

$$(0.21144) \hspace{1cm} (0.29797)$$

The CE indicates that before financial crisis, WTI has the positive effect on BDTI, when the expectation goes up, spot market becomes more active for crude oil trade; crude tanker orders has the opposite direction with BDTI, the oversupply in market would lower the tanker freight rate.

The results of this VECM model illustrates like the following table:

Table 3.3.1 VECM model results (before crisis)

Error Correction:	D(LNY)	D(LNX1)	D(LNX2)
ECM1(t-1)	-0.224005	-0.017345	0.015112
	-0.05835	-0.02904	-0.01128
	[-3.83912]	[-0.59718]	[1.33954]
ECM2(t-1)	0.124073	0.039004	0.000765
	-0.03627	-0.01806	-0.00701
	[3.42046]	[2.16014]	[0.10906]
D(LNY(-1))	0.333777	-0.065234	-0.010278
	-0.09216	-0.04587	-0.01782
	[3.62177]	[-1.42201]	[-0.57681]
D(LNY(-2))	-0.03597	-0.021185	-0.004786

	-0.09405	-0.04681	-0.01818
	[-0.38248]	[-0.45254]	[-0.26324]
D(LNX1(-1))	0.258381	0.023745	-0.055563
	-0.20189	-0.1005	-0.03903
	[1.27982]	[0.23628]	[-1.42345]
D(LNX1(-2))	-0.007994	-0.135647	0.031352
	-0.1979	-0.09851	-0.03826
	[-0.04039]	[-1.37697]	[0.81938]
D(LNX2(-1))	-0.534658	-0.710721	0.158033
	-0.47978	-0.23883	-0.09276
	[-1.11437]	[-2.97588]	[1.70363]
D(LNX2(-2))	0.665552	-0.114781	0.261903
	-0.48456	-0.2412	-0.09369
	[1.37352]	[-0.47587]	[2.79554]
R-squared	0.259867	0.111266	0.239314
Adj. R-squared	0.211447	0.053125	0.18955
Sum sq. resids	2.524058	0.625425	0.094353
S.E. equation	0.153588	0.076453	0.029695
F-statistic	5.36694	1.913717	4.808931
Log likelihood	56.41825	136.6418	245.3969
Akaike AIC	-0.842057	-2.237248	-4.128641
Schwarz SC	-0.651105	-2.046296	-3.93769
Mean dependent	0.007747	0.018815	0.008913
S.D. dependent	0.172959	0.078569	0.032985
Determinant resid covariance (dof adj.)		1.21E-07	
Determinant resid covariance		9.77E-08	
Log likelihood		438.5937	
Akaike information criterion		-7.071196	
Schwarz criterion		-6.307388	

Notes: The t statistic is greater than 1.660 or less than -1.660, indicating that the variable is significant at 5%

confidence level.

Take ECM1(t-1) item as an example, the first line of numbers are the parameter estimates; the second line numbers in brackets are the standard error estimates corresponding to parameter estimators; numbers in square frames represent the t statistics. The table expresses that the value of Adjusted R-squared in a single equation is small as 0.211447, 0.053125 and 0.18955, which seems not to be significant. But the value of AIC and SC is -7.071196, -6.307388, and Log likelihood is 438.5937, which prove that the explanatory ability of equation is good. What can be also seen from the previous table is that at 5 % significant level, in the equation that lny as an explained variable, two ECM terms are significant as the adjustment force are -0.224005 and 0.124073, and its first order lag term has impacts on its own fluctuations; at 10% significant level, t value is 1.29, so that the second lag order term of lnx_2 is significant to have influence on BDTI changes. When lnx_1 is as an explained variable, at 10% level, ECM2(t-1), D(LNY(-1)), D(LNX2(-1)) are significant indicators, which means that WTI futures price is effected by values of the first lag order of BDTI and new crude orders, and the force to pull the relationship to the balance is 0.039004. For lnx_2, D(LNX2(-1)), D(LNX2(-2)) and D(LNX1(-1)) has significant impacts on the number changes of crude orders at 10% level. To test the stability of the VECM model, an inverse unit root method is used, and the result shows in the next Figure 3.3.1.
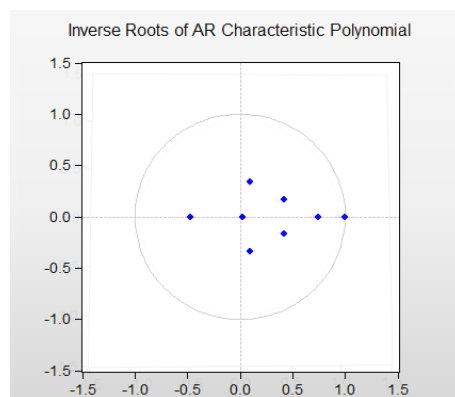
Figure 3.3.1 Inverse Roots (before crisis)

The unit roots, one falls on the unit circle and the rest is within the unit circle, which can be told that the model is stable.

The results of the second VECM model indicate one CE of series after crisis :

$$\text{lny}(-1)' = 0.043422\ \text{lnx}_1(-1)' + 0.172916\ \text{lnx}_2(-1)' + 5.460927 \tag{3-6}$$

$$(0.08214) \qquad (0.07439)$$

As the equation shows, not only WTI but also crude tanker orders has positive trend with BDTI. The new tanker order reflects the market's expectation of future supply and demand discrepancy. When the future supply seems to exceed demand, new orders quantity will decrease. When the situation is reversed, there will be more crude tankers to be ordered. In the present market environment at low tide, the new orders remain high or rise, usually indicating that spot freight rate will increase.

The VECM model results shows as follows:

Table 3.3.2 VECM model results (after crisis)

Error Correction:	D(lny')	D(lnx1')	D(lnx2')
ECM(t-1)	-1.01346	0.047806	0.098024
	-0.18397	-0.12592	-0.05467
	[-5.50873]	[0.37966]	[1.79315]
D(YY(-1))	0.194666	-0.049313	-0.028015
	-0.14265	-0.09764	-0.04239
	[1.36461]	[-0.50506]	[-0.66091]
D(YY(-2))	0.01273	-0.176327	0.001212
	-0.106	-0.07255	-0.0315
	[0.12009]	[-2.43035]	[0.03849]
D(XX1(-1))	-0.136756	-0.338967	0.027279
	-0.16054	-0.10988	-0.0477
	[-0.85185]	[-3.08491]	[0.57185]
D(XX1(-2))	-0.080469	-0.116055	0.020816
	-0.15078	-0.1032	-0.0448
	[-0.53369]	[-1.12459]	[0.46461]
D(XX2(-1))	-1.156831	0.230808	-0.750854
	-0.34846	-0.2385	-0.10354

	[-3.31985]	[0.96776]	[-7.25176]
D(XX2(-2))	-0.548705	0.076107	-0.202626
	-0.36327	-0.24863	-0.10794
	[-1.51047]	[0.30610]	[-1.87718]
C	-0.000223	0.00112	0.000339
	-0.01277	-0.00874	-0.00379
	[-0.01750]	[0.12816]	[0.08928]
R-squared	0.499773	0.218892	0.421147
Adj. R-squared	0.461294	0.158807	0.37662
Sum sq. resids	1.467374	0.687395	0.129558
S.E. equation	0.126984	0.086913	0.037732
F-statistic	12.9882	3.643029	9.458203
Log likelihood	68.00154	105.5384	188.1432
Akaike AIC	-1.212152	-1.970472	-3.639256
Schwarz SC	-1.002446	-1.760766	-3.42955
Mean dependent	-0.000461	0.000458	0.000249
S.D. dependent	0.173011	0.094762	0.04779
Determinant resid covariance (dof adj.)		1.57E-07	
Determinant resid covariance		1.22E-07	
Log likelihood		366.7147	
Akaike information criterion		-6.862924	
Schwarz criterion		-6.155164	

Notes: The t statistic is greater than 1.660 or less than -1.660, indicating that the variable is significant at 5% confidence level.

Source: Eviews 9.0

From the table, the Log likelihood is 366.7147, and AIC and SC value is respectively -6.862924 and -6.155164, which means a good explanatory ability. In the equation that lny' as an explained variable, the adjustment forces of lnx_1 and lnx_2 are 0.047806 and 0098024, and lnx_2 at 5 % significant level is significant because t value > 1.660. The

stability of the VECM model is tested by an inverse unit root method indicating as follows:
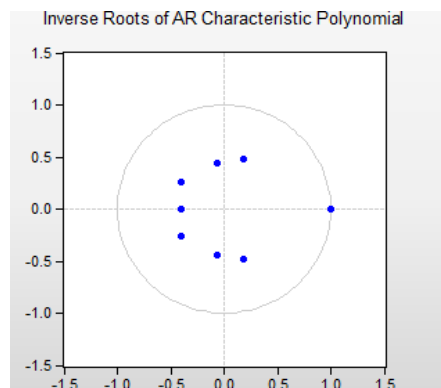
Figure 3.3.2 Inverse Roots (after crisis)
Source::Eviews 9.0

All the roots are in the unit circle, the model is proved stable.

3.4 Dynamic impacts of two factors on spot freight rate

1. Impulse response function

The impulse response function is used to analyze the impacts of a standard deviation size from a random perturbation term on variables in a certain period, which contributes to measure the mutual impacts among variables. In this paper, the impulse response function is based on the VECM models that have been done before to figure out the dynamic relationship among BDTI, WTI and crude orders. Considering the data selected, the period is set as 24 to do the study. The response figures (before crisis) show as follows.
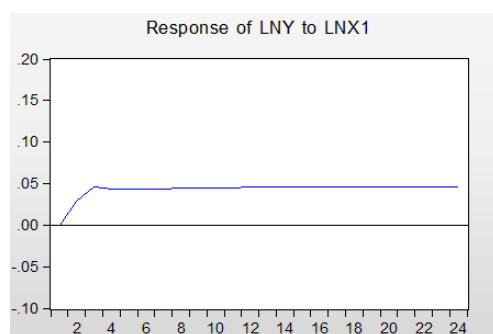
Figure 3.4.1 Response of LNY to LNX1   Figure 3.4.2 Response of LNY to LNX2
Source: Eviews 9.0
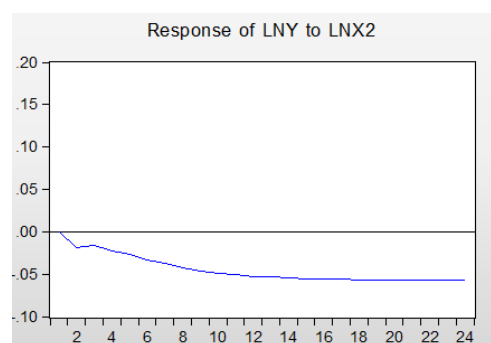
The horizontal axis of this illustration indicates the future response base of the impulse response function; the longitudinal axis is the Impact response degree of corresponding

variables to the perturbed term. From the first image, we can find that if there is a shock of innovation of WTI at beginning, in the first three periods, there is an evidently positive response of BDTI changes and the maximum value is reached at 0.046, starting from the fourth month, the changes tend to maintain a steady state. The increase of WTI shows the good expectation of crude oil price, which will drive the current demand for crude oil from marketers to prevent the rising cost of the purchase of oil. For this reason, there will be a growth of crude tanker transportation; on the other hand, the spot freight rate will be affected and go up as well. However, as the figure illustrates that this impact won't last for a long time, the spot freight rate still faces with many other factors and risks that affect its fluctuation, crude oil futures price has the most significant impact at the third period on BDTI. In the second figure above, the shock of new crude tanker orders has a negative impact on BDTI. There is not a direct downward trend in the curve, after reaching a low point in the second period, it has rebounded in the third period, and then in a state of decline, it is steady until about the 15th period. In the short term, the negative impact of new orders on BDTI has been repeated and not in a deep degree, the new capacity will increase the supply of tanker market as well as the capital problems of shipping company, which further expand the decrease on freight rates with the time passed by.

The response results (after crisis) indicate as Figure 3.4.3 and Figure 3.4.4.
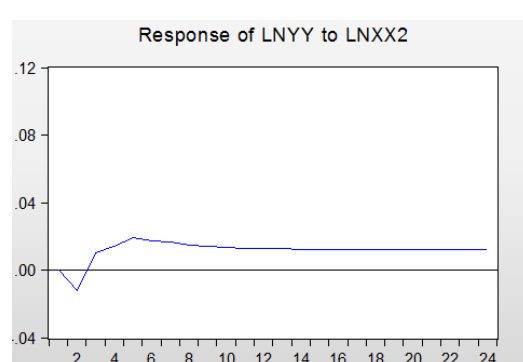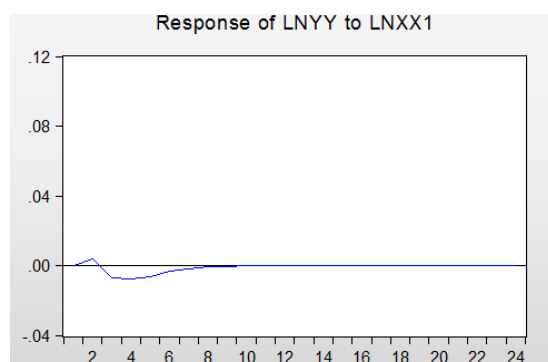
Figure 3.4.3 Response of LNYY to LNXX1   Figure 3.4.4 Response of LNYY to LNXX2

Source: Eviews 9.0

It can be seen from the first figure that there is an upward trend at beginning, even reaching the maximum value of 0.004 at the second period. After that, the curve declines, and the lowest point is -0.008 at the fourth period. Then, there is a trend to pick up slowly, it is stable from the ninth period at value of 0, which shows that WTI influence on spot

freight rate is mainly concentrated on the former nine periods. Crude oil futures price increases, freight rate level will increase at first two periods for the rising demand, at the same time, the rising price will push the cost much higher and no clear sign of a continued increase in demand for crude oil which will let spot rate go down. The world economy cannot afford more crude oil amount like before. The other figure is told that the second period is the lowest value -0.012, after that, reaching the highest value 0.019 at the fifth period, finally becoming stable at 13th period. More new orders have caused oversupply problem before, but if the market needs more tankers, it seems to be in a better condition so that spot freight rate will increase.

2. Variance decomposition

To know how much is the structural impact of two factors account for the proportion of the total contribution on BDTI, variance decomposition method is used. The results can be seen from next tables, and the period is also set as 24.

Table 3.4.1 Variance Decomposition of lny (before crisis)

Variance Decomposition of LNY:				
Period	S.E.	LNY	LNX1	LNX2
1	0.153588	100	0	0
2	0.233116	97.7754	1.552476	0.672123
3	0.270661	95.14354	4.001194	0.855262
4	0.286439	92.64444	5.935963	1.419599
5	0.294155	90.05385	7.788394	2.157758
6	0.299842	87.17773	9.558779	3.263495
7	0.305444	84.0689	11.26551	4.665598
8	0.311525	80.82082	12.84349	6.33569
9	0.318128	77.55655	14.28321	8.160237
10	0.325176	74.36127	15.5801	10.05862
11	0.332546	71.29888	16.74504	11.95609
12	0.340131	68.40459	17.78916	13.80625
13	0.347839	65.69534	18.72638	15.57828

14	0.355601	63.17368	19.56975	17.25658
15	0.363366	60.83403	20.33158	18.83439
16	0.371095	58.66607	21.02263	20.3113
17	0.378764	56.65735	21.65225	21.6904
18	0.386354	54.79478	22.22837	22.97685
19	0.393855	53.06553	22.75772	24.17675
20	0.401259	51.45748	23.24599	25.29653
21	0.408563	49.95946	23.69798	26.34256
22	0.415766	48.56131	24.11778	27.32091
23	0.422868	47.25389	24.50884	28.23727
24	0.429871	46.02897	24.87417	29.09686

Source: Eviews 9.0

From the analysis results, the contribution rate of two factors, except BDTI itself, increases as the time grows at different speed. A steady increase is in the contribution rate of WTI, and finally stabilized at around 24.8%. But for crude tankers orders, there is a slowly increase in the previous periods, starting from the middle periods, the increase in contribution rate goes up quickly, and in later periods, the rate is higher than that in WTI at 29.09%, which means new orders would cause more oversupply problems to the spot freight rate in later times.

Table 3.4.2 Variance Decomposition of lny (after crisis)

Variance Decomposition of LNY:				
Period	S.E.	LNY	LNX1	LNX2
1	0.111281	100	0	0
2	0.150354	99.24838	0.068106	0.683516
3	0.160767	98.75636	0.240304	1.003331
4	0.16325	97.85745	0.45076	1.691791
5	0.164823	96.39922	0.589955	3.01083
6	0.165875	95.33831	0.621209	4.040478
7	0.166816	94.38913	0.626175	4.984696

8	0.167588	93.64439	0.623014	5.7326
9	0.1683	92.98405	0.618614	6.397338
10	0.168951	92.40694	0.614026	6.979038
11	0.169572	91.87152	0.609561	7.518923
12	0.170167	91.37059	0.605307	8.024103
13	0.170746	90.8899	0.601227	8.50887
14	0.171311	90.42597	0.597314	8.976715
15	0.171867	89.97406	0.593534	9.432405
16	0.172416	89.53259	0.589874	9.877538
17	0.172958	89.0997	0.586311	10.31399
18	0.173497	88.67451	0.582832	10.74266
19	0.174032	88.25613	0.579425	11.16444
20	0.174563	87.84402	0.57608	11.5799
21	0.175092	87.43769	0.57279	11.98952
22	0.175619	87.03683	0.569551	12.39362
23	0.176144	86.64114	0.566357	12.7925
24	0.176666	86.25043	0.563207	13.18637

Source: Eviews 9.0

It is clear from the table above that the rising speed of contribution rate of crude tanker orders is quicker than that of crude futures price, the contribution rate of WTI fluctuates around 0.6%, and that of new orders is all the way up to about 13%, which can be told that WTI cannot have more influences on BDTI than new order quantity in later periods.

3.5 Summary

This chapter is used co-integration analysis, VECM model and dynamic relationship analysis to figure out how the WTI and new order quantity changes affect the fluctuation of BDTI before 2008 and after 2009.

Before the crisis, the data shows two co-integration relationships between variables, which can be deduced by the obviously rising trend of WTI and new orders. The CE

indicates that the ordering of crude tankers has a negative relationship with changes of BDTI, which means more capacity in the market would increase competition so that freight rate decreases. But this needs a lag period, what can be explained by the results of variance decomposition is that the consequence of increase of capacity may cause oversupply problems and drop freight rate in later periods. WTI has the same trend with BDTI, the rising of futures price will push forward the expectation of spot freight rate.

After crisis, the condition is not the same as that before 2008. From the basic figures, we can see that there is no clear trend in variables, and the changes of three variables are full of volatility, which is the sequela of global financial problems. There exists one co-integration relationship, and the direction of two variables changes are positive relationship with BDTI. This can be explained that if there is a growing demand for new tankers in current low market, it shows that the marketers have the confidence in future market, which may be a reason for the growth of spot freight rate. From the dynamic analysis, the increase of futures crude oil prices cannot have much influence on BDTI for that the oil price is very low comparing to the price level before, the market needs a period time to recover. For new crude orders, it has a quicker growth of contribution rate in BDTI, and the orders can represent the slowly warming of market.

Chapter 4 Impacts of WTI and new orders on freight rate of VLCC routes

4.1 Introduction of three routes

After financial crisis, tanker market has dropped at a low level for a period time, to reduce cost, the speed of navigation slow down as well as the size of tankers. The shipping companies hope to minimize the loss or maintain the least profit so that they are willing to choose larger ships to carry more cargo at one time. The larger the tonnage of tankers carrying oil, the greater the quantity of crude oil that can be transported by single tanker, which is a way that can lower the unit cost. From another aspect, the giant tanker can have huge capacity for storing crude oil to hedge the risk of crude oil price volatility. For these reasons, the need for giant tanker like VLCC is an important part of the tanker market. The analysis will choose the monthly data from June of 2009 to December of 2017 to see what impacts of WTI and VLCC orders on three routes of VLCC, which are TD1, TD2, TD3, and their fluctuation show as following three figures.
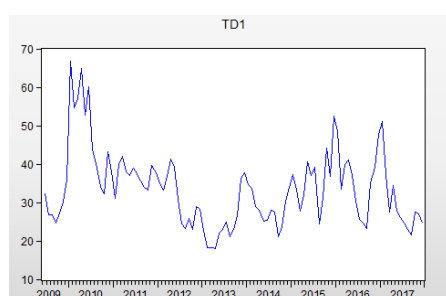
Figure 4.1.1 Fluctuations of TD1   Figure 4.1.2 Fluctuations of TD2
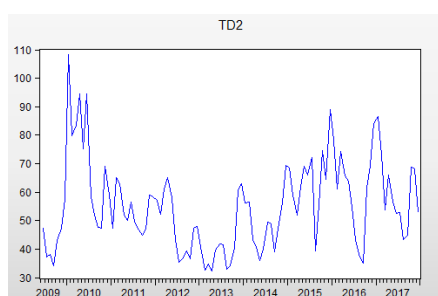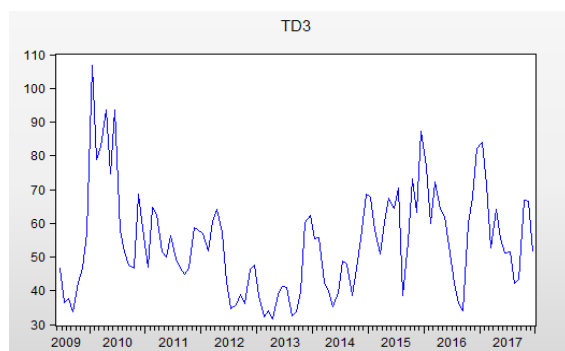
Figure 4.1.3 Fluctuations of TD3
Source: www.clarksons.net/portal

It can be indicated that during 2012 -2013, the freight rate was a low period, as a whole, the market condition of TD1 is much more serve than the other two routes. The smallest value of TD1 is lower than 20, and the highest one is below 70. What has caused this

condition can be that US is the third largest oil producing country after Saudi Arabia and Russia in the world, which narrows its need for crude oil so that there is no obvious drive force in TD1 increase.

4.2 The co-integration analysis between WTI and new VLCC orders

(1) Unit root test

First of all, there should be a unit root test to test the stability of series, only stable series that can be made the co-integration test. Through the test in Eviews that TD1,TD2,TD3 series fit the Level test with significant P value, however, sequences of new orders of VLCC and WTI are not the same. So, the first order difference should be made, which illustrates in Table 4.2.1.

Table 4.2.1 T value of ADF test

Augmented Dickey-Fuller test statistic					
Test critical values:		1% level	5% level	10% level	Prob.*
t-Statistic TD1	-8.24405	-3.49703	-2.890623	-2.58235	0
t-Statistic TD2	-7.44466	-3.49844	-2.891234	-2.58268	0
t-Statistic TD3	-7.41164	-3.49844	-2.891234	-2.58268	0
t-Statistic WTI	-7.80179	-3.49635	-2.890327	-2.5822	0
t-Statistic VLCC new order	-8.2999	-3.49635	-2.890327	-2.5822	0

Source: Eviews 9.0

The t- Statistic value of all series are less than their corresponding critical values at 5% significant level, the P value is close to zero, which proves their significance.

(2) Johansen test

There exists three variables, which needs Johansen test to see whether co-integration relationship is in variables. The test is also based on VAR model like what have done in the chapter 3 before. It is needed to select the lag order for the model, the estimation result with the lag length of 8 and lag intervals of 2 shows as below figures.

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-879.7112	NA	26799.60	18.70971	18.95166*	18.80747*
2	-868.3270	21.33052*	25498.86*	18.65952*	19.14341	18.85504
3	-863.4267	8.872079	27830.95	18.74583	19.47166	19.03912
4	-858.4354	8.721725	30353.18	18.83022	19.79800	19.22128
5	-852.1953	10.50948	32295.55	18.88832	20.09805	19.37715
6	-848.0536	6.714031	35985.65	18.99060	20.44228	19.57719
7	-846.6090	2.250462	42543.91	19.14966	20.84329	19.83401
8	-842.4989	6.143480	47692.03	19.25261	21.18818	20.03472

* indicates lag order selected by the criterion

Figure 4.2.1 Estimation results of TD1

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-942.3735	NA	100242.4	20.02892	20.27086*	20.12668*
2	-930.5472	22.15867*	94493.75*	19.96942*	20.45331	20.16494
3	-925.3302	9.445632	102450.4	20.04906	20.77489	20.34235
4	-922.5594	4.841580	117082.7	20.18020	21.14798	20.57125
5	-912.8648	16.32767	115836.7	20.16558	21.37531	20.65440
6	-909.0666	6.157076	130009.2	20.27509	21.72676	20.86167
7	-907.4826	2.467702	153252.4	20.43121	22.12484	21.11556
8	-903.3250	6.214556	171625.1	20.53316	22.46873	21.31527

* indicates lag order selected by the criterion

Figure 4.2.2 Estimation results of TD2

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-940.3989	NA	96160.79	19.98735	20.22929*	20.08511*
2	-928.5784	22.14787*	90657.16*	19.92797*	20.41186	20.12350
3	-923.3934	9.387520	98357.24	20.00828	20.73412	20.30158
4	-920.5776	4.920287	112298.4	20.13848	21.10626	20.52953
5	-911.0707	16.01162	111543.1	20.12780	21.33754	20.61663
6	-907.2063	6.264470	125015.8	20.23592	21.68760	20.82251
7	-905.6101	2.486592	147328.6	20.39179	22.08542	21.07614
8	-901.4923	6.155077	165129.5	20.49457	22.43014	21.27669

* indicates lag order selected by the criterion

Figure 4.2.3 Estimation results of TD3

Source: Eviews 9.0

The three results are told that the lag order of 2 is chosen by the test. There is no need to reestimate the VAR model, but for co-integration test, the lag interval should be 1. The Johansen test results can be seen as follows:

Table 4.2.2 Trace test results of three routes

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
TD1				
None *	0.199521	31.06049	29.79707	0.0356
At most 1	0.052313	8.583406	15.49471	0.4053

At most 2	0.03077	3.156609	3.841466	0.0756
TD2				
None *	0.227732	35.02887	29.79707	0.0114
At most 1	0.05561	8.928123	15.49471	0.3721
At most 2	0.0307	3.14933	3.841466	0.076
TD3				
None *	0.227907	35.00984	29.79707	0.0115
At most 1	0.055247	8.886157	15.49471	0.376
At most 2	0.030669	3.14611	3.841466	0.0761

Source: Eviews 9.0

As the table shows that TD1, TD2 and TD3 all have at least co-integration relationship with variables of WTI and new VLCC orders, which means that regression models can be made.

4.3 Regression analysis

The regression analysis is to see how the variables affect the dependent variable. First is the regression model of TD1, WTI and new orders of VLCC.

```
Dependent Variable: TD1
Method: Least Squares
Date: 05/27/18   Time: 16:38
Sample: 2009M06 2017M12
Included observations: 103
```

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.30090	3.710906	6.548511	0.0000
WTI	-0.054764	0.037366	-1.465625	0.1459
ORDER	0.109759	0.018828	5.829606	0.0000

R-squared	0.265094	Mean dependent var	33.51612
Adjusted R-squared	0.250396	S.D. dependent var	9.854011
S.E. of regression	8.531572	Akaike info criterion	7.154118
Sum squared resid	7278.772	Schwarz criterion	7.230858
Log likelihood	-365.4371	Hannan-Quinn criter.	7.185200
F-statistic	18.03591	Durbin-Watson stat	0.656878
Prob(F-statistic)	0.000000		

Figure 4.3.1 Regression results of TD1

Source: Eviews 9.0

It can be deduced from the figure that R- squared is 0.265, the independent variables can

explain the 26.5% change of the dependent variable, and this result is not so good. The P value (F-statistic) is $0.000 < 0.05$, which can reject the null hypothesis, indicating that there is a significant linear relationship between independent variables and dependent variable. But the P value of independent variables indicate that WTI variable is not significant at even 10% level, for $0.1459 > 0.1$; only new orders variable is significant.

The second regression model of TD2 shows as Figure 4.3.2:

Dependent Variable: TD2
Method: Least Squares
Date: 05/27/18   Time: 16:56
Sample: 2009M06 2017M12
Included observations: 103

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	62.94388	6.142865	10.24667	0.0000
WTI	-0.244865	0.061853	-3.958791	0.0001
ORDER	0.088106	0.031167	2.826925	0.0057

R-squared	0.190833	Mean dependent var	55.24650
Adjusted R-squared	0.174650	S.D. dependent var	15.54537
S.E. of regression	14.12278	Akaike info criterion	8.162148
Sum squared resid	19945.28	Schwarz criterion	8.238888
Log likelihood	-417.3506	Hannan-Quinn criter.	8.193231
F-statistic	11.79196	Durbin-Watson stat	0.831500
Prob(F-statistic)	0.000025		

Figure 4.3.2 Regression results of TD2
Source: Eviews 9.0

The R- squared is not high, but the P value (F-statistic) is $0.000025 < 0.05$, which proves the significant linear relationship. From the P values of two variables, they are all significant at 5% level because 0.0001 and 0.0057 are smaller than 0.05.

The third regression model of TD3 illustrates as following:

```
Dependent Variable: TD3
Method: Least Squares
Date: 05/27/18   Time: 17:23
Sample: 2009M06 2017M12
Included observations: 103
```

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	60.48319	6.054493	9.989803	0.0000
WTI	-0.228373	0.060964	-3.746049	0.0003
ORDER	0.090930	0.030718	2.960137	0.0038

R-squared	0.185113	Mean dependent var		54.36796
Adjusted R-squared	0.168815	S.D. dependent var		15.26786
S.E. of regression	13.91960	Akaike info criterion		8.133167
Sum squared resid	19375.54	Schwarz criterion		8.209907
Log likelihood	-415.8581	Hannan-Quinn criter.		8.164249
F-statistic	11.35820	Durbin-Watson stat		0.822347
Prob(F-statistic)	0.000036			

Figure 4.3.3 Regression results of TD3

Source: Eviews 9.0

The R-squared is 0.185, the P value (F-statistic) is 0.000036 < 0.05, which also prove the model is significant and reject the original hypothesis. P values of the other two variables are 0.003 and 0.0038 < 0.05, which are significant at 5% level.

4.4   Summary

The first model equation that can be got from the figure is: y = -0.054764x1 + 0.109759x2 +24.30090, among this, y is spot freight rate of TD1, x1 is WTI, x2 is new VLCC orders, so as the other two models.

The second model shows that WTI has the negative relationship with TD2 of VLCC, the increase of futures crude oil price will decrease the need for oil in ME, and buyers would choose VLCC as storage for oil to expect to have some profit from arbitrage, so that the spot freight rate of TD2 goes down. New VLCC orders increase shows a good expectation of market, tanker spot freight rate will increase.

The third equation is that y = -0.228373x1 +0.09093x2 + 60.48319. The results are similar like the regression results of TD2, there is a negative trend between WTI and freight rate of TD3 and a positive relationship between new orders and freight rate of

TD3. Because the destinations are all in Asia, the need from China, India and other countries drives the freight rate of two routes, so there's not a big gap between two equations.

TD1, TD2 and TD3 are all the routes starting from the Middle East, which is the place where manufactures and exports the major part of crude oil production. Among three routes, TD2, TD3 are seem to have almost the same trend for they all transport to Asia, which needs huge amount of oil to support countries economic development. And to lower the cost in such market condition, demand for VLCC will not decrease.

Chapter 5 Conclusion & Suggestion

5.1 Conclusion

It can be got from co-integration analysis that there are two co-integration relationships among variables in first part of data, which shows a positive trend between WTI and BDTI series and an opposite trend between newbuilding orders of crude tanker and BDTI. In second part, one co-integration relationship exists, what different from analysis before is that the quantity of new orders becomes a positive factor of BDTI fluctuations. Before crisis, spot freight rate fluctuated at a higher level, which thanks to the closer world connection that stimulated international trade as well as the demand for crude oil trade which is derived tanker transport to meet the needs of those emerging countries. Although some region limited wars in the world have caused economic turbulence which fluctuate tanker freight rate violently, crude oil price still changed by an overall upward trend due to the development of emerging countries before recession. It is well known that current market can't get rid of the impacts of oversupply and a downturn risk of world economy. Despite of the need of upgrading old tankers, the amount of newbuilding tankers cannot reach its highest point when the market crazily longed for vessels to accomplish orders of transporting crude oil. In current condition, how to manage to reduce business cost as far as possible is the first thing for marketers, so that if there is a sign of increase in profit which can be seen that the market has a recovery expectation, there can be a demand for new crude tankers, which indicates in equation that BDTI and new orders are correlated in a positive relationship. The crude oil price has dropped from the top, but owing to the characteristics of futures price represents functions of price discovery and need of hedging, when futures price goes up, demand for present cargo will increase. Therefore, there is a relationship changing by the same direction between WTI and BDTI series.

From the dynamic analysis, a positive shock of WTI hasn't a long-term effect on BDTI changes in first stage, although it does one of the factors that increase spot freight rate, the expectation of futures price is also an erratic element for this uncertain market. The rising

of oil price make the cost higher, and increase in new crude tankers aggravates the burden of cost management for such more capacity, which may come from the capital for new tankers, though the analysis that the negative impacts will be a more difficult problem in the later periods. Financial crisis has brought huge capital damage to the newbuilding market, as we all know that building a ship is really expensive, when demand cannot support increase in capacity, new orders will be cut. That's why the growth of new tankers would have an overall positive response on BDTI. Though the cost burden in short term cause problems, establishing market confidence and promoting recovery is needed in the long term. The contribution rate of WTI shows that continued downturn in crude oil prices and economy cannot generate more demand stimulus for the freight market. Tanker business is a derived need of crude oil trade, so demand growth is very important to the tanker market.

The regression analysis of VLCC is based on the relationship between influencing factors and its three routes, which is TD1, TD2, and TD3. The results indicates that WTI impacts on spot freight rate of these routes is weak which is mainly because the crude oil are from ME not the one from US. When US oil price goes up, there will be a little decrease in three routes. It can be concluded from Figure2.1.2 that four countries in Asia are in the top five crude oil importing countries, which their total amount is over the sum of others in top 10. New VLCC orders, according to the feature of this ship type, there might be increase in crude oil demand, which is good to the whole market.

5.2 Suggestion

The environment of supply part of crude oil exports has changed since US lifted its ban on exports of crude oil in 2015, and US has become one of the largest exporters. To overcome the oversupply problem in market, OPEC has decreased its production. In such situation, the impact of US on crude oil price fluctuations will be more and more important to the market, which may stimulate the growth of price, the market will become more uncertain and complicated. The marketers should pay more attention to US policy on supply of crude oil and world trade.

Based on the current data, except US accounts for the largest contribution of crude oil, Asia has been playing another key role in oil consumption, how will the demand part change affects the spot freight rate needs marketers to be more attentive to the development of Asia countries as well as USA. What another thing that cannot be avoided is the powerful effect of the national strategy of America, which will cause more serious problems on the crude oil trade and production, even transportation will be affected. In this condition, whether the crude oil price or the freight rate fluctuates unpredictable, this has a deep influence on the whole development of tanker market.

Of course, the oversupply is the main issue that has caused so much trouble to current market since financial crisis, to control the new orders of tankers and manage the operation cost in order to get more profit is the first thing that marketers need to worry.

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The Website of Clarksons Research gives more information of tanker market on the research (http://www.clarksons.net/markets/)

Appendix：

Data of BDTI, WTI and the ordering of crude tankers

Date	BDTI	WTI	CRUDE ORDER	Date	BDTI	WTI	CRUDE ORDER
1998-Aug	910	13.3819	187	2003-Jan	1,528	32.69952	229
1998-Sep	760	14.9719	185	2003-Feb	1,744	35.73316	232
1998-Oct	796	14.415	188	2003-Mar	1,981	33.15619	240
1998-Nov	814	13.03947	197	2003-Apr	1,317	28.13571	241
1998-Dec	854	11.31091	197	2003-May	1,224	28.07048	239
1999-Jan	939	12.48684	196	2003-Jun	1,227	30.51952	250
1999-Feb	886	12.02105	185	2003-Jul	882	30.70227	270
1999-Mar	890	14.68217	180	2003-Aug	784	31.59714	283
1999-Apr	763	17.30238	172	2003-Sep	1,012	28.31143	285
1999-May	719	17.771	168	2003-Oct	1,088	30.34522	281
1999-Jun	714	17.92	164	2003-Nov	1,461	31.05611	286
1999-Jul	692	20.09571	163	2003-Dec	1,888	32.14238	289
1999-Aug	682	21.27909	160	2004-Jan	2,113	34.22474	302
1999-Sep	739	23.78905	162	2004-Feb	1,670	34.5	296
1999-Oct	765	22.67476	155	2004-Mar	1,423	36.71826	305
1999-Nov	769	24.7665	154	2004-Apr	1,155	36.61667	299
1999-Dec	950	26.08857	148	2004-May	1,254	40.28	302
2000-Jan	991	27.01421	146	2004-Jun	1,454	38.04952	298
2000-Feb	1,143	29.2975	139	2004-Jul	1,488	40.80762	302
2000-Mar	1,286	29.89435	140	2004-Aug	1,360	44.88364	306
2000-Apr	1,282	25.53684	140	2004-Sep	1,402	45.93762	303
2000-May	1,428	28.80591	150	2004-Oct	2,678	53.09381	304
2000-Jun	1,605	31.53	150	2004-Nov	3,050	48.4755	305
2000-Jul	1,759	29.71632	172	2004-Dec	2,364	43.25619	313

2000-Aug	1,854	31.13783	174	2005-Jan	1,521	46.8515	321
2000-Sep	1,735	33.867	178	2005-Feb	1,493	48.05316	316
2000-Oct	2,083	32.93227	182	2005-Mar	1,543	54.62955	310
2000-Nov	2,158	34.263	190	2005-Apr	1,217	53.21762	302
2000-Dec	2,263	28.3985	191	2005-May	1,358	49.87095	298
2001-Jan	1,776	29.25952	204	2005-Jun	1,225	56.41955	300
2001-Feb	1,474	29.64474	201	2005-Jul	1,169	59.026	299
2001-Mar	1,678	27.27136	207	2005-Aug	1,047	64.99348	297
2001-Apr	1,345	27.621	217	2005-Sep	1,275	65.55286	289
2001-May	1,110	28.68409	224	2005-Oct	1,975	62.26857	278
2001-Jun	926	27.58476	222	2005-Nov	2,198	58.343	276
2001-Jul	978	26.46714	237	2005-Dec	2,060	59.44762	270
2001-Aug	1,003	27.30913	238	2006-Jan	1,664	65.5375	273
2001-Sep	1,019	25.92563	245	2006-Feb	1,383	61.92579	284
2001-Oct	996	22.21261	255	2006-Mar	1,149	62.96609	297
2001-Nov	776	19.668	254	2006-Apr	1,021	70.16105	351
2001-Dec	812	19.40368	256	2006-May	1,179	70.96091	354
2002-Jan	801	19.72905	252	2006-Jun	1,252	70.96955	354
2002-Feb	714	20.75579	252	2006-Jul	1,428	74.46316	366
2002-Mar	694	24.442	247	2006-Aug	1,453	73.08348	379
2002-Apr	741	26.25818	247	2006-Sep	1,278	63.895	402
2002-May	789	26.95318	253	2006-Oct	1,294	59.13682	418
2002-Jun	750	25.546	252	2006-Nov	1,098	59.403	442
2002-Jul	743	26.94	245	2006-Dec	1,205	62.0865	468
2002-Aug	664	28.2	245	2007-Jan	1,235	54.67238	478
2002-Sep	673	29.67	237	2007-Feb	1,168	59.38789	486
2002-Oct	925	28.86304	235	2007-Mar	1,158	60.74045	490

2002-Nov	1,191	26.18947	230	2007-Apr	1,178	64.036	497
2002-Dec	1,350	29.39333	227	2007-May	1,197	63.53091	497
2003-Jan	1,528	32.69952	229	2007-Jun	1,034	67.52952	497
2003-Feb	1,744	35.73316	232	2007-Jul	1,044	74.15048	506
2003-Mar	1,981	33.15619	240	2007-Aug	857	72.3587	498
2003-Apr	1,317	28.13571	241	2007-Sep	849	79.62632	505
2003-May	1,224	28.07048	239	2007-Oct	944	85.65826	502
2003-Jun	1,227	30.51952	250	2007-Nov	1,110	94.63143	496
2003-Jul	882	30.70227	270	2007-Dec	1,934	91.7425	501
2003-Aug	784	31.59714	283	2008-Jan	1,396	92.92905	503
2003-Sep	1,012	28.31143	285	2008-Feb	1,091	95.349	506
2003-Oct	1,088	30.34522	281	2008-Mar	1,325	105.42	503
2003-Nov	1,461	31.05611	286	2008-Apr	1,539	112.4627	507
2003-Dec	1,888	32.14238	289	2008-May	1,939	125.4586	524
2009-Jun	613	69.69545	510	2014-Jan	1,125	94.98348	176
2009-Jul	516	64.29318	494	2014-Feb	812	100.6705	178
2009-Aug	485	71.13857	482	2014-Mar	698	100.509	180
2009-Sep	512	69.4681	490	2014-Apr	679	102.0348	173
2009-Oct	565	75.82364	482	2014-May	662	101.9077	178
2009-Nov	639	78.145	472	2014-Jun	671	105.1467	177
2009-Dec	753	74.60318	467	2014-Jul	830	102.4513	184
2010-Jan	1,126	78.40263	472	2014-Aug	768	96.07619	187
2010-Feb	944	76.45263	449	2014-Sep	639	93.16136	187
2010-Mar	968	81.29	447	2014-Oct	700	84.33913	195
2010-Apr	959	84.57524	434	2014-Nov	887	75.447	198
2010-May	1,047	74.1175	443	2014-Dec	851	59.14304	193
2010-Jun	911	75.40455	441	2015-Jan	909	47.72609	205

2010-Jul	825	76.38286	450	2015-Feb	867	51.02095	217
2010-Aug	773	76.66682	442	2015-Mar	812	47.85409	237
2010-Sep	689	75.54857	457	2015-Apr	784	54.37864	243
2010-Oct	731	81.97476	461	2015-May	827	59.41864	246
2010-Nov	818	84.31476	463	2015-Jun	961	59.82864	261
2010-Dec	1,020	89.23318	456	2015-Jul	842	51.12957	283
2011-Jan	714	89.5785	457	2015-Aug	661	42.88905	303
2011-Feb	741	89.74316	441	2015-Sep	658	45.44304	310
2011-Mar	1,004	102.9813	432	2015-Oct	760	46.28955	324
2011-Apr	858	110.0385	416	2015-Nov	862	42.90714	334
2011-May	786	101.3567	402	2015-Dec	917	37.32727	348
2011-Jun	744	96.28864	397	2016-Jan	919	31.59571	365
2011-Jul	740	97.3405	382	2016-Feb	791	30.54591	356
2011-Aug	699	86.34087	363	2016-Mar	804	37.96091	355
2011-Sep	685	85.61	351	2016-Apr	774	41.12476	349
2011-Oct	800	86.4281	337	2016-May	730	47.03565	349
2011-Nov	778	97.16286	325	2016-Jun	722	48.85318	334
2011-Dec	847	98.57571	316	2016-Jul	617	45.16591	328
2012-Jan	811	100.3185	318	2016-Aug	508	44.79913	327
2012-Feb	798	102.2625	298	2016-Sep	572	45.17043	317
2012-Mar	823	106.205	292	2016-Oct	653	49.94	307
2012-Apr	779	103.346	282	2016-Nov	777	45.865	305
2012-May	754	94.71591	269	2016-Dec	900	52.21227	297
2012-Jun	678	82.40524	253	2017-Jan	1,001	52.65957	295
2012-Jul	640	87.93143	231	2017-Feb	855	53.5019	278
2012-Aug	617	94.16087	219	2017-Mar	827	49.67391	273
2012-Sep	637	94.55842	217	2017-Apr	793	51.11737	265

2012-Oct	669	89.57087	208	2017-May	776	48.6575	266
2012-Nov	699	86.73238	203	2017-Jun	699	45.19591	262
2012-Dec	737	88.2455	195	2017-Jul	648	46.69667	265
2013-Jan	647	94.82857	204	2017-Aug	629	48.05783	252
2013-Feb	659	95.32158	189	2017-Sep	738	49.64864	246
2013-Mar	672	92.957	188	2017-Oct	860	51.59455	241
2013-Apr	655	92.00143	177	2017-Nov	813	56.74091	238
2013-May	614	94.88409	170	2017-Dec	820	57.97762	248
2013-Jun	591	95.8005	164				
2013-Jul	621	104.5552	157				
2013-Aug	637	106.5391	150				
2013-Sep	589	106.26	153				
2013-Oct	600	100.5526	152				
2013-Nov	643	93.85286	152				
2013-Dec	815	97.89429	145				