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The analysis of BDTI in tanker transport market

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THE ANALYSIS OF BDTI IN TANKER TRANSPORT MARKET

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DRECLARATION

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

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

WANG ZHISEN

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Supervised by

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Abstract

Title of Integrative paper: **The Analysis of BDTI in Tanker Transport Market**

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The situation of the tanker market is one of the symbols of the shipping market and also a reflection of the world economy. The BDTI is an important indicator for the crude oil market. That is the reason that the BDTI is so important to the shipping industry. For shipping companies, the ability to forecast BDTI is very important as the trend of the shipping market will have important influence on the company's strategy decisions and operation plans.

Based on the this background, this dissertation firstly gives a comprehensive and detailed description of the situation of the reserves, output, consumption, total input and output of the world crude oil to organize a fundamental base of this dissertation. This part helps to give a clear big picture of the present global tanker transportation market. Then the dissertation will firstly analyze the supply and demand of the tanker market in recent years and analyze the factors that affect the BDTI. The factors we choose include Brent oil price, the fleet size of the tanker, the deliveries of tanker, the demolitions of tanker, the building price of tanker, the second hand price of tanker , global oil production standard & Poor's. Using the SPSS data processing software, this dissertation does the correlation analysis for the factors and BDTI to find out the relationship between them and help to provide a fundamental for the forecasting model. After the correlation analysis, we choose four factors that have good correlation relationship with BDTI to build the forecasting model of BDTI. Using the linear regression model in SPSS, we establish the linear regression BDTI forecasting model and from the result we can see the accuracy of the forecasting model is acceptable. The forecasting model can be used to forecast the BDTI which will help to better analyze BDTI for the shipping companies.

Key words: Global Tanker Transport, Demand and Supply Analysis, BDTI Forecasting

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1. Introduction

1.1 Background of this dissertation

Shipping industry is closely related to many industries like machinery manufacturing, oil industry, electric power industry, logistics and other industries. It is in the upstream of the industry chain and is one of the pillar industries of modern economy and social development. In the wide range of shipping industry chain, the upstream industry includes shipping finance, maritime insurance, maritime trade, maritime consulting, ship management, etc. The middle industries include cargo transportation, ship leasing, tugboat operation, etc. The downstream industries include dock, shipping agency, freight forwarding, customs clearance agent, tally management, crew labor, etc. The economic cycle of shipping industry, especially the shipping market of the Baltic freight index is paid close attention to by the industry and academic researchers. Its periodic volatility affects the process of economic globalization.

The shipping market is mainly composed of three major parts-dry bulk markets, oil tankers market and container market. Oil, as one of the most important strategic resources in the world, has become an important part of national economic and political security and of the development of global and economic landscape.

International tanker shipping market has a history of hundreds of years and plays a significant role in the international shipping market. Its rise and fall is directly related to the development of global economy, involving the economic development of every country. With the speeding up of the economic globalization and the advancement of global integration, multinational companies constantly set up their own production base around the world. Their investment, production and business operations around the world led to the prosperity and development of the international shipping and trade. Due to the tanker market at the bottom of the world economy and trade, the

economic development of every country to promote the global trade's prosperity is a motive force of the tanker shipping market growth. This is the reason that the international oil market and its periodic wave characteristics earn attention across countries and industries. So tanker market can be regarded as a symbol of global economic and trade prosperity and can also be interpreted as a judgment of the global economic development trend.

Since the financial crisis in 2008 which caused the great depression of the shipping market, the tanker market has been at the stage of the low. Although the demand did not reach the lowest point in 2012, 2013, it experienced a slight decline rather than rise compared with 2010 and 2010.In 2012, the averages of BDTI is 719 points which is lower than in 2011 which are 8. 15%. The BCT averages are 632 points which decreased 12.46% year-on-year. The similar fluctuation of shipping market and the world economy shows that the prosperity of the international oil market plays a decisive role for the rise and fall of global economy and trading. Therefore analyzing the periodic fluctuations of the tanker market and its future development trend will help the shipping industry enterprises or the relevant enterprise to formulate reasonable business strategy and take reasonable measures to avoid business risk and enhance their core competitiveness to ensure that their operating earnings.

Although the tanker market in the shipping industry has been studied by a lot of scholars around the world, it has experienced great changes and has appeared in the new features and characteristics with the global economic integration. So the "barometer" of the tanker market-the BDTI deserves an in-depth discussion and research under the new economic background.

1.2 Literature review

Both scientists in China and abroad have done quite a lot of research on market analysis of global tanker transport to better understand the global tanker transport

market.

First, research on market analysis of global tanker transport is abundant. Professor Xie Lianxin had the routes of the world crude oil and oil tanker fleet of ship form analyzed, and according to our country oil imports of transport and fleet development, he made the analysis and planning. Gu Jiajun summed up the world's oil shipping market supply and demand and the quantity to ship freight trends before 2000 and put forward some views on the development of China's oil fleet. In 1996, Wang Changyong briefly analyzed and predicted the international oil market's demand for oil, oil supply, and freight rate changes on the future market. in July 2003, Kong Fan Hua has carried on the summary analysis on the recent and future oil market rate, capacity, supply and demand and clear the prospects of the second half of the world oil market; Yajun Teng runners-up in his master's thesis from oil exporter of distribution, distribution of oil imports, the world will route distribution three aspects illustrates the characteristics of the world's oil transportation demand, from the tanker fleet scale, the master, owner, illustrates the distribution of four aspects of the world's oil supply Characteristic; Pan Xiaodan in her master's thesis, study the rules of oil rate market before, briefly analyzed the world's oil production and marketing status, shipping line layout and oil tanker fleet of ship type, that is, owner of the world, as the research basis. Despite a lot of article analysis of the oil market, but most are introduced the comparison of general and not comprehensive, although the mentioned two master's thesis is detailed, but for thesis earlier, on time lag cannot reflect today's oil market situation very well.

Second, some econometric models and method have been introduced into market analysis of global tanker market. Hawdon for the first time used econometric analysis of shipping market. He used the linear model to predict the tanker freight. In addition, he thinks the tanker freight rate is affected by the dry bulk market, as could be used to pack dry bulk tankers. Norman analyzed that ship market should not only include the freight and should also include analysis of ship supply freight and demand

relationship analysis. He first studied the demand of the market capacity, the capacity requirements and GNP, and found that these variables can largely explain the change of the requirements of capacity. He thinks the shipping market should put the freight rate and capacity supply and the demand for capacity after studying the proportion of their relationship. Along this line, in the 70 s and 80 s of last century many scholars developed the respective model. Zannetos thinks that we should focus on the analysis of the freight rate of sequence statistical process. In addition to the freight rate, he thinks analysis process should also include other variables, the freight rate interacts with each other and other variables can still get a meaningful joint behavior model.

However, problem and weakness still exist. A lot of factors have been chosen to analyze and predict the tanker market, but the factors are still not comprehensive. These could be found in Chinese articles from Meng Nan of her article -The analysis and forecasting of BDTI based on BP. There are some factors that the author takes into consideration. But in order to be more accurate to analyze and forecast the market, more practical factors can be taken into consideration .It will not only increase the accuracy of the research, but also make the analysis more comprehensive.

Some prediction method failed to take some emergency into consideration which makes the prediction not very accurate.

When predicting the global tanker transportation market, some research papers fail to avoid the effect of some emergency .Like when predicting the freight rate, the effect of war of Iraq or the financial crisis will have a huge influence on the accuracy of the final result.

When analyzing the crude oil market, some articles failed to take the product oil market into consideration. As the crude oil market and product oil market will affect each other, they can be analyzed together.

The crude oil market and the product oil market are inner connected and will influence each other in many ways. So when analyzing the crude oil market, it will be better to take the product oil market into consideration to make the study more comprehensive and accurate.

Some research papers fail to analyze the tanker market more detailed. It would e better if we can analyze the market from perspective of different ship types.
Many research papers are discussing about the global tanker transportation market generally. If we can analyze and make some predictions about the global tanker market in terms of different ship types, it will make the analysis more detailed and more comprehensive.

In a word, the analysis of global tanker transportation market still has a lot of areas waiting us to explore deeply inside. And Research on the analysis of the global tanker transportation market is not that abundant or practically mean well while using into real cases. Research of analysis of global tanker transportation market still has a long way to go.

1.3 The framework and content of the dissertation

The situation of the tanker market is one of the symbols of the shipping market and also a reflection of the world economy. The BDTI is an important indicator for the crude oil market. That is the reason that the BDTI is so important to the shipping industry. The BDTI has the characteristics of high volatility. Especially after Opec was born, the transport market is more volatile and the influence of many unexpected events will play a key role in it. These characteristics make BDTI prediction very difficult. In the past decades, many scholars put forward some prediction method to predict the BDTI, but the effect is not ideal. The main purpose of this dissertation is to analyze and forecast the modern tanker market by using econometrics models and try to give some practical advices for the shipping companies.

The dissertation will give a comprehensive and detailed description of the situation of the reserves, output, consumption, total input and output of the world crude oil to organize a fundamental base of this dissertation. Then the dissertation will firstly analyze the supply and demand of the tanker market in recent years and analyze the factors that affect the BDTI. By selecting some important factors that has close relationship with the BDTI, we try to establish an exact formula to forecast the BDTI for the next months.

The methodology this dissertation uses will be the regression model. The key factors we choose include Brent oil price, the fleet size of the tanker, the deliveries of tanker, the demolitions of tanker, the building price of tanker, the second hand price of tanker , global oil production standard & Poor's.

And at last this dissertation will provide some practical measures for the shipping companies to have a better operation of the company.

2. Description of the international tanker market and BDTI

2.1 Description of global tanker transportation

2.1.1 History of global tanker transportation

The history of the development of world oil tankers transport has been one hundred years and occupies an important position in the international shipping market system. This is because the tanker transportation market occupies a large proportion of the volume of world shipping and fleet size. Also, oil, as the most important strategic resource in today's world, has become an important part of national economic, political, security and has a large effect on the global political and economic landscape. The geographical imbalance of the world oil storage、production and consumption leads to the result that oil becomes the economic ties which links the country in various areas of the world. At the same time oil causes the difference of the resources distribution and the demand distribution which improves the development of the international oil tanker transportation market.

International oil transportation market will show a strong regularity and season difference in a certain period of time after long time of development, evolution, and self-improvement. In the 90’s, with the economic development of all countries on energy, especially oil demand is increasing, the world's oil production and exports has maintained steady growth and made oil transportation and turnover increase year by year which makes the international oil tanker transportation market overall development situation strong. By the year of 1997, the southeast Asia financial crisis broke out and the damage it brought to the international oil tanker transportation market brings should not be underestimated as its relative influence on the tanker transportation market proved to be strong. Since the 21st century, the oil price is rising quickly as the world oil market plays an important role in the international economic,

political, diplomatic, and military area. In 2002, the tanker accident of "Prestige" which is a single-hull brought a radical change to the tanker transport as the international maritime organization (IMO) restricted single hull tanker through the amendment of MARPOL convention. After that a large number of single-hulled tanker scrap caused the global tanker capacity nervous ahead of time. In addition, Asian factors such as "China" would improve the VLCC transport market's growth. Asia's economic development is the most remarkable in the world which makes China and India the largest potential VLCC market. The sustained and rapid development of Chinese economy provides the VLCC market opportunities and Asian countries' economic development also becomes the main factors to lead the VLCC transport market.

Tanker transportation market experienced a rapid growth since 2003. In 2004 world oil transportation market situation is still good. After 2005, we can see market freight situation presents a trend of steady state. From the change of the recent oil tanker, it is not hard to see that the next two years tanker transportation market will still remain at a higher level. Tanker fleet will peak in the update period and the global shipbuilding capacity cannot catch up with the increase of the demand. Even if the owner's shipbuilding desire is high, it is impossible to make a lot of ships in the short term. As the number of single hull tanker gradually reduced and the Chinese strong demand for oil, oil tanker transportation market in the next few years will still have considerable performance and ship owners will gain lots of profit from it. So, the international oil market is still a big market full of vitality.

2.1.2 Characteristics of global tanker transportation

2.1.2.1 The tanker transportation market has strong cyclical

Oil tankers transport is developed with the rise of offshore oil trade and it has nearly a history of more than a century. Oil tankers transport has been recognized as a standardized, high degree of specialization, information integrated, open and mature

industry. The change of world economic development lead to the change of the demand for oil and the change of the demand for oil will affect oil tankers transport. So, it can be seen from the past few decades, oil tankers transport industry has strong cyclical characteristics. Oil tanker market price is often affected by factors such as politics and economy. Political issues such as Iran, Lebanon make the international oil prices continue to rise. Then the rising of the oil prices make many countries start to have a larger storage of their oil. Factors like this can lead to the volatility of international oil tanker transportation market.

2. 1.2.2 The tanker transportation market generally uses long-term contracts

Due to the freight rate fluctuation, most oil transport company will choose to have a long-term contract with oil importers and exporters company in order to guarantee the stability of the supply of goods and reduce the risk of market fluctuations. The long-term contract is generally used as a form of cooperation between enterprises. The contract usually contains the contract deadline and transport volume. By signing a long-term contract of carriage with oil companies, owner can establish and promote the strategic cooperative relations. . On one hand, the oil company can offer the long-term and stable orders to the ship company; on the other hand, the ship company can guarantee the oil transportation for the oil company. “The price formula” is achieved under the premise of win-win. The oil companies and ship companies always coordinate their benefits with the long-term contracts.

2.1.2.3 The oil pollution prevention is highly required by the oil tanker market

According to the related files, 35% of marine environmental pollution is aroused by the shipping pollution, while the oil pollution is the main shipping pollution . During the transportation the crude oil, the oil pollution accidents can happen because of the marine accidents, wrong machines operation, bad equipments, personnel’s poor knowledge, oily water and bilge water mistakenly discharging. With the environmental awareness and environmental requirements arising, how to prevent the

pollution of the oil tankers has drawn more attention.

Most countries and areas have made more strict requirements for the newly-built ships. They would strengthen the test of the ship structure and make more harsh regulations for the single shell ships to transport the crude oil and heavy oil. They have made the schedule to obsolete the single shell ships. All these measures would radically reduce the ship pollution. The competent authorities of the port states should fully perform the regulations about the port safeties. They also make the overall check for the oil tankers. The oil tanker companies have taken the safety management more seriously. And, they have made more regulations for the ship operation. Every operation on the ship is sure to be carried out from the safety regulations. On the other hand, the oil companies also expend the checking contents and depth to improve the safety performance and the equipment running of the ships, as well as the safety awareness of the crew. Thus, the oil pollution prevention is highly required by the market.

2.1.2.4 The Single ship company operation mode in the tanker transportation market

The tanker is an industry of high risk. In case of the collision incidents or the oil leak, the owner will take huge liability to pay compensation. In order to avoid the risk of "sister ship" arrest system that the entire fleet operation is affected, in the practice of oil transportation, almost all the owners will break up the whole fleet into several ships to realize resource integration and asset stripping. They also hang the flags of convenience to register as the single ship companies. Registered as the single ship company with one oil tanker can limit the owner's liability in a certain range and it is very effective to reduce the risk of owner's responsibility. Also it would eliminate the bank's concerns of the loans that are used to build the ship. In addition, the single ship company saves the considerable fee for the owners in operating costs, daily expenditure, the crew employment fee, tax revenue.

2.1.2.5 The strong monopoly power of the supply in the tanker transportation market

In the world oil trade, big oil companies often occupy a leading position. They are the main body of the tanker market. Since the oil companies have the large scope of business all over the world, they are able to dominate the oil market all over the world and control the supply of oil in the international tanker transportation market. At the same time, in order to reduce operating costs and consolidate market position, more and more major oil companies begin to form their own tanker fleet and wharf. As a result, the supply of oil for the independent tankers owners will be less. And the independent tanker owners' bargaining power in the market is relatively weak.

2.1.3 Component of global tanker transportation

2.1.3.1 Oil

International tanker transportation market is special combination of tankers to provide service for the transportation of product oil and crude oil and other oil product. The oil's importance and its disequilibrium distribution generate the oil trade and transportation. The reason why the oil transportation is so important is that the oil transportation makes up a large proportion in the world shipping. There are serious imbalances in the oil consumption, storage and development. All these factors make the oil transportation market more prosperous and create more favorable conditions to the development of international oil shipping market.

2.3.1.2 Oil tanker

The world's tanker fleet is one of the world's largest fleet, which accounts for 38.5% of world gross tonnage of the caravan. Oil tanker is the specialized ship used to transport oil, product oil and its derivatives. According to the global Clarkson statistics, there are more than 5700 oil tankers (DWT: ten thousand tons) in the world. It is these tankers that transport the oil from producer countries to consumer countries. The statistics data shows that more than 50% of the sea freight is oil, Since1993 the

design of the oil tankers is the double deck structure. This can reduce large area pollution once the oil tanker strike the rocks causing oil spill. According to the load capacity, the oil tankers can be divided into the following categories:

1) Panamax Oil Tanker: Panamax tanker is the type of tanker that constructed according to the Panama Canal navigation conditions as the limitation. The Panamax tanker satisfies the following indicators: ship length no more than 274.32 meters, the ship width no more than 32.30m since the Panama Canal is as wide as 32.20m, deadweight generally between 60000 to 80000 tons. Panamax oil tankers are mainly used for the product oil as well as the crude oil of the coastal areas. Its route is mainly from the Far East to the Japan, Singapore to Japan, and the Far East to the west coast of India.

2) Aframax: Aframax tanker is an oil tanker smaller than 120,000 metric tons and with a breadth of longer than 32.31 m and therefore were unable to pass through the original Panama canal. The term is based on the Average Freight Rate Assessment (AFRA), a tanker rate system created in 1954 by Shell Oil to standardize shipping contract terms. Due to their favorable size, Aframax tankers can serve most ports in the world. These vessels serve regions that do not have very large ports or offshore oil terminals to accommodate very large crude carriers and ultra-large crude carriers. Aframax tankers are optimal for short- to medium-haul crude oil transportation. Aframax class tankers are largely used in the basins of the Black Sea, the North Sea, the Caribbean Sea, the South and East China Seas, and the Mediterranean. Non–OPEC exporting countries may require the use of tankers because the harbors and canals through which these countries export their oil are too small to accommodate the larger Suezmax or the larger still very large crude carriers and ultra-large crude carriers.

3) Suezmax Oil Tanker: Suez oil tanker is the type of tanker that constructed according to the Suez Canal navigation condition limitation, with the draft of 11.6

meters, deadweight tonnage of 12.2 million tons. For most European countries, the oil from the Middle East must go through the Suez River. The Suez oil tanker is widely used among the areas of West Africa, the North Sea and the Mediterranean countries. For example, Nigeria's crude oil, Russia's crude oil and the black sea's oil are mainly transported by the Suezmax tankers.

4) Very Large Crude Carrier: "Supertankers" are the largest tankers, including very large crude carriers (VLCC) and ULCCs with capacities over 250,000 DWT. These ships can transport 2,000,000 barrels (320,000m3) of oil/318,000 metric tons. By way of comparison, the United Kingdom consumed about 1.6 million barrels (250,000 m3) of oil per day in 2009. ULCCs, commissioned in the 1970s, were the largest vessels ever built, but the longest ones have already been scrapped. By 2013 only a few ULCCs remain in service, none of which are more than 400 meters long.

Because of their great size, supertankers often can not enter port fully loaded. These ships can take on their cargo at off-shore platforms and single-point moorings.On the other end of the journey; they often pump their cargo off to smaller tankers at designated lightering point’s off-coast. A supertanker's routes are generally long, requiring it to stay at sea for extended periods, up to and beyond seventy days at a time.

2.2 Describition of BDTI

BDTI is Baltic Dirty Tanker Index for short.It is also known as The Baltic crude oil Tanker freight Inde.BITR index was originally made up of 7 tankers transport routes. With the development of the international oil tanker transportation market, in order to adapt to the new changes, the Baltic exchange gradually increased to a few other important international tanker transportation routes in order to reflect the various oil tanker ship type of the spot market level. After a long time, BITR index reached as many as 12 oil tankers transport routes, including nine crude oil transportation routes

and three product oil transportation routes and all of the tanker transportation routes of freight rate in BITR index constitute. BITR index was formally dissolved into two constituent parts which are BDTI index and BCTI. Since then, with the rapid development of world economy and the changes of international political and economic situation, world demand for oil products is also rising which helps to expand international tanker transportation routes. In order to comprehensively and objectively reflect the status of international tanker transportation market and meet international tanker transportation market demand for more accurate BITR, we increased the index of the composition of the route and made adjustments to the existing route. Finally until today, BITR index covers a total of 17 international crude oil transport routes. At present, the international crude oil freight index BDTI is an important part of the Baltic international tanker freight index BITR and becomes an indicator of the level of international tanker freight rate and catches the attention of the whole shipping industry.

Table 2.1: BDTI route specific composition

No.	Deadweight(MT)	Route example	Maximum vessel age(year)
TD1	28	Ras Tanura-Loop	20
TD2	26	Ras Tanura-Singapore	20
TD3	26	Ras Tanura-China	15
TD4	26	Bonny-Loop	20
TD5	13	Bonny-Philadephia	20
TD6	13.5	Novorossiysk-Augusta	20
TD7	8	Sullom Voe-Wihelmshaven	20
TD8	8	Mena al	20

		Ahmadl-Singapore	
TD9	7	Puerto la Cruz-Corpus Christ	20
TD10	5	Aruba-New York	20
TD11	8	Banlas-Lavera	20
TD12	5.5	Antwerp-Houston	20
TD14	8	Seria-Sydney	15
TD15	26	Bonny-Ningbo	20
TD16	30	Odssa-Augusta	20
TD17	10	Primorsk-Wihelmshaven	15
TD18	3	Tallinn-Rotterdam	15

Source: Drewry shipping

2.3 Analysis of global tanker transport market

2.3.1 Demand analysis

According to BP world energy, by the end of 2014, the world's proven oil reserves of is about 1.6526 trillion barrels, a 19% increase compared with the year of 2013.It is enough to meet the demand of global production demand for 54.2 years. The oil of the Middle East accounts for 48.1% of the world's proven reserves, central and South America accounts for 19.7% of the world's proven reserves, followed by North America accounts for 13.2%. The Asia-pacific region has proven oil reserves of 2.5%. Annual growth rate of the world's oil production is 1.3%, which means 1.1 million barrels a day. Table 2.2 is the top 10 countries of the world's oil production capacity list in 2014.

Table: 2.2 2014 top ten global oil production countries

No.	Country	Production(Barrels/day)	Growth rate	Percentage
1	Saudi Arabia	11161	12.7%	13.2%

2	Russia	10280	1.2%	12.8%
3	USA	7841	3.6%	8.8%
4	Iran	4321	-0.6%	5.2%
5	China	4090	0.3%	5.1%
6	Canada	3522	5.0%	4.3%
7	Mexico	2938	-0.8%	3.6%
8	UAE	3322	14.2%	3.8%
9	Kuwait	2865	14.1%	3.5%
10	Venezuela	2720	-2.0%	3.5%

Source: BP world Energy Report

Net global oil production increase in 2013 almost all came from the OPEC. The oil production increase of Saudi Arabia, the United Arab Emirates, and Kuwait completely offset the Libyan's oil production suspension gap. Oil production of the Non-OPEC is roughly stable. The United States, Canada and Russia's output growth has made up for the UK, Norway and other old oil area's production continuing attenuation. It is remarkable that because of the continuous strong production growth of the land shale oil in USA, the America's oil production amplification comes first for three consecutive years in Non-OPEC countries (increased 285000 barrels per day). By the end of 2012, the oil production of the OPEC is more than 31 million barrels a day, 1 million barrels a day more than the daily production target. It is expected that global oil supply in 2013 will be abundant. Due to the continuous growth of oil production in USA, Libya postwar oil production quickly recovering, Saudi Arabia's oil production rising steadily high are the main reasons why the oil supply is abundant. It is expected that 2013 global oil output will be 912000 barrels of daily, rising 0.41% than that of 2012, equal with the oil consumption. It is expected the oil production will reach 305700 barrels for per day in OPEC countries; there will be small decline year on year.

Global oil consumption growth rate in 2012 is 0.7%, 88 million barrels a day. The increase is 600000 barrels, lower than the historical average. Oil consumption growth is the smallest among the global consumption of fossil fuels. Oil consumption in the OECD countries reduced by 1.2%.It is the fifth decline in the past six years, plunged to the lowest level since 1995. Oil consumption growth in the OECD countries increased by 2.8%. China has again become the primary country of the global oil consumption growth (an increase of 5.5%). However, due to the structural transformation of the Chinese economy, oil consumption growth rate is less than the average of the past ten years.

According to the International Energy Agency statistics, the global oil demand of the first three quarters of 2012 was 89430000 barrels per day, an increase of 0.9% compared with last year. The OECD countries' oil demand is 46070000 barrels per day, falling by 0.9%, the non-OECD countries' oil demand43330000 barrels per day, increasing by2.8%. Global oil demand of 2012 is 89600000 barrels per day, increasing by 0.8%. Global oil production is slightly over demand growth. The production of the first three quarters is 90370000 barrels per day, 1% higher than the same period last year. The fourth quarter's oil production is almost the same as the fourth quarter. The oil prices show a substantial shock trend in 2012.

During the first half of this year, due to European sanctions against Iran, the African oil producing unrest, the European debt crisis and economic recovery in the United States braking effect, combined with the oil supply slightly too seek, Brent crude oil spot price in March is very high but decline then. Since the late August, because of the dollar index fluctuations, oil prices shock again. International institution-Drew expects that global oil demand of 2013 will be 91.6 million barrels per day, increasing by 1.28% compared with last year. OECD countries' oil demand will be 45.8 million barrels a day, falling 0.7% year on year. The oil demand of Non-OECD countries will be 44.79 million barrels a day, increasing by 2.8% compared with last year. This trend of oil production will continue with a slight increase.

Table 2.3 The world's major oil-exporting countries export data (Barrels/day)

Country	2008	2009	2010	2011	2012	2013	2014	Percentage
USA	1129	1317	1439	1967	1947	2154	2579	4.7%
Canada	2201	2330	2457	2498	2518	2599	2804	5.1%
Mexico	2065	2102	1975	1609	1449	1539	1487	2.7%
South America	3528	3681	3570	3616	3748	3568	3763	6.9%
Russia	7076	7155	8334	8184	7972	8544	8688	15.9%
Middel east	19821	20204	19680	20128	18409	18883	19750	36.2%
West Africa	4358	4704	4830	4587	4364	4601	4655	8.5%
Asia	4243	4312	6004	5392	5631	6226	6233	11.4%

Source: BP world energy report

The main oil consuming countries and importing countries of the world are the United States, Europe, China and Japan. BP energy statistical yearbook of 2014 shows that Europe imported most oil which is 596.4 million of tons, followed by America which is 559.8 million of tons. American net oil imports decreased by 29% compared with their peak in 2005. In 2011, China and Japan oil imports were 328.1 million of tons and 221.8 million of tons respectively. Oil imports of other parts of Asia are 357.6 million of tons. Last year, about two third of the oil trade volume growth came from China, while China's oil net imports grow by 13% (6000000 barrels / day).

In 2012, the marine traffic of crude oil and oil product has been keeping a small margin of growth. Because of the dominant long-distance transport, maritime turnover growth is still greater than the growth rate of marine traffic. As one of the main cargo transport of refined oil market, it shows an overall shortage and significant regional differences for naphtha. The supply gap exists in the areas of Asia Pacific and North

America; the excess supply exists in the Middle East; the European areas are lack of light naphtha while the heavy naphtha excesses in Europe. Among them, the naphtha inventory of the Middle East exporting to Asia Pacific is very strong, which improves the demand of the product oil tanker LR ship. According to Clarkson statistic, the global crude oil shipping volume of 2012 is 18.63 million tons, a small increase of 1.2%; refined oil shipping volume is 8.63 million tons, an increase of 3.1%. The overall shipping volume of oil increased by 1.8%. From the point of shipping capacity demand, the shipping capacity demand for the crude oil is about 2.495 billion tons, an increase of 2.8%. The shipping capacity demand of refined oil is about 95.5 million of tons, an increase of 4.2%. Among them, the demand for LR2 ship increased by 19% to 2880 tons. The total oil tanker demand increased by 3.2%.

2.3.2 Supply analysis

The impact of the global financial crisis of 2012 is that the global tanker capacity continues to grow, with a total capacity reaching 4.9257 trillion tons. But compared with 2011, the growth rate obviously slowed down. According to Clarkson statistics, until December 1 of 2012, global active tanker fleet (more than 10000 tons ship) is composed of 5757 ship, 492.2 million deadweight tons, an increase of 3.4% compared with the beginning of 2011. The DWT of VLCC is 186 million tons totally, compared with the beginning of 5.9%. Compared with the same period last year, the total size of the fleet growth fell by 3.7%. The fleet size of the VLCC and Suezmax tankers increases by 6.3% and 5.7%.The growing rates for the Aframax tankers and the following ships are all below 2%.

Table 2.4 2011-2014 The growth of global tanker capacity(MT)

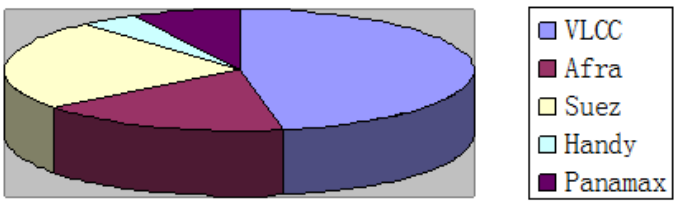
	2011	Quantit-y	2012	Quantit-y	2013	Quan-tity	2014	Quanti-ty
VLCC	159.62	532	163.23	539	176.06	578	186.37	609

Suezma-x	59.13	386	63.03	410	68.51	444	72.82	471
Aframax	87.81	836	93.17	881	96.72	910	97.62	913
Panama-x	27.37	384	28.19	393	29.36	408	29.86	414
Handy	97.70	393	101.00	3218	104.20	414	105.90	3352

Source: Clarkson

VLCC accounted for all 37% shipping capacity of all the tankers. The proportion of the rose by 1% compared with 2011.The Suez tankers, Panama tankers, as well as handy-size tankers are all basically flat this year. Aframax tankers account for 19% of the tanker shipping capacities, falling by 1%. It indicates that large-size tankers will be more and more popular in the shipping market. 200,000 tons of the large tankers will be the main vessel type in the market. The specialization of ocean-going vessels and effect of the economies of scale are the major reason for the growth of ship tonnage.

Table 2.5 2014 the proportion of all vessels tankers



Source: Clarkson

3. Potencial factor to influence BDTI

The relation between supply and demand is the primary cause of tanker freight index fluctuation.

The determination factors of freight price are made up of suppliers and demanders based on the structure of perfect competition market through free bids and reaching an equilibrium price. Therefore, under the market mechanism, when the market forces of supply and demand changes, the original in the market equilibrium price will be broken, thus forming the new market price. So in the shipping market, supply and demand are the inner reasons of freight rate fluctuations and they are to determine the basic cause of the freight market. Tanker shipping cycle is primarily to maintain global economic growth and two factors determine shipbuilding market cycle, global economic growth level determines the demand of shipping market; ship manufacturing cycle determines the capacity to market cycle. It can be seen from the history of tanker freight index fluctuation: when freight index is high, the owner, in order to earn more profits and expand the scale of the fleet, will make the market capacity of supply growth more than the market demand growth speed. Due to the imbalance between supply and demand in the market which results in the dry bulk freight index declining and due to market capacity has lags, the freight index plunging situation will happen ; Conversely, when shipping market turns down, the owner will crap old vessels to balance the supply and demand in the market. That makes freight market demand continue to increase and makes the balance of supply and demand to a situation where demand is greater than supply. So it makes the freight index rose, and because of the capacity to market need for a long time, so often in the form of surge freight index.

3.1 Brent oil price and global oil production

The main factors affecting the fluctuations of international oil price are: the supply and demand of international oil market, political factors and unexpected events such as dollar exchange and so on. From above it can be seen that demand and supply for oil is a decisive factor affecting international oil price, and other factors of oil prices changing will interfere the price in a given period.

The factors that affect oil price's demand mainly are as following:

The first factor is the changes of world economic development and economic structure. When the global economy has entered a certain period, the increase in oil demand and consumption will drive up crude oil prices; when the economy is into recession, international oil consumption will slow down so its price has the trend of coming down. The second is the alternative energy progress. The cost of alternative energy sources will determine the ceiling price of oil. Current alternative energy sources include some non-renewable energy such as oil, coal, natural gas and nuclear energy and other renewable energy sources such as solar energy, wind energy. The third is the promotion and application of energy-saving technologies. The direct role of energy conservation is to reduce oil consumption, making the changes in oil supply and demand and resulting in the falling of oil prices. While the fall in oil prices will lead to the increase in oil consumption.

The factors that affect oil price's supply mainly are as following:

Firstly, changes of world's crude oil reserve-production ratio. Reserve-production ratio of crude oil represents the scarcity of oil and long-term trend in oil prices. Secondly, OPEC crude oil production and its global position in the supply market. The third is crude oil exploration and production costs. Oil production costs are not only the basic factors determining the price of crude oil, but also the deciding factor

of other alternative energy sources. Since petroleum products are monopoly products, the final price will not be decided by the cost of production directly, but through the production of producer decisions, thereby affecting the price of oil.

In addition, exchange rate factors, changes in oil stocks of the United States and other major countries, the speculation of the international oil futures and a variety of short-term interference with emergency are also have an important impact on the trend of the oil price in short term.

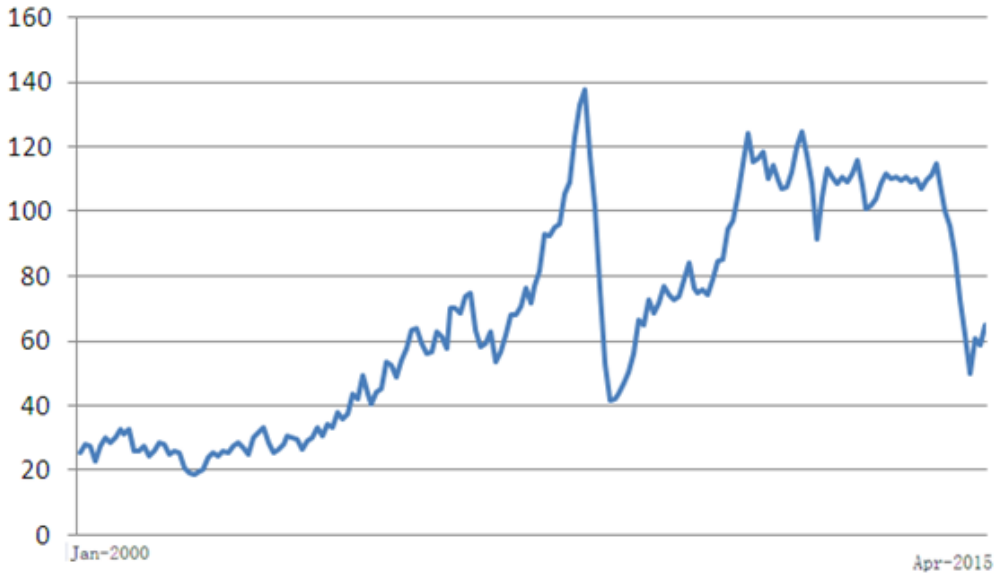


Figure 3.1 Brent oil price from 2000-2015

Source: Clarkson

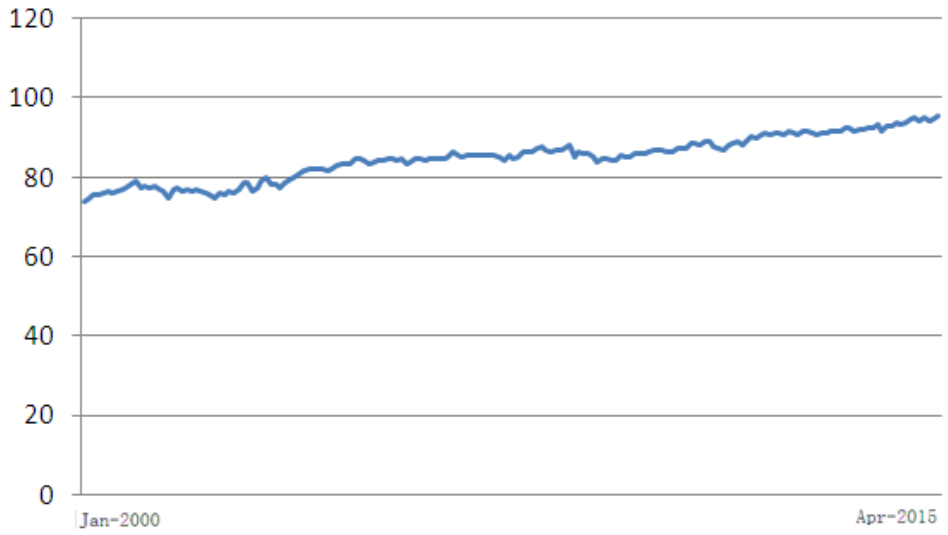


Figure 3.2 Global oil production from 2000-2015

Source: Clarkson

3.2 Fleet DWT and delivery

The demand for tanker has increased dramatically and big deadweight tonnage tanker became more popular.

From 1973 to 1987, this is the stage for the development of the oil tanker recession and instability. In the early 70 s, the international financial market sold dollars in great quantities which caused a lot of dollar depreciation. As the oil trade is mainly through the dollar, it led to oil selling industry got less income. In order to increase their income, the organization of petroleum exporting countries (OPEC) significantly increase oil prices, coupled with the 1973 outbreak of "the fourth Middle East war" in the Middle East oil production and the embargo, the first oil crisis, the western industry caused serious blow. After the crisis, demand for oil is significantly suppress. But on the other hand, the delivery of a large amount of VLCC increased dramatically. But as the Tanker capacity glut on the market, fuel oil cost increased, and the management of large tonnage tanker was not well developed, a large number of VLCC order was cancelled.

In the following, the second oil crisis erupted in 1979. Crude oil price sharply to levitate, crude oil shipping traffic demand, tanker capacity exceeds the demand situation continues to deteriorate. In the 15 years, each of the tanker with 23.34 million tons, increased in the total supply capacity. Growth rate has been declining, which appeared a negative growth in 1981-1986. In the 15 years, the average annual growth rate was only 1.89%.

From 1988 to 2002, this stage is the slow development of tanker development. Western economic was in recovery which made western countries reduce dependence on oil. That made the world's oil trade decrease and the price of oil drop. After that western countries again increased purchases of oil. And, the shipping company began to order the large oil tanker from shipyard in large quantities. In the 15 years, each of the tanker total supply capacity increased by about 50 million tons. The average annual growth rate was only 1.37%.

Since 2003, as the developing countries such as China and India’s demand for oil is strong, and from 2003 to 2009, oil supply presents a fast growth, seven years each of tanker supply increases the capacity of 130 million tons. The annual average growth rate is 5.71%.

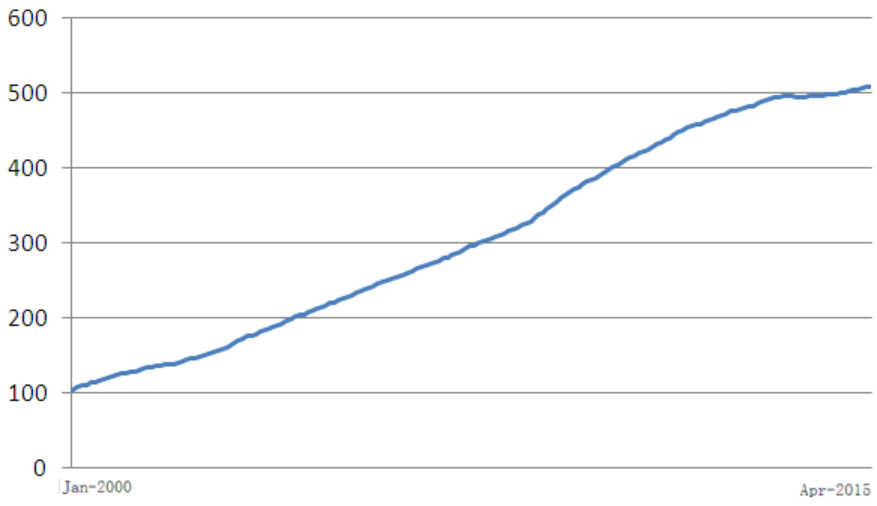


Figure 3.3 Tanker fleet development from 2000-2015

Source: Clarkson

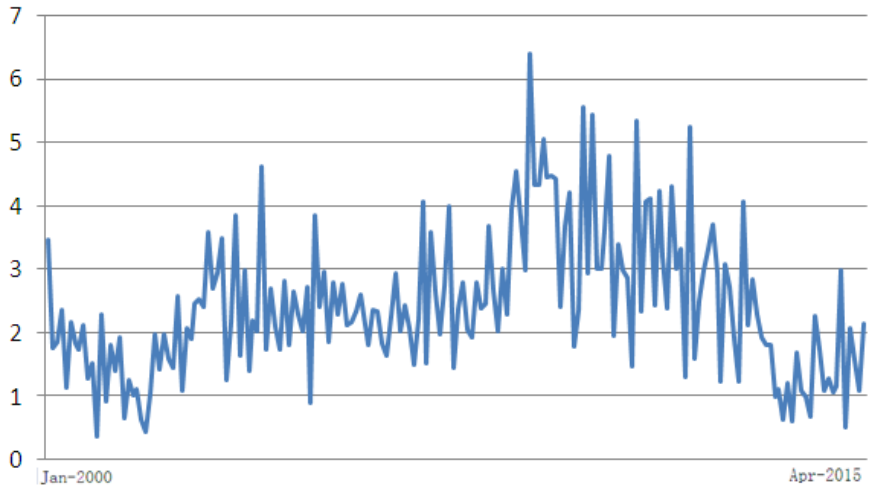


Figure 3.4 Tanker delivery from 2000-2015

Source: Clarkson

3.3 Demolition

The ship demolition industry has experienced three times of peak and trough, three times the world centers for the demolition also experienced many times. Global companies have focused on China, India, Bangladesh and Pakistan and ship demolition industry, as an indispensable part of the Marine economy, is to realize the Marine resources recycling scrap and ensure shipping industry operate safely and reduce carbon emissions. It is also an important link in adjusting the revitalization of the shipbuilding industries. In recent years, the world ship demolition industry shows the booming trend and the attention it gets is also rising.

Scrapping makes human make full use of all kinds of materials by recycling and naturally formed a unique market of the ship. Its formation and exist is important for shipping, steel, shipbuilding and other industries to have balanced development. At the same time, through the dismantling of ship recycling, all kinds of materials for iron and steel, shipbuilding, ship repairing, non-ferrous metals, civil engineering and

other industries can be used in other places. Demolition is important for all countries and restricted by various factors, mainly including the demand for steel, the international shipping market, national foreign exchange reserves and management system, the condition of labor and wages, national policies and regulations, etc.

Scrapping markets' rise and fall is directly related to international trade volume. If the shipping market is active, the owner sees advantages to continue operation of the ship, so they will try to prolong the lifespan of the ship and delay shipping scrapping scheme; when shipping market demand downturns, owner will seek a way for its spare ship, dismantling of ship is one of the ways in which to choose. The quantity of demolition in world shipping market is determined by the supply and demand of shipping market.

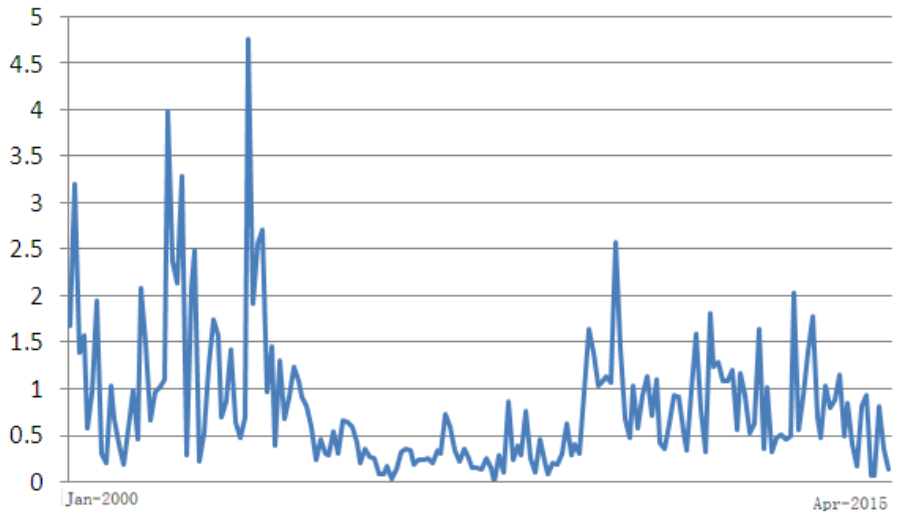


Figure 3.5 Tanker demolition from 2000-2015

Source: Clarkson

3.4 New building price index

Shipbuilding market demand is derived by the shipping market and international trade.

Demand varies from time to time. Usually when the world economic grows, international trade also correspondingly increases; On the other hand, when the world is in recession, the international trade will shrink. So if shipping market supply is insufficient, the shipbuilding industry will also be in depression.

The rise and fall of the world economy is reflected in the international trade and then reflected in shipbuilding industry. There is a certain period when international import and export trade has quite part of trade in the future time, so the shipbuilding market demand shows certain hysteresis. In addition, due to the complexity of shipbuilding construction process, including ship design, manufacture, composition, dock, sea trial, delivery and other steps, which makes the ship construction cycle very long. Owners tend to book orders two or three years in advance. So new orders are reflected in the future period of shipbuilding market demand.

Shipbuilding market demand has great sensitivity to the external environment change. The world economy, the change of political influence easily influences ship market's stable development. And in turn, the shipbuilding market fluctuations also affect the economic development.

So it is clear that the shipbuilding market demand has strong volatility and it fluctuates with the world economic cycle. Since the 1970 s, the shipbuilding market has experienced five times cyclical fluctuations.

It mainly displays in: Firstly, the modern ships sailing around the world has a strong international generality. Ship construction must follow a series of international norms and standards. Second, in today's world, the trend of economic globalization is obvious. Due to the factors of international trade, shipping has become the international trade of commodities and more than three-quarters of the total world shipbuilding is for export. The export of China shipping ratio is above 70%. Due to the different countries conditions, especially developed countries and developing

countries of the difference in their economic development level and technical level, it directly affects the construction of the ship quality, delivery and service quality, etc. The difference of these factors led to the shipyard offer's difference.

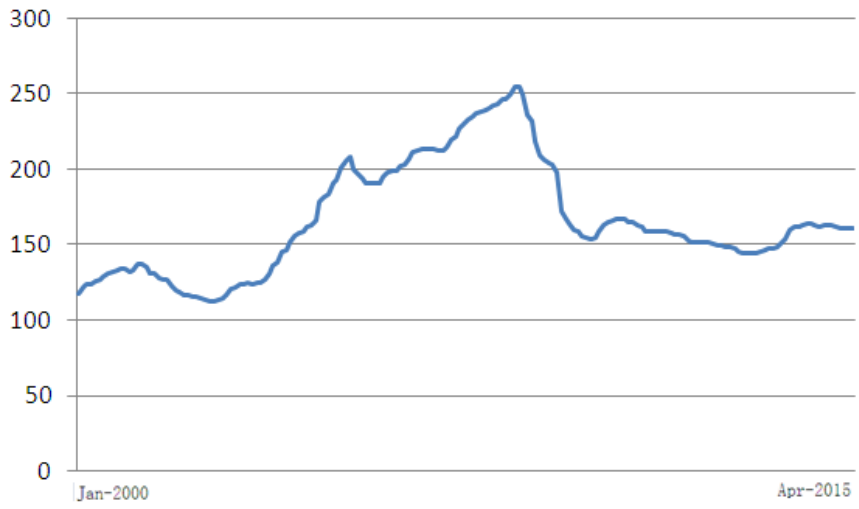


Figure 3.6 Tanker new building price from 2000-2015

Source: Clarkson

3.5 Tanker second hand price

Ship price index reflects the level of the prices on the global shipping market. There are many factors which will influence tanker second hand price. Political, military, policy, climate and many other factors will all have a certain effect on the ship market. As the shipping market has openness and freedom of competition, there is no buyer and the seller who has absolute control of monopoly power.

Ship is also a kind of commodity; its price and the price of other goods all follow the restriction of the law of value. Though, as the international shipping market prosperity and depression of ship market supply and demand, the influence of ship prices will produce a certain degree of continuous wave. But it will be always central fluctuating around the value. In a certain period, the international shipping price may be higher or lower than (or even far above or below) the value of the ship itself. But from the point

of a longer period, it is still the value of the ship.

Ship is a commodity, and like other commodities, it is affected by market supply and demand. Therefore, ship price changes must be placed in the market to analyze. In the shipping market, price change can be explained from the theory of supply and demand. Ship demand change is derived by the international economic situation and international trade market. When the world economy is in prosperity, it will lead to the sea freight volume increases, the freight rise and an increasing demand for capacity. When cargo demand exceeds supply capacity, ship price is raising quickly, ship owners become more hopeful about the future, so they increase the book orders from the shipyard and at this time secondhand ship trading is very active. After a period of time, when new ships began to operate, it will increase the capacity of shipping market, but there is no fleet tonnage growth in world economic growth speed, the ship will be relatively surplus, when the capacity to supply exceeds demand capacity, it will cause freight rate to fall.

Vessel prices also fell, but because of the competition, freight rate will also fall. When the rate fell to the level that its operating income plus storage costs are lower than the operating costs, the owner will decide to seal a ship. This part of the capacity will be forced to withdraw from the market and orders for new ships will be reduced, so the market achieves a relative balance. When the capacity decreases, or demand has risen sharply, fleet capacity can't meet the demand of shipping, this also makes freight rate and vessel prices rise.

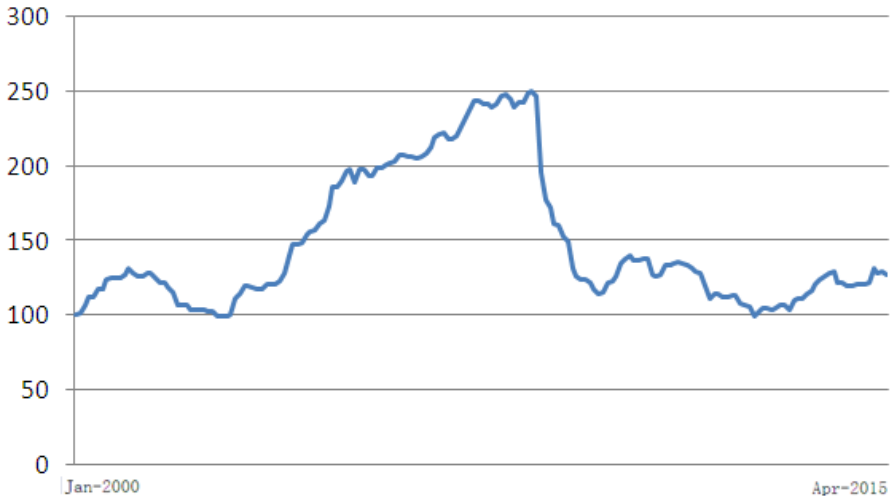


Figure 3.7 Tanker second hand price from 2000-2015

Source: Clarkson

3.6 S&P 500

The S&P 500, or the Standard & Poor's 500, is an American stock market index based on the market capitalizationsof 500 large companies having common stock listed on the NYSE or NASDAQ. The S&P 500 index components and their weightings are determined by S&P Dow Jones Indices. It differs from other U.S. stock market indices, such as the Dow Jones Industrial Average or the Nasdaq Composite index, because of its diverse constituency and weighting methodology. It is one of the most commonly followed equity indices, and many consider it one of the best representations of the U.S. stock market, and a bellwether for the U.S. economy. The National Bureau of Economic Research has classified common stocks as a leading indicator of business cycles.

The S&P 500 was developed and continues to be maintained by S&P Dow Jones Indices, a joint venture majority-owned by McGraw Hill Financial. S&P Dow Jones Indices publishes many stock market indices such as the Dow Jones Industrial Average, S&P MidCap 400, the S&P SmallCap 600, and the S&P Composite 1500. It

is a free-float capitalization-weighted index, and has many ticker symbols.

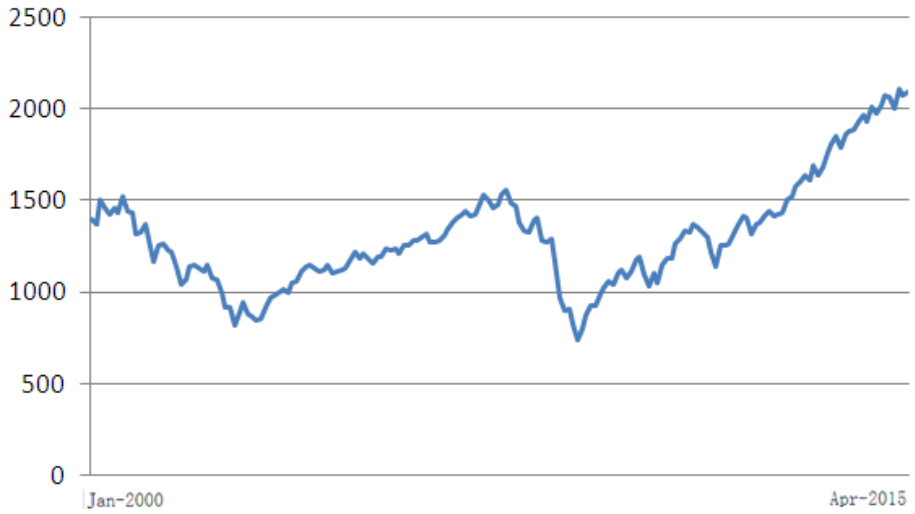


Figure 3.8 S&P index from 2000-2015

Source: Yahoo Finance

4. Correlation analysis

In order to build the forecasting model, we need to do the correlation analysis between the BDTI and the factors to check whether we should take it into consideration or not. The tool we use to do the correlation analysis is SPSS software. SPSS is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. The original SPSS manual has been described as one of "sociology's most influential books" for allowing ordinary researchers to do their own statistical analysis. In addition to statistical analysis, data management (case selection, file reshaping, creating derived data) and data documentation (a metadata dictionary was stored in the datafile) are features of the base software. The data we select is taken from Clarkson website.

The data we use is from January of 2000 to April of 2015.We do the correlation analysis between the BDTI and the factor one by one. The principles we depend on decide whether to use the factor in our model is as following:

1)If the correlation coefficient is smaller than the absolute value of 0.3, we cross off the factor as the correlation relationship between the BDTI and the factor is not good enough.

2)If the correlation coefficient is bigger than the absolute value of 0.3, we take the factor into the building of the forecasting model as their correlation relationship is good and we can guarantee that the model will be accurate enough to do the forecasting.

4.1 Correlation analysis between BDI and supply factors

After using software SPSS to do the data processing, we get the result of the correlation analysis between the BDTI and the factors as following:

4.1.1 Correlation analysis result between BDTI and tanker fleet development

Table 4.1 Data example of BDTI and Tanker fleet development

Date	BDTI	Tanker Fleet Development Million DWT
2014-Jan	1124	493.69
2014-Feb	812	494.99
2014-Mar	698	495.25
2014-Apr	679	495.85
2014-May	662	495.7
2014-Jun	671	496.91
2014-Jul	830	497.95
2014-Aug	768	498.29
2014-Sep	639	499.27
2014-Oct	700	500.21
2014-Nov	887	500.66
2014-Dec	851	502.94
2015-Jan	909	503.39
2015-Feb	867	505.63
2015-Mar	812	506.95
2015-Apr	788	507.33

Source: Clarkson

Table 4.2 Corrleation analysis result of BDTI and Tanker fleet development

	VAR00001	VAR00003
VAR00001Pearson Correlation	1	-0.549**
Significance	-	0.000
N	184	184
VAR00003Pearson Correlation	-0.549**	1
Significance	0.000	-
N	184	184

The result shows that the significance level is 0 and the correlation level is minus 0.549.The significance level is smaller than 0.05 and the absolute value of correlation level is more than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the tanker fleet development is high and it should be taken in consideration when building the forecasting model.

4.1.2. Correlation analysis result between BDTI and fleet demolition

Table 4.3 Data example of BDTI and Tanker demolition

Date	BDTI	Tanker 10K+DWT Demolition Million DWT
2014-Jan	1124	0.48
2014-Feb	812	1.04
2014-Mar	698	0.8
2014-Apr	679	0.88
2014-May	662	1.15
2014-Jun	671	0.49
2014-Jul	830	0.84

2014-Aug	768	0.4
2014-Sep	639	0.17
2014-Oct	700	0.82
2014-Nov	887	0.93
2014-Dec	851	0.06
2015-Jan	909	0.07
2015-Feb	867	0.81
2015-Mar	812	0.36
2015-Apr	788	0.48

Source: Clarkson

Table 4.4 Corrleation analysis result of BDTI and Tanker demolition

	VAR00001	VAR00004
VAR00001Pearson Correlation	1	-0.222**
Significance	-	0.002
N	184	184
VAR00004Pearson Correlation	-0.222**	1
Significance	0.002	-
N	184	184

The result shows that the significance level is 0.002 and the correlation level is minus 0.222.The significance level is smaller than 0.05 and the absolute value of correlation level is less than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the tanker fleet development is weak and it should not be taken in consideration when building the forecasting model.

4.1.3 Correlation analysis result between BDTI and deliveries

Table 4.5 Data example of BDTI and tanker delivery

Date	BDTI	tanker deliveries DWT
2014-Jan	1124	1.69
2014-Feb	812	1.08
2014-Mar	698	0.99
2014-Apr	679	0.68
2014-May	662	2.27
2014-Jun	671	1.74
2014-Jul	830	1.09
2014-Aug	768	1.27
2014-Sep	639	1.07
2014-Oct	700	1.17
2014-Nov	887	2.98
2014-Dec	851	0.51
2015-Jan	909	2.24
2015-Feb	867	1.55
2015-Mar	812	0.51
2015-Apr	788	1.69

Source: Clarkson

Table 4.6 Corrleation analysis result of BDTI and Tanker delivery

	VAR00001	VAR00005
VAR00001Pearson Correlation	1	-0.090**
Significance	-	0.222
N	184	184

VAR00005Pearson Correlation	-0.090**	1
Significance	0.222	-
N	184	184

The result shows that the significance level is 0.222 and the correlation level is minus 0.09.The significance level is more than 0.05 and the absolute value of correlation level is less than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the tanker fleet development is weak and it should not be taken in consideration when building the forecasting model.

4.1.4 Correlation analysis result between BDTI and tanker new building price index

Table 4.7 Data example of BDTI and tanker new building price index

Date	BDTI	tanker new building price index
2014-Jan	1124	160
2014-Feb	812	162
2014-Mar	698	162
2014-Apr	679	163
2014-May	662	164
2014-Jun	671	164
2014-Jul	830	163
2014-Aug	768	162
2014-Sep	639	163
2014-Oct	700	163
2014-Nov	887	163
2014-Dec	851	162
2015-Jan	909	161

2015-Feb	867	161
2015-Mar	812	161
2015-Apr	788	161

Source: Clarkson

Table 4.8 Corrleation analysis result of BDTI and new building price index

	VAR00001	VAR00006
VAR00001Pearson Correlation	1	-0.190**
Significance	-	0.010
N	184	184
VAR00006Pearson Correlation	-0.190**	1
Significance	0.010	-
N	184	184

The result shows that the significance level is 0.01 and the correlation level is 0.19. The significance level is less than 0.05 and the absolute value of correlation level is less than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the tanker new building price index is weak and it should not be taken in consideration when building the forecasting model.

4.1.5 Correlation analysis result between BDTI and tanker second hand price

Table 4.9 Data example of BDTI and tanker second hand price

Date	BDTI	tanker second hand price
2014-Jan	1124	124
2014-Feb	812	126
2014-Mar	698	128
2014-Apr	679	129

2014-May	662	122
2014-Jun	671	122
2014-Jul	830	119
2014-Aug	768	119
2014-Sep	639	120
2014-Oct	700	120
2014-Nov	887	120
2014-Dec	851	121
2015-Jan	909	131
2015-Feb	867	128
2015-Mar	812	129
2015-Apr	788	127

Source: Clarkson

Table 4.10 Corrleation analysis result of BDTI and Tanker second hand price

	VAR00001	VAR00007
VAR00001Pearson Correlation	1	-0.424**
Significance	-	0.000
N	184	184
VAR00007Pearson Correlation	-0.424**	1
Significance	0.000	-
N	184	184

The result shows that the significance level is 0 and the correlation level is minus 0.424.The significance level is less than 0.05 and the absolute value of correlation level is more than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the tanker second hand price is high and it should be taken in consideration when building the forecasting

model.

4.2Correlation analysis between BDI and demand factors

4.2.1 Correlation analysis result between BDTI and Brent oil Price

Table 4.11 Data example of BDTI and Brent oil price

Date	BDTI	Brent oil price
2014-Jan	1124	108.83
2014-Feb	812	109.74
2014-Mar	698	106.54
2014-Apr	679	109.07
2014-May	662	110.72
2014-Jun	671	114.29
2014-Jul	830	105.39
2014-Aug	768	99.88
2014-Sep	639	95.01
2014-Oct	700	86.24
2014-Nov	887	72.67
2014-Dec	851	61.69
2015-Jan	909	49.69
2015-Feb	867	60.57
2015-Mar	812	58.47
2015-Apr	788	64.75

Source: Clarkson

Table 4.12 Correlation analysis result of BDTI and Brent Oil price

	VAR00001	VAR00002
VAR00001Pearson Correlation	1	-0.341**

Significance	-	0.000
N	184	184
VAR00002Pearson Correlation	-0.341**	1
Significance	0.000	-
N	184	184

The result shows that the significance level is 0 and the correlation level is minus 0.341.The significance level is smaller than 0.05 and the absolute value of correlation level is more than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the Brent oil price is high and it should be taken in consideration when building the forecasting model.

4.2.2 Correlation analysis result between BDTI and global oil production

Table 4.13 Data example of BDTI and global oil production

Date	BDTI	Global oil production
2014-Jan	1124	92.16
2014-Feb	812	92.13
2014-Mar	698	92.94
2014-Apr	679	91.62
2014-May	662	92.63
2014-Jun	671	92.5
2014-Jul	830	93.4
2014-Aug	768	93.05
2014-Sep	639	94.48
2014-Oct	700	94.29
2014-Nov	887	94.66
2014-Dec	851	94.01

2015-Jan	909	94.62
2015-Feb	867	94.13
2015-Mar	812	94.78
2015-Apr	788	95.69

Source: Clarkson

Table 4.14 Corrleation analysis result of BDTI and global oil production

	VAR00001	VAR00008
VAR00001Pearson Correlation	1	-0.364**
Significance	-	0.000
N	184	184
VAR00008Pearson Correlation	-0.364**	1
Significance	0.000	-
N	184	184

The result shows that the significance level is 0 and the correlation level is minus 0.364.The significance level is less than 0.05 and the absolute value of correlation level is more than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the global oil production is strong and it should be taken in consideration when building the forecasting model.

4.2.3 Correlation analysis result between BDTI and S&P500

Table 4.15 Data example of BDTI and S&P500

Date	BDTI	S&P500
2014-Jan	1124	1975
2014-Feb	812	2101
2014-Mar	698	1996

2014-Apr	679	2002
2014-May	662	1988
2014-Jun	671	1820
2014-Jul	830	1978
2014-Aug	768	1866
2014-Sep	639	2011
2014-Oct	700	1867
2014-Nov	887	2044
2014-Dec	851	1963
2015-Jan	909	2078
2015-Feb	867	2031
2015-Mar	812	2322
2015-Apr	788	2108

Source: Clarkson

Table 4.16 Corrleation analysis result of BDTI and S&P500

	VAR00001	VAR00009
VAR00001Pearson Correlation	1	-0.161**
Significance	-	0.029
N	184	184
VAR00009Pearson Correlation	-0.161**	1
Significance	0.029	-
N	184	184

The result shows that the significance level is 0.029 and the correlation level is minus 0.161.The significance level is less than 0.05 and the absolute value of correlation level is less than 0.3.So from the result of the software, we can come to the conclusion that the correlation relationship between BDTI and the S&P500 is weak and it should

not be taken in consideration when building the forecasting model.

5. BDTI forecasting

5.1 Introduction of linear regression model

In statistics, linear regression is an approach for modeling the relationship between a scalar dependent variable y and one or more explanatory variables (or independent variable) denoted X. The case of one explanatory variable is called simple linear regression. For more than one explanatory variable, the process is called multiple linear regressions. (This term should be distinguished from multivariate linear regression, where multiple correlated dependent variables are predicted, rather than a single scalar variable.)

In linear regression, data are modeled using linear predictor functions, and unknown model parameters are estimated from the data. Such models are called linear models. Most commonly, linear regression refers to a model in which the conditional mean of y given the value of X is an affine function of X. Less commonly, linear regression could refer to a model in which the median, or some other quantile of the conditional distribution of y given X is expressed as a linear function of X. Like all forms of regression analysis, linear regression focuses on the conditional probability distribution of y given X, rather than on the joint probability distribution of y and X, which is the domain of multivariate analysis.

Linear regression was the first type of regression analysis to be studied rigorously, and to be used extensively in practical applications. This is because models which depend linearly on their unknown parameters are easier to fit than models which are non-linearly related to their parameters and because the statistical properties of the resulting estimators are easier to determine.

Given a data set $\{y_i,x_{i1},\ldots..,x_{ip}\}^{n}_{i=1}$ of n statistical units, a linear regression model assumes that the relationship between the dependent variable y_i and the p-vector of regressors x_i is linear. This relationship is modeled through a disturbance term or error variable ε_i — an unobserved random variable that adds noise to the linear relationship between the dependent variable and regressors. Thus the model takes the form

$$Y_i=\beta_1 X_{i1}+\ldots+\beta_p X_{ip}+\varepsilon_{i=}X_i^T\beta+\varepsilon_{i,} \quad i=1,\ldots n$$

where T denotes the transpose, so that$X_i^T\beta$ is the inner

product between vectors xi and β.

Often these n equations are stacked together and written in vector form as

$$Y=X\beta+\varepsilon$$

where

$$\mathbf{y} = \begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix}, \quad \mathbf{X} = \begin{pmatrix} \mathbf{x}_1^{\mathrm{T}} \\ \mathbf{x}_2^{\mathrm{T}} \\ \vdots \\ \mathbf{x}_n^{\mathrm{T}} \end{pmatrix} = \begin{pmatrix} x_{11} & \cdots & x_{1p} \\ x_{21} & \cdots & x_{2p} \\ \vdots & \ddots & \vdots \\ x_{n1} & \cdots & x_{np} \end{pmatrix}, \quad \boldsymbol{\beta} = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_p \end{pmatrix}, \quad \boldsymbol{\varepsilon} = \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_n \end{pmatrix}.$$

Some remarks on terminology and general use:

Y_i is called the endogenous variable, response variable, measured variable, criterion variable, or dependent variable (see dependent and independent variables.) The decision as to which variable in a data set is modeled as the dependent variable and which are modeled as the independent variables may be based on a presumption that the value of one of the variables is caused by, or directly influenced by the other variables. Alternatively, there may be an operational reason to model one of the variables in terms of the others, in which case there need be no presumption of causality.

$X_{i1},X_{i2},\ldots X_{ip}$ are called regressors, exogenous variables, explanatory variables, covariates, input variables, predictor variables, or independent variables (see dependent and independent variables, but not to be confused

with independent random variables). The matrix X is sometimes called the design matrix.

Usually a constant is included as one of the regressors. For example we can take $x_{i1} = 1$ for $i = 1, ..., n$. The corresponding element of β is called the intercept. Many statistical inference procedures for linear models require an intercept to be present, so it is often included even if theoretical considerations suggest that its value should be zero.

Sometimes one of the regressors can be a non-linear function of another regressor or of the data, as in polynomial regression and segmented regression. The model remains linear as long as it is linear in the parameter vector β.

The regressors x_{ij} may be viewed either as random variables, which we simply observe, or they can be considered as predetermined fixed values which we can choose. Both interpretations may be appropriate in different cases, and they generally lead to the same estimation procedures; however different approaches to asymptotic analysis are used in these two situations.

β is a p-dimensional parameter vector. Its elements are also called effects, or regression coefficients. Statistical estimation and inference in linear regression focuses on β. The elements of this parameter vector are interpreted as the partial derivatives of the dependent variable with respect to the various independent variables.

ε_i is called the error term, disturbance term, or noise. This variable captures all other factors which influence the dependent variable y_i other than the regressors x_i. The relationship between the error term and the regressors, for example whether they are correlated, is a crucial step in formulating a linear regression model, as it will determine the method to use for estimation.

5.2 BDTI forecasting model

Using the SPSS software to do the linear regression forecasting model, we have the result as following:

Table 5.1 SPSS result (1)

Model	Variables	Variables removed
1	VAR00002	-
-	VAR00003	-
-	VAR00004	-
-	VAR00005	-

There are altogether four factors we take into considerration when building the model which are “Brent oil price” “Tanker fleet development” “Tanker second hand price” ”Global oil production”. From the result we can know that no variable is removed by the software which means all the four variables are available to build the forecasting model.

Table 5.2 SPSS result (2)

Model	R	R square	Adjusted R square
1	0.768	0.589	0.580

From the result we can see that the R square of the forecasting model is 0.589 which means the forecasting accuracy of the model is acceptable.

Table 5.3 SPSS result (3)

Model	Unstandardized Coefficients		Typical coefficient	t	Sig
	B	Standard Error	-		
Constant	-8726.211	1228.073	-	-7.106	0.000
VAR00002	5.623	1.492	0.402	3.769	0.000
VAR00003	-8.788	0.869	-2.513	-10.115	0.000
VAR00004	-0.910	0.755	-0.089	-1.205	0.230
VAR00005	144.962	17.916	1.694	8.091	0.000

Table 5.4 SPSS result (4)

	Min	Max	Average	Standard deviation	N
Predicted Value	491.4214	1692.3308	1100.8750	357.6226	184
Residual	-539.5874	1358.1124	0.00	298.4549	184
Standard Predicted Value	-1.704	1.654	0.00	1.00	184
Standard Residual	-1.788	4.500	0.00	0.989	184

From the chart above, we can see that the number of each variable is 184.In order to make the model more accurate, enough number of data is essential to the building of the model.The data we select is from January of 2000 to the April of 2015.

According to the final result of the software, we can get the final regression forecasting model as following:

$$Y=-8726.211+5.623X_1-8.788X_2+144.962X_3$$

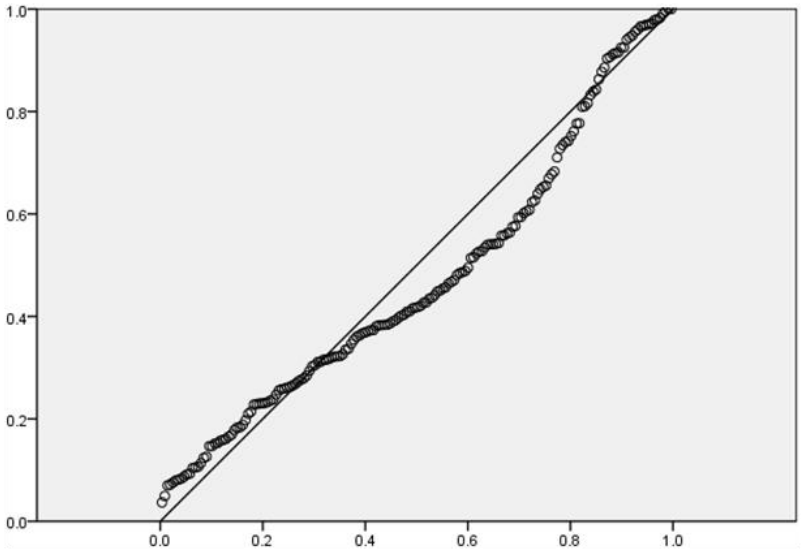
Where Y: BDTI

X_1: Brent oil price (USD)

X_2: Tanker fleet development (MT)

X_3: Global oil production (barrels/day)

The following picture is the fitting curve of the final forecasting result from which we can see that the data and the forecasting curve fits well.



5.3 The forecasting of BDTI in short future

The forecasting model shows that the BDTI has a positive relationship with Brent oil price and global oil production, and it has a negative relationship with the tanker fleet development. So from the relationship between BDTI and the three factors, we are able to forecast the trend of the BDTI though the potential change of the three factors.

Firstly, from the recent event of the international oil market, the global oil production and the Brent oil price has seen a trend of increasing. As these two factors have a positive correlation relationship with BDTI, the BDTI will increase with the increase of the two factors.

Secondly, the tanker fleet development which has a negative correlation relationship with BDTI is also increasing which would cause BDTI decrease. But in the forecasting model, we can see that the Brent oil price and global oil production carries more weight which means that the two factors would influence BDTI more. So in the

short-term future, the BDTI is more likely to experience a upward trend due to the increase of the demand in the tanker transport market.

6. Summary and Conclusion

This dissertation firstly gives a comprehensive and detailed description of the situation of the reserves, output, consumption, total input and output of the world crude oil to organize a fundamental base of this dissertation. This part helps to give a clear big picture of the present global tanker transportation market. Then the dissertation will firstly analyze the supply and demand of the tanker market in recent years and analyze the factors that affect the BDTI. The factors we choose include Brent oil price, the fleet size of the tanker, the deliveries of tanker, the demolitions of tanker, the building price of tanker, the second hand price of tanker , global oil production standard & Poor's. Using the SPSS data processing software, this dissertation does the correlation analysis for the factors and BDTI to find out the relationship between them and help to provide a fundamental for the forecasting model. After the correlation analysis, we choose four factors that have good correlation relationship with BDTI to build the forecasting model of BDTI. Using the linear regression model in SPSS, we establish the linear regression BDTI forecasting model and from the result we can see the accuracy of the forecasting model is acceptable. The forecasting model can be used to forecast the BDTI which will help to better analyze BDTI for the shipping companies.

In the future study, in order to better forecast the BDTI, researchers can seek more potential factors that have an influence on the fluctuation of BDTI to build a more accurate forecasting model. Also, more accurate and advanced mathematical forecasting models can be used to forecast the BDTI to get a better forecasting result for the need of shipping companies.

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