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Forecasting the capesize freight market

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FORECASTING THE CAPESIZE FREIGHT MARKET

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DECLARATION

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

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

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KIM, KYONG HOON

ABSTRACT

Title of Dissertation: **Forecasting the CAPESIZE market**

Degree: **Master of Science in Maritime Affairs (Shipping Management)**

This dissertation is a study of the Capesize freight market and ultimately in the forecasting of the freight rates in this market in view of the examination of the variables of supply and demand. A literature review of the Capesize shipping market is examined. Particularly, the market model and freight rate model have been scrutinized. Based on this foundation, the forecasting research can be done. The characteristics and overview of the Capesize freight market are described and the determinant factors which affect the demand and supply of the market are identified and analyzed. Linear regression and demand/supply models are verified to identify the appropriate methods for forecasting freight rates in the market. Practical work is done by applying identified forecasting methods to forecast the freight rates of the Capesize freight market in 2014. The concluding chapter identifies the limits of the dissertation with regard to data, methods and approaches. Recommendations are put forward to tackle the problems arising.

KEYWORDS: Capesize freight market, market models, freight rate models, variables, demand, supply, linear regression.

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1. INTRODUCTION

Many people think that shipping is an adventurous business. A number of scholars and experts defined that “shipping” is to transport cargoes from some port to a designated port by ships. Shipping industry has many characteristics such as cyclicality and the capital-intensiveness. However, shipping is also excessive volatile. This is because it is a global business, influenced by political shocks and economic fluctuations around the world. The volatile nature of the dry bulk freight market is due to the highly competitive characteristics of the dry bulk freight market where the freight rate depends on the balance of demand and supply.

Shipping is classified in tramp (bulk) and liner (container). The container market is characterized by oligopoly. This is because there are higher barriers to enter for a new shipping company and due to the conferences and alliances that exist. On the other hand, the dry bulk market is characterized by free competition. Anybody can enter into the market and there is no barrier of entry into the market. Therefore, competition is very intensive. Forecasting of the dry bulk market is very difficult because there are not only many players, but also many variables. Since the introduction of bulk freight indices, many experts including shipowners, brokers, shipper and researchers have tried to forecast the bulk market, but without accurate results. This is because this market is affected also by many external variables to shipping (such as world trade and growth of countries).

This dissertation mainly concentrates on the Capesize market. This is because the Cape size market is more volatile than the Handymax or Panamax markets. It is easily understood through table 1 that capsize carriers transport mainly iron ore and coal. Iron ore is used to manufacture steel products and cocking coal is used to generate electricity by power plants.

Table 1 Different type of bulk carriers with main cargoes and major trading routes

Dry bulk carriers	Iron ore	Coal	Grain
Capesize	70~80%	30~40%	0~5%
Panamax	10~20%	40~50%	40~50%
Handymax/Handy	10%	10~20%	45~55%
	Major trading routes		
Capesize	West Australia to western Europe W.Australia to Far East Brazil to W.Europe Brazil to Far East	E.Australia to w. Europe E.Australia to Far East S.Africa to w. Europe S.Africa to Far East	Argentina to E.Europe
Panamax	W.Australia to W.Europ W.Australia to Far East Brazil to W.Europe Brazil to Far East	N.America to W.Europ N.America to Far East S.Africa to W.Europe S.Africa to Far East	N.America to W.Europ N.America to Far East N.America to Near East
Handymax/Handy	India to Far East N.America to Far East W.Africa to W.Europe	S.Africa to Far East S.Africa to Europe	N.America to W.Europ N.America to Africa Australia to Far East

Source : Grammenos (2010) and interviews with shipbrokers

Two industries have an influence on many country´s economic conditions. The commodity of Cape size vessel is volatile and as such difficult to be forecasted. Even though a large amount of research has been done, "*there is no example of a successful freight rate forecasting model*" (Veenstra, 1999, p 42). This is the reason why freight rate forecasting is still a fruitful area for maritime research. If the market is possible to be forecasted, it can assist many shipowners to formulate managerial strategies in poor market conditions.

1.1 Objectives

The Capesize market has a cyclical nature unlike the container market; it circulates from depression to boom depending on various variables. Especially, the Capesize market is influenced by many economic and political variables. The phenomenon cannot be explained by specific variables because the market is very complex and reacts easily to some variables.

Because of the narrow profit margins of shipping, even the slightest fluctuation in freight rates can have a major implication on profits. The ability to accurately predict the market has the obvious potential advantage of allowing shipowners to better plan how to maximize profits or minimize losses or risks incurred in the shipping market. The objective of this dissertation is to attempt to forecast the Capesize freight rate by suggesting the most appropriate model. Furthermore, this dissertation will investigate which variables affect the Capesize the most.

Firstly, the dissertation will focus on finding the variables affecting the market. This is because the shipping market has a numerous data and they play an organic role with each other. The dissertation will not only summarize the supply and demand variables of the shipping market, but also will divide both internal and external variables.

Secondly, this dissertation will disclose the reason why iron ore and coal have an influence on the Cape size market. Even though the market depends on supply and demand, the commodities are important to the Capesize market. Up to now, many experts have focused on the supply side to forecast or analyze the market. This is because if the supply side has dramatically increased, the market may fall into the recession depending on the law of supply and demand.

1.2 Methodology

In order to carry out the dissertation effectively, Quantitative methodology and the balance between supply and demand will be used including past experiences of market and the interrelation among several variables defined in a preliminary stage of the study. This is may be one of the crucial steps of such models: identification of relevant indicators, their characteristics and interrelation.

The quantitative methodology is to analyze the correlation between the dependent variable and the independent variables, and how forecast can be used in the economic phenomenon through the quantitative analysis. Also, this dissertation will analyze the balance level between supply and demand, and it will be used to forecast the market.

The research methodology can be divided into two steps; the first step is related to secondary research and the second step is related to primary research. In phase one, secondary research consists of the knowledge of the shipping market and the Capesize market in particular. Beenstock and Vergottis (1993) Economic modeling of world shipping and Albert Veenstar's (1999) Quantitative analysis of shipping market provided a deep analysis of previous work on the topic. In addition, this research also uses information by Clarkson, Lloyd's List, Fairplay and other market reports.

In phase two, primary research includes data collection and analysis such as correlation and regression. This data includes world fleet, delivery, new ship construction, demolition, freight rates, trade volume, bunker, and GDP of major countries. This data is collected from major shipping research institutions (Clarkson, Lloyds list, Drewry, Fearnley and ISL), shipping newspapers and megazines and major shipping companies / shipowner's associations. In addition, this research will refer to some opinions of maritime professionals. These opinions are obtained from shipowners, shipping brokers, shipping companies and researchers from Greece, Denmark and Korea.

1.3 Structure of the dissertation

This dissertation will disclose the interrelation between variables and the shipping market, how some variables affect the shipping market as well as, what is the relationship between the demand and supply variables. This dissertation makes an attempt to provide an integrated framework for the economic research of the dry bulk shipping market. In order to secure objectivity of the research, past decade data of the shipping market and macro economical index will be used.

The structure of the dissertation consists of 5 chapters, as follows:

Chapter 1 starts with the background of dry bulk ships, introducing the objective of the dissertation. Also, the methodology of the dissertation is mentioned in this chapter as well as the objective of the dissertation,

Chapter 2 explains the development of the bulk shipping research. This chapter touches on a literature review of the dry bulk shipping. Many forecasting freight models of bulk shipping will be introduced. In addition, this chapter will analyze past cycles of the bulk shipping market and their cause and effect.

Chapter 3 collects and analyzes many variables from the demand and supply side, such as the volume of cargo, world fleet, and the price of second-hand ship affecting the Capesize market. In addition, the correlation research method is used to demonstrate the relationship between freight and influential variables. Further, to forecast the cape size market, linear regression is used. This chapter verifies the data through the multiple regression method. Lastly, the forecasting freight model of the Capesize market is built.

Chapter 4 establishes some assumptions about world economy, forecasting demand and supply for the cape size market in 2014. This chapter forecasts the Capesize market in 2014 depending on some assumptions. There also analyze another methodology to forecast the market, which it is measured by using the supply and demand. At the end of the chapter, the Capesize market in 2014 will be forecasted by using the methodologies.

Chapter 5 concludes the dissertation and suggests the forecasting Capesize market in 2014. There includes the limitation of the research, and the direction for further research related to the optimal freight level model between the demand and supply side of the Capesize market.

2. DEVELOPMENT IN THE CAPESIZE MARKET RESEARCH

2.1 Literature review

Shipping plays a vital role in world trade and economy. Currently, although a certain amount of the world trade is transported by truck, rail and airplane, most is carried by ships. It was estimated that 90 per cent of the world trade goods in volume are shipped by sea (Ma, 2012). Most bulk cargoes such as iron, coal and oil are transported by ships because ships have many advantages of transporting large quantities of cargo with the cheapest freight. The freight represents the situation of the market. This is because the freight is decided by demand and supply of the market. It is simply defined that the demand side is the needs of cargo in the market and the supply side is the volume of fleet in the world. However, the freight is easily affected by a number of variables, such as economic and political factors. According to this nature, there is a large movement in the short term. In addition, the market cyclically repeats the booming and recession. Many experts have claimed that the characteristics of shipping are volatile, fluctuate and cyclical.

Many ship owners have been investing into building their ships with a great deal of money because shipping is a capital intensive industry. They want to forecast the market to avoid risks. If some ship owners can forecast the market in the future, they can avoid risks. Due to these reasons, not only ship owners but brokers, charterers and traders have collected a considerable amount of shipping information and they have tried to forecast the market in the future. *Owing to the ongoing uncertainty in international shipping and the volatile nature of spot rates, the quantitative analyzes of spot rates or pricing the shipping freight market have always drawn much attention to researchers in the shipping industries* (Chen, 2012).

The pioneer researches of forecasting for the shipping markets are described Tinbergen (1959), Zannetos (1966), Wegeland (1981), Strandenes (1984), and Beenstock and Vergottis (1993). These studies consist of attempts to model freight rates in terms of a supply and demand framework and to identify factors that determine freight rates.

Especially, Tinbergen (1993) research the influence of total demand and supply of tonnage on the sensitivity of freight rates. He use the seaborne trade to quantify the demand which is considered to be absolutely inelastic with respect to freight rates. On the other hand, the supply determinants are the size of the fleet and the price of bunkers. An increase in the size of the fleet increases the supply. In contrast, the increasing of the bunker price will cause the supply at a given freight rate to contract because ships find that it is more economical to slow down. The supply and demand model of Tinbergen has the following structure:

$$qs = fs\,(fr, K, pb, \ldots), \quad qd = q, \quad qd = qs \tag{2.1}$$

this function could be changed into the expression of freight rate:

$$ft = f(K, qs, qb, \ldots.) \tag{2.2}$$

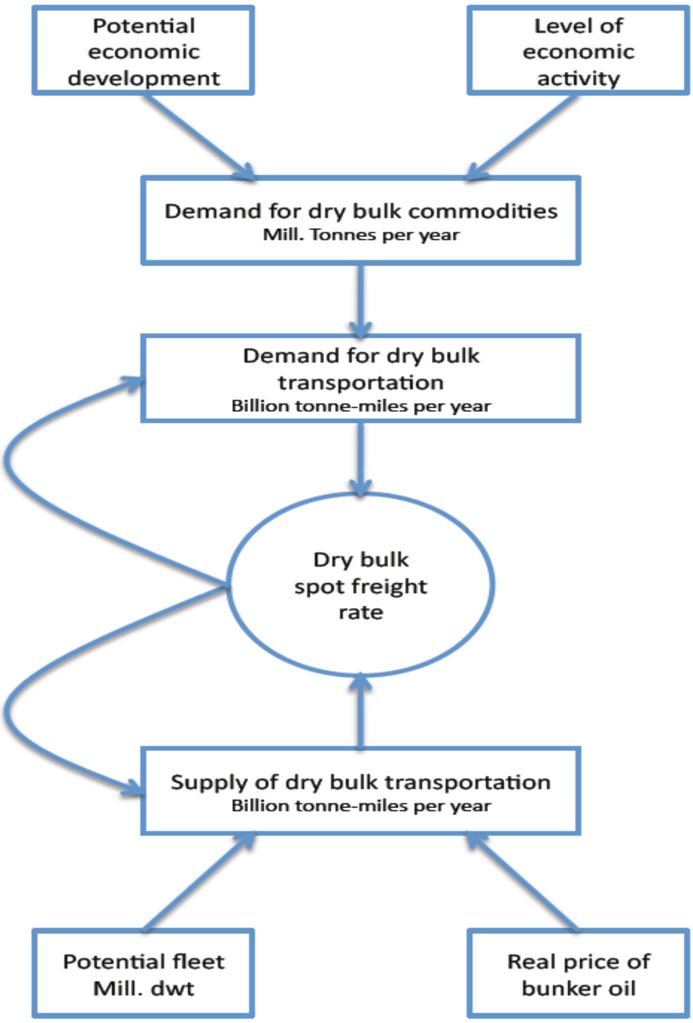
where qs is the quantity supply, qd is the quantity demand, fr is the freight rate, K is the fleet size (dwt), pb is the bunker cost and q is the amount of trade. In addition, *Tinbergen also eatimated the supply elasticity (the supply equation) as follows: α = 0.94, β = -0.23, γ = 0.59*

α, β, γ is the elasticity of supply with respect to the fleet, bunker cost and freight rate. From this, it is obviously that the elasticity of supply with respect to the fleet is close to the value of unity". In contrast, "*the supply is moderately inelastic with the bunker cost and freight rate*" (Veenstra, 1999).

Since Beenstock and Vergottis (1993), "*researchers have turned their attention to examine the statistical properties of freight rates and exploring further the dynamic relations between shipping prices by using reduced form autoregressive models* (Chen, 2012).

The demand and supply of sea transport by ship is triggered by a geographical imbalance between consumption of commodities, ton miles, and the size of fleet. *The supply and demand for sea transport is measured in ton miles, which is defined as average haul multiplied by tonnage of cargo* (Strandenes & Wegeland, 1980). Many models for forecasting shipping freight have been developed since Tinbergen (1959), who is one of earliest econometric applications. The basic concepts are similar, but the models have become more complicated and up-to-date. Strandens and Wergeland (1980) contributed by developing a forecasting freight model in the dry bulk market.

Figure 1 *An illustration of the NORBULK model.*



Source : Strandenes and Wergeland (1980)

Figure 1 can be described as follows; the freight level is an equilibrium point between supply and demand of shipping markets. Especially, the model assumed that the demand part includes macroeconomic conditions and the supply part includes the size of fleet, the bunker cost and the freight rate. "*Beenstock and Vergottis (1993)* *introduced a comprehensive model for the dry bulk market*”. They incorporate of the variables q and K in the voyage charter equation in the form (q-K) that is supply and demand balance. They assumed that demand is inelastic to the freight rates and the theoretical supply elasticity of the fleet is unity (Veenstra, 1999). Their estimation results of the freight market for dry bulk ships seem in table 2;

Table 2 *Beenstock and Vergottis estimating of freight market*

Freight market block	C	q-K	pb	AH
frs	6.05	4.22	1	-6.60

Source: Beenstock and Vergottis (1993). Econometric Modelling of World Shipping.

According to Martin Stopford (2009), *the model for freight prediction consists of three components, demand, supply, and the freight market which connects between demand and supply*. The demand part includes the world economic, seaborne cargo trades, average haul, random shocks, and transport costs. The supply part includes world fleet, fleet productivity, shipbuilding production, scrapping and losses, and freight revenue.

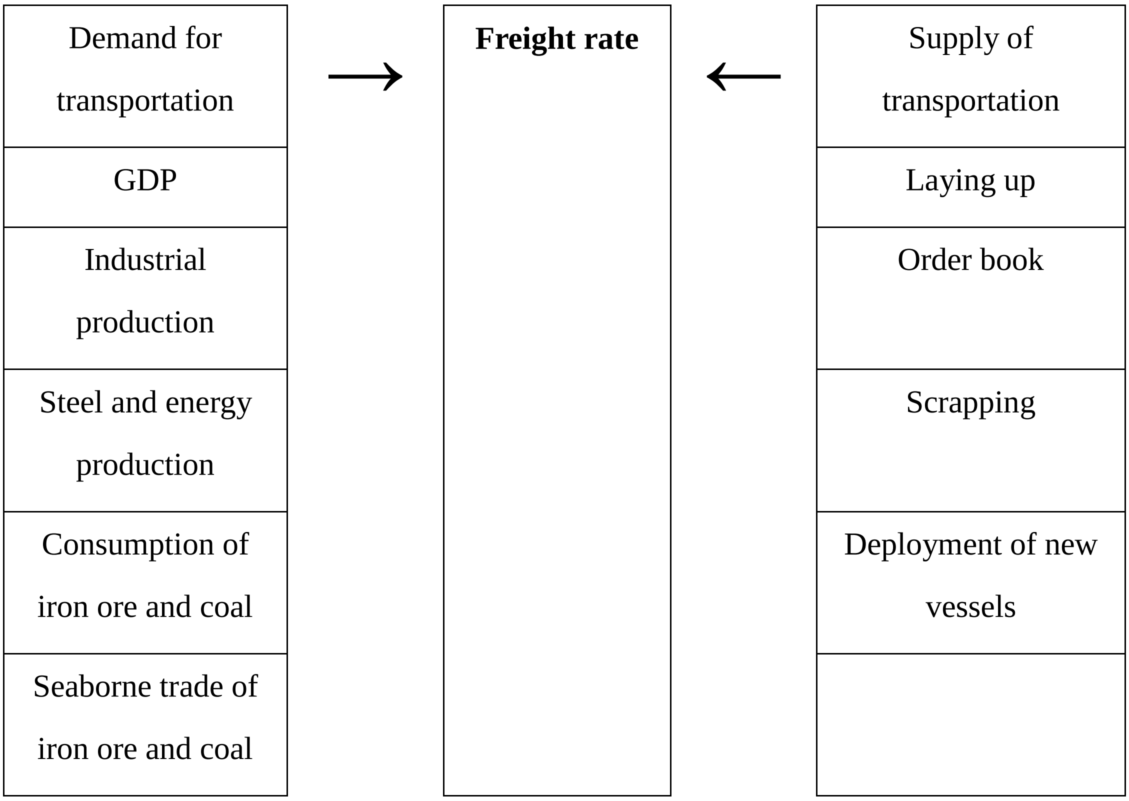
2.2 The freight rate model

To forecast the dry bulk market, there are usually used by many models such as ARIMA (Autoregressive integrated moving average), VECM (Vector Error Correction Model), and VAR (Vector Autoregression) model are commonly used. *The ARIMA model is that it takes into account the information content in the spot price movement in determining the forward price. The VECM model is argued to be more appropriate than the univariate ARIMA and bivariate VAR models in modeling the spot and forward prices as it takes into account both the short-run dynamics and the long-run relationship between variables. The VAR model is itself a restricted version of the VECM, where the two equilibrium correction terms are omitted. The VAR model, therefore, may require more parameters than the VECM to capture the dynamic behavior of the variables, and this lack of parsimony may cause problems when the model is used for forecasting. One problem is that the collinearity between the different lagged variables may lead to* *imprecise coefficient estimates* (Batchelor, Alizaden and Visvikis, 2007).

The freight forecasting model comprises the analysis of supply and demand for transportation of dry bulks, whose balance may affect the freight rates of the main trading routes. The supply will be addressed in terms of capacity available for transportation and how it is impacted by new building, scrapping of vessels, productivity of the fleet, lay-up and future expectation of capacity deployment, given by the order book in shipyards. On the other hand, demand for transportation will be assessed by the analysis of the seaborne trade of iron ore and coal, their world consumption, main drivers, such as world steel production and energy consumption, and most importantly, by economic indicators of the major consuming nations. The positioning of iron ore producers of different grades and the trade flow to final markets (China, other Asia, Europe, Americas) are relevant, once factors such as freight rates and its differential among transportation routes have a direct impact on the cost structure of the delivered iron ore (Wilken, 2004).

Figure 2 shows a basic schematic model of the main drivers influencing freight rates in any routes.

Figure 2 *Influence of economic factors in freight rates (basic model)*



Source : Leonardo Wilken, 2004, model for freight forecasting of capsize

2.3 Analysis of the dry-bulk market cycle and forecasting

To grasp and forecast the Capesize market, analysis of the dry bulk market is needed. This is because the Capesize market is a part of the dry bulk market and the cycle of cape size the market almost coincides with the dry bulk market.

Market cycles diffuse the shipping industry. As one shipowner put it "*when I wake up in the morning and freight rates are high I feel good, but when they are low I feel bad*" (Stopford, 2011). The shipping industry has a characteristic of cyclical, and there are a lot of shipping cycles in the past 100 years. Many experts and scholars have researched the shipping cycle because the cycle has a routine pattern. If they can grasp the pattern, they may forecast the shipping market and ship owners may respond to the recession. This sector will look into the history of shipping cycle, analyze the causes of the cycle, and predict the shipping cycle.

2.3.1 Characteristics of the shipping market cycle

Many industries have a cycle nature that it is not unique to the shipping market. According to Cournot (1856), a French economist, *it is necessary to recognize the secular vatiations which are independent of periodic variations*. According to Stopford (2011), the shipping cycle has three components. ***Firstly***, *it is a long-term shipping cycle. These long-term cycles are triggered by technical, economic or regional change. In case of bulk ships or container ships, the bigger size ships and efficient cargo handling technology have driven to a decreasing freight rates and mass transportation.* ***Secondly***, *the short-term component cycle is often called 'the business cycle', which corresponds more closely to most people's notion of a shipping cycle. It fluctuates up and down, and a complete cycle can last anything from 3 to 12 years form peak to peak. This is the form economic business cycles and they are important drivers of the shipping market cycle.* ***Thirdly***, *the seasonal cycle usually occurs by the demand for sea transport in a specific season within the year. For example, if July is a harvest season of grain, the freight may increase in this season because demand may far outstrip the supply*.

2.3.2 Stages in typical shipping cycles

Stage one involves which a trough has three characteristics. Firstly, there are some signals of surplus shipping capacity, so ship owners try to save fuel costs. The freight rates decrease considerably and second-hand ship prices decrease to scrap prices; therefore, many ships are scrapped.

Stage two is a recovery in which the surplus supply disappears to meet the demand; the freight rate gradually increases to operating cost and the proportion of laid-up tonnage decreases. Thus, new ship and second-hand ship's prices gradually increase.

Stage three involves a peak whereby there is a shortage of supply, many ship owners try to get more ships, so they order new ships to be built and they buy a second-hand ships. The price of new ships or second-hand ships considerably increases. The peak period may continue a few weeks or several years.

Stage four involves a collapse in which the supply overtakes the demand. The freight rate is plummeted under the operating cost. The price of second-hand ship is plummeted. Many ships are laid-up and ship owners reduce their ship's speed (Stopford 2011).

2.3.3 The history of the dry-bulk shipping market

Cycle 1: 1973-1979

The world economy was strongly shocked by the oil crisis in 1973 following the Yom Kippur War. The tanker market had plummeted, while the dry bulk market held up through 1974, but then it started to collapse. This is because the world economy fell into the recession due to the oil crisis. In the autumn of 1978 the dry cargo recovery started, leading to a very firm market, in 1979-1980. *By the end of 1978 freight rates had risen 30%, and they continued their climb through 1979 to a higher level than the 1974 peak. This is because power utilities around the world switched from oil to coal, giving a major boost to the thermal coal trade* (Stopford, 2010).

Cycle 2: 1980-1987

The dry cargo market boom continued until 1981, followed by the new high levels of ship values and the order book. The world economy fell into a severe recession because of the second oil crisis. *The world seaborne trade of dry cargoes decreased from 1,793 million MT in 1982 to 1,770 million MT in 1983* (UNCTAD, 1984). "*In 1984, the world seaborne trade increased to 6.55% compared to 1983, but the freight still remained at a low level. In mid-1986, the price of a five-year-old Panamax bulk carrier could be $6 million, compared with a new building price of $28 million in 1980. The value of dry bulk ship collapsed for the period from 1985 to1986*" (Stopford, 2010).

Cycle 3: 1988-1995

The world economy fell into recession in 1992. "*The dry bulk market had not much burden from the tonnage supply and after a brief dip bulk freight rates recovered, reaching a new peak in 1995*" (Chen, 2011). This is because "*the bulk carrier investors* *had become very conservative in their ordering activity, which resulted in low delivery during this period*" (Stopford, 2002).

Cycle 4: 1996-1999

In the three years from 1993 to 1995, many ship owners ordered bulk carriers of about 55 million, and new vessels were delivered into the market from 2006. The dry bulk market fell into the recession because of the surplus supply. In addition, the world economy moved into the recession because the Asian crisis occurred in 1997. At that time, BDI index decreased under 1,000 point.

Cycle 5: 2000-2002

The recession of the global economy continued until 2002 because of the bubble of the IT industry and 9/11 terrors of the World Trade Center in 2001. The dry bulk market also fell into the recession until 2002. However, many countries including China and the US had tried to develop their economy. They operated many economic booming policies.

Cycle 6: 2003-2008

After 2002, the shipping industry has experienced an unprecedented boom, because the Chinese opened their economy. They tried to develop their economy and to construct many social infrastructures, such as bridges, rails, roads, ports, airports and apartments. They needed a number of raw materials, such as iron ore and coal. For example, in the period between 2002 and 2007, China produced steel products from 144 million MT to 468 million MT. The BDI index soared to about 18,000 points in 2008. From 2005 to 2008, ship owners ordered new bulk ships of about 380M dwt, for example, 30M dwt in 2005, 60 M.dwt in 2006 and 180 M dwt in 2008 (Clarkson Research, 2012). In 2005, the fleet of world bulk was about 377 M.dwt, and in 2008, the fleet was about 464M dwt.

Cycle 7: 2009-2012

After 2008, the world economy has undergone serious financial risks induced by

PIGS's financial risk such as Portugal, Italy, Greece and Spain. Most countries had adjusted the speed of their economy development policy. AT that time, "*the world economic growth was reduced from 3.0% in 2008 to -1.1% in 2009*" (IMF, 2011). The world trade volume was also reduced from 3.0% in 2008 to -12.2% in 2009. This is because the dry bulk market, including the Capesize market was led by China's imports of raw materials. However, after 2008 Asia and China's economy significantly slowed down, resulting from the sluggish demand and the surplus of tonnage. Further, the Capesize market plummeted and the value of new ships and second-hand ships were low. For example, the price of a new ship (Capesize) was about $88 million in 2008, while the price plummeted to $46 million in 2012. The charter price of cape size (1year) was about $111,529 in 2008, but the price decreased considerably to $13,685 in 2012. The main cause of these slumps is a surplus supply as the tonnage of cape size already exceeds over the demand. As mentioned, "*the average length is about six years for six cycles from 1973 to 2012*" (Stopford, 2011).

2.3.4 Shipping cycle and forecasting

In general, it is not easy to predict a shipping cycle because it is irregular. Nobody knows for how many years the cycle will be in period of boom. The recession period may be over ten years. The cycles are sometimes 8 years or 4 years. However, the cycle obviously depends on the law of demand and supply. If demand is strong and supply is weak, the market may meet the booming. However if it is a reverse situation, the market may fall into recession.

To analyze the shipping cycle, the demand and supply need to be understood. On the demand side, there needs to be an analysis of the world economy, economic conditions, trade volume, transport cost and average haul. On the supply side, there needs to be an analysis of the world fleet, fleet productivity, shipbuilding production, scrapping and freight revenue. Careful analysis of these variables removes some, but not all, of the certainty and reduces the risk. However, these must be added the wild cards which often triggered the fantastic booms and slumps. "*The South African War in 1900, closure of the Suez Canal, stockbuilding, congestion and strikes in the* *shipyards have all played a part*" (Stopford, 2010).

Many experts want to grasp the turning point, however, it is very difficult because the world economy is very complicated and difficult to predict. This dissertation will try to analyze the signals of the present situation in the shipping cycle and the correlation between variables and the cape size market. *OECD's leading indicators index, for instance, is based on a wide range of indicators, including stocks, the number of workers laid off, orders, the amount of overtime, as well as financial statistics, such as company profits, and money supply, which such information is very important for analyzing short-term market trends* (Stopford, 2002). Based on these factors, the dissertation can effectively analyze the trend of the market and forecast the market.

3. RESEARCH METHODOLOGY

3.1 Capesize market

The shipping industry is considered one of the most volatility in which the Cape size market is massively fluctuated, and always has been. Since the Capesize market peaked in May 2008 with the Baltic Exchange Capesize Index (BCI) of approximately 17,000 index, propelling the business into an undreamed territory, it did not last too long. Only six months later it backed up and accelerated into the greatest shipping crash of all times. Earnings fell to $160,000/day in August; $80,000/day in September; $15,000/day in October and finally ended at $5,000/day in November of 2008.

Capesize carriers are cargo ships originally too large to transport the Suez Canal. "*To transport between oceans, such vessels used to have to pass either the Cape of Good Hope or Cape Horn. In effect, Cape size reads as unlimited*" (Lloyd's Register, 2007). "*There are approximately 289 million dwt (1,545 carriers) operating in the market*" (Clarkson Research, 2013). Typically, Capesize vessels are designed to be more than 150,000 dwt. A standard deadweight for Capesize bulk carriers is about 175,000 dwt, although larger ships which are up to 400,000 dwt or even more have been introduced recently to meet the increasing demand for ore carriers and to take full advantages of the economy of scale.

Capesize vessels deal with the transportation of a vast majority of raw materials (such as iron ore and coal), which are inputs for the steel and power industry – the root for development all over the world. Thus, the going up and down of Capesize market (illustrated by the BCI) might be in a responding relationship with the strength of the world production economy. Most of the cargo transported by Capesize vessels is iron ore and coal considered as the strategic goods of several countries for steel production and thermal power industry. That is the reason why the demand for iron ore and coal always has been in a continuous increase.

Capesize ships led the historical shipping boom from 2000 to 2008. This is because the demand for iron and coal had increased explosively. At that time, Capesize vessels were in a considerable short supply in the market. The freight and charter price had increased sharply due to the supply – demand law, leading to numerous new ship orders. It might imply that the Capesize shipping market is determined by the law of demand and supply.

"*The BCI index is ten daily Cape size vessel assessments including voyage and time charter rates*" (Baltic Exchange, 2013). Each voyage and time charter rate relates to a certain weight. The seven main Capesize shipping routes listed before are the calculation base for the BCI. The nature of the cape size market has a homogeneous service, free to enter into the market, and a perfect competition market. In conclusion, the Capesize market is a perfect competition, because the main cargo is iron ore and coal, and it depends on the law of demand and supply. The characteristics of the market are volatility, fluctuations, and cycles. The market is easily affected by some internal and external variables such as political and economic issues. The following section will analyze the influential variables of demand and supply affecting the freight rates.

3.2 Influential variables of demand for the capesize market

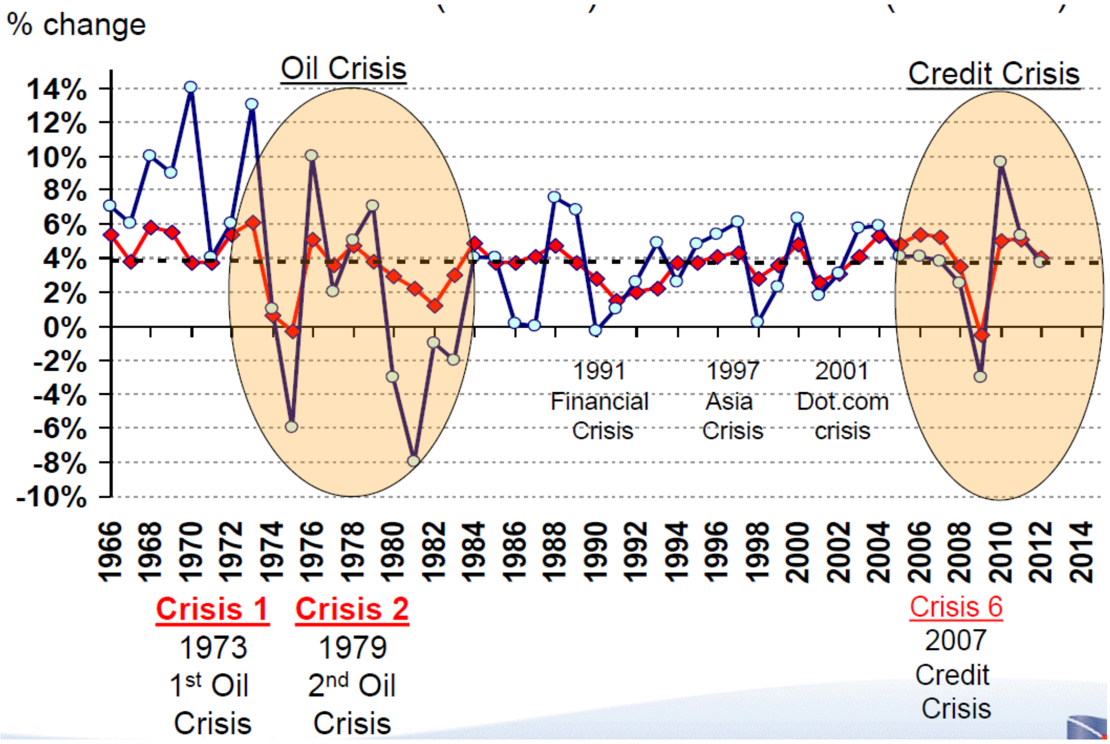
3.2.1 World economy

Shipping cannot create the demand by themselves; the demand can be created by the trade between countries. Undoubtedly, the most crucial single factor on ship demand is the global economy. According to Isseerlis(1918), "*there is similar timing of fluctuations in freight rates and cycles in the world economy*". *There should be a close relationship, since the world economy generates most of the demand for sea transport, though either the import of raw materials, such as iron ore and coal for the manufacturing industry or the trade in manufactured products* (Stopford, 2010).

On the other hand, figure 3 shows that the relationship between sea trade and the world industry is very complicated and indirect. There are two different phenomena of the global economy such as the business cycle and the trade development cycle.

The business cycles are based on the freight cycles. The fluctuation of cycles is affected by seaborne trade. Figure 3 show that there is a close relationship between world GDP and sea trade over the period 1966-2012. In particular, the shipping recessions in 1975, 1982, 1991, and 2009 coincided with the world GDP.

Figure 3 *World GDP cycles and sea trade*



Source : Clarkson research

There are three remarkable events. Firstly, in 1997, Asian countries suffered from the financial crisis. At that time world economy had drastically fallen and the trade volume also decreased considerably. Secondly, in 2001, there occurred the 9.11 terror, and the world economy fell into the recession, the world economy was mirrored by the cycle in sea trade. Thirdly, in December 2008, the credit crisis in the US and Southern EU countries occurred. The world economy plummeted and sea trade also decreased dramatically. Therefore, it seems that the world economy is closely related to the sea trade. *The ratio between the growth rate in world trade and the rate of economic growth is defined as the elasticity of world trade. For the last 30 years trade elasticity has been positive at an average of 1.58* (IMF, 2004).

Furthermore, the shipping industry has a nature of globalization, and the mechanism of freight rate is very complicated and affected by some macroeconomic variables, such as the exchange rate and global inflation. Especially, in the case of exchange rate, the main currency of the shipping industry is US$. If there is an appreciation of the dollar relative to other currencies, the freight rate may increase. On the other hand, if the dollar is depreciated, the freight rate may decrease. In conclusion, the fluctuation of exchange rates will indirectly affect the shipping industry.

Table 3 *World GDP and sea trade*

Date	Annual GDP World	Annual GDP USA	Annual GDP Japan	Annual GDP EU	Annual GDP China	World Seaborne Trade (million ton)
2000	4.8	4.1	2.3	4.0	8.4	6108.6
2001	2.3	1.1	0.4	2.3	8.3	6149.9
2002	2.9	1.8	0.3	1.4	9.1	6318.5
2003	3.7	2.5	1.7	1.6	10.0	6676.4
2004	5.0	3.5	2.4	2.6	10.1	7126.7
2005	4.6	3.1	1.3	2.3	11.3	7438.6
2006	5.3	2.7	1.7	3.6	12.7	7794.0
2007	5.4	1.9	2.2	3.4	14.2	8117.5
2008	2.8	-0.3	-1.0	0.5	9.6	8335.9
2009	-0.6	-3.1	-5.5	-4.2	9.2	8001.6
2010	5.2	2.4	4.7	2.0	10.4	8773.6
2011	4.0	1.8	-0.6	1.6	9.3	9173.2
2012	3.1	2.2	1.9	-0.2	7.8	9562.0

Source : Clarkson research

Table 3 shows that the average GDP of the world is approximately 3-5% from 2003 to 2008. Especially, the GDP of China is about 9-14% for the same period. At that time, the volume of sea trade had constantly increased about 5-10% yearly. However, in 2009, the world GDP was recorded -0.6 point because of the credit crisis, and China's GDP also decreased. Eventually, the volume of sea trade was down 4% compared with the previous year. In conclusion, two pints can be interpreted through the table. Firstly, there are correlations between GDP and sea trade. Secondly, China led the boom of the shipping industry.

3.2.2 Seaborne commodity trade

The trade volume of raw materials for production is the factor representing the demand side. Capesize vessels are mainly involved in the transport of raw materials for steel production and power generation. Obviously, as a consequence of economic development, countries need numerous amounts of these raw materials. These materials are also used to construct apartments, rails, ports, and roads for infrastructures. Therefore, the present downward trend of the global economy might not affect the stable increase in raw material trade volumes.

In the Capesize market, the crucial cargoes are obviously both iron ore and coal. It is already proven through history from 2003 to 2008. For the period, the shipping industry experienced the highest boom, and the cause of the boom was iron ore and coal. A remarkable point is that China had tried to develop its economy, so a number of raw materials such as iron ore and coal were needed. These cargoes are transported by Capesize carriers; therefore, the Capesize market led an unimaginable boom.

In this sector, the iron ore and coal trade will be analyzed.

3.2.2.1 Iron ore

In 2012, the world seaborne trade was about 9,561 million ton, and the volume of iron ore trade was about 1,052 million ton at a rate which accounted for about 11% of the total seaborne trade. The volume of world sea trade in 2012 increased approximately 1.5 times compared with 2000, the volume (450 M) of iron ore trade in 2012 was more than double compared with 2000 (1109 M).

In this point, the cause of the increasing volume of iron trade needs to be analyzed. Iron ore is used to make steel which it is used by the car industry, new ship building and social infrastructures. For example, China needs a considerable amount of raw materials to construct many bridges, rails, ports and apartments. Table 4 shows that China imported about 91 M ton of iron ore in 2000, and the rate was about 20% of world iron trade. However, the rate started to increase gradually by about 39% from 2000 to 2003. After that, the rate constantly increased by 72% in 2008. Therefore, China led the demand of world iron trade, and the Capesize market was faced with the best boom in 2008. However, the volume of China import dramatically decreased to 30% of world iron trade. At that time, the Capesize market plummeted. China import of iron ore is very crucial because the distance (ton-miles) is very long from South America to China. For example, some Capesize vessels (170,000dwt) transport the iron ore from South America to China, and the period of one voyage is about one month. If China imported the iron ore as in 2008, a number of Capesize vessels may be needed.

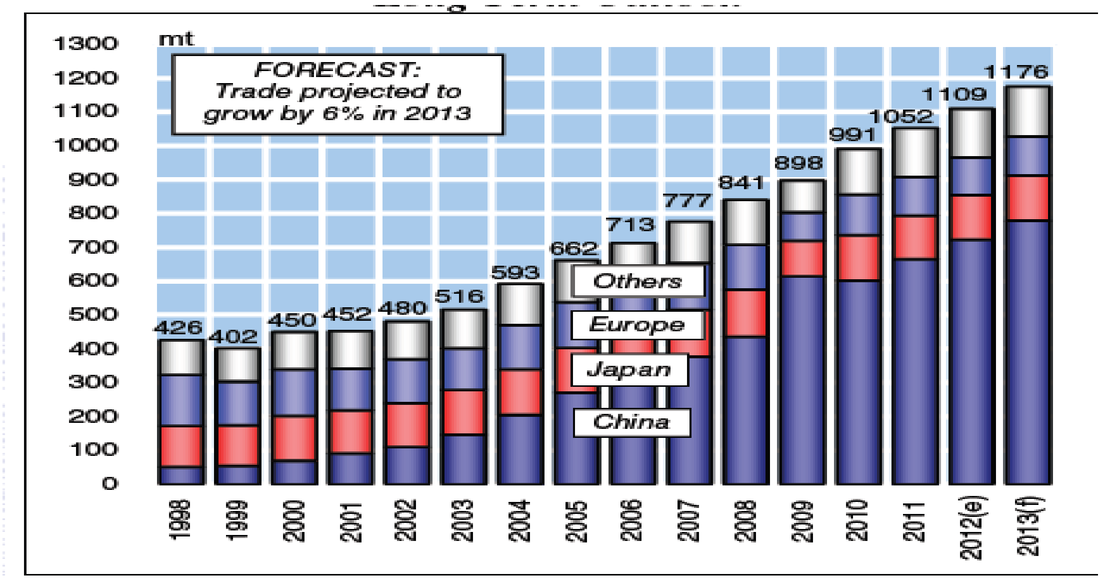
Table 4 *World seaborne trade and iron trade*

Date	World Seaborne Trade Volume (M ton)	World Seaborne Iron Ore Trade (M ton)	China Import Iron volume (M ton)
2000	6108.59	450.17	91.40
2001	6149.92	452.27	110.68
2002	6318.54	480.20	146.76
2003	6676.40	515.71	204.67
2004	7126.66	592.57	270.56
2005	7438.64	661.98	318.94
2006	7793.96	713.12	377.07
2007	8117.53	777.02	435.87
2008	8335.92	840.57	614.61
2009	8001.60	897.92	602.56
2010	8773.59	991.07	665.40
2011	9173.15	1052.15	723.93
2012	9561.96	1109.17	372.36

Source : Clarkson research

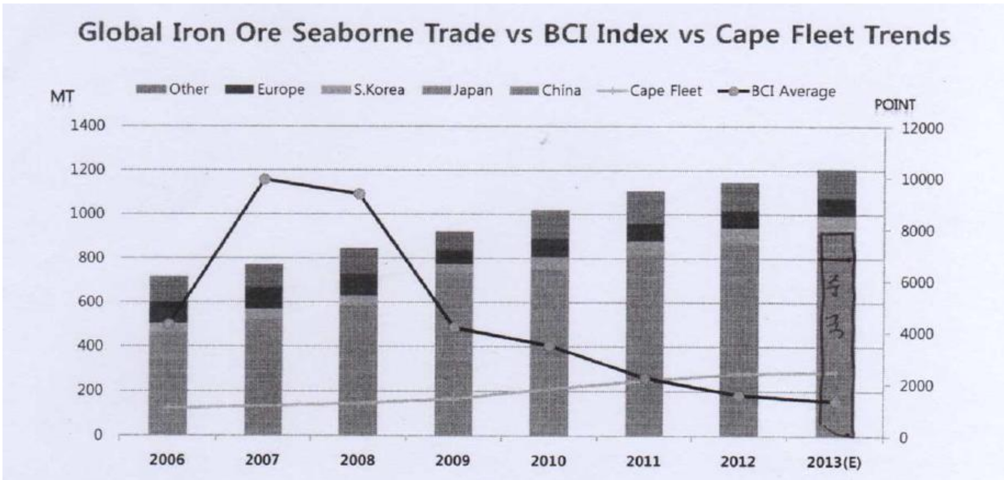
Figure 4 and 5 shows that there is a close correlation between world iron ore seaborne trade, the BCI index and the Capesize fleet. This is because the major demand of the Capesize market is iron ore, and the cargo is transported by cape size carriers because iron ore is a massive cargo, and it is economic to transport Capesize carriers. Therefore, after 2003, the market needed more Capesize vessels, so then many ship owners started to order many Capesize ships. Eventually, many ships flowed into the market as the volume of iron trade increased. The supply far exceeds over the demand after 2009; the BCI index plummeted and the down trend has been maintained up to now.

***Figure 4** World seaborne trade and iron trade*



Source : Clarkson research

***Figure 5** World seaborne trade and BCI index*



Source : Clarkson research

3.2.2.2 Coal

Coal is a source of energy to generate the electricity and to produce the steel products, because it is the most plentiful, safe and easy to be acquired in the world. Many countries have still used the coal to generate the electricity, about 40% of total coal is used to generate the global electricity. In addition, approximately 60% of world coal volume is used to produce the steel products, Coal is a crucial role to develop the global economy (Fearnley Reviews, 2004).

Table 5 explains that the global seaborne coal trade has surprisingly increased for the last 25 years from 300mt in 1987 to 1.1bt in 2012. The coal trade volume has constantly grown with about 5-10% from 2000 to 2012. Especially, the imports volume of China and India has dramatically increased to develop their economy at that period.

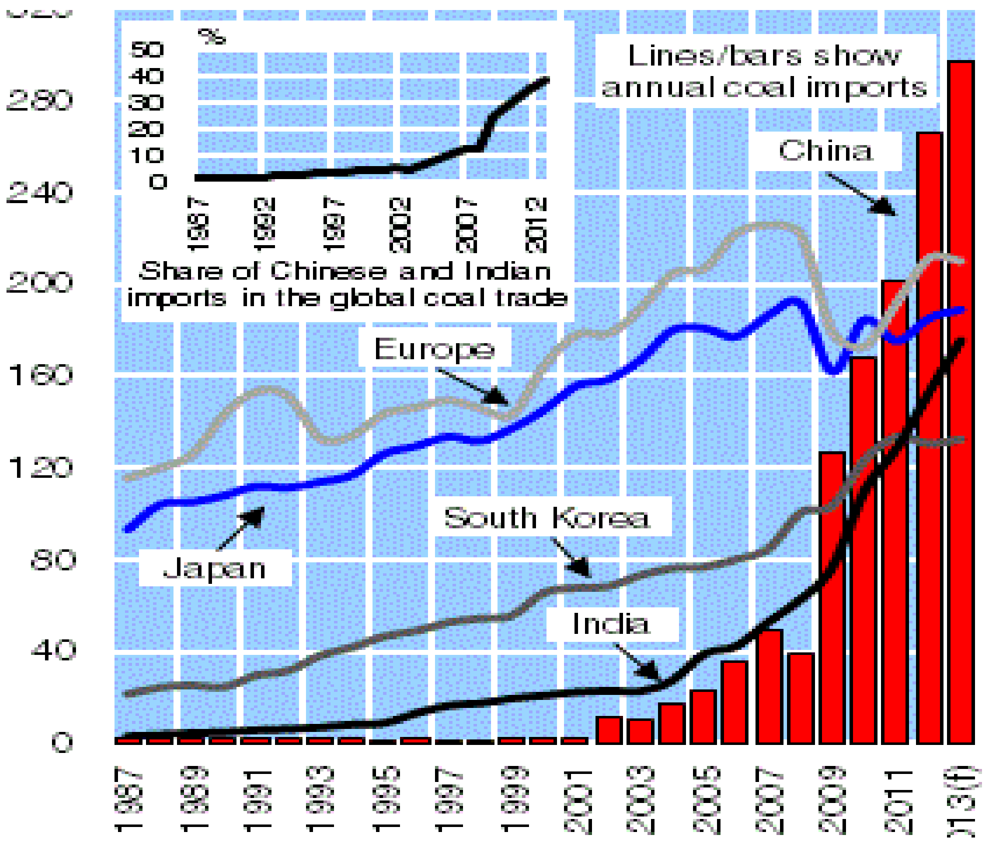
Table 5 *World seaborne coal trade*

	cocking coal	steam coal	total
2000	171.09	336.54	507.63
2001	170.00	376.41	546.41
2002	164.88	394.12	559.00
2003	166.06	435.34	601.40
2004	171.93	470.61	642.54
2005	179.94	492.57	672.51
2006	175.60	528.41	704.01
2007	194.10	558.99	753.09
2008	199.49	577.84	777.33
2009	187.85	589.62	777.47
2010	235.34	665.12	900.46
2011	222.64	723.53	946.17
2012	235.47	826.60	1062.07

Source : Clarkson research

Figure 6 explains the trade volume of world coal and the imports volume of major countries. The import volume of Korean, European, and Japan was approximately 62% from 1987 to 2003 (Clarksons Research, 2013). Especially, Korea has rapidly developed their economy including the new building ships and car manufactured industries, so they need more raw materials to generate the electricity and to make steel are needed. The world coal trade volume has constantly increased about 6% per annual from 2002 to 2008. India and China imported a tremendous volume of coal to develop their economy, they needed to produce a number of steel products and generate the electricity. Especially, the import volume of India and China dramatically started to increase from 2004 to now, the volume reached to almost double. In 2009, Europe, Korea, and Japan reduced the import volume by about 14-20% because of world financial crisis. Even though the world economy fell into the recession, the import volume of major countries has almost recovered in 2012.

Figure 6 *Turn of the coal tide*



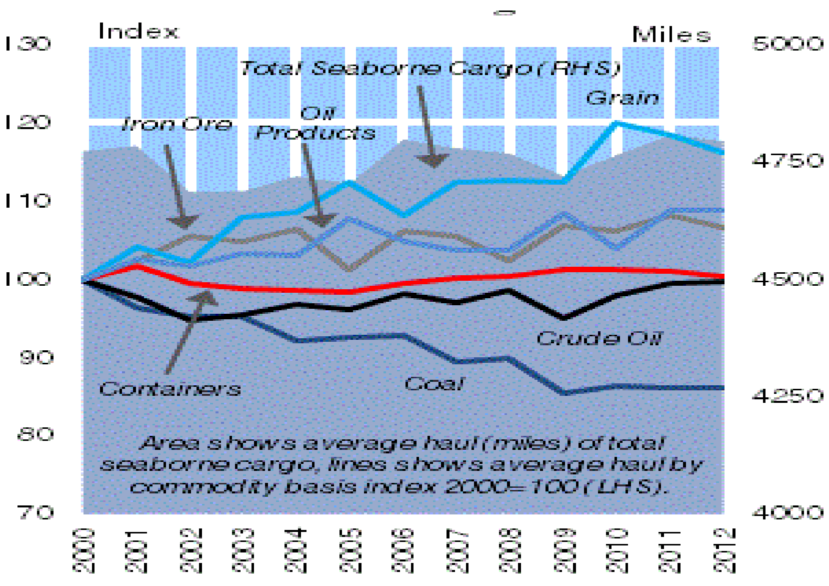
Source : Clarkson research

3.2.3 Average haul

Transport demand is decided by voyage distances, voyage period, and ship's size. Average haul is generally defined as distance efficiency from the Middle East to Western Europe. The average haul is calculated to measure the ton-miles, it is measured as a cargo shipped tons, multiplied by its average transport distance. The average haul is a crucial role to measure the demand of sea transport, many forecasting experts have used it to predict the market.

Figure 7 shows the steady average haul over time. The figure also shows the average haul of each major cargo such as grain, iron, coal, container, and crude oil from 2000 to 2012. In case of container cargo, the average haul is a stable at about 4,500 miles. The average haul of crude oil has maintained at the level of 4,400-4,500 miles. On the other hand, the average haul of coal has constantly reduced from 4,500 miles in 2000 to 4,250 miles in 2012, because the import volume of Asian countries such as China and Korea has dramatically increased from Australia and Indonesia. In case of grain, the average haul has dramatically increased from 4,500 in 2000 to 4,750 in 2012, because China and Korea have sharply expanded the import volumes. The average haul of iron ore has maintained very stable at the level of 4,600 miles.

***Figure 7** The long haul of the seaborne cargo*



Source : Clarkson research

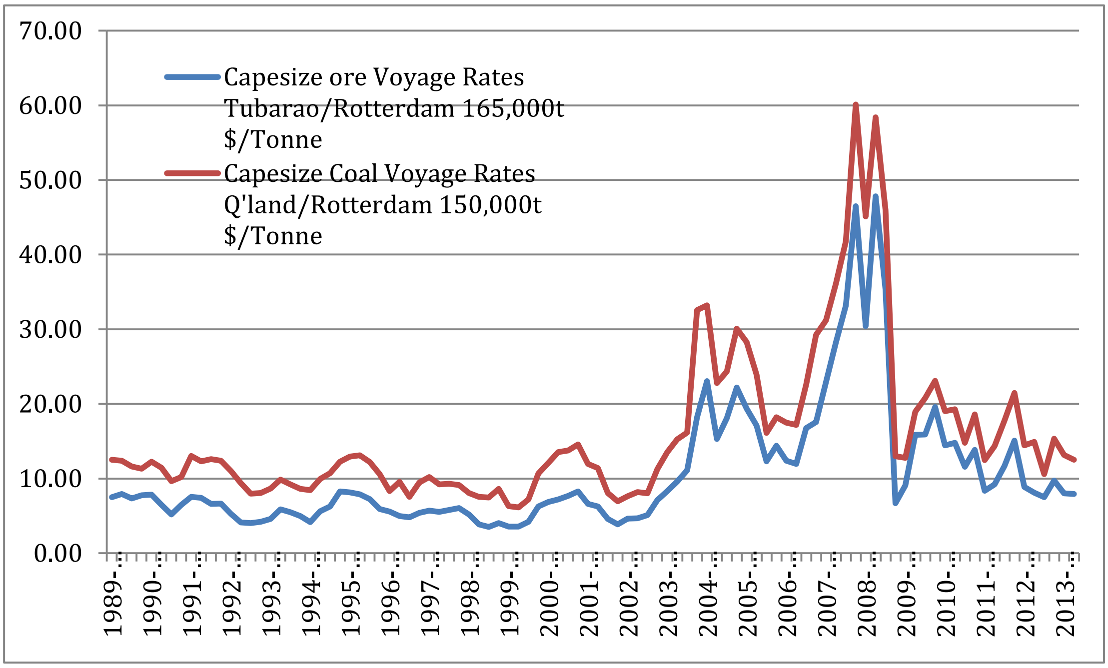
3.2.4 Transport cost

According to Stopford (2010), transport cost is determined by the law of supply and demand, it is ‘freight’. The Capesize market has a number of voyages; the freight is different depending on the voyage because the distance of voyage is different in spite of the same cargo. Capesize carriers transport raw materials including coal and iron ore. These cargoes have a low value and it is transported in enormous volumes by ships. According to an EEC study (1998), *in the early 1980s transport costs accounted for 20% of the cost of dry bulk cargo delivered to countries within the community. For the last 50 years, the technique of ship has surprisingly developed, the efficiency of ship has increased and the size of ships is getting bigger*. As a result, transport costs have constantly been reduced while the quality of services has increased.

In 1950 the coal would have travelled in a 20,000dwt vessel at a cost of $10-15 per ton. Forty years later a 150,000dwt bulker would be used, still at $10-15 per ton (Stopford, 2010). However, the costs rapidly increased between 2003 and 2008. For example, the cost peaked at about $60 in 2008. This is because the demand of raw materials exceeded over the supply. Since 2009, the costs sharply dropped at about $10-20 per ton. In 2012, the price of steaming coal was about $105-135, and the iron was approximately $120-130 per ton. The transport cost of coal was about $20, the cost of iron was about 15$. The transport cost of coal accounted for about 15-20%, while the iron accounted for about 10-15%.

The transport costs have steadily been reduced compared with the past because the size of ships is getting bigger. On the other hand, figure 8 explains that the cost had sharply increased from 2002 to 2008, because there were some shortages of supply, while the cost have dramatically dropped after 2009, because there are a number of Capesize ships in the market, in other words, there is oversupply.

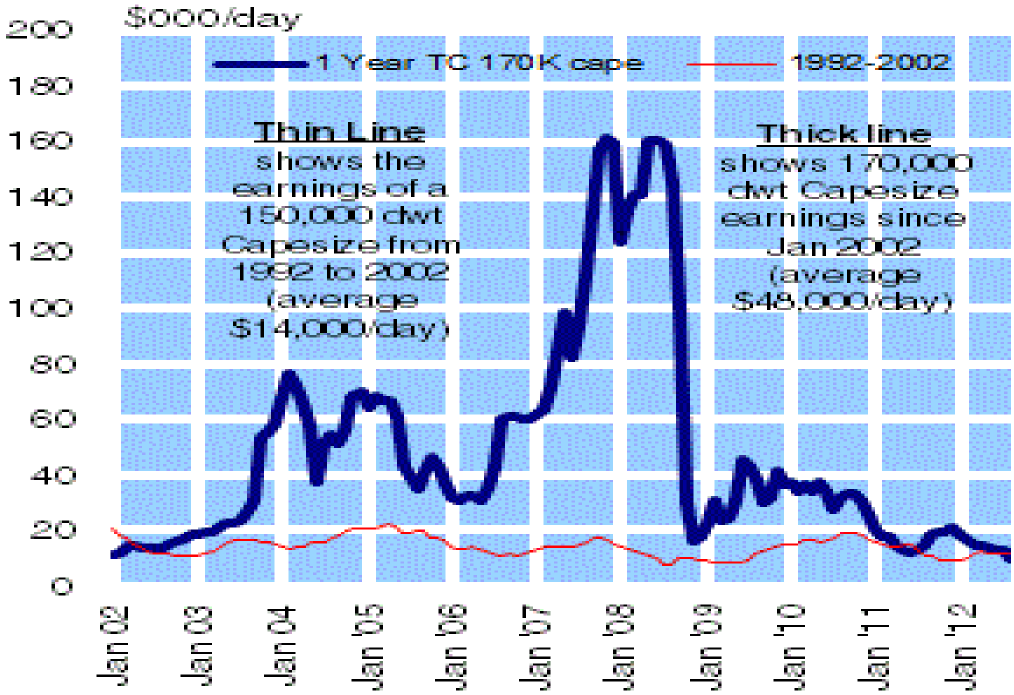
Figure 8 *Time charter rate of cape size carrier*



Source : Compiled by the author

Figure 9 shows one decade (1992-2002) compared with another decade (2002-2012). The result is absolutely different. The average t/c rate between 1992 and 2002 was about $14,000 per day, but the t/c rate between 2002 and 2012 was about $48,000 per day. The world economy experienced some recession for the period (1992-2002) such as the financial crisis in Asia. However, the economy suddenly recovered in the period between 2002 and 2008. In 2002, the t/c rate was about $11,000 per day. After three years, the rate increased to $60,000 per day. Eventually, the rate peaked at $160,000 per day in 2008. Since 2009, the rate has dropped about $14,000-15,000 per day.

Figure 9 *Time charter rate (2002-2012) compared with (1992-2002)*



Source : Clarkson research

3.3 Influential variables of supply for cape size market

3.3.1 The merchant fleet

The use of large bulk carriers played an integral part in the growth of major deep-sea bulk trades, such as iron ore and coal, because economies of scale allowed these raw materials to be imported at low cost (Stopford, 2010).

The fleet always plays a crucial role in the shipping market because it is a supply side. In terms of economics, every situation that happens in a market is to be analyzed by the law of supply and demand. Thus, the Capesize fleet development might affect the equilibrium resulting in the changes of BCI. In 1970, the Capesize fleet was about 1.29m.dwt (12 vessels), the volume increased to about 18.30m.dwt in 1980. After 1980, the volume had grown over 10%. This is because the coal demand substantially increased and the demand led to the supply side. In 2000, the Capesize fleet volume was about 80 m.dwt worldwide.

At that time, the new shipbuilding price was about 40 m.usd. Then the world economy experienced a boom in the period of 2000-2008. China did not stand beyond the market. Its economy had increased dramatically at that time. China attracted every kind of raw materials, especially iron ore and coal. Consequently, the demand of capsize vessels experienced a shooting up, doubling in 2008 (143 m.dwt) compared to that in 2000. Similarly, the new shipbuilding price increased from 40 m.usd in 2000 to 100 m.usd in 2008.

The most interesting point is the gap of the increase. Table 6 shows that the increasing volume between 1970 and 1980 was about 17m.dwt. The volume between 1980 and 1990 was about 30m.dwt, and the volume between 1990 and 2000 was completely 30m.dwt. The annually average increasing volume between 1980 and 2000 was about 3m.dwt.

On the other hand, after 2000, the trend had absolutely changed because of the China impact. Between 2000 and 2005, the increasing volume was about 26m.dwt, and the annually increase was about 5m.dwt. The market started to ignite from 2003, and the freight rate substantially increased. The market needed more Capesize carriers to transport iron ore and coal. The period between 2005 and 2008, the volume increased about 10m.dwt yearly. Many ship owners ordered to build a number of ships in this period. From 2009 to 2013, the volume grew exponentially. The average increasing volume was about 34m.dwt yearly in this period. In 2013, the Capesize fleet is about 279m.dwt (1,505 vessels).

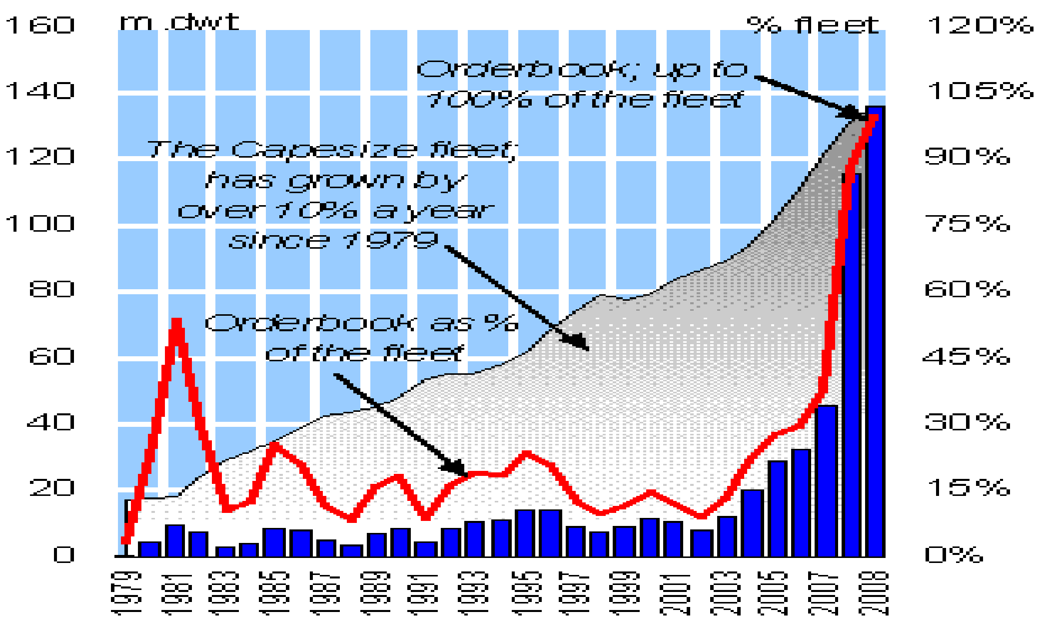
Table 6 *The transition of Capesize fleet*

Date	Capesize Fleet (Million DWT)	Capesize Fleet (Number)
1970	1.29	12
1980	18.30	146
1990	48.55	323
2000	79.76	492
2005	102.67	612
2006	111.32	659
2007	121.27	714
2008	131.77	770
2009	143.61	824
2010	170.10	956
2011	209.42	1164
2012	249.34	1365
2013	278.98	1505

Source : Clarkson research

According to figure 10, the Capesize fleet has continually increased by over 10% a year since 1979, especially, the fleet has dramatically grown from 2005 to 2008. Because of the increasing the fleet, the market has dropped since 2009.

Figure 10 *The transition of fleet and orderbook*



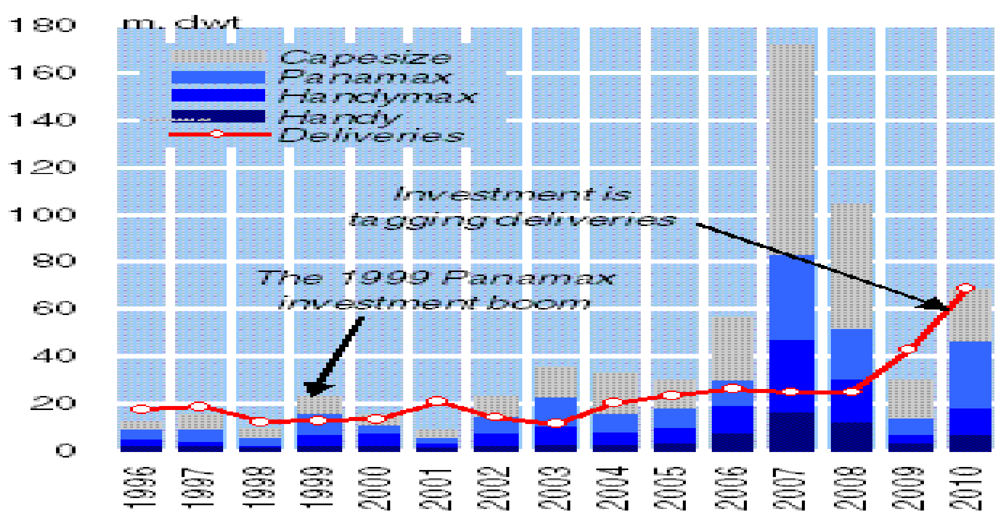
Source : Clarkson research

3.3.2 New building Capesize carrier

The shipbuilding industry plays a crucial role on the fleet adjustment side. *Shipbuilding is a long-cycle business, and the time-lag between ordering and delivering a ship is between one and four years, depending on the size of the order book held by the shipbuilders* (Stopford, 2010).

At present, the period of new building of capsize vessels is on average 2 years or 3 years. According to Clarkson's research, the deliveries of Capesize carriers were almost stable between 1996 and 2008. There were no serious fluctuations in the delivery volume side annually. However, since 2008, the delivery volume has dramatically increased. At that time, the shipping market suffered serious recession because of the financial crisis. Moreover, the demand of the shipping market remarkably decreased while the fleet volume exponentially increased between 2009 and 2012. A number of Capesize carriers flowed into the Capesize market. Table 7 and Figure 11 indicate the situation. The cause could be that many ship owners ordered a number of new ships between 2005 and 2008. At that time, shipping met the highest boom historically.

***Figure 11** The transition of bulker order and delivery*



Source : Clarkson research

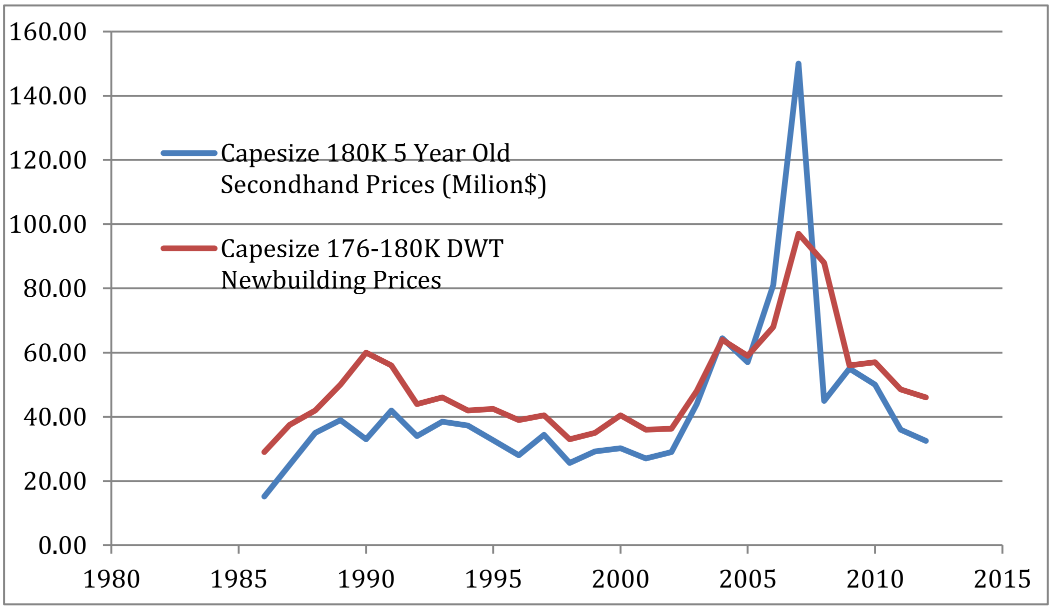
Table 7 *The transition of Cape size vessel delivery*

Date	Cape size carrier delivery (Million DWT)	Cape size delivery (Number)
1996	7.9	48
2000	5.2	31
2001	5.3	32
2002	3.7	21
2003	4.9	28
2004	7.4	41
2005	8.7	48
2006	10.7	60
2007	10.5	56
2008	8.6	44
2009	20.9	111
2010	38.5	213
2011	45.5	251
2012	41.8	213
2013	15.3	70

Source : Clarkson research

Currently, the price of new ships is higher than second-hand ships. Figure 12 and Table 8 explain that the period between 1992 and 2002, the price of second hand ships was about 25-38 M.USD, and the new ships was approximately 33-46 M.USD. However, the price started to increase from 2003 to 2008. The remarkable point is that the price of second hand ships was higher than new ships. This is because the demand far exceeded the supply side. The possible reasons for this is that the market needed more ships at that time, but new ships take about 2 years to be delivered. Therefore, ship owners preferred second hand ships, and the price of second hand ships overtook the price of new ships from 2006 and 2007. The phenomenon cannot be explained in 2007 because the price of second hand ships (150 M.USD) was far higher than new ships (97 M.USD). In conclusion, the price of second hand and new ships is an important variable because it is possible to grasp the market, and estimate the value of Capesize carriers through it.

***Figure 12** The transition of the price of second-hand and new ship*



Source :compiled by the author

***Table 8** The transition of the price of second-hand and new ship*

Date	Capesize 180K 5 Year Old Secondhand Prices (Milion$)	Capesize 176-180K DWT Newbuilding Prices
1991	42.00	56.00
1995	32.67	42.50
1996	28.00	39.00
1997	34.42	40.50
1998	25.67	33.00
1999	29.25	35.00
2000	30.25	40.50
2001	27.00	36.00
2002	29.00	36.25
2003	44.00	48.00
2004	64.50	64.00
2005	57.00	59.00
2006	81.00	68.00
2007	150.00	97.00
2008	45.00	88.00
2009	55.00	56.00
2010	50.00	57.00
2011	36.00	48.50
2012	32.50	46.00

Source : Clarkson research

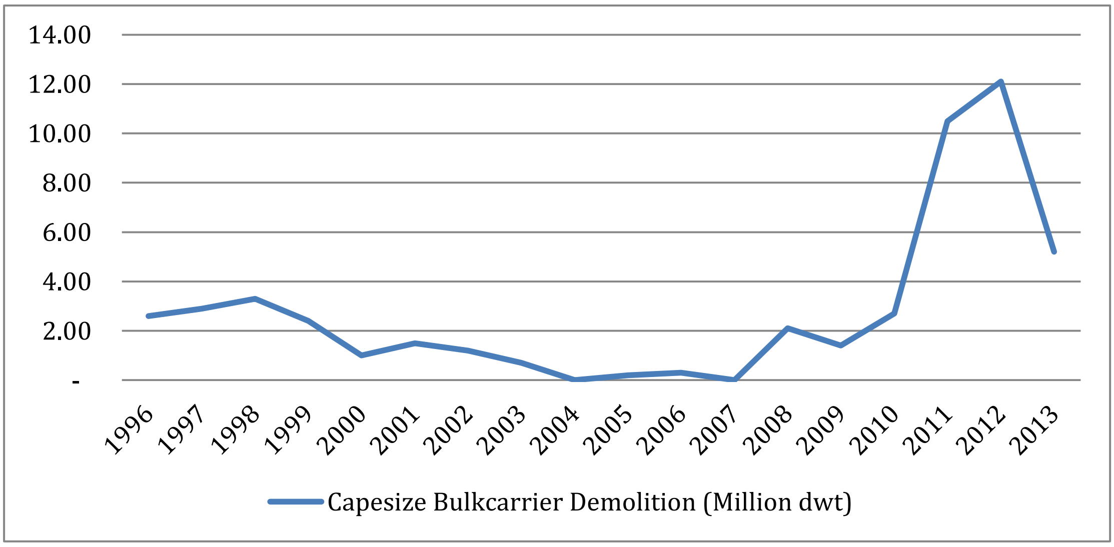
3.3.3 Ship demolition

It is obvious that demolition has an important part to play in clearing ships from the market, *scrapping depends on the balance of a number of factors that can interact in many different ways. The main ones are age, technical obsolescence, scrap prices, current earnings and market expectations* (Stopford, 2010).

There are no clear standards related to scrapping of ship. However, major port in Europe, the US and Korea do not like to use old ships over 20 years, because they have strengthened the PSC. Many ship owners consider that a ship over 25 years should be scrapped. Also, international standards such as IMO conventions have gradually incorporated requirements to meet new technical standards for vessels.

The most important part when considering scrapping is the price. This is because ship owners sell their ships to ship recycling facilities who demolish them, and they sell the scrap to the steel industry. Today, scrap prices fluctuate depending on the supply and demand. Most ship owners decide to scrap themselves that if the market falls into a long recession, and there is no profitability of the ship in the future. The phenomenon is easily explained because the market fell into a long recession in 2009. Many Capesize ships were laid-up because there were few cargoes in the market, and the freight went through the floor. However, there were no signals to survive the market in the near future. Figure 13 and Table 9 show that from 2010 to 2013, many Capesize carriers were scrapped, especially the scrapped volume had a remarkable record with about 12.1 m.dwt (72 numbers) in 2012. At that time, the bunker cost had an important influence on the scrap because the bunker cost had increased to 2 times compared with before. In conclusion, the market situation can be estimated through the scrapping volume; scrapping is affected by the market, operational costs, and financial parts.

Figure 13 *The transition of the demolition volume*



Source : compiled by the author

Table 9 *The transition of the demolition volume*

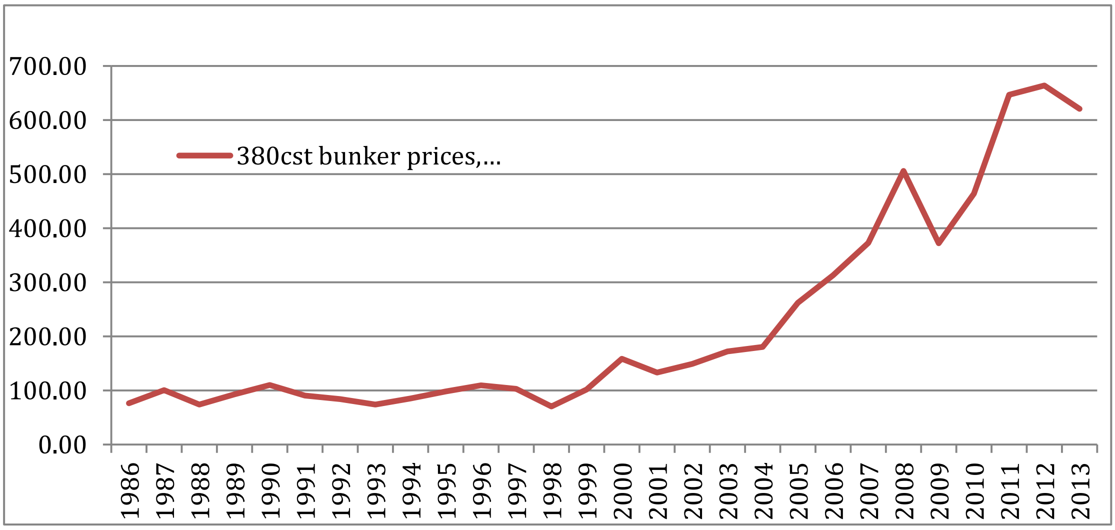
Date	Capesize Bulkcarrier Demolition (Million dwt)	Capesize Bulkcarrier Demolition(number)
1996	2.60	20
1997	2.90	18
1998	3.30	25
1999	2.40	19
2000	1.00	7
2001	1.50	11
2002	1.20	10
2003	0.70	6
2004	-	0
2005	0.20	2
2006	0.30	2
2007	-	0
2008	2.10	14
2009	1.40	8
2010	2.70	19
2011	10.50	67
2012	12.10	72
2013	5.20	30

Source : Clarkson research

3.3.4 Bunker cost

Beenstock and Vergottis (1993) estimate that *the elasticity of supply related to freights and bunker costs are about 0.59 and 0.23. In other words, the supply is inelastic related to freights and bunker costs* (Thien, 2005). Bunker price is another key element having an influence on the Capesize bulk carriers market. According to the Baltic Exchange, if steaming at 12 kts laden or 13 kts ballast, Capesize carriers may consume 44 ton of bunker fuel per day. Figure 14 and Table 10 explain that the bunker cost has dramatically increased from 261 USD in 2005 to 620 USD in 2012. The bunker cost accounted for about 40% of the total cost, if the freight rate is low and bunker cost is high. In this situation, many ship owners have obviously difficulty in making a profit. Many ships will be laid up or scrapped, and many ships may reduce fuel through the slow steaming. These situations affect the supply side so that the price of new ships and second-hand ships sharply decrease, and eventually the volume of the world fleet may decrease. Bunker costs directly affect the structure of ship operation costs, and indirectly the supply side.

Figure 14 *The transition of the 380cst bunker price*



Source : Clarkson research

Table 10 *The transition of the bunker price (380cst, Singapore)*

Date	380cst bunker prices, Singapore ($/ton)		
1986	76.12	2006	313.18
1990	109.63	2007	372.82
1996	109.47	2008	505.62
1997	102.73	2009	371.87
1998	70.01	2010	464.14
1999	101.80	2011	646.94
2000	158.72	2012	664.06
2005	261.90	2013	620.57

Source : Clarkson research

3.4 Empirical Analysis

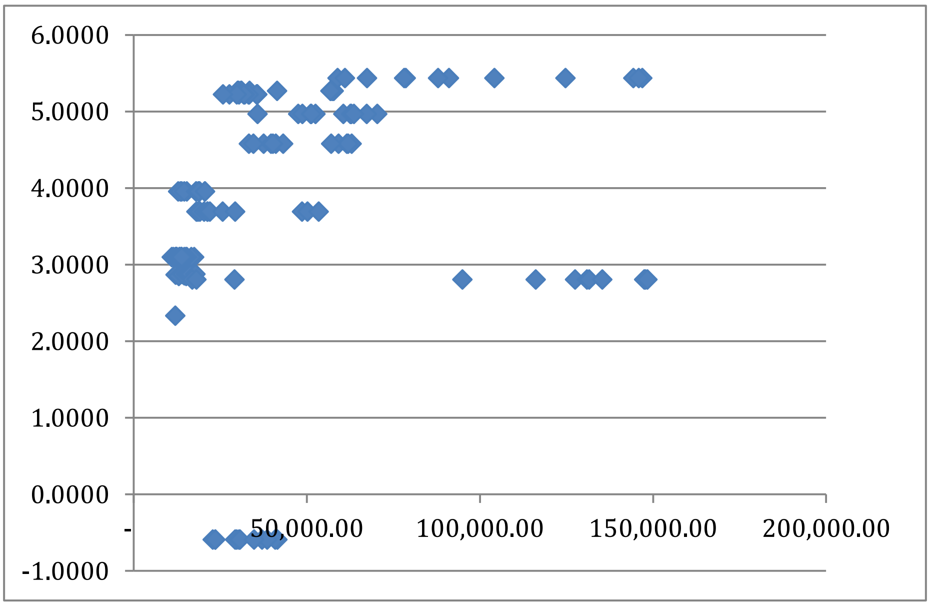
To forecast the Capesize market, there needs to be an analysis of the correlation between freight rates and influential variables, including fleet development, trade volume, the price of new building ships and second-hand ships, scrapping volume, and world Gross Domestic Products (GDP). The analysis of correlation is based on investigating and interpreting the time series and regression analysis.

3.4.1 Correlation between freight rates and World GDP

The freight rates are decided by the law of supply and demand; the most crucial side of demand is the world economy. The GDP are considered as a standard to measure the size of an economy. GDP is measured as the total value added and the total final demand is identical. In other words, GDP is a basket of goods and services supplied to final demands by industries, and it is also the sum of value added created by industries. The relationship between freight rates and world GDP can be easily understood through the historical data.

For example, in 2009, world GDP was at a low level, -0.59%; the trade volume sharply decreased and freight rates went down. However, there are some time lags until the world GDP affects the freight rates. This is because if world economies go down, it successively affects the trade and the trade volume may dramatically decrease, so eventually the freight rate will go down, however, Figure 15 shows that there hardly seem some correlation between freight and GDP. Although, GDP is directly related to the seaborne trade volume, it does not directly affect the freight rates.

***Figure** 15 The correlation between freight and GDP*

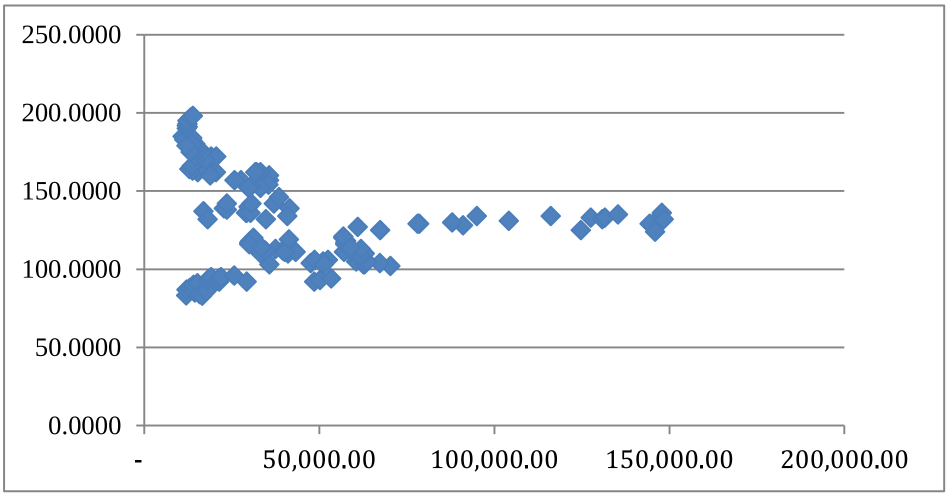


Source : Compiled by the author

3.4.2 Correlation between freight rates and seaborne trade volume of major commodities (iron ore and coal)

The starting point for the calculation of the amount of any type of cargo or commodity transported at sea is the total amount of international trade in that commodity, which is transported at sea, this is called seaborne trade. In the Capesize market, the two major commodities are iron ore and coal, accounting for about 90% of the total. There may be close relationships between freight rates and trade volumes. For example, the period between 2003 to 2008 freight rates were in the sky because China absorbed almost all iron and coal to develop their economy, however, figure 16 shows that the correlation between freight and trade is not a high. It is an obvious true, if trade volumes increase without increasing supply, the freight will obviously increase. The freight is decided by some balance between supply and demand. There may be a high correlation between freight rates and trade volumes.

***Figure** 16 The correlation between freight and trade*

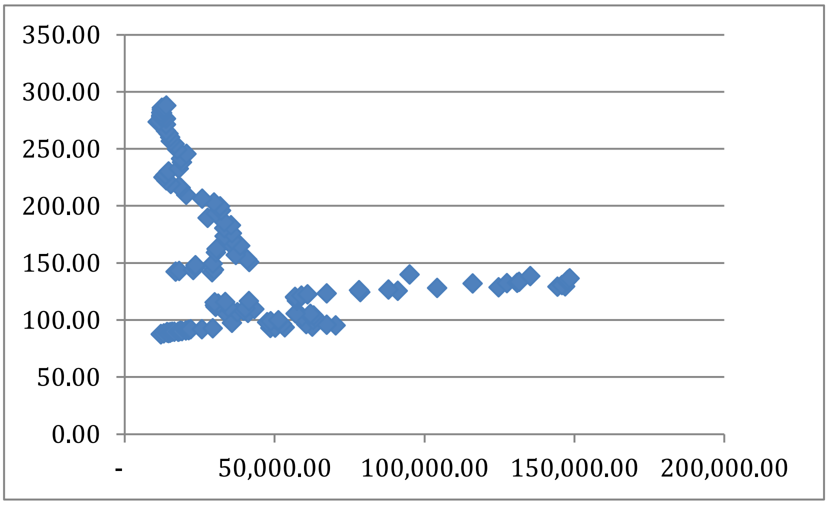


Source : Compiled by the author

3.4.3 Correlation between freight rates and the fleet volume

The fleet is the most influential variables in the supply side. This has been already proven through shipping history. If supply (fleet) exceeds the demand, the freight will obviously go down. To recover the freight, sometime is needed to demolish old vessels and to reduce the supply. Eventually, freight may be recovered at a certain point to meet the supply and demand. In conclusion, the direction of freight and fleet in figure 17 is in the opposite directions.

***Figure 17** The correlation between freight and fleet*



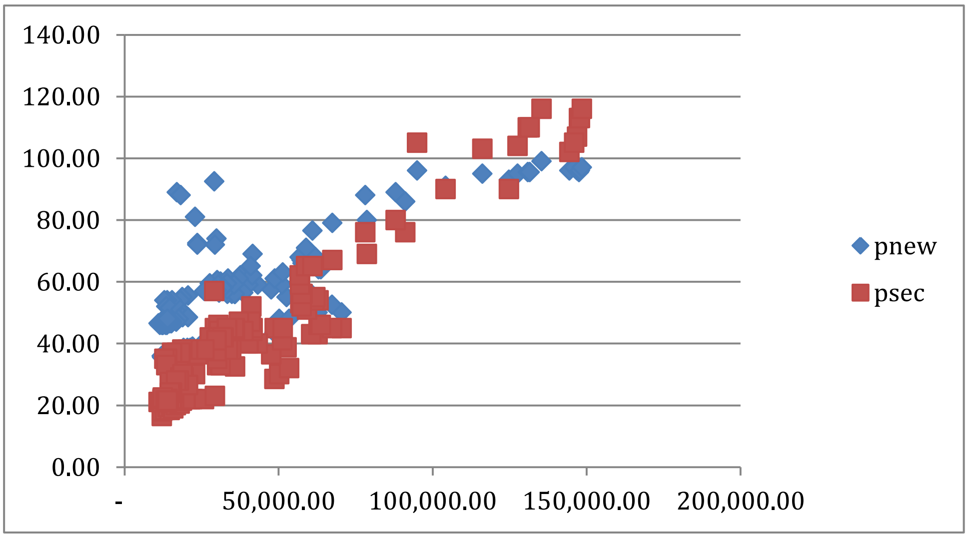
Source : Compiled by the author

3.4.4 Correlation between freight rates and the price of new building and second-hand ships

According to Koopmans (1939), "*if freight rates are at a high level, many ship owners will order new ships, so eventually, the price of new ships will increase*". However, there are some differences from the real market because there are some time lag between the increase of freight rates and new ship's prices. To explain the relationship, analysis is needed regarding the price of second-hand ships, freight rates and new ships. This is because the Capesize market met the boom from 2003 to 2008, so, ship owners suffered from the shortage of supply. They purchased many second hand ships instead of ordering new vessels because to build a new ship, two years is needed. At that time, the price of second-hand ships exceeded the price of new ones. Then, the price of new one sharply started to increase.

Figure 18 shows that there are obviously some correlation between freight rates and new ships and second-hand ships. Especially, the price of second-hand ships is directly affected by freight rates. The other variables multiply the effect on the freight rates, while the freight rates have an effect on deciding the price of second-hand ships. In conclusion, the variation of freight rates coincides with the price of second-hand ships.

Figure 18 *The correlation among freight , new ship and second-hand*



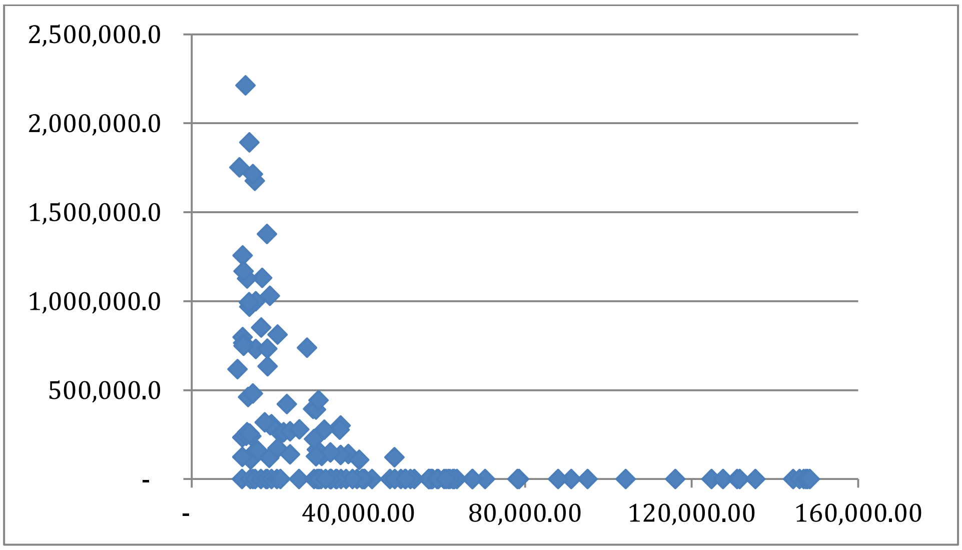
Source : Compiled by the author

3.4.5 Correlation between freight rates and deliveries and scrapping

There are close relationships between freight rates and scrapping. The period between 2003 and 2008 scrapping volumes of Capesize vessels were relatively at a very low level compared with the past because freight rates were at a top level in shipping history. Most ship owners wanted to operate more Capesize vessels to make a profit despite old ships because the freight rates were at the highest level.

However, the freight rates sharply dropped from the end of 2008, but the volume of scrapping started to increase. Eventually, the volume peaked at the highest level of 12.1 M dwt in 2012. The delivery volume between freight rates and scrapping volume needs to be analyzed. This is because the delivery volume may affect the freight rates, but the correlation between them should be analyzed together with scrapping. Figure 19 shows that the direction of freight rates and scrapping volumes may be in an opposite direction.

Figure 19 *The correlation between freight and scrapping*



Source : Compiled by the author

In conclusion, there are some correlation between freight rates and scrapping; however, scrapping volumes increased for a number of reasons, such as international regulations, low freight market and economic consideration of each shipping company.

3.4.6 Evaluation of correlation among freight rates and independent variables

It is true that freight rates are affected by a number of variables including economic, political, and international regulations. However, in case of GDP, which is an index to measure the macro economy, and there is some time lag until GDP affects freight rates. It is difficult to analyze the correlation between the freight rate and GDP. Furthermore, scrapping is determined by various reasons including market, regulations and economic conditions. Therefore, it is difficult to find some correlation between freight and scrap.

In the case of the price of new-ships, almost all ship owners build ships considering the most crucial determinants namely the future value of the ship for the future market and the fleet structure of the shipping company. Therefore, the price is decided by the future value, financing interests, and the supply and demand of the present market. To analyze and forecast the freight rate, the price of a second-hand ship is a crucial index to measure the present market compared with the new ship. In conclusion, this dissertation analyzes the correlation among freight rates, fleet volumes, sea-borne trade (iron ore and cocking coal) volumes, and the price of second-hand ships.

3.5 Regression analysis

Regression analysis is a statistical technique for modeling the relationship between variables in the shipping market. Spreadsheets make estimation of regression equations straightforward, and with so much data available in digital form (Stopford, 2010). In this part, there is not only a simple regression analysis, but also a multiple regression analysis to acquire an accurate forecasting. Regression analysis is related to analyzing and evaluating the relationship between a given variable called ‘dependent variable’ and other variables called ‘independent variables’.

3.5.1 Simple regression

A regression equation is fitted to the data to estimate the average relationship between the dependent variable Y and the independent variable X.

$$Y = a + bX + e \qquad (3.1)$$

In this equation, which represents a straight line, 'a' and 'b' are parameters and 'e' is the error term. The parameter 'a' shows the value of Y when X is zero, the parameter 'b' measures the slop of the line, and 'e' is the difference between the actual value and the value indicated by the estimated line. This is 'simple regression. The objective is to find the line which fits the data best (Stopford, 2010).

3.5.2 Standard error

The standard error of the regression measures how well the curve fits the data by calculating the average dispersion of the Y values around the regression line.

$$S_Y = \sqrt{\frac{(Y-Y_C)^2}{N-K}} \qquad (3.2)$$

N is the number of observations and K is the number of parameters estimated.

Standard error of the regression coefficient needs to establish the confidence limits which can be placed on the estimated value of the regression parameters 'a' and 'b'. If 'b' is normally distributed, it can estimate its standard error (Stopford, 2010).

$$S = \frac{S_Y}{\sqrt{x^2}} \qquad (3.3)$$

3.5.3 The t-test and F statistics

If the independent variable does not contribute significantly to an explanation of the dependent variables, the estimated value of b to equal zero would be expected. To test whether b could have come from a population in which the true value was zero, the t-test is used. The coefficient is divided by its standard error (Stopford, 2010).

$$t = \frac{b}{S_b} \qquad (3.4)$$

As a result of thumb, the value of 't' needs to be at least two to pass the test at the 5% significance level. If it is less than two, the estimated parameter is probably not worth using (Stopford, 2010).

An alternative test statistics to the t test is the F statistics which is defined as follows:

$$F = \frac{Variance\ explained}{Variance\ unexplained} \qquad (3.5)$$

Typically F will be a number in the range of 1-5, with higher numbers indicating better fit (Stopford, 2010).

3.5.4 The coefficient of correlation and the Durbin-Watson statistics

A more general measure of the relationship between two variables is the coefficient of correlation. This statistics explains the average variation in Y from its mean as a proportion of the total variation in Y (Stopford, 2010).

$$R^2 = \frac{Y_c - Y}{Y - Y} \qquad (3.6)$$

A little reflection will make it is clear that it clear that the value of R will fall between 0 and 1 (Stopford, 2010).

The Durbin-Watson statistics for autocorrelation of the residuals, this statistics shows a value of about 2 and is defined as follows:

$$D \quad = \frac{e_t - e_{t-1}\ ^2}{e_t{}^2} \qquad (3.7)$$

D takes values between 0 and 4, values of D below 2 indicate that the residual values are close together and that there is positive autocorrelation which causes bias in the parameter estimates. Value of D above 2 indicates negative autocorrelation (Stopford, 2010).

3.6 Multiple regression

Most economic phenomena are determined by numerous factors, especially the Capesize market is easily affected by many variables, and the market is very complicated and difficult to forecast because the market has the characteristic of volatility, fluctuations, and cycles. Many independent variables including fleet, trade volume, scrapping, and new ships affect the dependent variables called freight rates at the same time. The multiple regression needs to be analyzed the forecasting freight rates of Capesize market. The basic concept of multiple regression is the same compared with the single regression, but more than one independent variables is needed to analyze the multiple regression related to the dependent variable. "*In multiple regression, the dependent variable is Y, and independent variables are* X_1 *,* X_2*,* X_3*, ...,*X_n*. The regression equation is as follows*": (Stopford. 2010);

$$Y = a + b_1x_1 + b_2x_2 + \text{------} + b_nx_n \qquad (3.8)$$

3.7 Regression results

3.7.1 Data collection and analysis

In this part, the data is used to analyze the regression and to forecast the freight rates from the following information. All data is collected from Clarkson research and the period of data is about 24years from January 1989 to July 2013.

i) Freight rates (FR) consist of 2 kinds such as 6 months and 1year Time Charter rates (T/C), (170,000DWT).

ii) Major commodity (Trade) is demand side and it is just iron ore and cocking coal.

iii) Supply side is considered by world Capesize fleet development (FLT)

iv) Price of second-hand ships (PS)

All variables data are transformed into logarithms.

3.7.2 Single Regression measurement by EVIEWS

- Rergression (Freight and Trade volume)

Dependent variable - Freight

Independent variable – commodity volume (iron ore, cocking coal)

Model : Y = a + bx

Table 11 *The single regression (freight and trade volume)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.637648	0.844202	-0.755326	0.4519
DTRD	1.665234	0.835655	1.992729	0.0491

R-squared	0.039721	Mean dependent var	1.043707
Adjusted R-squared	0.029718	S.D. dependent var	0.279198
S.E. of regression	0.275018	Akaike info criterion	0.276238
Sum squared resid	7.260957	Schwarz criterion	0.328992
Log likelihood	-11.53564	Hannan-Quinn criter.	0.297576
F-statistic	3.970970	Durbin-Watson stat	1.730685
Prob(F-statistic)	0.049130		

Source : Compiled by the author

The output analyzed by the linear model the relationship freight and trade volume. The equation of model is as follows:

ln(freight) = -0.637648 + 1.665234*ln(Trade)

The figure of b is somewhat positive as expected, there is a statistically significant relationship between freight rate and trade volume because the P-value in the table is less than 0.05%. The R-squared explains 0.39 of the variability in ln(freight), and the standard error is about 0.275.

- Rergression (Freight and fleet development)

Dependent variable - Freight

Independent variable – fleet development

Model : Y = a + bx

Table 12 *The single regression (freight and fleet)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.991755	1.862318	2.143434	0.0346
DFLT	-2.892821	1.827224	-1.583178	0.1167

R-squared	0.025445	Mean dependent var	1.043707
Adjusted R-squared	0.015293	S.D. dependent var	0.279198
S.E. of regression	0.277055	Akaike info criterion	0.290995
Sum squared resid	7.368907	Schwarz criterion	0.343750
Log likelihood	-12.25877	Hannan-Quinn criter.	0.312333
F-statistic	2.506454	Durbin-Watson stat	1.738005
Prob(F-statistic)	0.116670		

Source : Compiled by the author

The output analyzed the relationship between freight and fleet volume by the linear model. The equation of the model is as follows:

ln(freight) = 3.991755 – 2.892821*ln(Fleet)

There is a statistically insignificant relationship between freight rate and fleet volume because the P-value in the table is greater than 0.05%. The R-squared explains 0.02 of the variability in ln(freight), and the standard error is about 0.277.

- Rergression (Freight and the price of second-hand ship)

Dependent variable - Freight

Independent variable – second hand ship

Model : Y = a + bx

Table 13 *The single regression (freight and the price of second-hand ship)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.383357	0.184471	-2.078139	0.0404
DSEC	1.414388	0.181505	7.792547	0.0000

R-squared	0.387457	Mean dependent var	1.043707
Adjusted R-squared	0.381077	S.D. dependent var	0.279198
S.E. of regression	0.219650	Akaike info criterion	-0.173368
Sum squared resid	4.631619	Schwarz criterion	-0.120613
Log likelihood	10.49501	Hannan-Quinn criter.	-0.152029
F-statistic	60.72379	Durbin-Watson stat	2.091010
Prob(F-statistic)	0.000000		

Source : Compiled by the author

The output analyzed the relationship between freight and fleet volume by the linear model. The equation of model is as follows:

ln(freight) = -0.383357+ 1.414388*ln(second price)

There is a statistically significant relationship between freight rate and the price of second-hand ships because the P-value in the table is less than 0.05%. This is because the increasing freight rate is closely connected to the increasing second-hand ship price.

In conclusion, there is obviously a statistically significant relationship among freight, trade volume, and the price of second-hand, however there is no a statistically significant relationship between freight and fleet. Therefore, this chapter analyzes the relationship among freight, trade volume, and the price of second-hand ship through the multiple regression.

3.7.3 Multiple regression between freight rates and independent variables

3.7.3.1 Analysis of multiple regression between dependent variable and independent variables

Dependent variable : ln (freight)

Independent variables : ln(Trade), ln(second)

The model which explains Freight is shown in Equation as follows:

Estimation Equation:

Ln(Freight) = C(1) + C(2)*Ln(Trade) + C(3)*Ln(Second price)

Table 14 *The multiple regression*

Dependent Variable: DFRT

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.775417	0.677967	-2.618737	0.0103
DTRD	1.398483	0.656329	2.130766	0.0357
DSEC	1.394605	0.178490	7.813349	0.0000

R-squared	0.415396	Mean dependent var	1.043707
Adjusted R-squared	0.403089	S.D. dependent var	0.279198
S.E. of regression	0.215708	Akaike info criterion	-0.199644
Sum squared resid	4.420365	Schwarz criterion	-0.120512
Log likelihood	12.78254	Hannan-Quinn criter.	-0.167637
F-statistic	33.75162	Durbin-Watson stat	2.059929
Prob(F-statistic)	0.000000		

Source : Compiled by the author

The output analyzed the relationship between freight, trade volume, fleet volume, and second hand ship by the linear model. The equation of the model is as follows:

Ln(FRT) = -1.775417 + 1.398483*Ln(Trade) + 1.394605*Ln(second-hand ship price)

There is a statistically significant relationship among freight rate and variables the P-value in the table is less than 0.05%. R-squared is 0.415 with adjusted R-squared 0.403. F-statistics is 33.75 with p-value 0.000, the null hypothesis that all coefficients are jointly zero, the null hypothesis is rejected.

Table 15 *The correlation among freight, trade volume and the price of second-hand ship*

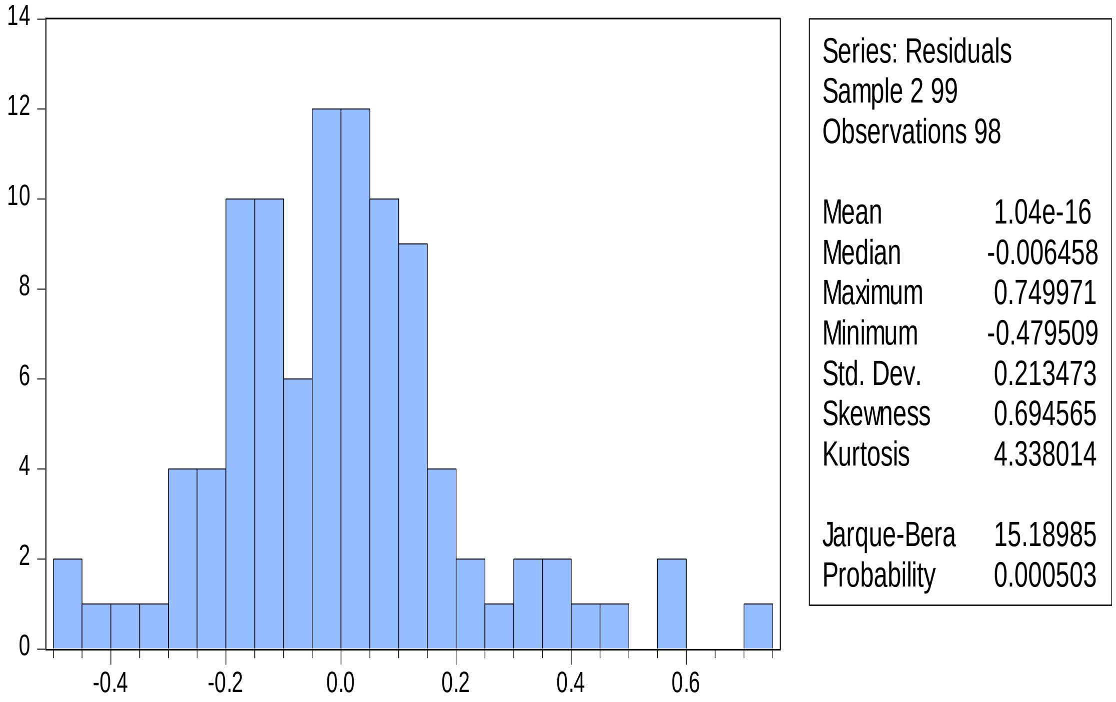
	DFRT	DTRD	DSEC
DFRT	1.000000	0.199302	0.622461
DTRD	0.199302	1.000000	0.052017
DSEC	0.622461	0.052017	1.000000

Source : Compiled by the author

From the table 15, it can be concluded that there is close correlation between freight and the price of second-hand ships, some correlation between freight and trade volume; however, the correlation between freight and trade volume is not strong.

- Normality test is as follows;

Figure 20 *Normality test*



Source : Compiled by the author

To satisfy with the condition of normal distribution, the Skewness have to be zero, and the Kurtosis have to be three. Figure 20 shows that the Skewness is 0.694565, and the Kurtosis is 4.338014. Therefore, the model does not satisfy with the normal distribution. The null hypothesis of normality is rejected.

- Heteroskedasticity Test : White

Table 16 *White test*

F-statistic	3.596732	Prob. F(5,92)	0.0051
Obs*R-squared	16.02419	Prob. Chi-Square(5)	0.0068
Scaled explained SS	25.13212	Prob. Chi-Square(5)	0.0001

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/23/13 Time: 13:11
Sample: 2 99
Included observations: 98

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.21541	5.194005	2.929418	0.0043
DTRD	-16.23959	5.959420	-2.725028	0.0077
DTRD^2	1.113483	1.274177	0.873885	0.3845
DTRD*DSEC	15.07871	4.945112	3.049215	0.0030
DSEC	-15.10297	4.867857	-3.102592	0.0025
DSEC^2	-0.034728	0.191718	-0.181141	0.8567

R-squared	0.163512	Mean dependent var	0.045106
Adjusted R-squared	0.118051	S.D. dependent var	0.082833
S.E. of regression	0.077790	Akaike info criterion	-2.210332
Sum squared resid	0.556721	Schwarz criterion	-2.052069
Log likelihood	114.3063	Hannan-Quinn criter.	-2.146318
F-statistic	3.596732	Durbin-Watson stat	1.619929
Prob(F-statistic)	0.005131		

Source : Compiled by the author

One of the assumptions in linear regression is to have a constant variance of error terms, which means that the regression has to be Homoscedastic. White test was performed to assess Heteroskedasticity of the model (Visvikis, 2013). The F-statistic is 3.596 with probability 0.005, and R-squared is 16.024 with Prob. Chi-square 0.006 is less than significance level, so the null hypothesis is rejected. The Hetroskedasticity exists in the error term.

- White correction

Table 17 *White correction*

Dependent Variable: DFRT
Method: Least Squares
Date: 10/03/13 Time: 14:35
Sample (adjusted): 2 99
Included observations: 98 after adjustments
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.775417	0.663435	-2.676099	0.0088
DTRD	1.398483	0.590212	2.369460	0.0198
DSEC	1.394605	0.205152	6.797918	0.0000

R-squared	0.415396	Mean dependent var	1.043707
Adjusted R-squared	0.403089	S.D. dependent var	0.279198
S.E. of regression	0.215708	Akaike info criterion	-0.199644
Sum squared resid	4.420365	Schwarz criterion	-0.120512
Log likelihood	12.78254	Hannan-Quinn criter.	-0.167637
F-statistic	33.75162	Durbin-Watson stat	2.059929
Prob(F-statistic)	0.000000		

Source : Compiled by the author

White correction is appropriate when the residuals are Heteroscedastic but serially uncorrelated. Table 17 shows that the null hypothesis is not rejected, because the Durbin-Watson is around two.

- Breusch-Godfrey

Table 18 *Breusch-Godfrey Serial Correlation LM Test*

F-statistic	0.371645	Prob. F(2,93)	0.6906
Obs*R-squared	0.777042	Prob. Chi-Square(2)	0.6781

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 09/23/13 Time: 13:12
Sample: 2 99
Included observations: 98
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.080786	0.689489	-0.117168	0.9070
DTRD	0.067863	0.666084	0.101883	0.9191
DSEC	0.011836	0.189522	0.062454	0.9503
RESID(-1)	-0.042856	0.109477	-0.391458	0.6964
RESID(-2)	-0.081486	0.105137	-0.775048	0.4403

R-squared	0.007929	Mean dependent var	1.04E-16
Adjusted R-squared	-0.034741	S.D. dependent var	0.213473
S.E. of regression	0.217150	Akaike info criterion	-0.166788
Sum squared resid	4.385316	Schwarz criterion	-0.034902
Log likelihood	13.17261	Hannan-Quinn criter.	-0.113443
F-statistic	0.185823	Durbin-Watson stat	1.997885
Prob(F-statistic)	0.945248		

Source : Compiled by the author

The F-statistic is 0.371 with probability 0.6906, and R-squared is 0.777 with Prob. Chi-square 0.6781 is greater than significance level, so the null hypothesis of no autocorrelation which is in line with Durbin-Watson is not rejected.

- Ramsey reset

Table 19 *Ramsey RESET Test*

	Value	df	Probability
t-statistic	0.418887	94	0.6763
F-statistic	0.175466	(1, 94)	0.6763
Likelihood ratio	0.182762	1	0.6690

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.008236	1	0.008236
Restricted SSR	4.420365	95	0.046530
Unrestricted SSR	4.412129	94	0.046938
Unrestricted SSR	4.412129	94	0.046938

LR test summary:

	Value	df
Restricted LogL	12.78254	95
Unrestricted LogL	12.87392	94

Dependent Variable: DFRT

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.221946	1.264910	-1.756604	0.0822
DTRD	1.687498	0.954246	1.768410	0.0802
DSEC	1.656700	0.650869	2.545366	0.0125
FITTED^2	-0.097852	0.233599	-0.418887	0.6763

R-squared	0.416486	Mean dependent var	1.043707
Adjusted R-squared	0.397863	S.D. dependent var	0.279198
S.E. of regression	0.216651	Akaike info criterion	-0.181100
Sum squared resid	4.412129	Schwarz criterion	-0.075592
Log likelihood	12.87392	Hannan-Quinn criter.	-0.138424
F-statistic	22.36428	Durbin-Watson stat	2.031120
Prob(F-statistic)	0.000000		

Source : Compiled by the author

Ramsey reset test is performed to see the assumptıon of lınear functıonal form ın the regression. The t-statistic is 0.418 with probability 0.6763, F-statistic is 0.175 with probability 0.6763 greater than significance level, so the null hypothesis is not rejected. There is no apparent non-linearity in the regression.

- Chow test

Table 20 *Chow Test*

F-statistic	0.211737	Prob. F(4,90)	0.9313
Log likelihood ratio	0.917918	Prob. Chi-Square(4)	0.9220
Wald Statistic	0.846946	Prob. Chi-Square(4)	0.9320

Source : Compiled by the author

The point of 60 is the period of hıstorical booming whıch the BDI index is more than 11,000 points. At the point of period 60, the F-statistic is 0.211 with probability 0.9313, Wald-statistic is 0.8469 with probability 0.9320 greater than significance level, so the null hypothesis is not rejected. Then, the Chow forecast test is analyzed for the period of 60 to 90 using the data from the beginning to the period of 60.

Table 21 *Chow Forecast Test*

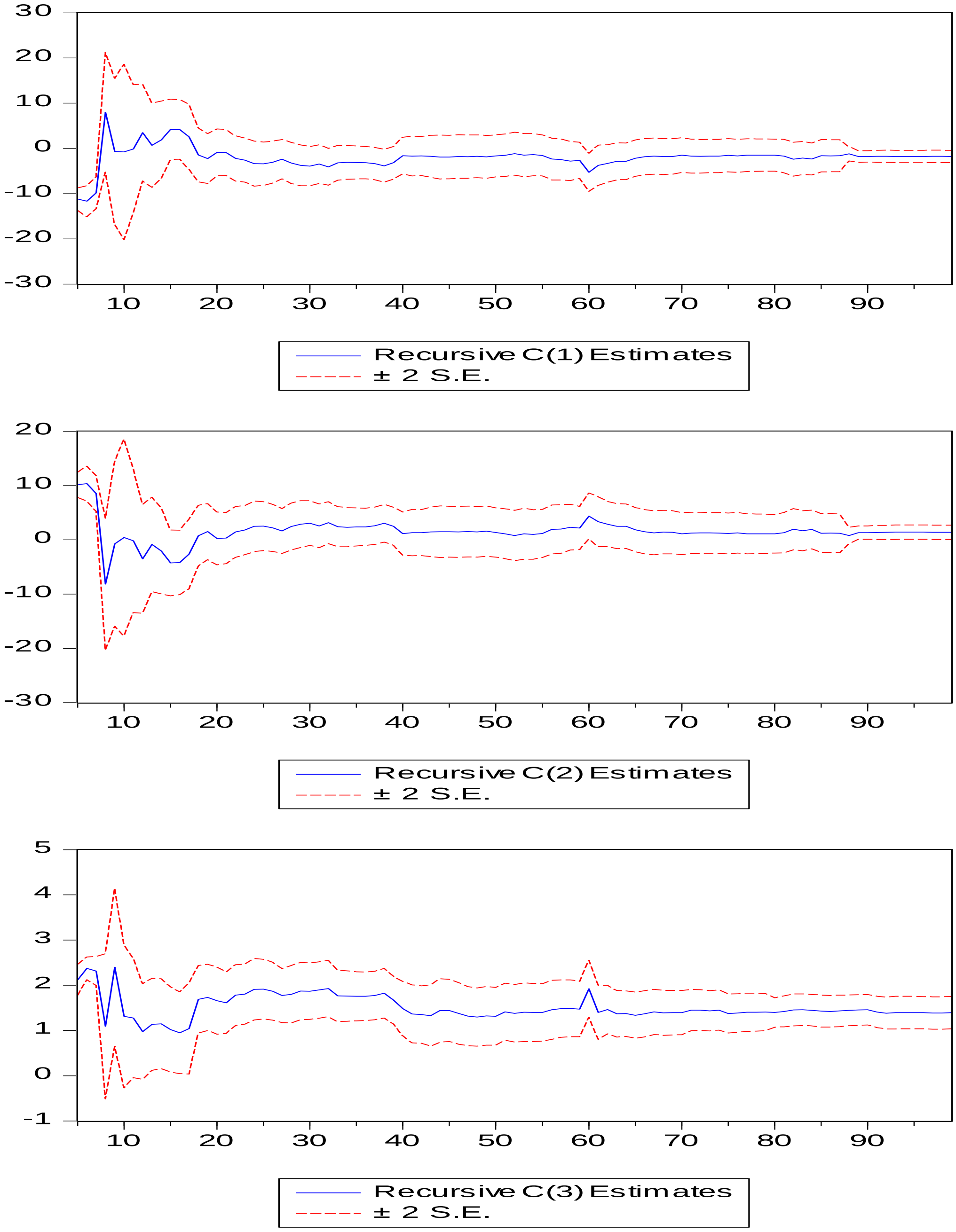
	Value	df	Probability
F-statistic	2.918396	(40, 54)	0.0001
Likelihood ratio	112.8111	40	0.0000

Source : Compiled by the author

The F-statistic is 2.918 with probability 0.0001, the test suggests parameter instability in the model, the result presents that the null hypothesis is rejected that the model cannot predict the observations after the period of number 60.

- **RECURSIVE**

Figure 21 *Recursive*

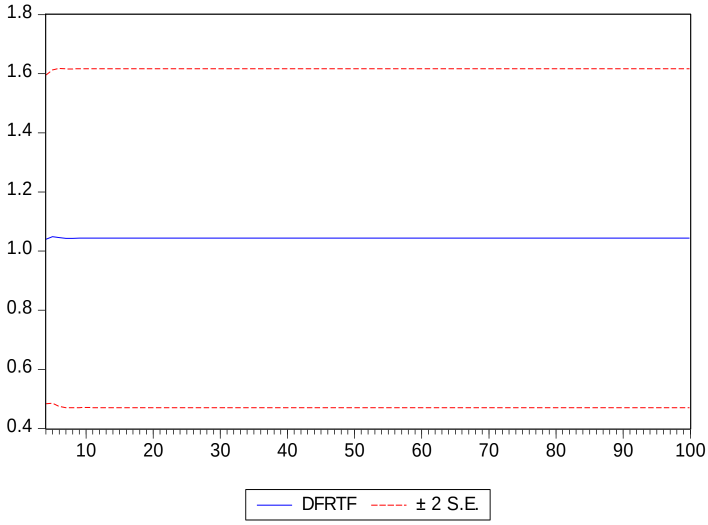


Source : Compiled by the author

Three figures are explained each one for the corresponding estimated coefficient showing the recursive estimates and plus/minus two standard errors bands around them. The regression model is not strong enough to that significant even, or in the other meaning is the model is not stable.

- DYNAMIC and STATIC

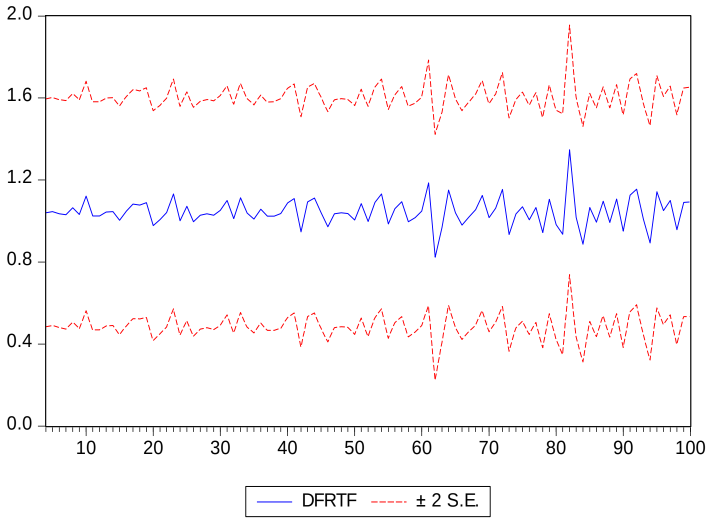
Figure 22 Dynamic



Forecast: DFRTF	
Actual: DFRT	
Forecast sample: 1 100	
Adjusted sample: 4 100	
Included observations: 96	
Root Mean Squared Error	0.280651
Mean Absolute Error	0.206011
Mean Abs. Percent Error	29.64913
Theil Inequality Coefficient	0.132077
Bias Proportion	0.000000
Variance Proportion	0.994819
Covariance Proportion	0.005180

Source : Compiled by the author

Figure 23 Static



Forecast: DFRTF	
Actual: DFRT	
Forecast sample: 1 100	
Adjusted sample: 4 100	
Included observations: 96	
Root Mean Squared Error	0.272047
Mean Absolute Error	0.199933
Mean Abs. Percent Error	28.58066
Theil Inequality Coefficient	0.127881
Bias Proportion	0.000000
Variance Proportion	0.605809
Covariance Proportion	0.394191

Source : Compiled by the author

In the dynamic and static models, the Theil inequalıty coefficient of value equal to one means that the model equally in accurate, while less than one implies that the model is superior to the benchmark. The dynamic and static model is possible to predict, *the Theil Inequality Coefficient (below 1), Bias Proportion (close to 0), Covariance Proportion (close to 1) are within the established standards* (Visvikis,2013).

There are several abnormal data (break points) in the model from 1989 to 2013. Among them, it is the most remarkable part such as No. 82 and 84. In 2008, the Capesize market reached at the sky, which the freight rate (6 month) was about 120,000 US$. No one explain about the situation of 2008, because the market included a number of bubbles and speculative power at that time. In January 2009, the market fell into the deepest recession because of the sub-prime mortgage crisis in the USA called global financial crisis. The freight rate was under 10,000US$ and the BDI was about 662 points at that time. After that, the market started to fall into the recession from 2009. At the break point of No.94, the market was the lowest in 2012. A number of Capesize vessels were scrapped from 2009 to 2012, among them, the scrapping percentage of Capesize vessel was the highest in 2012, which the volume was about 12.1 M tons. However, the market still is that supply far exceeds demand.

In conclusion, this chapter tried to analyze the relationship among freight, trade volume and the price of second hand ships through the multiple regressions. However, there are some errors between real freight and forecasting freight through the multiple regressions. This is because the model includes some problems. Firstly, this model is not a perfect model including supply and demand because the variable of the fleet is exempt from the model. There is no statistical significance between freight and fleet contrary to expectations. Secondly, the price of second hand ships is difficult to be forecasted because the variable is closely connected to the freight. This dissertation would like to define that it is a part of the Capesize freight category in a broad sense. Eventually, this model has just one variable, such as trade volume to predict the market; however, the situation of the Capesize market cannot be explained. Therefore, to effectively forecast the Capesize market, the balance between supply (fleet) and demand (trade volume) needs to be analyzed because the Capesize market has just two cargoes, such as iron ore and coal.

4. ESTABLISHING THE DEMAND AND SUPPLY MODEL, AND FORECASTING THE CAPESIZE MARKET IN 2014

Many experts have already researched a number of forecasting models to forecast the market. They used to analyze supply and demand of the market. This is because the freight rates determined depend on the supply and demand of the market. It is very a reasonable methodology to forecast the market. However, there may be some limitation because all variables using forecast are based on past data while future of supply and demand had to be analyzed. This chapter discuss forecasting model that are used. The forecasting freight rates of the Capesize market in 2014 will be analyzed. To forecast the freight rates, the forecasting a number of variables including world economy, fleet, and seaborne trade volume need to be analyzed.

4.1 The supply and demand model of freight rates of the Capesize market

The methodology of the supply and demand model consists of nine stages as follows:

Stage 1: Economic assumptions

Some economic assumptions need to be established to forecast the cape size market accurately. If an accurate economic assumption is established demand and supply can easily be forecasted, and thus the market can be forecasted accurately. *Specific requirements of the forecasting model are an assumption about the rate of growth in domestic products (GDP) and industrial production in the main economic regions* (Stopford, 2010). In addition, some political issues and oil price need to be analyzed.

Stage 2: Saborne trade volumes

The seaborne trade volume is very crucial to forecast the Capesize market because it is the demand side. It needs to develop the economy of all countries because it is necessary raw material. It is affected by many variables, especially GDP is an important factor. The simplest method is to use a regression model of the following.

The equation is as follows (Stopford, 2010):

$$ST_t = f \ \ GDP_t \qquad (4.1)$$

Where, ST = Seaborne Trade, t = year

Linear equation of this model is $ST_t = a + bGDP_t$ *(4.2)*

The estimation of a and b was analyzed by Stopford during the period 1982-1995, as follows:

$$ST_t = -26.289 + 30.9GDP_t \qquad (4.3)$$

Through the equation, for each 1 point increase in the GDP index, seaborne trade increased by 30.9 million tons between 1982 and 1995 (Stopford, 2010).

Stage 3: Average haul forecast

There are two approaches to forecast the average haul. *Firstly it is based on historic trends in the average haul for each commodity, attempting to identify the variables that might cause the average haul to increase or decrease. Secondly, the trade matrix for each commodity should be analyzed, and from this to calculate the average haul can be calculated (Stopford, 2010).*

Stage 4: Ship demand forecast

The total demand for transport is calculated by multiplying seaborne trade (ton) by the average haul (mile) (Stopford, 2010).

Stage 5: Merchant fleet forecast

The supply side of the Capesize fleet is calculated by adding the predicted volume of deliveries and minus the forecast volume of scrapping. These factors are complicated because if the market increases, ship owners stop to demolish their ships, conversely, the market will go down, and ship owners will start to demolish.

Stage 6: Ship productivity forecast

The productivity of a ship is measured by the number of ton miles of cargo carried per deadweight of merchant shipping capacity annually. There are two methods to forecast it, namely the method of past statistic data or changing the trend in the future.

Stage 7: Shipping supply forecast

The shipping supply is calculated in ton miles by multiplying the available dwt of ships by their productivity (Stopford, 2010).

Stage 8: Balance of supply and demand

The supply must equal the demand at the same match point, if supply exceeds demand, many vessels are scrapped; conversely, if demand exceeds supply, the fleet productivity may increase.

Stage 9: Freight rates

Freight rates are determined by the matching point between supply and demand. If there are some surplus, freight rates may go down, while if there is over-demand, the rates may go up. To forecast the market accurately, the supply and demand side needs to be measured. This is measured by regression equation on an assumption model.

4.2 World Economies Assumptions for 2014

According to IMF, "*global growth increased slightly from an annualized rate of 2.5% in the second half of 2012 to 3.75% in the first quarter of 2013*." There are three causes, firstly, the economy of major emerging market such as India and Brazil continued to decrease, there are affected by many factors such as weaker infrastructure and economy policies. Secondly, the recession of the Euro regions was deeper than expected. Thirdly, *the US economy expanded at a weaker pace, as stronger fiscal contraction weighed on improving private demand. Regarding the forecast of the growth of major countries, the US is planned to rise from 1.75% in 2013 to 2.75% in 2014* (IMF, 2013). The projection assumes that the sequester will remain in place until 2014. In Japan, growth will average 2% in 2013, 1.25% in 2014 because of the reflecting weaker global environment. *The Euro area will remain in recession in 2013, and growth will rise to just under 1% in 2014* (IMF, 2013). In the emerging market (BRICS) and developing economies, the growth was 5% in 2013, and it will increase to 5.5% in 2014. However, there are some risks because some countries including India, Indonesia, and Thailand have some risky symptoms of their economies such as low level of foreign exchange reserves. In conclusion, global growth may recover from slightly above 3% in 2013 to 3.75% in 2014. However, some risks remain because of downside risks to global growth, the recession of the euro area, increasing US debt ceiling and the financial risks of emerging countries. In addition, if the US attacks to Syria, there may be war in the Middle-East region. As a result, the oil price may sharply rise and the world economy will fall into recession. Also, it will negatively affect the shipping market because the bunker price will increase considerably. If the freight level is maintained at like the present level, many ships will be laid up.

4.3 Forecast of the supply and demand for the Capesize market for 2014

4.3.1 Forecast of the seaborne trade volume of the Capesize market

The forecast of the seaborne trade volumes can be measured by using the regression equation, which was established by Stopford (2010) and world GDP in the IMF. He made the equation by estimating between the tonnage of dry cargo trade each year and world GDP. The regression coefficient is about 0.989; the error is about 7% over 10 years.

The equation is as follows (Stopford, 2010):

$$DCT_t = 65.103 + 18.458GDP_t \quad (4.4)$$

The regression equation explains that if one point increases in the GDP, the seaborne dry cargo trade volumes increase by 18.458million ton. This dissertation has dealt with iron ore and cocking coal because steel is made by using iron ore and cocking coal. Therefore, this part will analyze the trade volumes of iron ore and cocking coal. For example, the trade volume was about 888.72M tons in 2006, and IMF forecasted 5.4% of the GDP. The trade volume can be easily predicted through this equation. The increasing trade volume in 2007 equals 18.46 multiplied by 5.4, which is 99.68M tons.

The forecasting trade volume in 2007 is about 988.40 M ton (888.72 M ton + 99.68 M ton). However, the actual trade volume was about 971.12M ton in 2007, so there are some errors.

The trade volume was about 1274.79 M tons in 2011. The GDP was 3.1% in 2012. The trade volume in 2012 can be estimated by using the equation, which equals 18.458 M tons multiplied by 3.1 which is 57.2M tons, the forecasting volume is about 1331.99M tons. The actual volume in 2012 was about 1344.64 M tons. In 2013, the trade volume of iron ore and cocking coal may be about 1414.78M ton because the accurate data will be published at the end of 2013 by research institution. IMF forecasted about 3.8% of World GDP in 2014. The increasing trade volume is about 70.14M ton.

The equation is as follows (Thien, 2005):

$$\varrho_t = \varrho_{t-1} + \Delta_{t-1}^{t} \qquad (4.5)$$

ϱ_t : forecast of trade volume in year t

ϱ_{t-1} : trade volume in year t-1

Δ_{t-1}^{t} : forecast of increasing the trade volume in year t compared with year t-1

$\varrho_{2014} = \varrho_{2013} + \Delta_{2013}^{2014}$ = 1414.78 M ton + 70.14 M ton = 1,485 M ton

4.3.2 Forecast of the average haul

Forecasting the average haul can be measured by using historical data. According to Clarkson research, between 2002 and 2012, the average haul of iron ore were estimated about 5,600 miles, and the average haul of coal were estimated about 4,700 miles. In addition, the trade trend of the Capesize carriers will not change in the short term. The above average haul is analyzed by historical statistics; however, this dissertation will analyze the average haul of the Capesize carriers through real shipping business. For example, if some Capesize carriers transport about 170,000 tons of iron ore, the average haul of iron ore is about 5,600 miles. One voyage period of vessel may be about 50 days because the round trip sailing period is about 40 days; the waiting day to enter into the port is about 3-5days; the cargo handling period is about 5-7days. The total voyage number of the vessel may be about 5 or 6 voyages annually. According to Korean and China major shipping companies, Capesize carriers are operated about an average of 5.5 voyages annually. In conclusion, the average haul of Capesize carriers is about 5,600 miles of iron ore and 4,700 miles of cocking coal. However, this dissertation will apply to the average voyage number

4.3.3 The ship demand forecast

The total demand for sea transport equals seaborne trade volume multiplied by the average haul.

The equation is as follows (Thien, 2005):

$$\varrho_D = \varrho \quad * \ AH \tag{4.6}$$

ϱ : forecast of cape size ship seaborne trade

ϱ_D : forecast of total demand

: 1,485 million ton * 5,400 miles = 8,019 billion ton-mile

4.3.4 Forecast of the cape size fleet

According to Clarkson research (2013), the fleet volume of Capesize was about 279 million tons at the end of 2012, and the volume was about 287.7 million tons in June of 2013. The volume at the end of 2013 may be about 296.4 million tons because 90 Capesize carriers (about 17.4 million tons) will be delivered to the market in 2013. Further, Clarkson research forecast that 75 cape size carriers will be delivered to the market in 2014. The delivery volume is about 15.2 million tons. Eventually, the fleet volume in 2014 may be about 311.6 million tons.

However, this forecast data does not include the demolition volume because this dissertation uses the conservative method to forecast the supply. Over 20 years old ships accounted for about 7% of the total fleet volume. In general, the age of scrapping is over 25 years, and the ratio is about under 3%. The scrapping volume of 2014 may be lower than 2013. However, the forecast of scrapping is not easy because it depends on the market situation, bunker costs and international conventions. In conclusion, the fleet volume of 2014 may be about 311.6 million ton.

4.3.5 The ship productivity forecast

The ship productivity is measured by overall cargo performance, speed, cargo deadweight, and flexibility of obtaining backhaul cargoes (Stopford, 2010).

The equation is as follows (Stopford, 2010):

$$P_{tm} = 24 * S_{tm} * LD_{tm} * DWU_{tm} \quad (4.7)$$

= 24 * 11kts * 270 * 296.4 = 21,127 billion ton miles (2003)

According to major shipping companies in Korea, the average operation days of Capesize carriers are about 270 days. Recently, shipping companies have tried to slow down from 14kts to 11kts because they can reduce the bunker costs more than 30%.

P_{2014} = 24 * 11 * 270 * 311.6 =22,210 billion ton miles

4.4 Balance of supply and demand

$B_{2013} = totalS - totalD$ = 21,127 – 7,646 = 13,481 Billion ton miles

$B_{2014} = totalS - totalD$ = 22,210 – 8,019 = 14,191 Billion ton miles

Table 22 shows that the balance of demand and supply in 2013 is measured at 13,481 billion ton-miles; however, the balance in 2014 will increase at 14,191 billion ton-miles. In conclusion, the fleet of Capesize carriers is rising and exceeds demand in 2014, and the gap between supply and demand will expand. In 2012, the balance was about 15,236, so the balance will be forecasted at the level of 14,000 in 2014. Therefore, the freight may be determined between the freight in 2012 and 2013.

Table 22 *The transition of the over-supply*

Year	SUPPLY	DEMAND	BALANCE (Over-supply)	TC
2001	7,594	3,422	4,172	12,550.00
2002	7,923	3,547	4,376	14,984.00
2003	8,137	3,749	4,388	26,843.00
2004	8,517	4,204	4,313	51,624.00
2005	9,308	4,630	4,678	44,162.00
2006	10,094	4,887	5,207	40,805.50
2007	10,997	5,341	5,656	91,363.00
2008	11,949	5,720	6,229	96,894.50
2009	13,023	5,971	7,052	30,498.50
2010	15,440	6,745	8,695	30,960.00
2011	19,010	7,011	11,999	17,168.50
2012	22,631	7,395	15,236	14,383.50
2013	21,127	7,646	13,481	15,128.00
2014 e	22,210	8,019	14,191	

Source : compiled by the author

On the other hand, Table 23 explains that there is an obvious correlation among freight rates, fleet volumes and seaborne trade volumes. This is because the freight rate is determined by supply (fleet) and demand (trade volume). If an average voyage the number of Capesize carriers is about 5.5 voyages, the even point of making profit is obviously 5.5 voyages. For example, in 2008, the fleet volume was about 131.72 M tons, the trade volume was about 1,040.06 M ton and the freight rate was about 96,894 US$. In conclusion, the demand far exceeded the supply in 2008 because the balance of supply and demand was about 724.46 M ton (131.72 x 5.5). However, there was a shortage of supply. Therefore, the freight rates soared unimaginably. The ratio of balance can be established that supply is divided by demand. The data can be seen on Table 22 that the there are some correlation between ratio and freight. Especially, there was a shortage of supply in the Capesize market from 2004 to 2008, so then the freight rates increased unbelievably. At that time, the ratio was more than 7.9, and the freight rates were approximately 51,000-96,000 USD. However, the ratio has constantly decreased to 5.069, the freight rate also decreased to about 14,000 USD. On the other hand, the ratio was about 7.3 in 2001/2002, the freight rate was approximately

12,000-15,000. The freight rates in 2011/2012 is almost same compared with 2001/2002, however the ratio is some different. It can be easily analyzed that the vessel size after 2008 is bigger than before 2002, the technology and operation skill is more advanced than before, and the market and economic situation have changed. Transport efficiency has improved more than before. Eventually, an annual average voyage number of capsize ship may gradually increase compared with the before. For example, if the even average voyage number of making profit was approximately 5.2 in 2002, however if the average voyage number increase to 5.6 in 2012, there may need more trade volume to meet the balance between supply and demand.

Table 23 *The transition of the ratio (trade/fleet)*

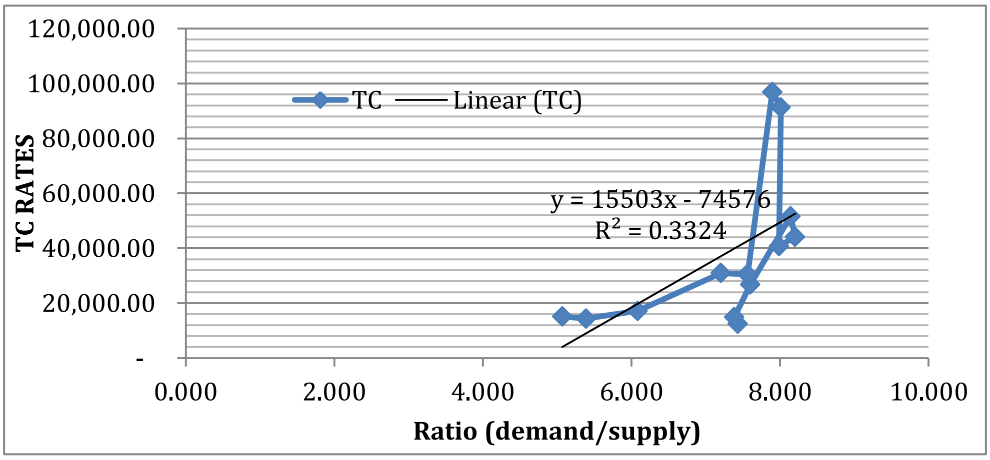
Date	Fleet (a)	Trade (b)	Ratio (b/a)	TC
2001	83.71	622.27	7.434	12,550.00
2002	87.34	645.08	7.386	14,984.00
2003	89.70	681.77	7.601	26,843.00
2004	93.89	764.50	8.143	51,624.00
2005	102.61	841.92	8.205	44,162.00
2006	111.27	888.72	7.987	40,805.50
2007	121.22	971.12	8.011	91,363.00
2008	131.72	1040.06	7.896	96,894.50
2009	143.56	1085.77	7.563	30,498.50
2010	170.20	1226.41	7.206	30,960.00
2011	209.55	1274.79	6.083	17,168.50
2012	249.46	1344.64	5.390	14,383.50
2013 E	279.10	1414.78	5.069	15,128.00
2014 E	296.40	1485.00	5.010	

Source : compiled by the author

According to Figure 24 and Table 23, there are some regular trends between freight rates and ratio (trade volume/fleet), in which the ratio can be explained as an average voyage number of Capesize carrier annually to transport the cargo. However, it is difficult to be explained that there is clear relationships because the freight structure of the shipping market is very complex.

The correlation among freight rates, fleet volumes, and trade volumes is as follows;

Figure 24 *The correlation between freight and the ratio (trade/fleet)*



Source : Compiled by the author

The relationship can be analogized that if the ratio is greater than the average voyage number of Capesize carriers annually, the freight rate will increase. However, it is not easy to forecast the freight rate accurately.

For example, in 2004 the ratio was about 8.143 and the freight rate was about 51,624$, but, in 2008, the ratio was about 7.896 and the freight rate was about 96,894$. The shortage of supply in 2004 was greater than in 2008. Therefore, the freight rate in 2004 had to be greater than 2008, but it occurred on the opposite side. The reason of this phenomenon is that the shipping market is affected by macro economy, financing, political issues and international regulations. In conclusion, fleet and trade volume implied for a number of variables, such as GDP, LIBOR, SDR, stock index, bunker, steel price, and oil price. Therefore, this dissertation will deal with two major variables, such as fleet and trade volumes, which will be used to forecast the freight rate.

4.5 Forecasting the freight rate of the Capesize market in 2014

In order to forecast the freight rate, it is important to predict the seaborne trade volume (iron ore and cocking coal), the second-hand ship prices. The price of second-hand ship in 2014 may be the almost same with 2013 because the economic situation is almost same compared with 2013 such as the increasing of fleet volume and trade volume. In this part, there are some assumptions and scenarios that if the increase of fleet volume is greater than expected, and the increase of seaborne trade volume is smaller than expected, how will the level of freight rates be? In case of fleet volume, suddenly increasing the fleet volume is difficult because the period of a new-building ship is 1 or 2 years. So it is possible to predict the delivery volume into the market. Therefore, it is comparatively accurate to predict the fleet volume.

However, forecasting seaborne trade volumes is not the same as with fleet volumes. This is because the trade volume is easily affected by economic and political issue. If major country, such as China and the US decide the boom policy in 2014, the freight rate may increase immediately. Especially, in case of iron ore and coal, every country has to stock major raw materials for 6 months or 1 year. This part has the assumption that the even point of profit is about 5 voyages of the cape size vessels annually. Therefore, the trade volume is directly related to the GDP or economic policy.

This part has the assumption of increasing trade volumes as follows:

1) If GDP is 4% in 2014, how many ton is the trade volume?

$$DCT_t = 65.103 + 18.458GDP_t \quad (4.8)$$

The trade volume may be about 1,488.58 M tons through the above equation. The fleet volume will be the same with the expected figure such as 296.40M tons.

The ratio (trade volume/fleet) is about 5.022

The freight rates in 2014 may be the same or lower than in 2013 because the ratio is almost the same compared with this year. The supply (fleet volume) exceeds the demand (trade volume).

2) If GDP is 4.5% in 2014, how many ton is the trade volume?

The trade volume may be about 1497.06 M tons through the above equation. The fleet volume will be the same with expected figure such as 296.40M tons.

The ratio (trade volume/fleet) is about 5.05

The freight rates in 2014 may be the same or lower than in 2013 because the ratio is almost the same compared with this year.

3) If GDP is 5.0% in 2014, how many ton is the trade volume?

The trade volume may be about 1506.29 M tons through the above equation. The fleet volume will be the same with expected figure such as 296.40M tons.

The ratio (trade volume/fleet) is about 5.08

The freight rates in 2014 may be the same or higher than in 2013 because the ratio is higher than this year.

4) If GDP is 5.5% in 2014, how many ton is the trade volume?

The trade volume may be about 1515.52 M tons through the above equation. The fleet volume will be the same with the expected figure, such as 296.40M tons.

The ratio (trade volume/fleet) is about 5.11

In conclusion, the freight rates in 2014 may be the same or higher than in 2013 because the ratio in terms of supply and demand is almost same level compared with 2013.

Fleet volume is a surplus compared with the seaborne trade volume. If fleet volume is maintained at the same level, the increase of the freight rate is difficult. If GDP is more than 5% in 2014, the freight rates will be better than in 2013. On the other hand, this dissertation will analyze the over-supply because the cape size market is the supply exceeds the demand. The freight rate of cape size market is determined by the supply and demand. To measure the balance between supply and demand, there need to analyze the ratio about over-supply. The ratio between demand (trade volume) and balance (over-supply) is about 110-125% from 2001 to 2009. However the ratio has suddenly increased to about 170-185% from 2010 to now. Its meaning is that even though many cape size carriers have scrapped from 2009 to now, a number of new ships have flow into the market. The seaborne trade volume was about 3,422 M ton in 2001, and the average increasing of trade volume is about 6-9% annually. Whereas, the fleet volume was about 7,594 M ton in 2001, the average increasing of fleet volume is more than 15% from 2006. There are a number of cape size carriers in market, and there need some time to meet the balance between supply and demand. In other words, more ships will have to be scrapped in the market. According to Clarkson research (2013), the fleet volume of more than 25 years is approximately 10% of total fleet volume. In future, if the market situation will continue, ship owners may decide to scrap their old vessel. To stabilize the market there need some methods both scrapping old ships and decreasing new-building ship to reduce the fleet volume.

5. CONCLUSION

This dissertation has focused on the analysis of the Capesize market, forecasting methods of freight rates by using supply and demand, and multiple regressions. A general analysis of macro or micro economy may reveal that if there are some correlated variables, the economy will be affected, and then the GDP or economy index will go up or down. However, the shipping market is different from this situation. This is because the dry bulk market has some unique characteristics such as volatility, fluctuations, and cyclical phases. Especially, the volatility of the cape size market is very sensitive.

This dissertation analyzed the characteristics of the market, the market cycle for about sixty years and the causes of the market cycle. However, it is very difficult to measure one cycle period between booms, or between recessions and booms. There is some time gap between the recession and boom of the market. Until now, a number of economic scholars have researched and analyzed the forecasting model of the shipping market. It is obviously valuable research to analyze the forecasting shipping market; however, the forecasting shipping market is very difficult because there are a number of variables.

The demand and supply side related to forecasting can be analyzed in the shipping market. The demand side is the world economy, seaborne trade volume as well as, economic and political issues. On the supply side, it is the fleet volume, the price of new-ships and second-hand ships, delivery and scrapping volume, and bunkering costs.

This dissertation analyzed the variables of the demand and supply side. The author expected that there would be some correlation between freight rates and variables. However, the correlation is low contrary to the expectation. There are some causes that cannot be analyzed through statistical data. It may be an invisible hand such as, some bubbles, speculative forces, and expectation. Nobody can accurately analyze the causes of the market from 2004 to 2009.

However, there is an apparent principle, which is the law of demand and supply, to analyze the forecasting market. Therefore, this dissertation has concentrated on the demand and supply. Demand is the seaborne trade volume of iron ore and coking coal, and supply is the fleet volume of Capesize carriers. This is because trade volume implies all economy situations such as GDP, industrial production, and exchange rates, and the fleet volume implies all the supply sides, such as delivery and scrapping volume and the price of new ship and second-hand ships.

It was tried to analyze the forecasting Capesize market through the multiple regression, the balance of supply and demand; however, the correlation among freight rates, fleet volume and trade volume is very low contrary to the expectation.

On the other hand, to forecast the shipping market through the balance of supply and demand is quite reasonable method. If the balance of supply and demand is measured accurately, it will be a useful method. For example, the trade volume is about 5,720M ton, over-supply (6,299 M ton) in 2008, its ratio between over-supply and trade volume is about 10%, 18% in 2009, 27% in 2010, 38% in 2011, 100% in 2012. The ratio has grown exponentially. In other words, the market has continued the situation of over-supply since 2009, so the situation is getting worse. Therefore, the market in 2014 will be the same or lower compared with the market in 2013.

The last method is the even point of making profits related to the average annual voyage number. Almost all shipping companies operated the annual average 5.5 or 6 voyages with their cape size carriers. This dissertation analyzed the average number of voyage of Capesize carriers from 2001 to 2014(e). In 2008, the average number of voyages of Capesize carriers was about 7.896. However, the voyage number has dropped to about 5.069 in 2013. The figure will be about 5.101 in 2014. Therefore, the market may be difficult to recover in 2014.

Last but not least, there are a number of methodologies to forecast the Capesize market; however, the best method of forecasting the shipping market is to grasp the balance between supply and demand. This dissertation tried to approach the forecasting market through the quantitative methodology; however, the overall situation of the market cannot be easily explained. This is because there are some invisible hands such as some bubble and speculative forces in the market. Therefore, this dissertation used the over-supply and average annual voyage number to forecast the market. As a result, the phenomenon of over-supply will be continued in 2014, the level of freight rate (1yr T/C) of the Capesize market may be about 14,000 – 18,000 $, and BCI index may be about 1,800-2,200 points. This dissertation suggests to the shipowners that they have to reasonably adjust the ratio between long-term and spot contraction, and they have to grasp the turning point of the market, which the point may be in 2013. Therefore, shipowners have to establish their business policy to respond the paradigm.

This dissertation has unavoidable limitations. Firstly, it was difficult to collect the data. This dissertation has analyzed various data based on quarterly and yearly figures. However, if it is based on monthly figures, the accuracy may increase considerably.
Secondly, even though it seems that the multiple regressions is a reasonable method to forecast the cape size market, a more innovative approach method which is possible to apply to the real shipping market needs to be developed.
There are a number of tools to forecast the shipping market such as AR, VAR, and ARMA. To increase the accuracy of forecasting the shipping market, there needs to be a number of detailed data of the supply and demand side. In other words, the supply side has to be detailed ‘fleet volume each’, ‘the age of a vessel, for example 5M tons of 5yrs and 20M tons of 10yrs’, ‘average scrapping age’, and ‘even points of making profit related to operation cost’. In case of the demand side, it can be specified as ‘a monthly based trade volume data’. If these detailed data can be collected, it is possible to measure the average voyage number and the balance. If the average annual voyage number of cape size carriers can be measured, or the balance between supply and demand is possible to be measured, the accuracy of forecasting the market will increase considerably. In the future, if this research is carried out, the accuracy of forecasting will improve considerably, and it will be possible to adjust the balance between supply and demand. Finally, if this research is performed, it might be more valuable for the Capesize shipping industry.

REFERENCES

Adland, R & Cullinane, K. (2005) *A time-varying risk premium in the term structure of bulk shipping freight rates*, Journal of Transport Economics and Policy, 39(2), 191-208.

Alizadeh, A. & Nomikos, N. (2010) *An overview of the dry bulk shipping industry*, Lloyd's lister, London, UK

Baltic Exchange (2013), retrieved from www.balticexchange.com

Batchelor, R., Alizadeh, A. & Visvikis, I. (2007). *Forecasting spot and forward prices in the international freight market.* International journal of forecasting, 23(1), 101-114

Beenstock, M. & Vergottis, A. (1993). *Econometric Modelling of World Shipping*, London: Chapman and Hall.

Brooks, C. (2013). *Introductory econometrics for finance (2nd ed)*. London : Cambridge.

Chang, Y. and Chang H. (1996). *Predictability of the dry-bulk shipping market by BIFFEX*. MaritimePolicy and Management, 23(2), 103-114.

Chen, S. (2011). *Modelling and forecasting in the dry bulk shipping market.* Unpublished Ph.D dissertation, Delft University of Technology. Retrieved from http://repository.tudelft.nl/view/ir/uuid%3A05352864-1c44-4fae-a5cc-818c24bfa60f/

Chen, S., Meersman, H. & Van, E. (2012), *Forecasting spot rates at main routes in the dry bulk market*. Maritime Economics and logistics, 14, 498-537.

Clarkson Research Studies (2012) *Dry Bulk Trade Outlook*. London : Author.

Clarkson Research Studies (2013). *The Tramp Shipping Market*, London : Author.

Clarksons Shipping Intelligence Network (2013), retrieved from http://www.clarksons.net/

Cullinane, K.P.B. & Mason, K.J. (1999). *A comparison of models for forecasting the Baltic Freight Index*. International journal of maritime economics, 1, 15-39. Retrieved from, http://www.palgrave-journals.com/mel/journal/v1/n2/abs/ijme199910a.html

Drewry Dry Bulk Forecaster (2010). Retrieved from, http://www.drewry.co.uk/publications

Drewry Dry Bulk Forecaster (2012). Retrieved from, http://www.drewry.co.uk/publications

International Monetary Fund (2013). *World Economic Outlook*. Retrieved from http://www.imf.org/external/pubs/ft/weo/2013/01/weodata/index.aspx

Internet Ships Register of Lloyd's Register Fairplay. (2011). Retrieved from http://www.ships-register.com

Kanamura, T. (2011). The roll of cape size vessels in freight markets. Retrieved from http://www.ioz.pwr.wroc.pl/pracownicy/weron/EFC11/Kanamura_EFC11.pdf

Lun, Y.H.V & Quaddus, M.A. (2009) *An empirical model of the bulk shipping market*. International Journal of Transport Logistics, 1, 37-54.

McConville, J.(1998). *Economics of Maritime Transport, Theory and Practice.* London : Witherby & Co Ltd.

Ma, S. (2012). M*aritime economy*. Unpublished lecture handout, World Maritime University, Malmö, Sweden

Sandvig Thorsen, I. (2010). *Dry bulk shipping and business cycles*. Norwegian School of Economics and Business Administration, Bergen, Norway. Retrieved from http://brage.bibsys.no/nhh/bitstream/URN:NBN:no-bibsys_brage_23778/1/Thorsen%202010.pdf

Scarsi, R. (2007), *The bulk shipping business: market cycles and shipowners' biases*, Maritime Policy andManagement, 34(6), 577-590.

Seaborne trade. (January/ February 2013). *Institute of Shipping Economics and Logistics*, 1(2), 30-70.

Stopford, M. (1997). *Maritime Economics*. London: Routledge.

Stopford, M. (2002). Shipping Market Cycles. In C. Grammenos (Eds.), *The Handbook of Maritime Economics and Business* (pp. 203-224). London: Informa Professional.

Stopford, M. (2010). *Maritime Economics (4TH ed)*, London : Routledge.

Thien le Duc (2005). *Forecasting the dry bulk freight market*. Unpublished Master dissertation, World Maritime University, Malmö, Sweden

United Nations Conference on Trade and Development. (1970-2012). *The Review of Maritime Transport,* Geneva : Author

Veenstra, A. W. (1999). *Quantitative Analysis of Shipping Markets.* Delft : Delft University of Technology.

Visvikis, I. (2013). *Quantitative methods and market analysis*. Unpublished lecture handout, World Maritime University, Malmö, Sweden.

Visvikis, I. (2013*). Financial management*. Unpublished lecture Handout, World Maritime University, Malmö, Sweden.

Visvikis, I. (2013). *Shipping management*. Unpublished lecture handout, World Maritime University, Malmö, Sweden.

Wergeland, T. (1981). *Norbulk: A simulation model of bulk freight rates*. Unpublished Ph.D dissertation, Norwegian School of Economics and Business Administration, Oslo, Norway.

Wilken, L. (2004), *Model for forecasting of capsize dry bulk carriers*, Unpublished Ph.D dissertation, Erasmus University, Rotterdam, Netherlands