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Strategic management of oil tankers companies during recession periods

Kareem J. Hasan
World Maritime University

WORLD MARITIME UNIVERSITY

Malmo, Sweden

STRATEGIC MANAGEMENT OF OIL TANKERS COMPANIES DURING RECESSION PERIODS

By

KAREEM JABBAR HASAN

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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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Date...........14/10/2013..

Supervised by: Dr. Ilias Visvikis

World Maritime University

Assesor: **Dr. Aykut Ölçer**

Co-assessor: **Kyriaki Mitroussi**

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Kareem Jabbar Hasan

Abstract

Title: Strategic Management of Oil Tankers Companies during recession periods

The increase in demand for oil in the international markets offers good opportunities for the maritime sector to gain and expand. However, the shipping industry has a volatile nature that imposes companies to implement new strategies to avoid risks and remain competitive during recession periods. Therefore, it is imperative for maritime companies to develop a clear and well thought strategy, to mitigate risks and uncertainties, which may lead to financial difficulties. In this dissertation, the risks surrounding the profitability of tanker owning maritime companies will be analyzed and the tools available to secure the sustainability of the companies against the exposure to such commercial risks will also be researched. Consequently, according to the results, an evaluation and recommendations for the maritime sector can be obtained and verified. Similarly, the attempt can be used as a guideline for those who are keen on developing and building a new maritime company and to increase the levels of efficiency in order to deal with the volatile and high competitive market.

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LIST OF ABBREVIATIONS

Aframax	Average Freight Rate Assessment Tanker
BCTI	Baltic Exchange Clean Tanker Index
BDTI	Baltic Exchange Dirty Tanker Index
COA	Contract of Affreightment
D/H	Double Hull
ESS	Explained Sum of Squares
FFA	Forward and Future Agreement
GDP	Gross Domestic Product
LR	Long Range oil product tanker
MEG	Middle East Gulf (Arabian Gulf)
MR	Medium Range oil product tanker
RSS	Residual Sum of Squares
Suezmax	Largest ship able to use Suez Canal
T/C	Time Charter
TSS	Total Sum of Squares
VLCC	Very Large Crude Carrier
WS	World Scale

Chapter.1 Introduction

1.1 Oil market

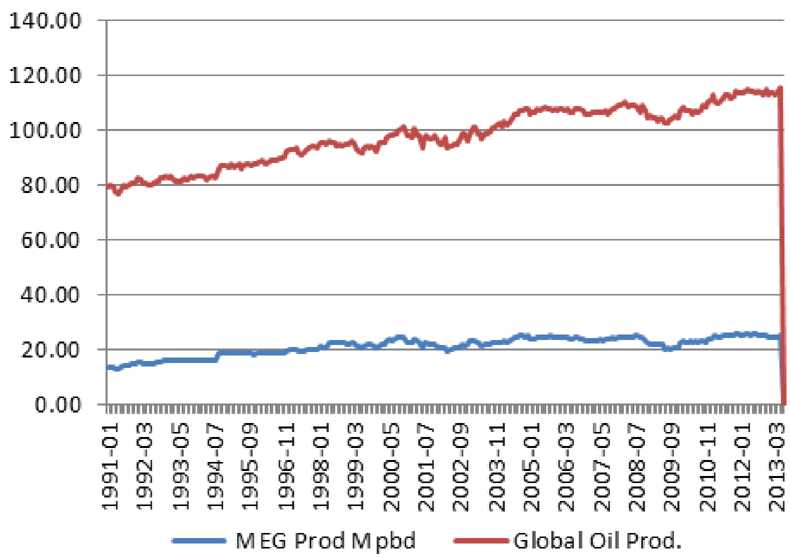
The world runs on energy for day to day activities, ranging from transportation to manufacturing. The world's consumption of liquid fuel is said to have increased significantly. According to a British Petroleum (BP) report (2012), the growth of energy consumption projected to increase by 1.6% annually (BP, 2012). The oil is a source of clean energy. Its technology is more developed than other forms of energy, such as nuclear power. The major reason that crude oil has been the largest single commodity in maritime transportation is not only that it is a principle source of energy, but that except for the USA and Russia, world oil production and consumption are concentrated in different parts of the world, separated by oceans (Ma, 2012, p.18). Consequently, the international energy market depends on transportation to bridge the deficit of consumption from surplus producers. .

Oil transportation is a function of the consumption in industrialized countries. The International Energy Agency (IEA) estimated that the global supply of crude oil will increase to 103 million bpd in 2018, an increase of 8.4 million barrels per day. According to IEA, this surge in oil production is due to the increase of Iraqi oil and North America production. Meanwhile, global demand is expected to grow to reach 96.7 million bpd in 2018. In May 2013, oil prices stood higher than $100 per barrel (Figure 1.1). IEA reports that the oil price is affected by the growth in global oil demand, especially the China market. IEA added that Iraq will be the energy support to OECD countries. Iraqi oil supply may reach 8.3 million bpd in 2035 (IEA, 2013). On the other hand, global oil production is expected to deplete more rapidly than in the Middle East region. Middle East has the largest portion of global oil reserves with 66% (IAGS, 2013). (Figure 1.2) shows that the Middle East oil production is estimated to increase faster than global oil production. Accordingly, oil plays an extremely important role in the advancement of the world economy and it is difficult to substitute in the short term. It is needed for the production of energy and there are no competitive alternative sources of energy. Therefore, the needs for oil are price inelastic (Ma, 2013).

Figure 1.1 Brent Crude oil price in USD

Source: Clarksons Research Service Limited, (2013)

Figure 1.2 Middle East oil production, Global oil production M bpd



Source: Clarksons Research Services Limited, (2013).

1.2 Crude oil tanker market volatility

In 2008 the world economy faced an economic recession rarely seen before. The Investment climate and faith for future growth was great, right up to the day of the collapse became a reality. This experience has proved fatal to many, and the recovery seemed too hard. The effect of the crisis was evident in all sectors in shipping. One of these is the crude oil tanker market which is a capital-intensive industry, with major investments in a company's fleet of ships. The crisis hit the shipping industry like no other industry in the current economic climate as both the earning capacity of shipping companies and the costs are strongly influenced by economic trends. Both freight markets and fuel markets that represent revenue and expenditure are characterized by high volatility (Kavussanos and Visvikis, 2006 p.3).

The price of freight is determined by supply and demand in shipping and this balance is very much dependent on the international economic climate. The world oil market affects the price of bunker fuel for vessels, which is an important part of the total operating costs of the ship and volatility of the bunker cost has an immediate impact on shipping companies.

Freight rate risk and bunker fuel risk are of the highest importance for the field of maritime transport. The economic crisis which suddenly hit the shipping industry by the end 2008 highlighted the importance of risk management and strategic planning for shipping companies. Another important aspect which is related to oil price and must be considered is that the prevailing view that the major oil price increases were caused by oil supply disruption triggered by political unrest, such as the ambiguous future in the major oil export region, the Middle East. On the other hand, the demand shocks played an important role in oil price uncertainty (McConville, 1999, p.291). According to Visvikis, (2013), the aim of the strategic planning is to thoroughly analyze a company's resources and goals, based on the analysis to try to find the right strategy that fits the company's business purpose and mission. The right strategy, depending on what is directed, should help the company strengthen its position on the market, increase profits and help with further development. If a company implements a wrong strategy, it can cause bad damage or it can have a huge financial impact on the company which could even end up in bankruptcy. Shipping is exposed to extreme volatility and macroeconomic conditions on the world market. Both the revenue, in the form of freight rates, and the operating costs, in the form of bunker fuel, are thus characterized by high volatility.

1.3 Dissertation Objectives

The shipping market industry is facing a number of challenges that threaten their business and compromise the financial efficiency level provided to the tankers owning companies. Cash flow security presents a challenges to ship owners, particularly incoming cash through freight rates. The shipping market uncertainty and deteriorating of freight rates can contribute to difficult financial position to oil tanker owners, other challenges include bunker cost volatility which could potentially impose significant financial disruption on oil tanker companies. Because the oil transport industry is so vital to the global economy, freight rates volatility requires a careful study. The purpose of this Dissertation is to identify a maritime sector strategy by using the quantitative tools to mitigate the negative effects of falling freight rates. On the other hand, oil tanker freight rate modeling and forecasting are important to better address planning and policy issues, ranging from short term and long term planning. However, demands for oil tanker freight models are vital due to the recent development of oil transportation system and deployment of VLCC tankers. in addition, the presence of shipping cycle risks requires freight rates modeling in order to predict the market and not fall to the bottom of the shipping market when the market cycle at trough. Clarkson Research Limited provided a wide range of data on shipping market activities. Therefore, analyzing the freight rate models are the contribution of this Dissertation. In addition, it is an attempt to evaluate the freight rate mechanism and the structure of the shipping market. An important contribution of this Dissertation is the attempt to investigate the possibility of different freight rates for different tanker sizes and in different routes. In other words, the different models simulate different income under different freight rates. In addition, a 3-year time charter model represents the contribution of the security cash model. Freight rate risk is an important issue on maritime transportation due to market volatility. The amount of risk has increased significantly in recent years. Uncertainty dominates the shipping market. For a company to survive such market, it is essential to be protected against such adverse price fluctuations. It is, therefore, imperative to know the market in order to make the right decision. However, to seek information on future freight rates, someone must have good knowledge about the factors that influence the shipping market to develop the right strategy (Cullinane, 2011, p.122). The objective of this Dissertation is to find an answer to the following questions:

- How can shipping companies use the financial tools to forecast the future freight rate and bunker fuel markets, in order to survive the recession period?
- What is the effectiveness of risk management tools available on the shipping market to protect companies from freight rate and bunker price fluctuation?
- According to the data of IEA which indicate the ambitious production level of the Middle East crude oil in the forthcoming years beside the expected depletion of oil reserves in the other part of the world in nearest future makes the distance longer between oil producers and consumers. Therefore, the maritime sector can have a competitive advantage to expand and an opportunity for new players to own and operate a tanker fleet in order to secure the transportation of the increasing production amount. In addition, the income from shipping is quite lucrative when the market cycle is in the peak status. The growth of maritime companies needs a well-planned strategy to be competed in the complex shipping market. With the application of risk management tools, the dissertation try to emphasis the possibility of using such tools by a crude oil companies to be a successful in the shipping market.

1.4 Research Methodology

Ship owners must be able to have a prediction power on the future course of the shipping market. In decision-making, for ship owners, it is reasonable to secure the company from uncertainty. The management has the opportunity to use the forecasting tools as a way to protect their company. So it is important to know the basics of risk management and forecasting tools. For the ship owners, the most important decision is the choice whether to go in spot or time charter in relationship to what is the best use for the ship in the future. The decision depends on expectations influenced by the condition of the market.

The linear regression model will be used as the statistical tool for the tanker shipping market analysis. The regression model allows predicting the behavior of a dependent variable by knowing the value of the explanatory variable. It can also estimate the effect of one variable on another (Brooks, 2008, p.30).

$$y_t = a + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots\ldots\ldots + \beta_t x_t + u_t \ldots\ldots \quad (1)$$

Where, y_t denote the dependent variable, x_t denote the explanatory variable, and u_t is the error term. The important step in forecasting is to specify the nature of the model by identifying the explanatory variables which explain the dependent variable (1). By knowing the data historical records of the variables and by quantifying them, the relationship between them are measured and known as the parameters. These parameters need to be tested prior of use in the model. The purpose of testing is to see whether the relationship between the dependent variable and the independent variables is significant (O'connell and Bowerman, 1979, p.425).

For the purpose of this Dissertation, Voyage charters for different oil tankers segments, namely, VLCC, Suezmax, and Aframax crude oil tankers and Medium Range product Carriers will be used. However, it has to be noted that there are no exact tools to ensure profit maximization. Nevertheless, ship owners can control the risk through suitable hedging tools to stabilize their cash flow. In this case they may like to secure the freight rate from being down. On the other hand, the major ship expense is the bunker fuel cost, as for VLCCs it represents around 47.6% of the voyage cost (Chrzanowski, 1985 p.82). The goal of the risk management (hedging) tools is to stabilize the revenues and expenses and improve performance compared to the volatile market (Kavussanos and Visvikis, 2006, p.20). Therefore, the result from VLCC

3-year time charter model will be used as a further stability to maritime company revenues and strengthen its resilience. Moreover, the model can be used as a hedging tools due to lack of freight and bunker derivative data.

Before the emerging of the derivatives market and to insure the availability of cash, shipping companies used the traditional risk management to avoid market uncertainty. Owners normally diversify their investments. Several types of diversification are used, such as investing in different market segments, like real estates and banks, trading in different commodities or employing the vessels in different types of charter contracts. Also diversification in different vessel sizes is quiet useful, as small ships can handle different types of cargoes and as such, earnings are less volatile than the specialized large ships, which tend to be more volatile. But to find which market is more suitable takes a lot of time besides the additional costs which represent a heavy burden for the growth of a company. Therefore, the shipping company has to focus towards limiting its exposure through the derivatives market which offers various types of risk protection, such as forward contracts, future contract, swap contracts and option contracts. The derivatives market is efficiently operated and creates a new investment strategy. In addition, they mitigate the risks for all market participants (Kavussanos and Visvikis, 2006, p.2). The derivatives are financial instrument used to protect against risk, it is a contract regarding a transaction to be achieved in the future in a certain time between buyer and a seller. They made the cash more predictable and facilitate the company's future investing plan (Alizadeh and Nomikos, 2009, p.10).

1.5 Dissertation structure

The Dissertation is made up of five chapters. The first chapter is the introduction which is compiled from the oil and the oil tanker market volatility besides the methodology used to assist the author to prove his argument. Chapter two is the literature review which deals with the behavior of the shipping market in general, describing the type of relationship that connects the freight rates with other market elements and analyzing the influential factors on freight rates encompassing supply and demand factors. In addition, it roughly reviews and analyzes the oil tanker market. Moreover, it is analyses the shipping market cycles with analyzing the strategy to mitigate the shipping cycle risks.

The third chapter is the research methodology chapter which is preceded by a review of the Classical linear regression model components, the variables affecting the freights rates, the hypothesis tests and the available data that assist to form consistent models.

Chapter four is the result chapter which contains the findings of the research methodology, different oil tanker models and includes the statistical output of the data. In addition, it analyzes to the forecast models, the significance level of the seaborne trade variables and the usefulness of the models in short and long term forecasts.

Chapter five is the conclusion obtained from the research and a clear evaluation of the oil tanker market. In addition, a recommendation to the owners of oil tanker companies are been disclosed to ensure that a perfect company strategy can be applied in order not to lose business because of freight rate volatility.

1.6 Chapter Conclusion

The increase of oil prices are mainly driven by the increase in demand for crude oil. Demand growth was caused by the fastest growing oil consuming nations, such as China and India besides North America the top consumer (Table 1). These consumer nations are separated by oceans from the main producers in the Middle East area and West Africa, allowing advantageous growth opportunities to seaborne trade. But the shipping market is uncertain; therefore, information and forecasting are essential to secure maritime companies cash flow.

Table 1.1 World Oil Demand Growth in 2013, M bpd

	2012	1Q13	2Q13	3Q13	4Q13	2013	Growth	%
Americas	23.70	23.71	23.75	23.89	23.83	23.80	0.10	0.43
Europe	13.74	13.15	13.60	13.56	13.38	13.43	-0.31	-2.28
Asia Pacific	8.59	8.95	7.97	8.29	8.74	8.49	-0.10	-1.21
Total OECD	**46.03**	**45.82**	**45.32**	**45.74**	**45.96**	**45.71**	**-0.32**	**-0.69**
Other Asia	10.83	10.89	11.02	11.10	11.14	11.04	0.21	1.94
Latin America	6.26	6.21	6.47	6.70	6.59	6.49	0.23	3.69
Middle East	7.58	7.79	7.75	8.18	7.75	7.87	0.29	3.80
Africa	3.42	3.42	3.42	3.38	3.52	3.43	0.01	0.26
Total DCs	**28.10**	**28.30**	**28.66**	**29.36**	**29.01**	**28.83**	**0.74**	**2.63**
FSU	4.41	4.33	4.18	4.59	4.84	4.49	0.07	1.63
Other Europe	0.64	0.63	0.59	0.63	0.71	0.64	-0.01	-0.81
China	9.74	9.79	10.19	9.89	10.41	10.07	0.33	3.38
Total "Other regions"	**14.80**	**14.75**	**14.95**	**15.10**	**15.96**	**15.19**	**0.40**	**2.68**
Total world	**88.92**	**88.86**	**88.93**	**90.20**	**90.92**	**89.74**	**0.82**	**0.92**

Source: Organization of the Petroleum Exporting Countries. *Monthly market report*, Sept (2013), Vienna, Austria.

Chapter.2 Literature Review

2 .1 shipping company's strategy

Companies have to avoid risk by being careful through retaining sufficient and consistent liquidity, in order to meet the substantial expenses, such as operating costs, bank loans and other obligations. Companies have learned to take advantage of opportunities in recession times by implementing successful strategies and proper business policies to obtain their goals of gaining high profit when the market recovers (Stopford, 2009, p.219).

According to Lorange (2005) the features of the shipping industry tends to be very cyclic and turbulent. Therefore, a company working in such an environment in order to be successful should see the cyclicality and turbulence as an opportunity, and not a threat. Taking the advantage requires maturity in how to formulate and execute an effective strategy (Lorange, 2005, p.22). Also Lorange (2005) suggest that shipping is a global business. Therefore, global economy requires a skillful and effective management to compete beyond the domestic market and knowledge to avoid the risk and exploit opportunities for growth (Lorange, 2005, p.187).

Accordingly, managers whose companies operate in uncertain markets have to keep their strategies up to date. They should always know what is happening in the shipping industry; if it is changing, oversupply, slow down or growing, being up to date are essential factors for a company to survive (Stopford, 2009, p.132). There are also certain external factors that a company should be aware of, such as political unrest, economic crisis and technological advances among others. In the shipping business someone must take into account all constraints that impede the company from generating income. In addition, the main concern of ship owners is how to guarantee a good cash flow, which improves the chances of survival and success of the company. Survival is the most important objective of strategic management. The manager tries to earn maximum profit for the company in the short and long term (Ma, 2012, p.120). However, the company can earn profit even in the long term if the management takes proper financial decisions to offset any negative economic effect from market uncertainty (Harwood, 2006 p.93). Based from the above the cash flow is the important resource for the company to stand on a stormy market. Stopford (2009) implied that cash flow is the difference between the incoming cash and the outgoing cash of the business. The outgoing cash is the operating costs, which, mainly consist of crew and bunker fuel costs. The bunker fuel price is the biggest concern nowadays in the shipping industry, as soaring bunker prices makes operating costs spike. High bunker prices could also minimize the profit margin of the shipping company. Owners of a crude oil tanker, whose incoming cash is mainly the freight revenue, have to ensure the earnings and secure the cash flows from the volatile market. The key to survive in recession is how to stabilize the cash flow, mainly by achieving better freight rates and secure low bunker fuel costs (Cullinane, 2010, p121).

2.2 Tanker Freight Market

2.2.1 World Scale

The cost of crude oil shipping freight rates expressed in terms of percentage is internationally defined by a scale called the world scale. It is a concept developed during World War II, prepared jointly by two large associations of ship chartering brokers in London and New York. The world scale is set for each year and for all tanker shipping routes in the world. It represents the cost of transporting of crude oil per ton deadweight, in US dollars for each of shipping route from loading port to discharging port. The characteristic of standard ship used for world scale is 75,000 metric ton deadweight tanker; with performance speed of 14.5 knot consumed 55 metric tons per day of fuel oil 380 cst per day at sea and 5 metric tons at port. With 96 hours lay time, plus 12 hours taken in account the other factors, such as port charges and difficulties of access to the ports. The world scale is updated annually to reflect the changes occurred in bunker prices, currency fluctuations and changes in port charges. world scale is recognized internationally by all market participants. The way to use the world scale is by taking the flat rate as world scale 100 (WS100). When the world scale is WS45, as an example, the transportation cost is reduced to 45 percent of the flat rate.

Alternatively, if it is WS135, then the freight is 35 percent above the flat rate (Buckley, 2008, p.168).

2.2.2 Tanker spot market analysis

According to Clarksons (2013), the year 2013 has a double effect on the crude oil tanker market due to increase in global oil demand reaching 90.6 million bpd and being led by strong demand particularly from China, which is expected to import 11% more by tankers and the steady oversupply of new vessels on the marker. The 5-year time charter for VLCC, Suezmax, Aframax was reduced by 2.4%, 1.3%, 1.6%, respectively. The fall continues, at the time of writing, but the Long Range tanker rate for the 5-year time charter increased by 0.8%. The routes which have suffered the most are those serving the Europe and US demand. Unlike these routes which serve Asia, they benefit from the Indian and Chinese growth. The new trend of crude oil flow has the most significant changes related to the traffic from the Middle East toward Asia which has continuously risen. The volume of flow decreased between the Middle East and Europe and in parallel, North America global imports also fell (Clarksons, 2013).

The supplies of tankers over 60,000 m/t deadweight grew in 2012; the total tonnage of the tankers over 60,000 m/t deadweight was 347.8 million dwt in 2010 compared with 2011 the total tonnage was 370.7 million dwt reaching 386.5 million dwt in 2012. At the same time, the demolition tonnage increased in 2012. Nevertheless, it was insufficient to absorb the overcapacity related to the entry of new vessels. The combination of tonnage over supply and the slight decline in demand were behind the continuous drop of the freight rates (Clarksons, 2013).

2.2.2.1 VLCC tanker market

The foundation of the Very Large Crude Carrier (VLCC) market is the export of crude oil from the Middle East to major consumption areas mainly the US, Europe and the Far East. The VLCC which served the US and Europe routes have been widely affected as the consequences of the 2008 financial crisis. Demand in China and India maintained the balance in the Middle East - Far East route. The average spot rate for

VLCC travel Middle East to Europe was WS37 in 2011, WS32 in 2012 and estimated to be WS9 in 2013, while the average earning was $15,461, $18,296, and $6,497, respectively. However, the Middle East – India route was WS60 in 2011, WS56 in 2012 and estimated to be WS40 in 2013. These figures illustrate the inconceivable market volatility. Currently, the VLCC fleet consists of 609 double hull tankers. In addition, the turnover rate is particularly high. New vessels will enter the market, so the fleet size is projected to reach 193.9 million tons deadweight in 2013 (Clarksons, 2013).

According to Fearnley's consultant (2013), the VLCC activity has increased in all shipping routes during 2013. Particularly from the Middle East Gulf toward the US Gulf and the Far East due to higher exports from Iraqi Oil. Furthermore, West Africa/ Far East route competes on the other part of the VLCC tonnage. The World scale rate reached the level of WS40 on MEG/Far East which indicates a little earning improvement for VLCC owners.

2.2.2.2 Suezmax tanker market

Suezmax vessels can carry between 120,000 and 200,000 m/t deadweight amount of cargo. It is mainly positioned on routes such as West Africa – US coast and Black Sea/ Mediterranean – US coast. The average spot rate fluctuates for different routes. The West Africa – US coast was WS81 in 2011, WS78 in 2012 and is estimated to be WS62 in 2013. However, the average spot rate for the route Middle East – Mediterranean reached WS61 in 2011, WS48 in 2012 and is estimated to be WS32 in 2013. The Suezmax fleet consists of 471 Double Hull tankers. In addition, new vessels are currently on order. The new delivered tonnage reached 3.1 million deadweight added to the fleet, which is projected to increase to reach 72.2 million tons deadweight in the end of 2013. The over supply growth will prevail for the next year as the capacity of the demolished tonnage does not exceed 0.3 million dead weight (Clarksons, 2013).

2.2.2.3 Aframax tanker market

The Double Hull Aframax tanker capacity varied between 80,000 and 120,000 m/t deadweight. The letters AFRA are an acronym which is derived from the old chartering range, Average Freight Rate Assessment (Stopford, 2009). Vessels can be positioned on several markets either transporting crude oil on specific routes such as Caribe – US coast or possible carrying refined products. The total tonnage of Aframax tankers increased significantly in 2012 to reach 97.6 million dwt, compared with 2010 where the total tonnage was 87.8 million dwt. The supply growth also increased significantly. Conversely, demand declined from 53.9 to 50.5 million dwt in 2010 and 2012, respectively. The economic decline in world demand is associated with the decline of oil imports in North America. The year 2013 is marked by double negative effects. In the Caribe – US route the decline was due to an increase of US oil production plus the competition by the Suezmax tankers. The other factor is the effect of the European fiscal crisis on the Aframax market, which resulted in more drops in freight rate (Clarksons, 2013). Aframax ice class tonnage, sailing toward the Baltic Sea, normally has steady earnings for the most of the ice season. Suddenly, the market increased to reach WS215 in April 2013, but the rate was reduced to WS50 when ice restriction ended (Fearnley's, 2013).

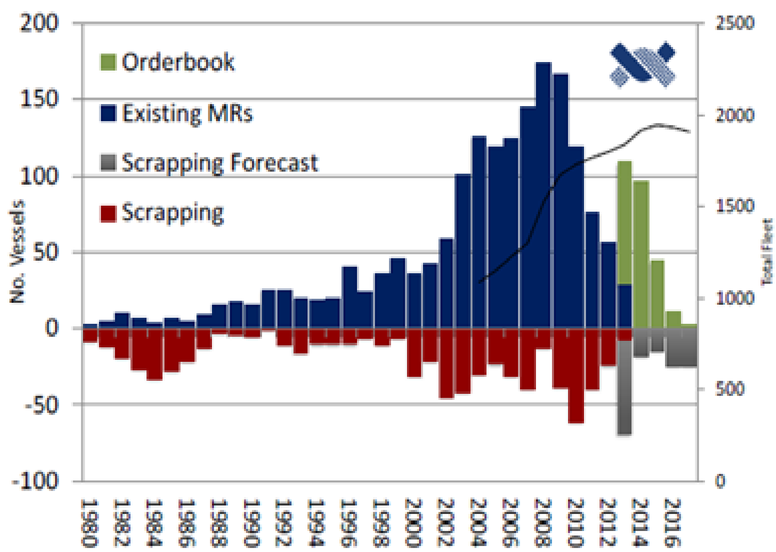
2.3 Oil product demand

2.3.1 Medium Range Product carrier

Generally, seaborne imports of oil products have a significant increase by 3.9 percent to reach 19.6 million bpd in 2013. However, the uncertain demand in Europe due to the effect of 2009 Eurozone crisis has declined the import to 5.7 million bpd in 2012. On other hand, the import in 2011 was 5.9 million bpd. In Northern America the imports continue to decline by 6 percent year on year since 2009 to reach 1.7 million bpd in 2012. The increase in throughput by US refineries and the opening of the Motiva oil refinery in Texas reduce the demand in northern America (Clarksons, 2013).

Since 2000, there was a marked increase in Medium Range 2 Product tankers (MR2 size 40,000-55,000 m/t deadweight) supply from 344 to 1174 tankers. Investment was obvious on MR2 size between 47,000 to 55,000 tons dwt (Figure 2.1). It has increased up to 80 percent in respect to all tonnage ordered in 2005. On other hand, the supply of the Medium Range 1 or what is called handy size (MR1 size 25,000 – 40,000 m/t dead weight) has slightly increased. The market size for each category relied on the route it served. For instance, the MR1 has restrictive opportunities; the main market for such type is mainly northwest Europe. But it has little opportunity in the Mediterranean market. However, there is vast market for MR2 in the Far East and South Asia market (Hellenic shipping news 2012). Apparently the MR market showed improvement in April 2013. The freight rates increased from WS142 at end of March to reach WS 145 in middle April (Clarkson, 2013).

Figure 2.1 Medium Range product tanker fleet growths



Source: Fearnresearch, (2013).

2.4 Bunker cost

Bunker prices represent the major cost component for crude oil tanker nowadays. The price of IFO 380 cst on 26 June 2013 at the port of Rotterdam was $571/mt. In Fujairah the price of IFO380 cst reached $601/mt, while in Singapore the price recorded $580/mt (Bunker world, 2013). The reason for such increases is due to the global increase demand for oil. The surge threatens the shipping industry simultaneously with the economic crisis in Europe and the reduction in demand for oil transport caused a sharp drop in freight rate. Many ship owners face financial difficulties, especially the newcomers that are not aware of the market business cycles (Cullinane, 2011, p.123). Bunkers represent the major operating cost with almost 50% of operation expenses (Stopford, 2009, p.233). On the other hand, shipping companies can protect themselves sufficiently from bunker price increases, beside ensuring their freight rates, either by the following the traditional strategy such as chartering the vessels for long term contract, or using the hedging tools against bunker price market volatility (Kavussanos and Visvikis, 2006 p.57).

2.4.1 Bunker price used in World scale

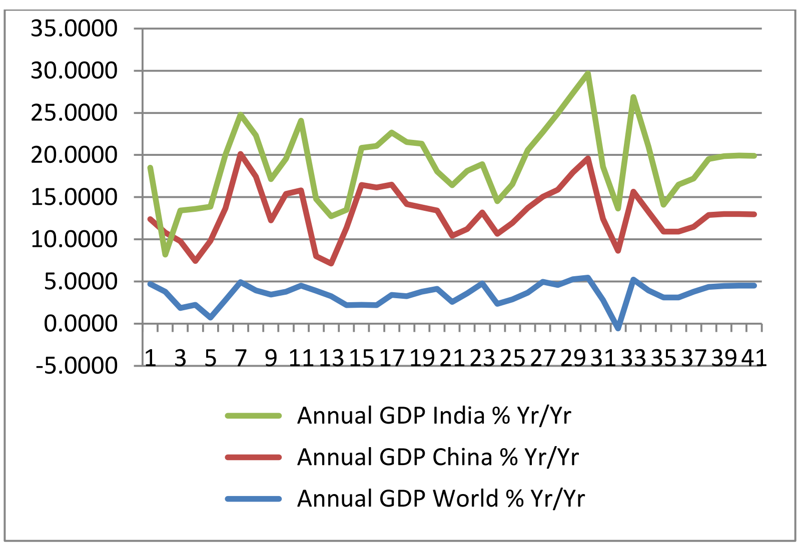
The bunker world index is a daily weighted index of 20 major bunkering ports and can be used as indicator of the world bunker fuel market (Bunker world, 2013). Furthermore, the bunker fuel price (380 cst) is assessed worldwide by Cockett Marine Oil Limited. In the past, the daily World scale price represented the average price of the period from 1st October to 30th September of the previous year. The way how to calculate the bunker price was one of the essential issues for the World Scale Association as various methods were applied. The other version which led to serious anomalies had two revisions annual and semiannually, where the bunker prices depended on prices in load and discharge ports. The 1998 version represents the world wide average of the previous year calculated for 12 months average ended on 30th September of the year prior to the Schedule year. But, again a substantial discrepancy appeared in this version which led INTERTANKO to make suggestions to improve the way that bunker price been obtained (INTERTANKO, Jan 2001).

2.5 The law of demand and supply

2.5.1 The demand for sea transport

The main factor affecting sea transport is the world economy. Therefore, the demand for tankers reflects the need for energy. The growth of the world economy increases the demand. Consequently, the shipping market movement increased as it is derived from the amount of trade (Stopford, 2009, p.140). It is quite clear that the increase in gross domestic production, GDP has positive influence on the growth of sea trade. (Cullinane, 2011, p.13). Figure 2.2 illustrates the rapid increasing GDP in India and China. Stopford (2009) implied that the world economy cycles reflected external and internal factors. War and political unrest made sudden changes in oil prices. Consequently, demand increases. The internal factors are reflected by the structure of the commodity itself. The change to new sources of energy is difficult to achieve in the short run. Therefore, there is no substitute for oil as a source of energy. The other important variable affecting the demand is the distance which is usually measured in ton miles. The demand for oil tankers is determined as the carrying quantity or the required dead weight multiplied by the distance covered. The demand is positively affected if there is an increase in oil production in one area and lack of reserve in other

Figure 2.2 GDP growths of China and India



Source: Clarksons research limited, (2013).

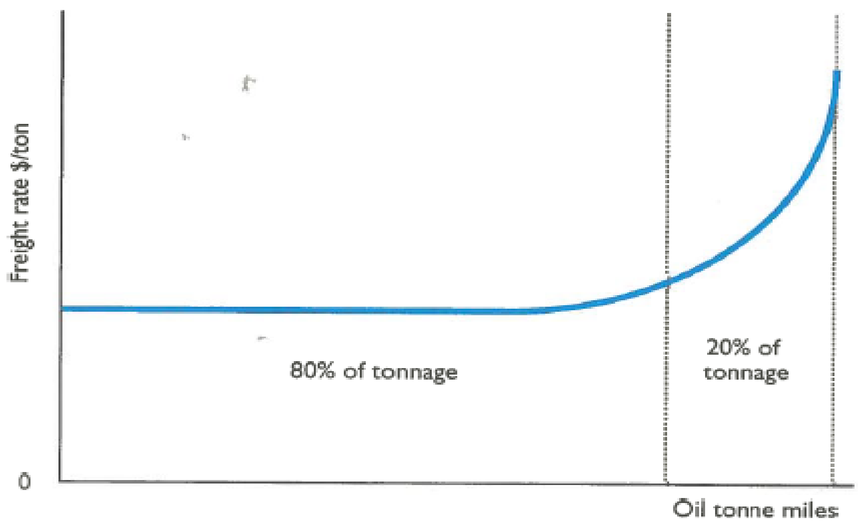
areas, such as the oil shipped from the Middle East Gulf toward the US and Japan. However, the increase of oil production by the US reflects the decline in demand for the MEG - USG route. On the other hand, the differences in regional economic growth affect the tanker demand by changing the distance covered (Stopford, 2009, p.147).

Also Stopford (2009) suggested that the demand was affected by transport costs in a long term. Bigger ships have great influence in reducing the cost of the trade. They load more cargo which affects the whole cost by reducing the cost per ton mile.

2.5.2 The supply of sea transport

The utilization of the tanker fleet adjusted the supply for the short run. Ship building increases the supply and demolition reduces the supply. Hence, the factors influencing the shipping service supply are the quantity of existing tonnage and its productivity. In the long run the shipbuilding progress enhances the supply.

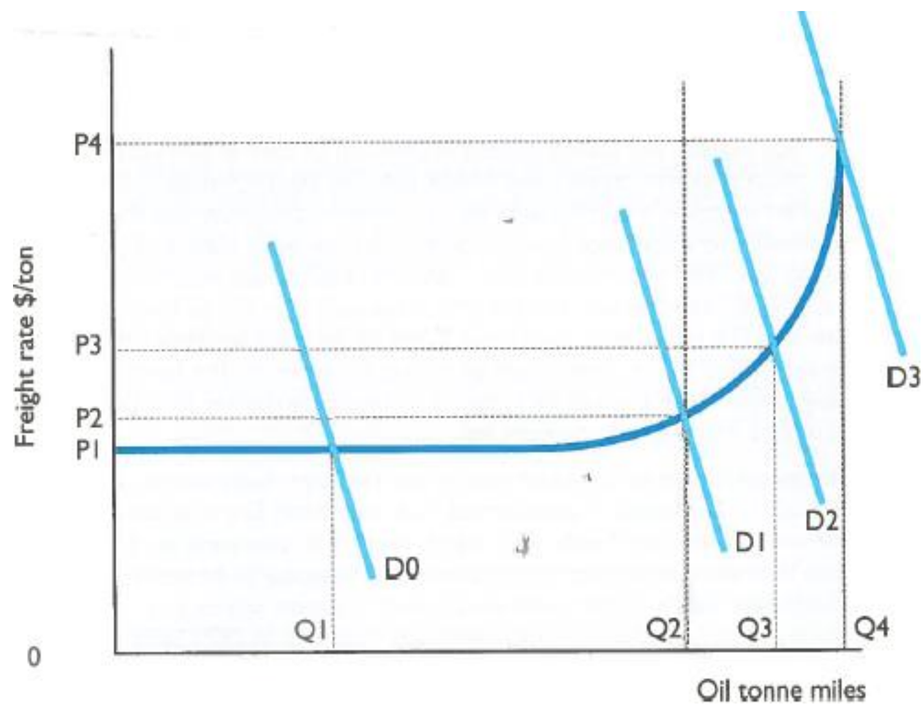
Fig 2.3 Tanker supply curve



Source: Institute of chartered ship brokers 2013

Supply of new tonnage in the tanker market always has a lapse of time, since new ships take time to be build (Chrzanowski, 1985, p.54). The supply function illustrated in the Figure 2.3 which reflects the quantity of available tonnage versus the level of the freight rate. The supply curve is almost flat when the market is bearish where the freight is low and the excess tonnage is laid up, and also the active ships move at slow speed. On the other hand, when the market is bullish and the freight rates surge, ship owners put the laid up vessel in operation and new build orders are normally placed (Stopford, 2009, p.161). In Figure 2.4 the intersection point between demand and supply reflects the freight rate. In tanker ships the demand curve is drawn with a perpendicular cut to the supply curve due to lack of tonnage required to transport cargo. Also the increase of freight P2 to P3 indicates that cargo D1 to D2 required to be moved regardless of the freight (ICS, 2013, p.141).

Fig 2.4 Modeling Demand and Supply in the short run



Source: Institute of chartered ship brokers 2013

2.6 Shipping Market

2.6.1 Freight Market

Freight rate is concluded according to the amount of cargo to be transported versus the supply of tonnage available in the market (Stopford, 2009, p.160). Also the freight market is affected by the trade region, such as the freight rate in North Atlantic differs from the freight market in the Far East market. On other hand, there are factors characterized in the freight market such as type of commodity, distance between load and discharge ports, ports facilities, port dues and fuel bunker costs (Chrzanowski, 1985, p.56). Pace (1979) wrote that the freight rate reflects the balance between the existent fleet productivity and the available cargo to be transported.

2.6.1.1 Freight rates for different size Tanker Vessels

The market of different tanker sizes is subject to individual forces of supply and demand. The submarket has different seasonality cycles in the tanker sector, either in different duration of chartering or the different sizes of tankers. The following market characteristics were based on study for a period from January1990 to March 2005.

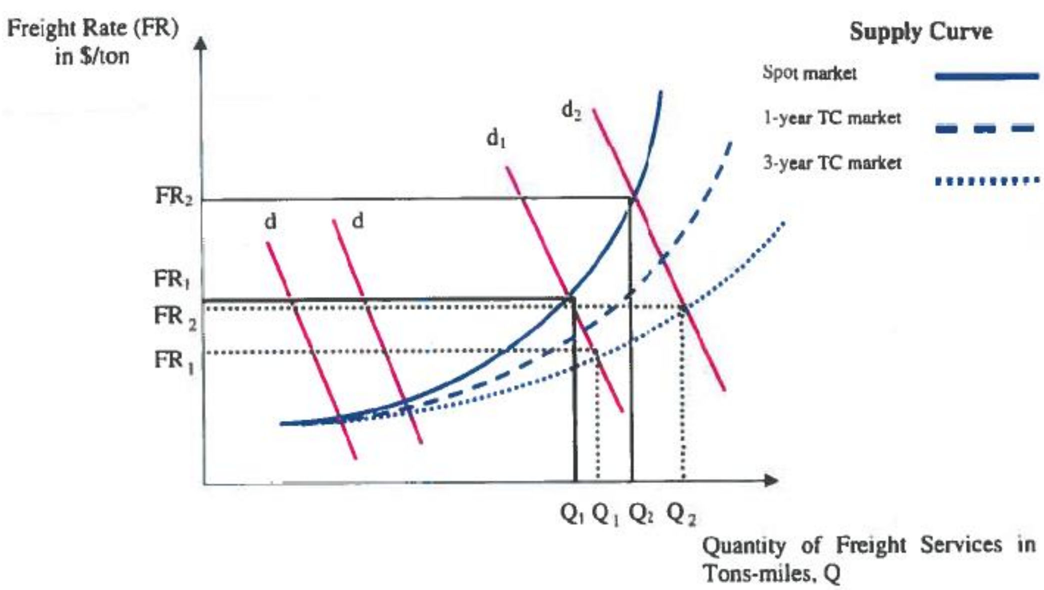
a. Spot market of small size tankers is less volatile than those of large tankers. VLCC market shows a higher volatility than the handy size tanker market. Also the market of Aframax tankers and Suezmax tanker are more volatile than the Handy size market but less volatile compared to VLCC market. Therefore, diversification in tanker sizes is a good option for tanker owners operating in the spot market to minimize their freight rate risk.
b. Differences in freight rate volatilities are reduced when all sizes of tankers are engaged in one year time charter. Differences in freight rates volatility are eliminated for the three year time charter and longer time charter duration. Therefore, ship owners owning large tankers can avoid freight rate risks by operating them in long term charter parties.

Certainly, the spot market is highlt volatile because the market is affected by several factors, such as exposure to the day-to-day market conditions, bunker prices and unemployment risks. On the other hand, the rates of the one year time charter are smoother than the spot rates. It is expected to be the average earning of the spot market (Kavussanos, and Visvikis, 2006, p.57).

2.6.1.2 Freight rates for different duration contracts

The response of the supply curve on the three years' time charter is less than the response of the one year time charter curve when the market fluctuates. Also the voyage charter rate is affected considerably when there is change in the market. Figure 2.5 illustrates how flat the three year time charter supply curve is compared with one year time charter and voyage charter in response to the demand and freight rate fluctuations. The supply curve of the three year time charter is less elastic than the supply curve of the voyage charter. Consequently, the supply curve of the one year time charter lies in between (Kavussanos, and Visvikis, 2006, p.47).

Fig 2.5 Shipping Freight Markets for Different Duration Contracts



Source: (Kavussanos, and Visvikis, 2006, p.46).

2.6.2 Shipbuilding

Shipbuilding is an important variable which affects freight rates and adjusts the supply of tonnage with the required demand. Investors order new vessels when freight rates increase. In addition, new builds improve the quality of the maritime transportation mode. On other hand, speculators order vessels when the building cost is low in order to sell when the market rises. Therefore, expectations and predictions are important. The new build trends are determined by supply and demand. But the price of a new built is influenced by factors in the shipping market, such as, the price of second hand vessels, the order book and demolition prices. Sometimes orders for new builds increase due to application of new technologies. Shipbuilding requires large investments, so decisions are made after analyzing the market based on the amount of information, the opportunity cost and detailed negotiation. This is considered a low process with a time lag between time of delivery and when orders are placed. (McConville, 1999, p.70).

2.6.3 Scrapping

The scrap market fluctuates in accordance with the freight rates level. Old ships are being scrapped when operating costs increase due to the depreciation and the expected revenues are minimized. One important factor which affects the scrap market is the new regulation imposed by IMO to phase out the single hull tankers. The new double hull tankers must meet the requirements on environment protection and improve safe working standards. But, tonnage withdraws reduces the tonnage supply to the shipping market (Grammenos, 2010, p.221). The decision to scrap a specific ship is a complex matter, and there are several factors which influence the decision, such as ship age, technical obsolescence, scrap price and the expect income from that vessel (Stopford, 2009, p.158).

2.6.4 Second Hand Market

The second hand market is considered as the adjustment factor which enhances supply but does not change fleet capacity by increasing market efficiency and lessens freight surge (Grammenos, 2010, p.228). This market can be utilized successfully by ship owners who buy cheap and sell high, based on good timing. But the financial burden may force ship owners to sell when prices decrease in order to cover their debt and provide liquidity (Lorange, 2005, p.44). According to Veenstra (1999) the low freight rate lasted for long periods compared with short periods of the high freight rate market. Therefore, ship owners sell when they are forced due to long duration of the bearish market. On the contrary, they hold their ships when the market is in bullish conditions and freight rates increase.

2.6.5 The integration of the four shipping markets

The four shipping market: freight, new build, second hand and scrap markets are highly correlated. The fluctuation in the freight rates positively influences the other markets. Ship owners main revenues come through freights which can be obtained either by utilizing the ship in voyage, time charters, or contract of affreightment (COA). Other cash can be collect from selling an old ship which is more useful during recessions. The cash flow among these markets ultimately drives the market cycle. An example of the wave of cash flows is if the demand increaseds, then the freight rates will rise. Consequently, the second hand price increases together with the order for new built ships. On delivery of new builds the market is adjusted at the beginning but the excess of new builds lead to over supply that then lead to drop in freight rates and the whole market is reversed and squeezed. Those investors who are aware of market uncertainty, keep good cash for recession periods when freight rates drop and asset prices fall. Otherwise, weak investors not having the liquidity to maintain their ships will be forced to sell at low prices, and lose the opportunity when the market recovers (Stopford, 2009, p.178).

2.7 Shipping market cycles

The shipping market cycles are characterized by four stages, starting with trough, followed by recovery, which leads to market peak, and then to the market collapse stage. The shipping cycles can be categorized in three different types. The first one is the long term cycle which may last for 60 years. The upward movement of the cycle indicates that the profit increases but when it moves downward is indicating bad times arising. Sometimes the descending is too deep, which may force ship owners to lay up their vessels. The second type is the short term cycles or the business cycle. The cycle period varies from 3 to 12 years from peak to peak. It is marked by high fluctuations and considered as a stirrer for the shipping business. The third type of the shipping cycle is the seasonal cycle. This type of cycle fluctuates regularly. For example, the increase in oil demand in winter-time or the ice restriction in the Baltic Sea could cause a sharp increase in freight rates (Stopford, 2009, p.95)

2.7.1 Shipping cycles and shipping risk

The shipping risks arise from unforeseen overtakes by supply over demand for maritime transport. The ship owner and cargo owner are the primary risk takers but, they are in adverse positions. When the freight is high, the cash transfers to ship owner. Conversely, when the freight rates move downwards due to oversupply the cash transfers to the cargo owner. The market cycle overruns the shipping industry. Ship investors feel more comfortable when the freight rate is high but become desperate when the freight rates collapse. Shipping market cycles like waves ripple through investors financial live. In such complex environment business decisions are crucial and investors are facing risks, especially when the shipping cycle is in a trough. The freight rates fall to operating expenses, and the phenomenon of negative cash flow prevails. Prudent ship owners who are aware about such conditions will survive the hard trough. On the other hand, ship owners with lack of cash will be forced to sell the least efficient ships at scrape price. Consequently, the demolition market becomes active (Stopford, 2009, p.102).

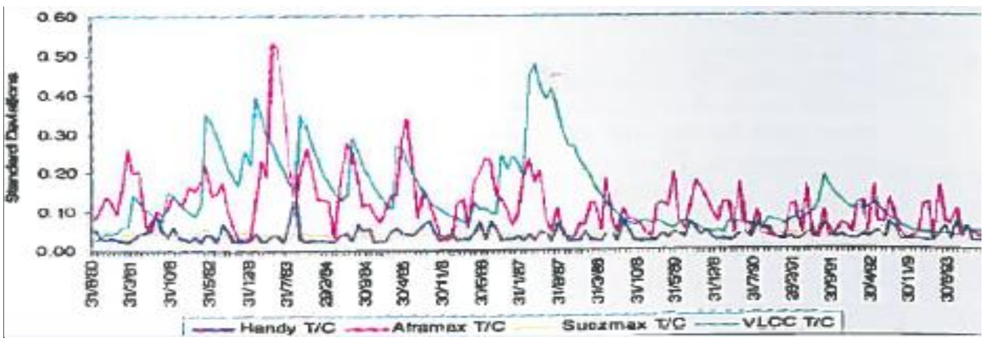
2.8 Strategy of risk management

Stopford (2009) argues that predictions should be based on accurate information but this is hard to be obtained. Investors who venture in such volatile markets are highly exposed to financial risks because the main aim for investment is to use the minimum recourse to gain high income. Therefore, wise investors should utilize all available information and market analysis when making decisions. The important key elements to survive in the shipping market are the revenue and cost of running ships. The freight rate represents the major cash income and fuel bunker represents the major outgoing cash. Accordingly, operating ships in uncertain international markets have huge business risks. But risks are not always inevitable. Well planned companies closely analyze market cycles and provide the intensive information concerning variables affecting the shipping market can survive the bad time (Kavussanos and Visvikis, 2011, p.1). During the period 2003 to mid-2008 the freight rates reached a peak, They increased up to 300 percent, then followed by a collapse by falling by 95 percent at the end of 2008. The freight rate volatility has a direct impact on the revenues of the shipping company. In addition, shipping market is exposed to major cost volatility represented by bunker fuel costs, which are used as a source of energy in power driven vessels. Bunker prices are highly correlated to the World oil market which fluctuates in short and long terms. Therefore, it is needed to secure the revenues and the costs by investors in order to have predicted cash and to avoid uncertainty and volatile environment (Alizadeh, and Nomikos, 2009, p.3). It is extremely obvious that risk management is important in a market which has made and destroyed a wide range of investors over the years. This explains why ship owners are not willing to charter there vessels for long terms when freight rates are high and they regret not fixing their ships for long term charter after freight rates have fallen. Also charterers regret not fixing ships for long terms when the freight rate is low based on the wrong expectation. In addition to the above results, a study made by Kavaussanos and Visvikis, (2006) of the tanker market trends for different charter agreements for different sub markets sectors, between 1990 and 2005, found that volatilities in freight rates are time varying. Changing market conditions affect the variances in the average value of freight rates and rates volatility. Figure 2.6 shows how volatilities in the tanker market vary overtime and across sizes. The concurrence of a decline in demand for shipping services worldwide and the 1980/81 oil crises followed by other political crises like, the Gulf war 1990/91 and the lasting effect of a sharp decline in oil prices. It was clearly inferred that the tanker market volatility level positively correlated with oil prices (Kavussanos, and Visvikis, 2006, p.59). Figure 2.7, Figure 2.8 and Figure 2.9 Illustrate examples of time varying volatility in freight rates of VLCC and Suezmax, a comparison made for the spot market and one year time charter which found that the one year time charter volatility is higher in the VLCC market than the spot market for two periods between 1982-1985 and 1987-1988. It is concluded that time charter rates become more volatile when the market is low; this is due to an increase in the sensitivity towards future markets and perception differences. It is quite clear to charterers that they should fix long duration charters in a trough market and alter to spot fix when the market is at a peak stage (Kavussanos, and Visvikis, 2006, p.62).

2.8.1 Summary of traditional risk management strategy

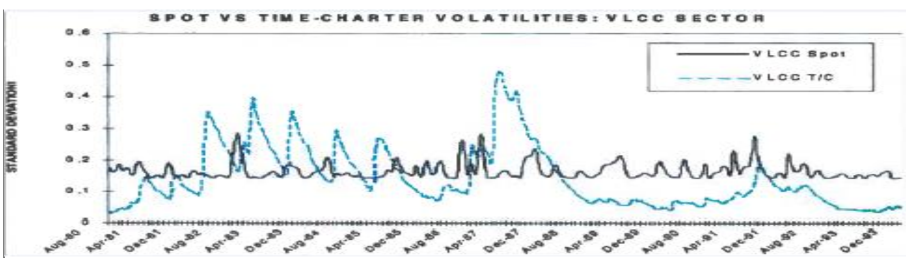
Diversification in tanker sizes or hiring vessels for different duration periods provide a good risk reduction. Owners who wish to avoid risk can invest in small tankers and long duration time charters. Others who seek higher returns should invest in large sizes and engage their vessels in spot markets. Asset risk is another risk which could be avoided. Investors can lease ships instead of owning them. Then they avoid capital gain/loss risk elements that normally appear in the ship owner’s cash flow. But owners should be aware of certain situations where time charter volatility may rise above the spot market (Kavussanos, and Visvikis, 2006, p.70).

Figure 2.6 One Year Time Charter Rate Volatilities for Different Size Tanker Vessels



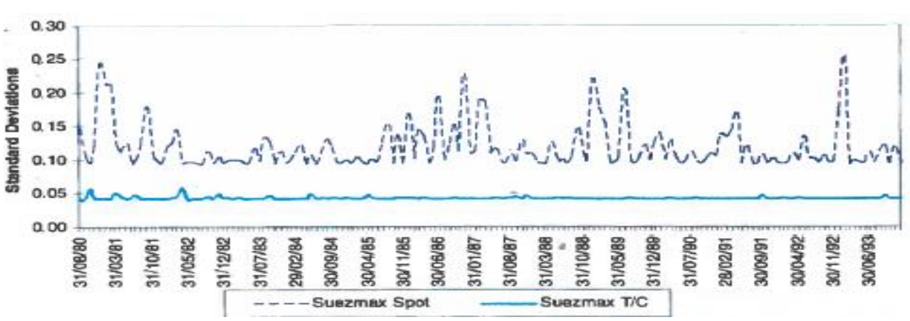
Source: Kavussanos and Visvikis (2006).

Figure 2.7 Spot vs. Time-Charter Volatilities (Standard Deviation): VLCC Sector



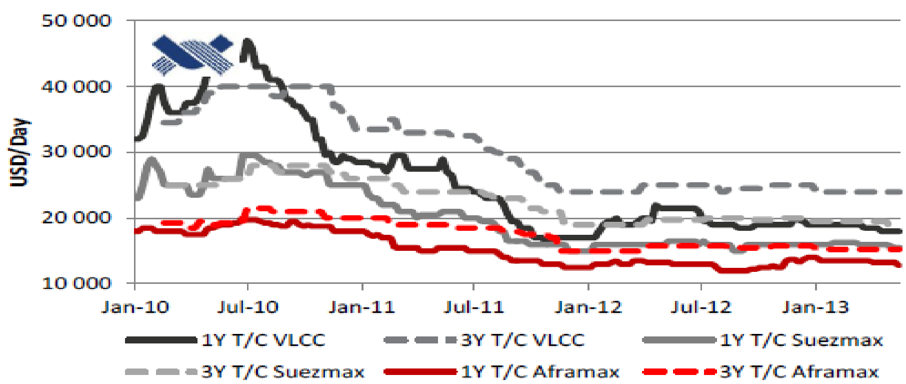
Source: Kavussanos and Visvikis (2006).

Figure 2.8 Spot vs, Time-Charter Volatilities (Standard Deviations): Suezmax Sector



Source: Kavussanos and Visvikis (2006)

Figure 2.9 Charter Freight Rates in USD for Different Tanker Sizes



Source: Fearnresearch (2013).

2.8.2 Risk management and the use of derivatives

Traditional risk management may be helpful but there are a lot of disadvantages. It is expensive to sale and purchase a vessel in order to change to different size segments. Such actions have a lack of flexibility when market conditions change rapidly. There will be a cost for changing chartering strategies like walking out of a certain freight contract and getting in another freight contract. In real life, it seems difficult to change the strategy as if could cause damage to the companies' reputation. In addition, chartering vessels for long duration could be hard for ship owners or charterers when the market declines or improves, respectively. The introduction of the financial derivatives since May 1985 was widely used for reducing the uncertainty risk of freight rates. Ultimately, the derivatives become businesslike tools for the management of market risks. The value of the derivative contracts derived from the underlying asset whose economic value required to be hedged. There are four types of derivatives contracts: the forward, future, swap and option contracts (Kavussanos, and Visvikis, 2011, p.2).

2.8.2.1 Forward and future Contract

The main objectives of ship owners are to maximize returns and minimize risk. Therefore, derivatives are contracts that developed from the need to minimize or eliminate risk. The word derivatives originate from the function of the contact. Precisely, it has no independent value, the values of the derivatives drive from the value of the underlying asset. A forward contract is an instrument used to secure the price of a commodity at a specific future date. The seller has the obligation to handover the agreed quality and quantity of the underlying asset at the fixed future date; the buyer has the obligation to take delivery of the agreed quality and quantity of the underlying asset at the fixed future date. The most specific feature of forward contracts are traded over the counter (Alizadeh, and Nomikos, 2009, p.9). Forward contracts are defined as a today made contract between two parties, where settlement take place on a specific date in the future at an agreed price. Forward contracts are used to eliminate uncertainty and reduce risk exposure. The market function is to enable the transfer of risk from one participant to another (Smithson et al. 1995, p.149). In order to insure that the forward agreement between two parties will be fulfilled, a margin requirement needed to be settled daily. Therefore, delivery of goods is rearranged by offsetting trade and the future contracts are supervised and controlled by a clearing house. The clearing house is an establishment which is responsible for settling trading accounts and clearing trades dispute. In addition, the clearing house maintains and regulates derivatives contracts to every clearing house member (Alizadeh, and Nomikos, 2009, p.11).

2.8.2.2 Swap and option contract

- The function of swap agreement is based on transfer risk between the contract

parties in exchange of fees during a period of time at specified intervals. There are four types of swap contracts: interest rate swap, asset swap, currency swap and credit swap (Alizadeh, and Nomikos, 2009, p.12).

- The holder of an option contract has the flexibility to choose either to use the derivative or not according to his position in the market. There are two types of option contracts, the put option and the call option. In the put option the holder has the right but not the obligation to sell the underlying asset at a specific price. On the other hand, the holder of the call option has the right but not the obligation to buy the underlying asset at a specific price. Both option rights last until specific date (Alizadeh, and Nomikos, 2009, p.12). It is important to know the statistical details of shipping derivatives and the properties of the fluctuation of freight rates and the hedging of freight rates derivatives. Freight derivatives or forward freight agreements were developed for efficient management and cost effective, risk control, such as risk resulting from freight fluctuation and bunker price soaring.

2.9 Chapter Conclusion

Clearly, supply and demand are the main specific factors that affect tanker freight rates. Over supply will lead to drop the freight rates. On the contrary, increase in demand surges the freight rates upward. But the shipping market is featured with uncertainty, such as political unrest in oil production areas could cause disruption of oil supply and cause unexpected turbulence in the freight rates curve. Consequently, shipping companies' cash flow security is exposed to risk. Therefore, investors must know and calculate the dynamic market elements which contribute significantly in the future of oil tanker market. The importance of utilizing statistical tools to forecast future market trends is inevitable. The classical linear regression model is an essential tool that can be utilized in order to predict and understand the oil shipping market.

Chapter.3 Methodology

3.1.1 Forecasting

The statistical or the quantitative forecasting method is the estimation of the value of a dependent or stochastic variable to predicting the future. There are different forecasting techniques which have been developed over the past years. A forecasting method is usually carried out in order to provide an aid for future planning and to the decision making process (Farnum, and Stanton, 1989, p.4).

Does any market, depend on demand and supply? The tanker freight rate market is also determined by the interaction of supply and demand. The freight rate is the price that a ship owner or operator charges for transporting cargo (UNCTAD, 2010, p.74). Hence, freight rates may be forecasted by using the financial econometrics which is the application of statistical techniques to economic problems. The main goal of this research is to analyze the freight rate movement for oil tankers and to provide an approach to the integration of an accurate model for oil tanker freight rates. On the other hand, analyzing uncertainties for the oil tanker freight rates is a major issue for oil tanker owners and other players in the market, who seek to improve profitability and reduce financial risk exposure. Therefore, the understanding of freight rates volatility is vital and imperative. This research aims to grasp knowledge of the shipping market. The outcome can aid ship owners in particular maritime oil companies in improving profit margins, through integral operations and also to enhance investment decisions. In addition, ship owner can reduce financial risk exposures by improving risk management through the use of freight and bunker derivatives.

3.1.2 Regression Analysis

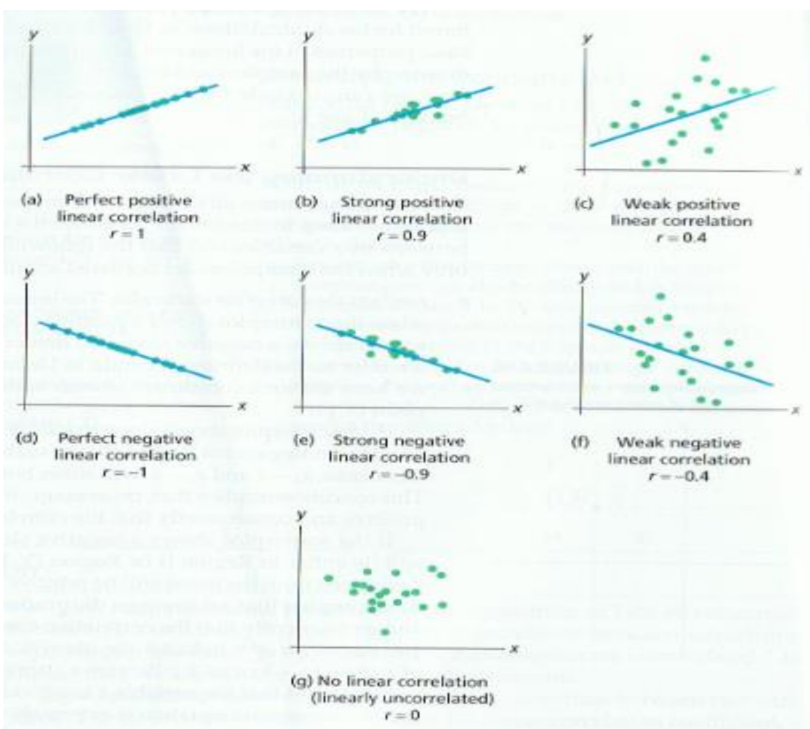
Regression forecasting analysis is an important tool that is used to predict the value of a variable based on the value of another variable. The stochastic variable is the dependent variable or the outcome variable. Its movement can be explained by the movements of other variables. The linear regression is a forecasting technique used to create the relation between the dependent variable and the independent variables

(Brooks, 2008, p.27). On the other hand, to form a regression equation which is able to forecast a variable, it is required only the value of the predictor variables to fit into the estimated equation (Farnum, and Stanton, 1989, p.254).

3.1.3 Regression versus correlation

Fig 3.1 indicates the strength of a linear relationship or the degree of linear association between two variables. Correlation infers to the test of significant data and their association. If two variables are correlated, then they are being treated in a completely symmetrical way. In regression, both variables are treated differently. The dependent variable value is stochastic and its movement explained by the non-stochastic independent variable which have fixed values in repeated samples (Brooks, 2008, p.28).

Fig 3.1 Various Degrees of Linear Correlation



Source: Weiss, (2008).

3.1.4 Multiple Linear regression model

According to Brook (2008) the model has predictive capabilities. The stochastic variable is explained by reference to behavior of the non-stochastic variable. The stochastic or the dependent variable is designated as Y and the non-stochastic or the independent variable designated as X_1 in the simple regression model form is;

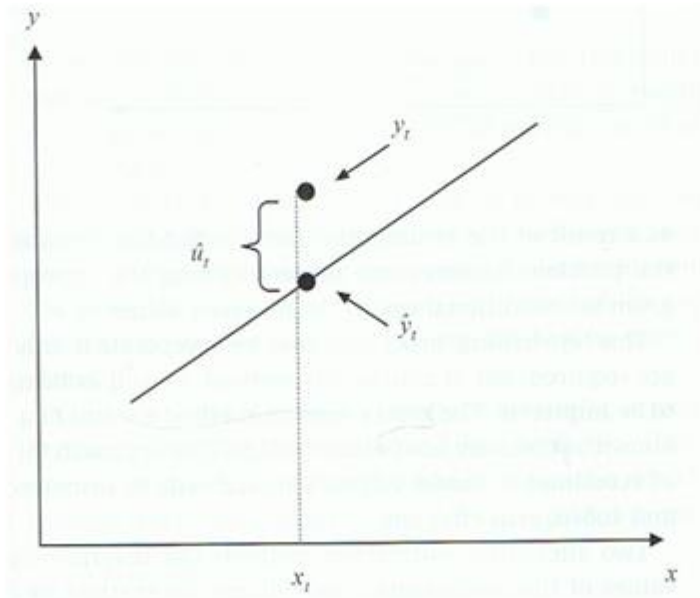
$$y = \alpha + \beta x_1 + \mu_t \ldots\ldots\ldots\ldots (2)$$

The intercept (α) is the value of the position on y axis in which the straight line passes. Or is the average values that y takes when x is zero. The regression model, thus predict changes in dependent variable as a function of changes of values of the other independent variable. But in many cases using one independent variable is not enough to explain the future behavior of the dependent variable. Therefore, it is recommended to use more than one explanatory variable and examine the effects of all of them in one regression model which is called the multiple regression models;

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots\ldots + \mu_t \ldots\ldots\ldots\ldots (3)$$

Accordingly, the multiple regression is a statistical technique used to predict the unknown value of a variable from the changes in value of several known variables. But in reality, the data of independent variables does not fit exactly on a straight line. Therefore, the error term applied to the equation in order to make the model more realistic. Fig 3.2 The error term denote by u. Consequently, the error terms summed in order to eliminate each other. In other words, the error terms has a mean value equal to zero. Afterward they squared and minimized the result known as (RSS) the residual sum of squares. Hence, the equation about the estimation of coefficients β_1, β_2, β_t, of given variables x_1,x_2,x_t to give the best estimate. In addition, the estimated residual is the vertical distance between the estimated regression line and the data point (Brook, 2008, p.33).There are some assumptions for the linear regression:First, is the linearity, which concludes that the linear regression assumes that there is a straight line relationship between the explanatory or the independent variables and the

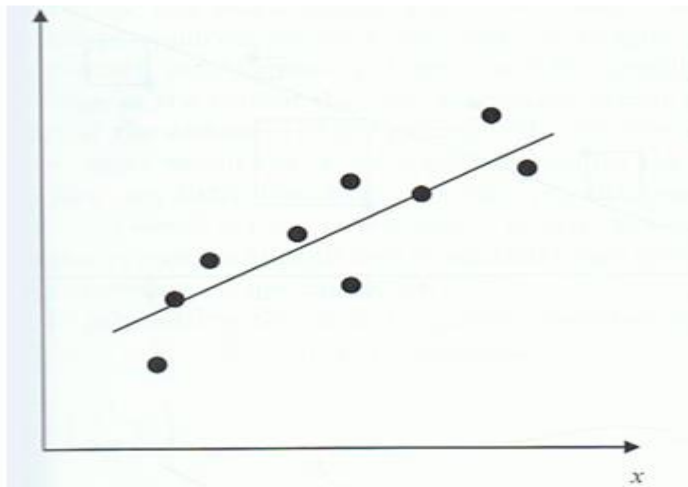
Fig 3.2 Plot of a single observation, the residual and the fitted value



Source: Brooks. (2008).

dependent variable Fig 3.3 presents a Scatter plot which examines the relationship between the variables. On the other hand, it is an important step to determine whether the variables are related (the trend and strength of the relationship). A scatter plot is a graph with the dependent variable y on one axis and the independent variable x on the other axis. Moreover, the linearity signs are either positive or negative. Positive imply that y increases as x increases; a negative sign implies that y decreases as x increases (Weiss, 2008, p188). The second assumption is the normality (Figure 3.4); the independent variable should be normally distributed around its mean value. The distribution shape for each variable is checked by the skewness and kurtosis. Kurtosis measures the peak of the distribution while the skewness measures how the data are symmetrically distributed. The normal distribution form is symmetric about its mean and not skewed and said to be mesokurtic. When the data is skewed then the mean is not in the middle of the distribution, thus the data is not normally distributed (Brooks, 2008, p.161)

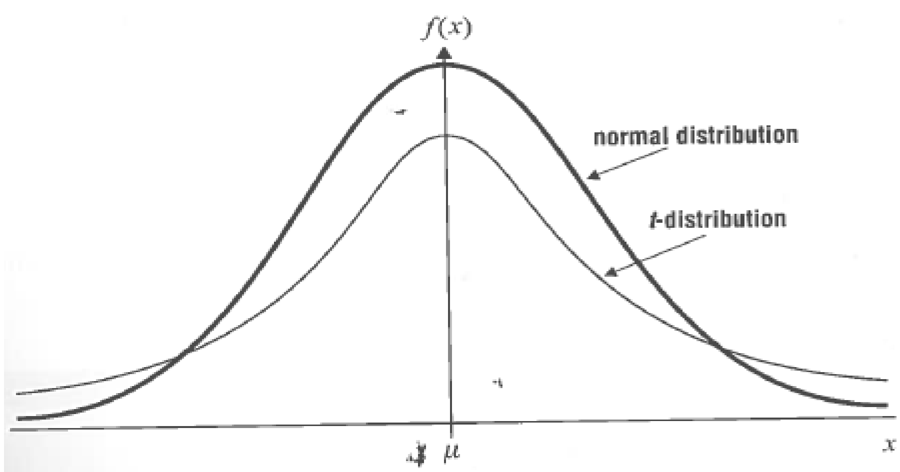
Fig 3.3 Scatter plot of two variables with a line of best fit



Source: Brooks, (2008).

On the other hand, the normal shape is not too peaked and not too flat. The kurtosis value of the shape should be not greater or less than 3 of the normal distribution (Visvikis, 2013, p.30).

Fig 3.4 The Normal distribution versus the *t*-distribution



Source: Brooks, (2008).

The third assumption is homoscedasticity; it describes the situation in which the error term is the same across all values of the independent variables. Moreover, this means that the residuals are approximately the same. On the contrary, heteroscedasticity exists when the size of the error terms differs across the values of an independent variable. By looking at the residual plot, data is homoscedastic if the residual plot is the same width for all values of the predicted depended variable. Heteroscedasticity is usually shown by a cluster of points that is wider as the values for the predicted variable get larger and their variance is increasing symmetrically with x axis. Detecting homoscedasticity in a linear regression model is by performing the White test (Brook, 2008, p.132).

The fourth assumption is the multicollinearity; it is described as a condition where the one predictor variable is very highly correlated with other independent variable than with the dependent variable. It is a kind of problem if the purpose is to estimate the contributions of individual predictor. Ultimately, if there is a high bivariate correlation, one of the two variables has to be deleted from the model (Abraham, and Ledolter, 1983, p.46).

The last assumption is the serial correlation; it is the violation to the assumption Cov $(u_i, u_j)=0$ for $i \neq j$; it confers rise to auto correlation. That means the values of error term are not independent. In a way, that the errors in specific period influence the error in another period of time. The overtime relationship between errors called autocorrelation or the errors are serially correlated (Brooks, 2008 p.139).

The following is a brief of the unobserved error terms assumptions;

1. Linearity assumption, the interpretation is that the error have mean zero $E(\mu_t)=0$
2. Homoscedasticity assumption, the interpretation is that the variance of the error terms is constant on entire value of the independent variable $Var(\mu_t)=\sigma^2$
3. **Autocorrelation** assumption, which means that the errors are statistically independent of each other Cov $(\mu_t,\mu_j)=0$

4. 4. The error has no relationship with the corresponding x variants Cov $(\mu_t, x_t)=0$

5. The errors are normally distributed.

3.1.5 The Equation Parameters

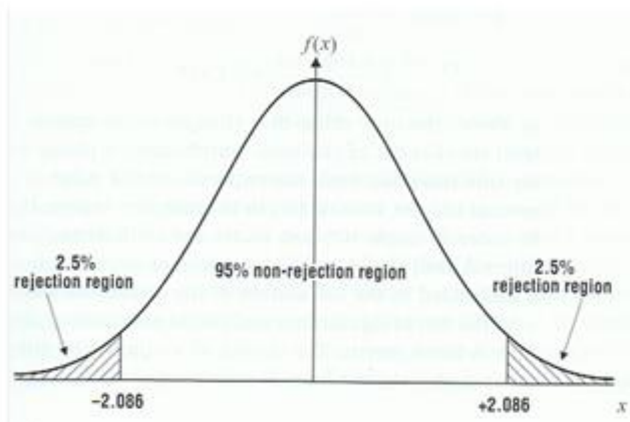
The effect of an independent variable on the behavior of a dependent variable is quantified by the parameter *b*, the slop of the line. In a multiple regression, the effect is measured after eliminating the effect of all other given explanatory variables. For example, the effect of x_2 on y measured by b_2 after holding constant the effect of x_1 ,x_2, x_3,……,x_t. In other words the regression coefficient is the coefficient of variables is interpreted as the change in the response by one unit change in the coordinating explanatory variable keeping all others variables held constant (Brooks, 2008, p.89).

3.1.6 Hypothesis Testing

In the classical linear regression model the response of variable y to the effect of the independent variable x should be tested. If β=0 then the variables are not related. By using the hypothesis testing the relationship between x and y can be tested, where the null hypothesis H_0: β=0 and the alternative hypothesis is H_1: β≠0. The hypothesis used to determine whether the relationship between x and y is significant. In multiple regression problems, certain tests of hypothesis about the model parameters are useful in measuring model adequacy. Moreover, hypothesis testing in simple and multiple regression requires that the error terms in the regression model are independently and normally distributed with the mean zero and variance σ^2. The statistical hypothesis that is actually being tested is the null hypothesis. The remaining outcome of interest represents the alternative hypothesis. After the assumption that the error term is normally distributed, and in order to perform a statistical test the distribution should be known under the null hypothesis. The distribution depends largely on the assumptions made in the model. Since u_t value effects partially on y_t. Therefore, y_t in the null hypothesis, the significance level is the probability of rejecting

H_0 when it is in fact true. In other words, the significance level is the probability of rejecting H_0 given that H_0 is true, Hypothesis testing rules are designed by making the probability of error fairly small, common value for significance level, often denoted *a* is 0.05 (Fig 3.5), although some times 0.1 is used (Brooks, 2008, p.56)

Fig 3.5 Rejection regions for a two sided 5% hypothesis test



Source: Brooks, (2008).

3.1.7 Coefficient of determination

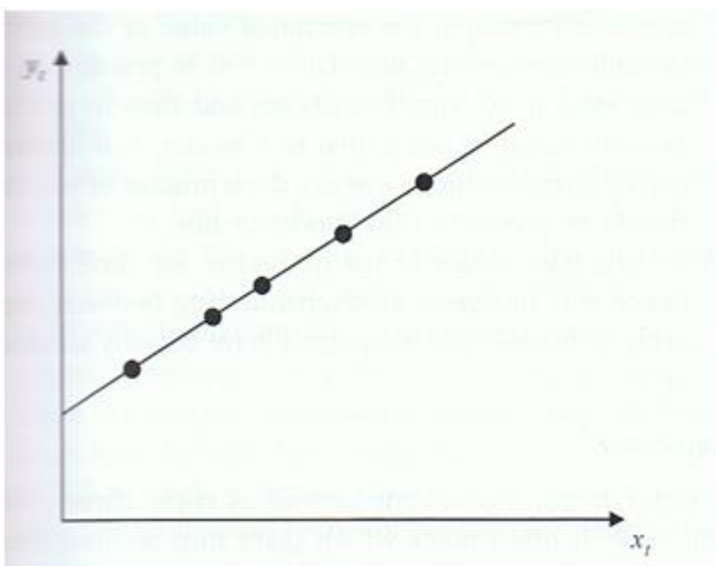
In regressions, R^2 is a statistic that will give guidance about the goodness of fit of model. R^2 defined as the ratio of variation between the actual and fitted data for that observation.

$$R^2 = \frac{ESS}{TSS}$$

Where ESS is the explained sum of squares and TSS is the total sum of squares. The coefficient of determination is a statistical measure which indicates how well the regression model approximate or actually fit the data. Also, it is defined as the square of correlation coefficient. The value of R^2 lies between 0 and 1.0. An R^2 of 1.0 value

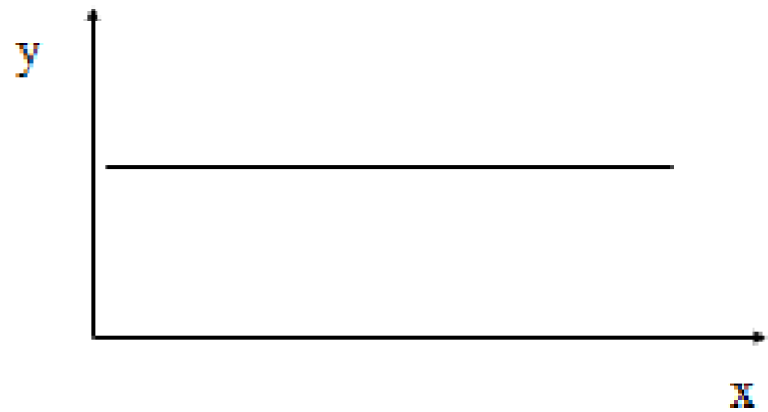
R^2=1 slop indicates that the regression model fits the date well (Fig 3.6). On the contrary, R^2 of zero value represented by a flat estimated line (Fig 3.7) indicates that the regression model is not providing a good fit to the data. In some instances, where R^2 is used, R^2 increases as the number of variables in the model increases and not decreases. At last, there is no improvement when someone tries to include more variables to the model. As R^2 increases as more variables are added to the model, the adjusted R^2 are often used which takes into account the number of independent variables in the model. Adjusted $R^{2\ is}$ also used to determine the effectiveness of the variable in the model. In other words, high R^2 value means all variables are significant (Brook, C. 2008, p.110).

Figure 3.6 All data points lie exactly on the estimated line R^2=1



Source: Brooks, C. (2008)

Figure 3.7 Flat estimated line R^2=0



Source: Brooks, C. (2008).

3.2 Data collection

3.2.1 The shipping market model

The data for this research was collected and the analysis was extracted from Clarkson intelligence network, (2010). Clarkson publishes data which is used as a solution in this research and comprises data for the relevant variables such as the industrial growth, BDTI, New Building vessel price, fleet size, bunker price, second hand and scrapping vessel price. The model is estimated using the world oil tanker shipping market monthly statistics from 2000 to 2010, applying the classical linear regression model.

Therefore, an owner who predicts correctly the market peak when the others are wrong, will get the best opportunities. Consequently, investors should develop a theoretical explanation of how peaks are generated and to solve the complexity of the freight rate market (Stopford, 2009, p.136). Freight rates are normally determined by the balance between demand and supply through perfect competition among owners, operators and charterers. The oil tanker market is enormously complex. Therefore, the first step is to simplify the model by single out those variables that are most important. On the other hand, redundant details might be ignored in order not to hinder a clear analysis. From the influences in the shipping market those important variables can be chosen, some affecting the demand of oil tanker transport and others affecting the supply side.

These are summarized according to the following; Demand a) GDP growth or industrial production b) seaborne oil trade c) political unrest d) bunker price. Supply a) New Build b) Existing fleet c) Scrapping. Other variables such as the distance covered which is considered as a tangible variable. For instance, the distances between MEG and China or India can be precisely obtained. Therefore, tangible variables are more efficient provided sufficient research is achieved (Stopford, 2009, p.704). The technique of the model works in two directions. The demand directions consist of (GDP growth) as the first explanatory variable through the activities of industrial countries which generate various types of goods and require power to run the factories and household appliances. Ultimately, the demand for oil transport is affected accordingly, giving final demand for shipping services simply more tonnage is required. The cost of transport is important for decision making. Therefore, a forecast decision is required by cargo owners to find sufficient volume for their cargo and suitable transport (Stopford, 2009, p.704). On the other hand, ship owners should examine the trade balance and establish decisions according to the results. In addition, ship owners through market analysis should enable the identification of the opportunities and threats to the shipping market (Branch, 1998, p.314).

On the supply side, the existing fleet represents the tonnage availability in the short term. The supply then is increased by new buildings and reduced by scrapping. The amount of tonnage provided also depends on the efficiency with which oil tankers are operated, particularly ships speeds. For example, an oil tanker vessel steaming at reduced speed carries less cargo than the same size tanker steaming at a high speed performing the same voyage. The fleet productivity variable is expressed in ton miles per deadweight. Moreover, Supply represents the available tonnage multiplied by productivity and calculated in ton miles (Stopford, 2009, p.722). Ultimately, demand and supply are important to the model because they increase competition that makes the price fluctuate. Excess in demand induces competition among charterers and surges the price up. On the other hand, excess in supply induces competition among owners and pulls the price down.

3.2.2 Model consistency

The freight rates market links supply and demand. It is the pivot point which controls the balance of supply and demand. When tonnage is in short supply, freight rates start to increase and cash flows into ship owners' accounts. At this point, owners start ordering new tonnage and charterers start seeking other alternatives to reduce the cost of transportation. When tonnage is over supply, freight rates fall to a level where ship owners barely cover the operation costs. Adversely, cash at this point flows into the charterers accounts. It is obvious that the relationship between market balance and freight rates is the most important bond in the model analysis. In other words, demand is uncertain, unpredictable and volatile. On the other hand, supply is slow and kills time to change. Ultimately, a forecaster can see the future close enough if his forecast is based on reliable information which makes the forecast more accurate (Stopford, 2009, p.709).

Econometric modeling can be successfully applied to analyze the behavior of the oil tanker market. Time series data analysis can be applied to the statistical model using important variables in shipping activities discriminated by their correlation and their cyclic characteristics. On the other hand, it is preferable not to use raw data for indices and prices; those are commonly converted into returns (Brooks, 2008, p.7).

Simple returns $R_t = = \frac{Pt - Pt-1}{Pt-1} \times 100\%$ …………………………… (4)

Where R_t refers to the simple returns at time t and P_t refers to the price of the asset at time t.

Brooks, (2008) implies that if the regression model complies with the assumptions, then the ordinary least squares is an efficient and unbiased estimator of the model parameter. In other words, the model is known as the best linear unbiased estimator (Blue). Therefore, the first process is to determine whether the independent variables are at a significant level. The p- value of independent variable should not exceed 5 percent or 10 percent if the variables are jointly can explain the dependent variable by performing the F-test. Then drop one of the high correlated variables in order to avoid multicollinearity. Afterward the normality is tested, and dummy variables applied if the residuals are negatively skewed. Applying dummy variables are one way to remove the big outliers in the data. In addition, the consequence of presence of serial correlation and heteroscedasticity leads to inefficient or no Blue coefficient of the estimator. If the estimated equation is heteroscedastic but not serially correlated White correction is used. But for the presence of both heteroscedasticity and autocorrelation the Newey-West is used. If autocorrelation is present, R^2 is likely to be magnified relative to its correct value. The model with autocorrelated residual can be solved by adding lagged values of the dependent variable or the explanatory variable. By adding lagged values of dependent variable violates the assumption that the independent variables are non-stochastic, although the coefficient estimates are still consistent. Moreover, examining parameters consistency can be performed by using the Chow test for detecting broken points and Ramsey test to ensure model structural stability. In addition, Brooks, (2008) States that the ordinary least square estimators holding the assumptions are unbiased, meaning that the coefficient estimate values as equal to their true values.

$$E(\hat{\alpha}) = \alpha \qquad \text{and} \qquad E(\acute{B}) = B$$

Brooks, (2008) states that in order to know whether the estimates are reliable and not diverges much from one sample to another within the given population; the estimate is given by its standard error. Standard error is a general measure of the accuracy of the regression Parameters.

3.3 Time charter market decision model under uncertainty

A forecast made by Fearnley's (2013) indicates that the one-year time-charter (T/C) for VLCCs will end up to $20,000/day at the end of 2013, for Suezmax the one-year T/C will end up with $16,500/day and for Aframax the one-year T/C will end up with $14,000/day. Currently the one-year T/C market for the three segments is gaining $17,500, $15,000, and $12,750, respectively. Another forecast report on the first quarter of 2012 by Drewry shipping consultants' indicates that overall views of the tanker time charter market are expected to remain bearish. In addition, tankers over supply continued comparing with fewer cargoes. The time-charter market is featured with lack of confidence. On the other hand, the one year rate is downward by 2.5% from the fourth quarter of 2011 (Drewry, 2012). Thus, time chartering covers a longer period and requires an ideal opportunity to take a reasoned view of market prospects. Moreover, forecasting a time-charter depends on the forecasted freight rates level of the spot market compared with the available time charter rate and the residual value of the oil tanker when the charter ended (Stopford, 2009, p.708). Random shocks such as political unrests and war upset the stability of the economic system and leads to the cyclic process and increase uncertainty. Therefore, short term market prediction is useful. On the other hand, long term prediction is not reliable.

3.4 Variables affect freight rates

The Baltic Exchange International Tanker Routes (BITR) consists of the Baltic Exchange Dirty Tanker Index (BDTI) and the Baltic Exchange Clean Tanker Index BCTI). The BITR (see Table 3.1) reports on 14 dirty tanker routes out of 19 international routes and publishes a daily fixture list. The BDTI index daily assessments provide daily summaries of crude oil tanker and freight rates on international dirty tanker routes. It also provides an assessment for future behavior of freight rates, where the BCTI provides daily assessments of international clean tanker routes. Thus, BDTI examines the strength and weakness of freight rates return on the portfolio of crude oil tankers. Moreover, The Baltic Exchanges (2013) states that freight rates play the most important role among other factors in securing shipping company cash flow. But freight rates depend on a number of external variables which drive the fluctuation behavior of the freight rates (The Baltic Exchange, 2013).

(i). Fleet supply is one important variable which includes fleet size and operational efficiency, new build orders and scrap price and amount of laid up vessel. Thus, increasing active fleet size means low freight rates. On the contrary, the declining of active fleet size means higher freight rates.

(ii). Commodity demand; volatility in commodity price fluctuates overtime; the increase of industrial production requires more power. Therefore, if more oil is needed, it means increasing sea freight rates.

(iii). Weather deterioration contributes highly to the fluctuation of freight rates, such as ice in port or flooding rivers have big impact on the freight rate level.

(iv). Bunker price: generally, bunker costs represent a major part in the ship running costs. Therefore, the high cost of bunker price has a big impact on the shipping market. Rise in bunker price generates an increase in ship operating costs.

(v). Chock points; this factor particularly threatens the tanker freight market and undermines the reliability of ocean freight shipment. The increase of congestion means less reliable loading and unloading times, because most of world oil is passing through congested and relatively narrow channels, such as Suez canals, Bosporus and Strait of Hormuz. In addition, the threat of conflicts, collisions and terrorist attacks attribute in overcrowding of shipping lanes (Baltic Exchange, 2013). In addition, there is lot of unpredictable variables which might cause impact on freight rates, such as, the closure of one of the world largest oil refinery in the United States Virgin Islands, causing short-term declines on region trade. On the other hand, high competition from new build oil refineries in emerging countries provides a positive effect on tanker freight rate. Other reasons such as political unrest in Libya caused a drop in oil extraction from 1.57 million barrels per day to 300 thousand barrels per day. In addition, bad weather caused congestion on the Bosporus leads to increasing tanker freight rates. There are huge amounts of oil passing every day through this bottleneck (UNCTAD 2012, p.64).

3.1 Table 2 Baltic Dirty Tanker Index Routes

---	From	To	Size	Class
TD1	MEG	USG	280,000mt	VLCC
TD2	MEG	Singapore	260,000mt	VLCC
TD3	MEG	Japan	250,000mt	VLCC
TD4	WAF	USG	260,000mt	VLCC
TD5	WAF	USAC	130,000mt	Suezmax
TD6	Black Sea	Mediterranean	135,000mt	Suezmax
TD7	North Sea	Eur Continent	80,000mt	Aframax
TD8	Kuwait	Singapore	80,000mt	Aframax
TD9	Caribbean	USG	70,000mt	Aframax
TD10	Caribbean	USAC	50,000mt	Panamax
TD11	Mediterranean	Mediterranean	80,000mt	Aframax
TD12	Antwerp	Houston	55,000mt	Panamax
TD14	Indonesia	Japan	80,000mt	Aframax

Source; Oil Tankers, 2007. http://oiltankers.blogspot.kr/2007/10/test-bdti-table.html

Chapter 4 Empirical Results

The Empirical analysis is undertaken by analyzing the following oil tanker segments; Very large crude carrier VLCC, Suezmax, Aframax and Medium range product tanker. The empirical results are devoted to analyzing the freight rates for different tanker segments besides a comparison between two VLCC tanker routes. In addition, empirical results obtained for 3 years' time-charter rates as a security prove a long duration charter. The aim of these results is to explore the behavior of the different oil tanker market segments and to determine the factors influencing the freight rates.

The monthly data from 2000 to 3013 were collected from Clarkson shipping intelligence network. The first two regression models utilize two VLCC trade routes characterized with high trading activities TD1 MEG-USG and TD3 MEG-JAPAN. The econometric software packages EVIEWS 7 were used.

4.1.1 VLCC spot freight model; Ras Tanura-LOOP, MEG-USG

In this model, the dependent variable is the spot freight rates for the VLCC tanker serving the MEG-USG route. The independent variables are; BDTI TD1 (DBDTI), Fujairah 380 cst bunker price (DBKRPC), Arabian light crude oil price (DCRUDPC), the industrial production of USA (DINDUS), LIBOR (DLIBOR), VLCC New Build Price (DNBPC), VLCC Second Hand Price (DSHPC), VLCC Scrap Price (DSCPC), VLCC Fleet development (FLEET), North America Oil Production (NA_OILP).

After running the first regression (Table 4.1) which examined the independent variables data and determine whether the independent variables are significant or not, the null hypothesis. The F-test probability value is 0.00. Therefore, all variables jointly are significant. But some variables showing high p-value, threfore, should be excluded from the model. The rule is, if the p- value of the coefficient estimate is less than 0.5% then the explanatory variable is considered to be significant. In addition, and for the purpose of avoiding multicllinearity, the independent variables should not be highly correlated.

Table 4.1 VLCC Model Ras tanura-LOOP Route, Results of first regression

Dependent Variable: VLCFRET
Method: Least Squares
Date: 10/01/13 Time: 09:42
Sample (adjusted): 2 157
Included observations: 155 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	227.5466	26.47291	8.595449	0.0000
DBDTI	0.332116	0.076049	4.367136	0.0000
DBKRPC	-0.271924	0.322068	-0.844307	0.3999
DCRUDPC	-0.666945	0.297070	-2.245080	0.0263
DINDUS	-3.28E-06	1.57E-05	-0.208870	0.8348
DLIBOR	0.196786	0.249316	0.789307	0.4312
DNBPC	4.755037	1.160929	4.095889	0.0001
DVLSHPC	1.856612	0.565795	3.281420	0.0013
DVLSCPC	-0.092941	0.275139	-0.337796	0.7360
FLEET	-0.456313	0.146384	-3.117224	0.0022
NA_OILP	-11.78703	4.524351	-2.605243	0.0101

R-squared	0.571648	Mean dependent var	66.26845
Adjusted R-squared	0.541901	S.D. dependent var	36.63721
S.E. of regression	24.79716	Akaike info criterion	9.327659
Sum squared resid	88545.49	Schwarz criterion	9.543644
Log likelihood	-711.8936	Hannan-Quinn criter.	9.415387
F-statistic	19.21720	Durbin-Watson stat	0.796592
Prob(F-statistic)	0.000000		

On the other hand, Table 4.2 shows a high corelation between crude oil price and bunker price, as well as high correlation between fleet and North Americal oil production. Therefore, running the second regression (see Table 4.3) should be performed without one of the two correlated variables by excluding the variable with high p- value. But Brooks, (2008) argues that if one of the correlated variables dropped off, then the other insignificant variables at an early stage might become significant at a later stage.

Table 4.2 VLCC model, Ras Tanura-LOOP, Correlation Table

Correlation

	DBDTI	DBKRPC	DCRUDPC	DINDUS	DLIBOR	DNBPC	DVLSHPC	DVLSCPC	FLEET	NA_OILP
DBDTI	1.000000	0.082198	0.097197	-0.084923	0.083949	0.103103	0.211305	0.037886	-0.075938	-0.068464
DBKRPC	0.082198	1.000000	0.664524	0.007339	0.037305	0.054482	0.191663	0.217541	-0.008254	0.017451
DCRUDPC	0.097197	0.664524	1.000000	-0.100834	0.064809	0.141699	0.242137	0.257634	-0.035026	0.005783
DINDUS	-0.084923	0.007339	-0.100834	1.000000	0.015162	0.033339	0.029999	-0.070635	-0.043447	-0.080623
DLIBOR	0.083949	0.037305	0.064809	0.015162	1.000000	0.399277	0.134462	-0.272576	-0.064998	-0.083744
DNBPC	0.103103	0.054482	0.141699	0.033339	0.399277	1.000000	0.420971	0.058603	-0.292112	-0.194420
DVLSHPC	0.211305	0.191663	0.242137	0.029999	0.134462	0.420971	1.000000	0.362872	-0.206149	-0.072796
DVLSCPC	0.037886	0.217541	0.257634	-0.070635	-0.272576	0.058603	0.362872	1.000000	-0.078177	-0.007525
FLEET	-0.075938	-0.008254	-0.035026	-0.043447	-0.064998	-0.292112	-0.206149	-0.078177	1.000000	0.709619
NA_OILP	-0.068464	0.017451	0.005783	-0.080623	-0.083744	-0.194420	-0.072796	-0.007525	0.709619	1.000000

The second regression was performed with six idependent variables after excluding the crude oil price and the VLCC scrap price. Normally *t* -test is performed to single hypothesis and F- test for more than one coefficient. The finding shows that all the six independent variables are at the significant level. In other word, F-test result is 0.00, therefore, the null hypothesis is not rejected that the all of the coefficients are jointly zero.

Table 4.3 VLCC Model, Ras Tanura-LOOP Route, Test Results of 2nd Regression

Dependent Variable: VLCFRET
Method: Least Squares
Date: 10/01/13 Time: 10:40
Sample (adjusted): 2 157
Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	228.6885	26.51744	8.624082	0.0000
DBDTI	0.340914	0.075655	4.506195	0.0000
DBKRPC	-0.760482	0.244630	-3.108704	0.0023
DNBPC	4.861739	1.071358	4.537923	0.0000
DVLSHPC	1.664111	0.531020	3.133799	0.0021
FLEET	-0.429079	0.145981	-2.939281	0.0038
NA_OILP	-12.53701	4.516701	-2.775700	0.0062

R-squared	0.550549	Mean dependent var	66.18981
Adjusted R-squared	0.532451	S.D. dependent var	36.53204
S.E. of regression	24.97972	Akaike info criterion	9.317840
Sum squared resid	92974.00	Schwarz criterion	9.454692
Log likelihood	-719.7915	Hannan-Quinn criter.	9.373423
F-statistic	30.41931	Durbin-Watson stat	0.782098
Prob(F-statistic)	0.000000		

Unfortunately, the null hypothesis for normal distribution is rejected (Figure 4.1). The non normality caused by outliers points (Figure 4.2) severly deviates from the straight line (Brooks, 2008 p.167). Therefore, the null hypothesis of the first regression indicates that the residuals are not normally distributed. Therefore, and in order to remove the large amount of outliers, the dummy variables are used. The dummy variable is adding a seasonal adjustment and enables to be regressed as a part of the model (Brooks, 2008 p.169).

Figure 4.1 VLCC Model, Ras Tanura-LOOP Route, Non Normality Test Results

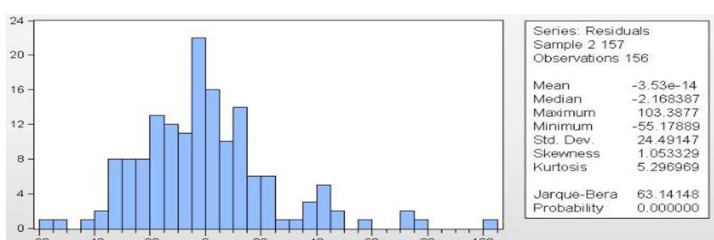


Figure 4.2 VLCC Model, Ras Tanura-LOOP, Residual graph

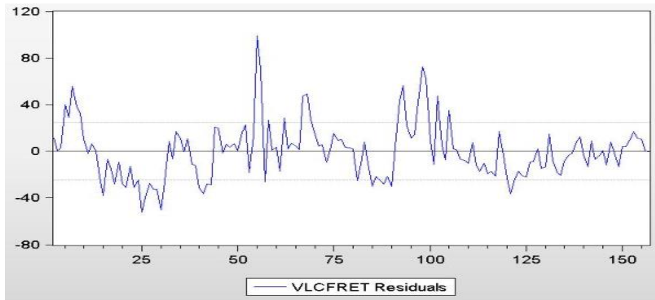


Table 4.4 VLCC Model, Ras Tanura-LOOP, 3rd Regression Results

Dependent Variable: VLCFRET
Method: Least Squares
Date: 10/01/13 Time: 19:37
Sample (adjusted): 2 157
Included observations: 156 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	182.1163	15.98394	11.39370	0.0000
DBDTI	0.408769	0.045062	9.071338	0.0000
DNBPC	5.471746	0.644169	8.494269	0.0000
DVLSHPC	0.929223	0.312165	2.976701	0.0034
FLEET	-0.674482	0.088390	-7.630769	0.0000
NA_OILP	-2.960237	2.756023	-1.074097	0.2845
DMY1	27.37215	3.411914	8.022521	0.0000
DMY2	41.29712	2.742436	15.05856	0.0000

R-squared	0.842984	Mean dependent var	66.18981
Adjusted R-squared	0.835557	S.D. dependent var	36.53204
S.E. of regression	14.81431	Akaike info criterion	8.278985
Sum squared resid	32480.65	Schwarz criterion	8.435388
Log likelihood	-637.7608	Hannan-Quinn criter.	8.342509
F-statistic	113.5109	Durbin-Watson stat	1.520775
Prob(F-statistic)	0.000000		

Two dummy variables (with a value of zero or one) included in the last regression and the outcomes results were valid (see Table 4.4) because of the null hypothesis tests for the three assumptions; the normal distribution (Figure 4.3), no heteroscedasticity (see Table 4.5) and no serial correlation (see Table 4.6) are not rejected. Also R^2 equals to 0.84. Therefore, the model holds all the assumptions, so the estimators are Blue.

Figure 4.3 VLCC Model, 3rd regression, Histogram of Normality Results

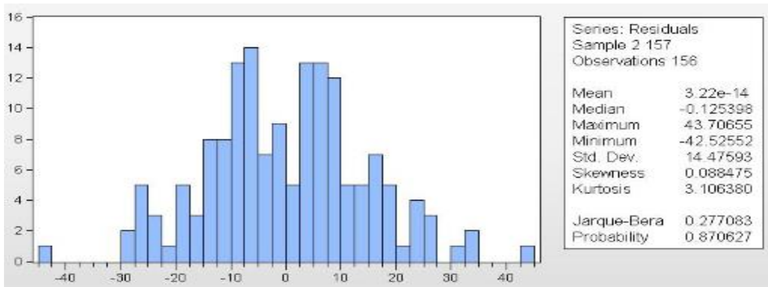


Table 4.5 VLCC Model, Ras Tanura-LOOP, No Heteroscedasticity Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.800246	Prob. F(7,148)	0.0912
Obs*R-squared	12.24064	Prob. Chi-Square(7)	0.0929
Scaled explained SS	11.60340	Prob. Chi-Square(7)	0.1144

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/01/13 Time: 19:31
Sample: 2 157
Included observations: 156

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-99.84085	321.3351	-0.310706	0.7565
DBDTI	0.357226	0.905901	0.394332	0.6939
DNBPC	2.051688	12.95013	0.158430	0.8743
DVLSHPC	3.972227	6.275651	0.632959	0.5277
FLEET	-2.868688	1.776954	-1.614386	0.1086
NA_OILP	88.18453	55.40603	1.591605	0.1136
DMY1	81.47141	68.59182	1.187771	0.2368
DMY2	156.2646	55.13287	2.834327	0.0052

R-squared	0.078466	Mean dependent var	208.2093
Adjusted R-squared	0.034880	S.D. dependent var	303.1551
S.E. of regression	297.8212	Akaike info criterion	14.28078
Sum squared resid	13127229	Schwarz criterion	14.43719
Log likelihood	-1105.901	Hannan-Quinn criter.	14.34431
F-statistic	1.800246	Durbin-Watson stat	1.357269
Prob(F-statistic)	0.091243		

Brooks, (2008) states that t Durbin-Watson statistics, is the simple test used for detecting autocorrelation. And the results should be equal to 2, but the Durbin-Watson Test cannot detect many forms of serial correlation. Therefore, a joint test for autocorrelation should be performed by the Breush-Godfrey test.

Table 4.6 VLCC Model, Ras Tanura-LOOP, No Serial Correlation Results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.629802	Prob. F(10,138)	0.1042
Obs*R-squared	16.47780	Prob. Chi-Square(10)	0.0867

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/01/13 Time: 19:24
Sample: 2 157
Included observations: 156
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.225590	15.79850	-0.014279	0.9886
DBDTI	0.033598	0.046762	0.718481	0.4737
DNBPC	-0.482063	0.670241	-0.719238	0.4732
DVLSHPC	0.002794	0.321659	0.008686	0.9931
FLEET	-0.013737	0.087246	-0.157451	0.8751
NA_OILP	0.312006	2.730630	0.114262	0.9092
DMY1	-1.487683	3.433855	-0.433240	0.6655
DMY2	-3.304364	2.916832	-1.132860	0.2592
RESID(-1)	0.227424	0.095158	2.389963	0.0182
RESID(-2)	0.180981	0.097173	1.862472	0.0647
RESID(-3)	0.017486	0.094966	0.184130	0.8542
RESID(-4)	0.092131	0.095995	0.959744	0.3389
RESID(-5)	-0.026824	0.096147	-0.278994	0.7807
RESID(-6)	-0.013019	0.095115	-0.136877	0.8913
RESID(-7)	0.049927	0.094272	0.529612	0.5972
RESID(-8)	0.006522	0.094197	0.069237	0.9449
RESID(-9)	0.005263	0.094833	0.055500	0.9558
RESID(-10)	-0.063155	0.093340	-0.676612	0.4998

The results of the final estimate parameter can be substitutes in the multiple regression equation. The model function can be used to predict the value of the freight rates for the VLCC tankers serving the route MEG_USG.

VLCC Freight rates= 182.116 + 0.409*DBDTI + 5.472*DNBPC +0.929*DSHPC-0.674*FLEET – 2.960*NA_OILP + 27.960*DMY1 + 41.297 DMY2

The coefficient of determination is equal to 0.84 which means that the model is good enough to explain the freight rates. It also indicates that about 84 % of the variation in statistics of the freight rates can be explained by the relationship to the independent variables; the Baltic Dirty Tanker Index, New Build Price, Second Hand Price, Fleet, North America Oil Production and the dummy variables. Therefore, the investigation from the regression model revealed that the abovementioned independent variables significantly determine the behavior of the spot freight of the route Ras Tanura – LOOP. In addition, results showed that other variables could not be significant to determine the VLCC voyage charter freight rates. The outcome of the investigation explains that if BDTI goes up, the freight rates go up as well by 0.409 units. The new build has great effect in explaining the freight rates; the results shows, that if the new built rises the freight rates rise by 5.475 units. The high price for new buildings implies that the demand for more tonnage is high and there is a shortage in supply. On the contrary, if the new built price is low, the market is oversupplied and fewer ships are in the order book. Second hand price implies the market needs for tonnage. Therefore, when the second hand ship price increases, it will affect the freight rate market to increase by 0.929 units. The fleet size in metric tons presents the supply and the huge volume offered in the market. Any increase in fleet capacity will adversely affect on the freight rates by 0.674 units. The upsurge in oil production in North America has an opposite effect on the VLCC freight rates. The increase in oil production leads to reducing the imported amount of the crude oil. Any increase in North American oil will reduce the VLCC freights by 2.96 times for the tanker serving the MEG-USG route.

4.1.2 VLCC Ras Tanura-Chiba Route

Table 4.7 VLCC Model, Ras Tanura-Chiba Route, First Regression Results

Dependent Variable: VLCFRET
Method: Least Squares
Date: 10/04/13 Time: 12:03
Sample (adjusted): 2 185
Included observations: 184 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	36.70696	47.36990	0.774901	0.4394
DBDTI	0.523783	0.068707	7.623395	0.0000
DBKR	-0.639538	0.248882	-2.569640	0.0110
DNBPC	5.598330	1.206749	4.639182	0.0000
DSHPC	44.60517	6.045603	7.378118	0.0000
FLEET	-0.032342	0.179366	-0.180315	0.8571
JP_IMP	27.47098	5.843366	4.701225	0.0000

R-squared	0.580121	Mean dependent var	81.68549
Adjusted R-squared	0.565888	S.D. dependent var	46.52918
S.E. of regression	30.65675	Akaike info criterion	9.720884
Sum squared resid	166351.1	Schwarz criterion	9.843191
Log likelihood	-887.3213	Hannan-Quinn criter.	9.770457
F-statistic	40.75842	Durbin-Watson stat	0.918394
Prob(F-statistic)	0.000000		

In this model the dependent variable is the spot freight rate for the VLCC tankers serving the route Ras Tanura-Chiba. The independent variables are; the BDTI –TD3 (DBDTI), the Bunker Price (DBKR), New Build Price (DNBPC), Second Hand Price DSHPC), the Fleet size (FLEET) and crude oil import by Japan (JP_IMP). The significant findings of the test are that all the independent variables are able to explain the dependent variable excluding one variable, the Fleet which has more than 0.5 %. But the F-test implies that all the variables are jointly significant and coefficient of determination close to 60 % which indicates the good fit of the data (see Table 4.7). On the other hand, the hypothesis test for the normality rejected, the residuals are not normally distributed (Figure 4.4). Table 4.8 shows a high correlation between FLEET and JP_IMP. Therefore, the independent variable with more than 0.5 % or the insignificant variable should be dropped off. The next regression performed after excluding the FLEET but the hypothesis test for normality was also rejected. Then the last regression (see Table 4.9) performed after two dummy variables were applied in order to obtain normal distribution (Fig 4.5). Afterward the test no heteroscedasticity hypothesis was performed. The null hypothesis implies not to reject the null, no heteroscedasticity (Table 4.10). But the null hypothesis for no serial correlation is rejected (see Table 4.11). Therefore, a remedy was performed by adding lag of the dependent variable.

Figure 4.4 VLCC Model, Ras Tanura-Chiba, 1 Regression, Non-Normality Results

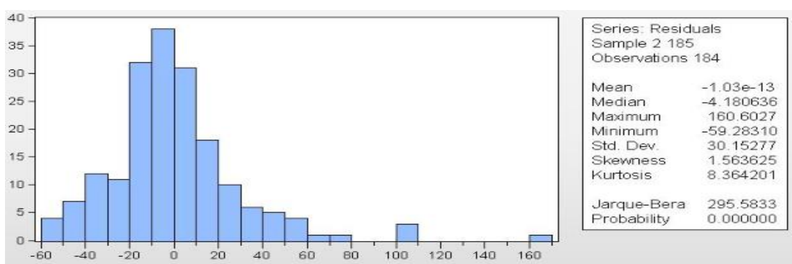


Table 4.8 VLCC Model, Ras Tanura-Chiba Route, Correlation Table

	Correlation					
	DBDTI	DBKR	DNBPC	DSHPC	FLEET	JP_IMP
DBDTI	1.000000	0.043437	0.033875	-0.071172	-0.033133	-0.017968
DBKR	0.043437	1.000000	0.061453	-0.032056	-0.033696	0.023295
DNBPC	0.033875	0.061453	1.000000	0.166151	-0.233404	0.295927
DSHPC	-0.071172	-0.032056	0.166151	1.000000	0.176843	-0.031750
FLEET	-0.033133	-0.033696	-0.233404	0.176843	1.000000	-0.756397
JP_IMP	-0.017968	0.023295	0.295927	-0.031750	-0.756397	1.000000

Table 4.9 VLCC Model, Ras Tanura-Chiba Route, Last Regression Results

Dependent Variable: VLCFRET
Method: Least Squares
Date: 10/09/13 Time: 17:29
Sample (adjusted): 2 185
Included observations: 184 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	205.7796	12.72207	16.17501	0.0000
DBDTI	37.94122	4.913815	7.721337	0.0000
DBKR	-56.83598	14.73440	-3.857366	0.0002
DNBPC	8.514540	0.732133	11.62977	0.0000
DSHPC	38.29138	3.736992	10.24658	0.0000
FLEET	-0.542470	0.073790	-7.351584	0.0000
DMY1	74.38026	5.092424	14.60606	0.0000
DMY2	47.54086	5.117424	9.290000	0.0000

R-squared	0.843217	Mean dependent var	81.68549
Adjusted R-squared	0.836981	S.D. dependent var	46.52918
S.E. of regression	18.78645	Akaike info criterion	8.746653
Sum squared resid	62115.80	Schwarz criterion	8.886433
Log likelihood	-796.6921	Hannan-Quinn criter.	8.803308
F-statistic	135.2240	Durbin-Watson stat	1.172993
Prob(F-statistic)	0.000000		

Figure 4.5 VLCC Model, Ras Tanura-Chiba, Last regression, Normality Results

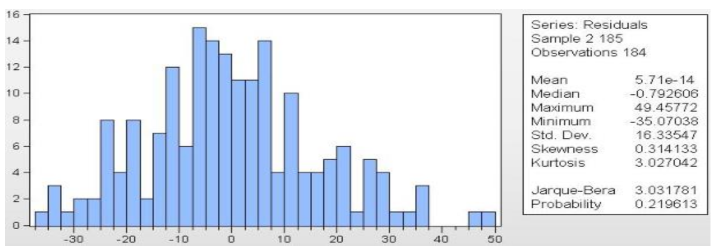


Table 4.10 VLCC Model, Ras Tanura-Chiba, No Heteroscedasticity Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.819941	Prob. F(7,176)	0.0861
Obs*R-squared	12.41967	Prob. Chi-Square(7)	0.0876
Scaled explained SS	9.641915	Prob. Chi-Square(7)	0.2098

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/09/13 Time: 17:35
Sample: 2 185
Included observations: 184

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	957.0495	294.0502	3.254715	0.0014
DBDTI	92.13871	113.5749	0.811259	0.4183
DBKR	188.7215	340.5620	0.554147	0.5802
DNBPC	21.22904	16.92209	1.254517	0.2113
DSHPC	22.58593	86.37456	0.261488	0.7940
FLEET	-4.166194	1.705526	-2.442762	0.0156
DMY1	-54.79343	117.7032	-0.465522	0.6421
DMY2	122.3575	118.2810	1.034465	0.3023

R-squared	0.067498	Mean dependent var	337.5859
Adjusted R-squared	0.030410	S.D. dependent var	440.9754
S.E. of regression	434.2186	Akaike info criterion	15.02748
Sum squared resid	33184057	Schwarz criterion	15.16726
Log likelihood	-1374.528	Hannan-Quinn criter.	15.08413
F-statistic	1.819941	Durbin-Watson stat	1.716378
Prob(F-statistic)	0.086050		

Table 4.11 VLCC Model, Ras Tanura-Chiba, Serial Correlation Results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	5.528560	Prob. F(10,166)	0.0000
Obs*R-squared	45.97023	Prob. Chi-Square(10)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/09/13 Time: 17:36
Sample: 2 185
Included observations: 184
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.176602	11.47268	0.799866	0.4249
DBDTI	7.541694	4.700513	1.604441	0.1105
DBKR	-2.502021	13.42058	-0.186432	0.8523
DNBPC	-1.409032	0.720513	-1.955595	0.0522
DSHPC	1.819104	3.362996	0.540918	0.5893
FLEET	-0.045013	0.066312	-0.678800	0.4982
DMY1	-4.759567	4.768986	-0.998025	0.3197
DMY2	-2.255234	4.776249	-0.472177	0.6374
RESID(-1)	0.418259	0.079509	5.260529	0.0000
RESID(-2)	0.164311	0.083630	1.964741	0.0511
RESID(-3)	-0.026162	0.080788	-0.323841	0.7465
RESID(-4)	-0.075103	0.081651	-0.919798	0.3590
RESID(-5)	-0.019097	0.081869	-0.233259	0.8158
RESID(-6)	0.112961	0.083219	1.357399	0.1765
RESID(-7)	-0.067323	0.081354	-0.827533	0.4091
RESID(-8)	-0.171375	0.081976	-2.090551	0.0381
RESID(-9)	-0.005165	0.083377	-0.061946	0.9507
RESID(-10)	0.133690	0.077850	1.717281	0.0878

R-squared	0.249838	Mean dependent var	2.19E-14
Adjusted R-squared	0.173014	S.D. dependent var	18.42364
S.E. of regression	16.75423	Akaike info criterion	8.567883
Sum squared resid	46596.90	Schwarz criterion	8.882387
Log likelihood	-770.2452	Hannan-Quinn criter.	8.695355
F-statistic	3.252094	Durbin-Watson stat	1.917984
Prob(F-statistic)	0.000045		

Table 4.12 VLCC Model, Ras Tanura-Chiba, Regression Results after adding lag

Dependent Variable: VLCFRET
Method: Least Squares
Date: 10/09/13 Time: 18:20
Sample (adjusted): 2 185
Included observations: 184 after adjustments
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.496395	3.632446	-0.411952	0.6809
LVLCFRET	0.985760	0.021252	46.38492	0.0000
DBDTI	73.50311	3.032305	24.24002	0.0000
DNBPC	-0.587652	0.301506	-1.949057	0.0529
DSHPC	1.572728	1.479266	1.063181	0.2892
JP_IMP	1.249834	0.952099	1.312715	0.1910
DMY1	72.79141	4.220996	17.24508	0.0000
DMY2	32.36853	3.342431	9.684128	0.0000

R-squared	0.977388	Mean dependent var	81.68549
Adjusted R-squared	0.976488	S.D. dependent var	46.52918
S.E. of regression	7.134543	Akaike info criterion	6.810278
Sum squared resid	8958.699	Schwarz criterion	6.950058
Log likelihood	-618.5456	Hannan-Quinn criter.	6.866933
F-statistic	1086.772	Durbin-Watson stat	2.239123
Prob(F-statistic)	0.000000		

TD3 MEG-JAPAN voyage rate model for the route Ras Tanura – Chiba

VLCC freight = -1.496 +0.996*LVLCFRET + 73.505*DBDT – 0.587*DNBPC + 1.572 DSHPC + 1.25*JP_IMP + 72.781DMY1 + 32.366DMY2

The Durbin-Watson statistics is more than two which indicates that the model complied with the assumption of no serial correlation (see Table 4.12). Brooks, (2008) stated that if the Durbin- Watson statistics is not close enough to 2 after adding the lag then the model is no longer BLUE.

The model shows the positive response of the freight rate to the increase of the BDTI, the second hand price and the amount of oil imported by Japan. There are big gaps in demand between the two routes of the VLCC, the TD1 and TD3. The increase in demand in the Far East is a great opportunity for the tanker market. On the other hand, the demand decreases from the MEG_USG route due to the increase in the oil production in North America.

4.2 Suezmax spot freight model; Ras tanura- treist

The third model was conducted to investigate the behavior of the freight rates for the Suezmax tanker. Mainly these types of tankers serve the Mediterranean Sea region through the Suez Canal among other areas. The independent variables are: the BDTI (DBDTI), Bunker Price (BKRPC), the crude oil price (DCRUDPC), Europe industrial production (DINDURP), second hand price (DSMSHPC), new built price (DSMNBPC), Suezmax fleet size (FLEET), North Sea oil production (NS_OILP). The first regression indicates that four independent variables are insignificant; DBKR, DCRUDPC, DINDURP, DSMSCPC (Table 4.13). But the F-test shows that all variables are jointly significant. Table 4.14 shows high correlation between the bunker price and the crude oil price. It also shows a high correlation between the fleet size and the North Sea oil production. The second regression was conducted after excluding the European industrial production, the crude oil price and the price of the scrap and keeping other variable with less than 10% significant level. But the null hypothesis of normality was rejected (Figure 4.6). Therefore, dummy variables were applied in order to adjust the outliers point.

Table 4.13 Suezmax Model, Ras Tanura-Trieste, 1st Regression Results

Dependent Variable: SMFRET
Method: Least Squares
Date: 10/02/13 Time: 10:21
Sample (adjusted): 2 159
Included observations: 157 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	393.1603	83.49714	4.708667	0.0000
DBDTI	0.255504	0.124546	2.051484	0.0420
DBKRPC	-0.763937	0.511314	-1.494065	0.1373
DCRUDPC	-0.448945	0.494059	-0.908686	0.3650
DINDURP	-0.000217	0.000587	-0.368939	0.7127
DSMSHPC	1.728710	0.881693	1.960671	0.0518
DSMNBPC	7.053189	1.636819	4.309082	0.0000
DSMSCPC	-0.432483	0.381414	-1.133895	0.2587
FLEET	-4.023416	0.899386	-4.473514	0.0000
NS_OILP	-18.27943	8.578109	-2.130939	0.0348

R-squared	0.488343	Mean dependent var	102.2455
Adjusted R-squared	0.457017	S.D. dependent var	51.77346
S.E. of regression	38.15051	Akaike info criterion	10.18253
Sum squared resid	213952.9	Schwarz criterion	10.37720
Log likelihood	-789.3287	Hannan-Quinn criter.	10.26159
F-statistic	15.58907	Durbin-Watson stat	0.757591
Prob(F-statistic)	0.000000		

Table 4.14 Suezmax Model, Ras Tanura-Trieste, Correlation Table

Correlation		DBDTI	DBKRPC	DCRUDPC	DINDURP	DSMSHPC	DSMNBPC	DSMSCPC	FLEET	NS_OILP
DBDTI	DBDTI	1.000000	0.039308	0.043806	-0.036608	0.160017	0.162454	0.116107	-0.039506	0.043888
DBKRPC	DBKRPC	0.039308	1.000000	0.688520	0.027865	0.096869	0.077098	0.218245	-0.025919	0.003367
DCRUDPC	DCRUDPC	0.043806	0.688520	1.000000	0.187309	0.138067	0.098670	0.262816	-0.030034	0.004306
DINDURP	DINDURP	-0.036608	0.027865	0.187309	1.000000	-0.031782	-0.009975	-0.014327	-0.009303	-0.011458
DSMSHPC	DSMSHPC	0.160017	0.096869	0.138067	-0.031782	1.000000	0.406690	0.342743	-0.187920	0.187528
DSMNBPC	DSMNBPC	0.162454	0.077098	0.098670	-0.009975	0.406690	1.000000	0.095429	-0.219466	0.195135
DSMSCPC	DSMSCPC	0.116107	0.218245	0.262816	-0.014327	0.342743	0.095429	1.000000	-0.074636	0.076850
FLEET	FLEET	-0.039506	-0.025919	-0.030034	-0.009303	-0.187920	-0.219466	-0.074636	1.000000	-0.949286
NS_OILP	NS_OILP	0.043888	0.003367	0.004306	-0.011458	0.187528	0.195135	0.076850	-0.949286	1.000000

with less than 10% significant level. But the null hypothesis of normality rejected. Therefore, dummy variables applied in order to adjust the outliers point.

Figure 4.6 Suezmax Model, Ras Tanura-Trieste, Non-Normality Results

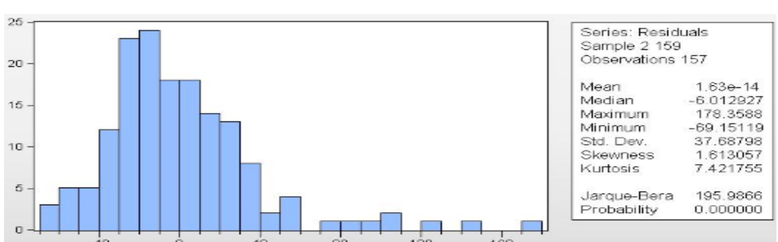


Table 4.15 Suezmax Model, Ras Tanura-Trieste, last Regression

Dependent Variable: SMFRET
Method: Least Squares
Date: 10/02/13 Time: 19:18
Sample (adjusted): 2 159
Included observations: 158 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	201.0119	10.72966	18.73423	0.0000
DBDTI	0.153681	0.086004	1.786903	0.0760
DSMSHPC	1.356440	0.592673	2.288683	0.0235
DSMNBPC	5.443302	1.129111	4.820876	0.0000
FLEET	-2.064476	0.199285	-10.35939	0.0000
DMY1	65.29824	11.58023	5.638770	0.0000
DMY2	67.76435	11.11762	6.095222	0.0000

R-squared	0.753299	Mean dependent var	102.6981
Adjusted R-squared	0.743497	S.D. dependent var	51.92088
S.E. of regression	26.29593	Akaike info criterion	9.419998
Sum squared resid	104412.9	Schwarz criterion	9.555683
Log likelihood	-737.1799	Hannan-Quinn criter.	9.475101
F-statistic	76.84627	Durbin-Watson stat	0.719929
Prob(F-statistic)	0.000000		

The final regression (Table 4.15) shows that the coefficient of determination is quite good at about 70%. The null hypothesis for normal distribution was accepted, the residuals are normally distributed (Fig 4.7). But the null hypothesis for both no heteroscedasticity Table 4.16) and no serial correlation (Table 4.17) was rejected. Therefore, the model does not comply with the two assumptions. no heteroscedasticity and no auto correlation.

Fig 4.7 Suezmax Model, Ras Tanura-Trieste, Normality Results

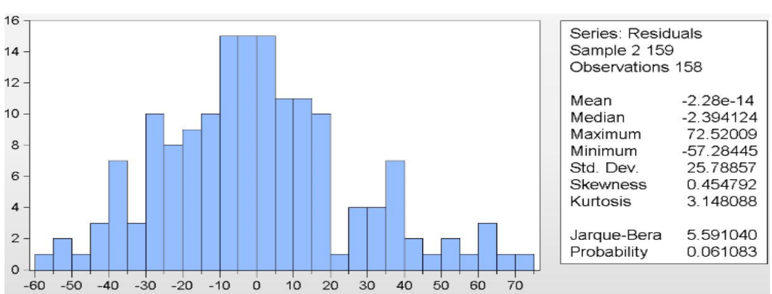


Table 4.16 Suezmax Model, Ras Tanura-Trieste, Heteroscedasticity Results

Heteroskedasticity Test: White

F-statistic	4.015648	Prob. F(25,132)	0.0000
Obs*R-squared	68.25479	Prob. Chi-Square(25)	0.0000
Scaled explained SS	66.95683	Prob. Chi-Square(25)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/02/13 Time: 19:23
Sample: 2 159
Included observations: 158
Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2344.310	1943.883	1.205993	0.2300
DBDTI	-13.45636	17.41253	-0.772798	0.4410
DBDTI^2	-0.019799	0.090001	-0.219990	0.8262
DBDTI*DSMSHPC	0.582657	1.084681	0.537169	0.5921
DBDTI*DSMNBPC	4.463122	1.937464	2.303589	0.0228
DBDTI*FLEET	0.245925	0.330079	0.745048	0.4578
DBDTI*DMY1	-43.09901	31.97483	-1.347913	0.1800
DBDTI*DMY2	12.67424	32.16700	0.394014	0.6942
DSMSHPC	-85.15703	144.9640	-0.587892	0.5576
DSMSHPC^2	-1.165209	3.709421	-0.314122	0.7539
DSMSHPC*DSMNBPC	7.470989	11.80049	0.633106	0.5278
DSMSHPC*FLEET	1.495357	2.753520	0.543071	0.5880
DSMSHPC*DMY1	179.6615	200.1370	0.897692	0.3710
DSMSHPC*DMY2	-141.8356	168.4350	-0.842079	0.4013
DSMNBPC	103.4092	257.5013	0.401587	0.6886
DSMNBPC^2	-17.71281	12.08284	-1.468402	0.1444
DSMNBPC*FLEET	-3.133205	5.162711	-0.606891	0.5450
DSMNBPC*DMY1	47.95172	522.4649	0.091780	0.9270
DSMNBPC*DMY2	864.1376	763.7783	1.131398	0.2599
FLEET	-35.40238	73.35620	-0.482596	0.6302
FLEET^2	0.051146	0.661911	0.077271	0.9385
FLEET*DMY1	-293.7143	113.4348	-2.589280	0.0107
FLEET*DMY2	158.8541	117.7402	1.349192	0.1796
DMY1	13809.05	5210.074	2.650451	0.0090
DMY1*DMY2	2739.294	1436.549	1.906857	0.0587
DMY2	-8955.884	4663.538	-1.920405	0.0570

R-squared	0.431992	Mean dependent var	860.9412
Adjusted R-squared	0.324415	S.D. dependent var	971.6320
S.E. of regression	798.6230	Akaike info criterion	16.35298
Sum squared resid	84189425	Schwarz criterion	16.85695
Log likelihood	-1265.885	Hannan-Quinn criter.	16.55764
F-statistic	4.015648	Durbin-Watson stat	1.466370
Prob(F-statistic)	0.000000		

Table 4.17 Suezmax Model, Ras Tanura-Trieste, Serial Correlation Results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	14.16605	Prob. F(10,141)	0.0000
Obs*R-squared	79.18461	Prob. Chi-Square(10)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/02/13 Time: 19:20
Sample: 2 159
Included observations: 158
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.448567	7.856038	0.184389	0.8540
DBDTI	0.059693	0.068787	0.867798	0.3870
DSMSHPC	0.139176	0.443494	0.313818	0.7541
DSMNBPC	0.144062	0.882020	0.163332	0.8705
FLEET	-0.016217	0.145919	-0.111136	0.9117
DMY1	-14.55678	8.887994	-1.637803	0.1037
DMY2	0.990438	8.346165	0.118670	0.9057
RESID(-1)	0.571924	0.083965	6.811432	0.0000
RESID(-2)	0.238392	0.096166	2.478951	0.0144
RESID(-3)	-0.183083	0.100269	-1.825921	0.0700
RESID(-4)	0.208250	0.099206	2.099158	0.0376
RESID(-5)	-0.104698	0.100345	-1.043376	0.2986
RESID(-6)	-0.113892	0.099904	-1.140015	0.2562
RESID(-7)	-0.009319	0.098687	-0.094427	0.9249
RESID(-8)	0.041590	0.097991	0.424423	0.6719
RESID(-9)	0.013509	0.096105	0.140561	0.8884
RESID(-10)	0.121716	0.086216	1.411748	0.1602

R-squared	0.501168	Mean dependent var	-2.29E-14
Adjusted R-squared	0.444563	S.D. dependent var	25.78857
S.E. of regression	19.21961	Akaike info criterion	8.851094
Sum squared resid	52084.46	Schwarz criterion	9.180613
Log likelihood	-682.2364	Hannan-Quinn criter.	8.984916
F-statistic	8.853782	Durbin-Watson stat	1.999963
Prob(F-statistic)	0.000000		

Therefore, the Newey-West correction was used in order to obtain a valid model Table 4.18). The Newey-West correction method is a simultaneous correction of the standard error in the presence of both heteroscedasticity and autocorrelation. Newey-West develops a consistent variance-covatiance estimator (Brooks, 2008, p.152).

Suezmax spot freight rates model;

Freight rate= 201.01 + 0.153*DBDTI + 1.356*DSMSHPC + 5.44*DSMNBPC – 2.06*FLEET + 65.29 DMY1 + 67.76DMY2

The model shows the presence of positive impact in the Baltic Dirty Tanker Index, the second hand price and the new build price, By 0.153, 1.35 and 5.44 respectively. The new build creates an oversupply but the new build has its advantage by increasing the quality of the tonnage. One the other hand, the fleet size generates negative relation with the freight rate. An increase in fleet size by one unit reduces the freight rate by 2.06 units.

Table 4.18 Suezmax Model, Ras Tanura-Tries, Newey-West remedy (HAC)

Dependent Variable: SMFRET
Method: Least Squares
Date: 10/02/13 Time: 19:42
Sample (adjusted): 2 159
Included observations: 158 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	201.0119	19.45640	10.33140	0.0000
DBDTI	0.153681	0.075638	2.031799	0.0439
DSMSHPC	1.356440	0.636230	2.131995	0.0346
DSMNBPC	5.443302	1.609522	3.381937	0.0009
FLEET	-2.064476	0.316875	-6.515111	0.0000
DMY1	65.29824	18.23991	3.579964	0.0005
DMY2	67.76435	11.22422	6.037330	0.0000

R-squared	0.753299	Mean dependent var	102.6981
Adjusted R-squared	0.743497	S.D. dependent var	51.92088
S.E. of regression	26.29593	Akaike info criterion	9.419998
Sum squared resid	104412.9	Schwarz criterion	9.555683
Log likelihood	-737.1799	Hannan-Quinn criter.	9.475101
F-statistic	76.84627	Durbin-Watson stat	0.719929
Prob(F-statistic)	0.000000		

The increase in the fleet size means increase in the supply side. In addition, the high sensitivity to fleet size might be due to the competition of Aframax tankers in the

Mediterranean trade. On the other hand, the rates of the new build and the order book affected in the same direction. In such condition ships owners prefer spot voyages and do not tie up their ships for long duration. Therefore, it is hard to secure long-term agreements when the market is low. Adjusted R^2 equal to 0.75 which means the regression line best fit the data.

4.3 Aframax spot freight model

The fourth model was conducted for the Aframax tanker segment serving the route TD9 Caribb-USG. The dependent variable is the spot freight rate for the Aframax and the independent variables consist of the following: the Baltic Dirty Tanker Index (DBDTI), bunker price (DBKRPC), US industrial production (DINDUS), LIBOR (DLIBOR), second hand price (DAFSHPC), new build price (DAFNBPC). fleet size (FLEET), North America oil production (NA_OILP). The first regression (Table 4.19) shows two insignificant variables the (DINDUS), the fleet (FLEET) and (DLIBOR).But the F-stastics p- value indicates the all the variable are jointly significant. the Wald test

4.19 Aframax model, Carrib-USG, First Regression results

Dependent Variable: AFFRET
Method: Least Squares
Date: 10/03/13 Time: 11:22
Sample (adjusted): 2 187
Included observations: 185 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	424.0463	44.10266	9.614983	0.0000
DBDTI	0.674770	0.132560	5.090288	0.0000
DBKRPC	-1.257791	0.339862	-3.700884	0.0003
DINDUS	-0.010262	0.029159	-0.351948	0.7253
DLIBOR	0.258309	0.424144	0.609012	0.5433
DAFSHPC	1.975182	0.798619	2.473247	0.0143
DAFNBPC	7.346013	1.735428	4.232968	0.0000
FLEET	-0.107695	0.229372	-0.469522	0.6393
NA_OILP	-33.02267	6.113711	-5.401412	0.0000

R-squared	0.460803	Mean dependent var	150.0026
Adjusted R-squared	0.436294	S.D. dependent var	61.47904
S.E. of regression	46.15867	Akaike info criterion	10.54947
Sum squared resid	374989.7	Schwarz criterion	10.70614
Log likelihood	-966.8262	Hannan-Quinn criter.	10.61297
F-statistic	18.80143	Durbin-Watson stat	0.594554
Prob(F-statistic)	0.000000		

Was performed with P-value result 0.85 (Table 4.21), therefore does not reject the null, so the three variables are equal to zero. Table 4.20 shows no high correlation between the independent variables. But, after performing several trials of regression, a conclusion was made to run the final regression with five independent variables besides one dummy variable after detecting big outliers (Fig 4.8) and no normality in the regression model (Fig 4.9). The findings from the last regression consist of R^2=0.74 which is good indicator for data fit and the Durbin-Watson statistic = 1.17 which indicates the presence of the serial correlation (Table 4.22). But the null hypothesis for normality (Fig 4.10) and no heteroscedasticity (Table 4.23) was not rejected. The model complies with the all assumptions except the assumption of no correlation (Table 4.24).

Fig 4.8 Aframax model, Carrib-USG, Residual Graph

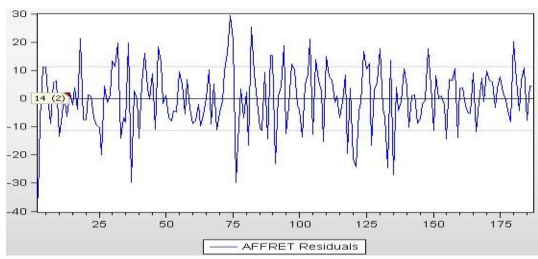


Table 4.20 Aframax model, Carrib-USG, Correlation Table

Correlation								
	DBDTI	DBKRPC	DLIBOR	DAFSHPC	DAFNBPC	DINDUS	FLEET	NA_OILP
DBDTI	1.000000	0.050124	0.072846	0.113200	0.229665	-0.021217	-0.028711	-0.049858
DBKRPC	0.050124	1.000000	0.052594	0.170139	0.061772	-0.047630	-0.034160	-0.034586
DLIBOR	0.072846	0.052594	1.000000	0.095400	0.363999	-0.001972	-0.059311	-0.084507
DAFSHPC	0.113200	0.170139	0.095400	1.000000	0.360648	-0.041405	-0.120117	-0.029177
DAFNBPC	0.229665	0.061772	0.363999	0.360648	1.000000	0.128408	-0.134954	-0.129920
DINDUS	-0.021217	-0.047630	-0.001972	-0.041405	0.128408	1.000000	0.017129	-0.055418
FLEET	-0.028711	-0.034160	-0.059311	-0.120117	-0.134954	0.017129	1.000000	0.492333
NA_OILP	-0.049858	-0.034586	-0.084507	-0.029177	-0.129920	-0.055418	0.492333	1.000000

Figure 4.9 Aframax model, First regression, Non-Normality Results

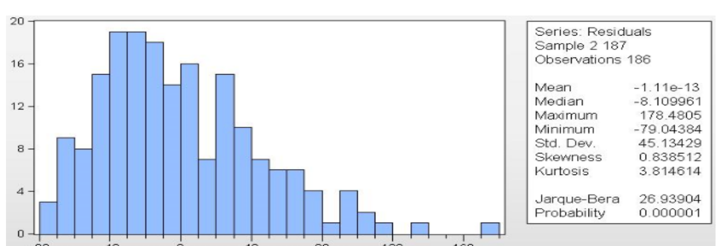


Table 4.21 Aframax model, Wald test

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.252453	(3, 176)	0.8595
Chi-square	0.757360	3	0.8596

Null Hypothesis: C(4)=0, C(5)=0, C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	-0.010262	0.029159
C(5)	0.258309	0.424144
C(8)	-0.107695	0.229372

Restrictions are linear in coefficients.

Table 4.22 Aframax Model, Carrib-USG, 2nd Regression Results

Dependent Variable: AFFRET
Method: Least Squares
Date: 10/03/13 Time: 13:17
Sample (adjusted): 2 187
Included observations: 186 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	401.5829	29.63987	13.54874	0.0000
DBDTI	0.888175	0.091693	9.686439	0.0000
DBKRPC	-1.010584	0.232387	-4.348715	0.0000
DAFNBPC	13.17267	1.163712	11.31952	0.0000
DAFSHPC	-0.151283	0.561979	-0.269197	0.7881
NA_OILP	-31.51866	3.646405	-8.643762	0.0000
DMY1	94.46328	6.682751	14.13539	0.0000

R-squared	0.743972	Mean dependent var	149.9504
Adjusted R-squared	0.735390	S.D. dependent var	61.31678
S.E. of regression	31.54149	Akaike info criterion	9.777393
Sum squared resid	178081.0	Schwarz criterion	9.898792
Log likelihood	-902.2975	Hannan-Quinn criter.	9.826588
F-statistic	86.69049	Durbin-Watson stat	1.179978
Prob(F-statistic)	0.000000		

Fig 4.10 Aframax model after applying dummy variable, Normality Results

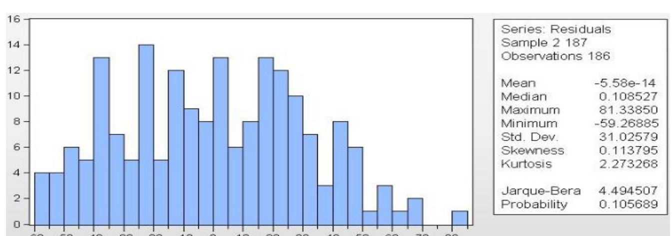


Table 4.23 Aframax Model, Carrib-USG, No Heteroscedasticity

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.117908	Prob. F(6,179)	0.3536
Obs*R-squared	6.718017	Prob. Chi-Square(6)	0.3477
Scaled explained SS	3.961057	Prob. Chi-Square(6)	0.6819

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/03/13 Time: 13:22
Sample: 2 187
Included observations: 186

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2197.691	1016.015	2.163049	0.0319
DBDTI	3.701142	3.143100	1.177545	0.2405
DBKRPC	-0.465532	7.965909	-0.058440	0.9535
DAFNBPC	39.13047	39.89051	0.980947	0.3279
DAFSHPC	-5.559118	19.26388	-0.288577	0.7732
NA_OILP	-155.5270	124.9939	-1.244276	0.2150
DMY1	407.8286	229.0758	1.780322	0.0767

R-squared	0.036118	Mean dependent var	957.4245
Adjusted R-squared	0.003809	S.D. dependent var	1083.266
S.E. of regression	1081.200	Akaike info criterion	16.84644
Sum squared resid	2.09E+08	Schwarz criterion	16.96784
Log likelihood	-1559.719	Hannan-Quinn criter.	16.89564
F-statistic	1.117908	Durbin-Watson stat	1.879006
Prob(F-statistic)	0.353645		

Table 4.24 Aframax Model, Carrib-USG, Serial Correlation Results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	7.119987	Prob. F(10,169)	0.0000
Obs*R-squared	55.13399	Prob. Chi-Square(10)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/03/13 Time: 13:17
Sample: 2 187
Included observations: 186
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.839856	26.65492	-0.219091	0.8268
DBDTI	0.095633	0.081872	1.168079	0.2444
DBKRPC	0.176878	0.204450	0.865140	0.3882
DAFNBPC	-0.467699	1.060015	-0.441219	0.6596
DAFSHPC	0.269169	0.500891	0.537380	0.5917
NA_OILP	0.681076	3.282686	0.207475	0.8359
DMY1	-12.72350	6.240906	-2.038726	0.0430
RESID(-1)	0.395393	0.079478	4.974881	0.0000
RESID(-2)	0.191040	0.081606	2.341018	0.0204
RESID(-3)	0.109286	0.080441	1.358592	0.1761
RESID(-4)	-0.032705	0.080622	-0.405664	0.6855
RESID(-5)	-0.160013	0.079586	-2.010570	0.0460
RESID(-6)	0.191846	0.080241	2.390872	0.0179
RESID(-7)	-0.035857	0.080477	-0.445559	0.6565
RESID(-8)	-0.002396	0.082233	-0.029132	0.9768
RESID(-9)	-0.015856	0.080298	-0.197462	0.8437
RESID(-10)	0.119627	0.076908	1.555445	0.1217

R-squared	0.296419	Mean dependent var	-5.58E-14
Adjusted R-squared	0.229808	S.D. dependent var	31.02579
S.E. of regression	27.22841	Akaike info criterion	9.533347
Sum squared resid	125294.3	Schwarz criterion	9.828173
Log likelihood	-869.6013	Hannan-Quinn criter.	9.652822
F-statistic	4.449992	Durbin-Watson stat	1.894176
Prob(F-statistic)	0.000000		

Table 4.25 Aframax model, Regression Results after adding lagged Values

Dependent Variable: AFFRET
Method: Least Squares
Date: 10/05/13 Time: 15:15
Sample (adjusted): 2 187
Included observations: 186 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	58.98118	13.58448	4.341806	0.0000
LAFFRET	0.796254	0.020550	38.74787	0.0000
DBDTI	1.308922	0.040429	32.37595	0.0000
DBKRPC	-0.047436	0.086445	-0.548739	0.5839
DAFNBPC	2.896028	0.430547	6.726394	0.0000
DAFSHPC	-0.000946	0.198182	-0.004773	0.9962
NA_OILP	-4.285399	1.467925	-2.919358	0.0040
DMY1	27.33136	2.536190	10.77654	0.0000

R-squared	0.967200	Mean dependent var	149.9504
Adjusted R-squared	0.965910	S.D. dependent var	61.31678
S.E. of regression	11.32126	Akaike info criterion	7.733300
Sum squared resid	22814.41	Schwarz criterion	7.872041
Log likelihood	-711.1969	Hannan-Quinn criter.	7.789523
F-statistic	749.8239	Durbin-Watson stat	2.010908
Prob(F-statistic)	0.000000		

Finally, the regression included one lag of the dependent variable to cure the model from the serial correlation (Table 4.25). According to Brooks, (2008) it is a violation to the assumption that the explanatory variables are non-stochastic because of the inclusion of the lagged value of the dependent variable. In addition, if the presence of the autocorrelation continued in the residuals even when lagged value were added, then the OLS estimators will not even be coherent.

The Model

The Aframax spot freight rate = 58.98 + 0.79*LAFFRET + 1.3*DBDTI – 0.4*DBKRPC + 2.89*DAFNBPC – 0.001*DAFSHPC - 4.285*NA_OILP + 27.33DMY1

The bunker price and the second hand price became insignificant. Therefore, their signs are not reliable. But the other independent variable can explain the Aframax freight market significantly. The oil production in North America has negative impact on the freight rate. The increase of oil production will reduce the demand for the seaborne trade. Therefore, ship owners should seek alternative market for their ships. The Far East promising market is the best opportunity for ship's owner. **.** In the Aframax model adjusted R^2 is equal to 0.96 which means that the independent variables highly explain the freight rates movements. The slowing of economic growth in the United States is usually combined with fall in oil demand affecting the freight rates of Aframax. In addition, these reductions are due to continued oversupply and reduced demand for oil. On the other hand, Aframax has positive relation by 1.3 units with the Baltic Dirty Tanker Index.

4.4 Medium Range product tanker freight rate model;

Table 4.26 MR Model, First Regression Results

Dependent Variable: PA_FRET
Method: Least Squares
Date: 10/03/13 Time: 19:24
Sample (adjusted): 2 141
Included observations: 140 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	400.9656	39.58967	10.12804	0.0000
DBCTI	1.215781	0.396823	3.063787	0.0027
DBKRPC	-2.597219	0.963917	-2.694442	0.0080
DPNBPC	4.483982	4.054747	1.105860	0.2708
DPSHPC	2.313784	1.932191	1.197493	0.2333
DPSCPC	-1.255514	0.869745	-1.443543	0.1513
DIND_IN	3.63E-07	2.09E-05	0.017310	0.9862
FLEET	-2.953627	0.523296	-5.644275	0.0000
POIL_IMP	38.34849	12.65092	3.031280	0.0029

R-squared	0.340977	Mean dependent var	267.7286
Adjusted R-squared	0.300731	S.D. dependent var	103.6491
S.E. of regression	86.67376	Akaike info criterion	11.82431
Sum squared resid	984116.6	Schwarz criterion	12.01341
Log likelihood	-818.7014	Hannan-Quinn criter.	11.90115
F-statistic	8.472372	Durbin-Watson stat	0.463197
Prob(F-statistic)	0.000000		

The Medium Range tanker freight rate model consists of the following independent variables: the BCTI (DBCTI), bunker price (DBKRPC), new built price (DPNBPC), second hand price (DPSHPC), India industrial production (DIND_IN), fleet size (FLEET) and product oil import (POIL_IMP). The first regression findings shows that four insignificant variables exists in the model; the new built price, second hand price, scrap price and the industrial production of India (Table 4.26). Wald test indicate that these variables jointly equal to zero is not rejected (4.27). But the normality hypothesis rejected (Fig 4.11).

Table 4.27 MR model, Wald test

Wald Test:
Equation: Untitled

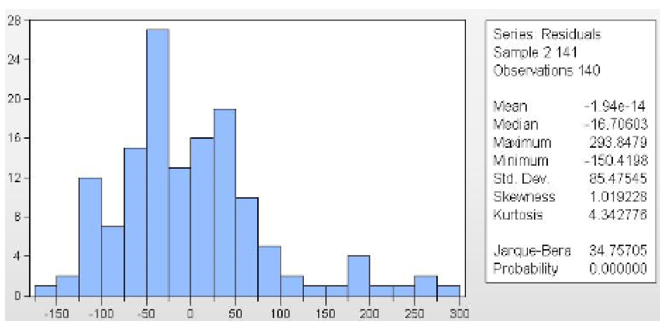
Test Statistic	Value	df	Probability
F-statistic	1.478804	(4, 131)	0.2123
Chi-square	5.915216	4	0.2056

Null Hypothesis: C(4)=0, C(5)=0, C(6)=0, C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	4.483982	4.054747
C(5)	2.313784	1.932191
C(6)	-1.255514	0.869745
C(7)	3.63E-07	2.09E-05

Restrictions are linear in coefficients.

Fig 4.11 MR model, First regression Non-Normality Results



The second regression was performed with five variables after excluding the new built price, the second hand price and India industrial production (Table 4.28). The outcome shows R^2 =0.31 which is not expressed as a best line fit. In addition, the null hypothesis of normality was rejected,, the residuals are not normally distributed. Therefore, a dummy variable was added to the model (Table.29). Afterwards the null hypothesis test was carried out. The model complied with the assumptions of normality (Fig 4.12) and no heteroscedasticity (Table 4.30) but failed in the presence of autocorrelation (Table 4.31). Therefore, lagged value of the dependent variable was added to the model Table 4.32). Consequently, the LM test was performed and the hypothesis finding was did not reject the null of no autocorrelation (Table 33).

Therefore, the model is consistent. In addition, Ramsey test performed to ensure the structural stability of the model which concludes positive findings (Table 4.33).

Table 4.28 MR model, 2nd Regression Results

Dependent Variable: PA_FRET
Method: Least Squares
Date: 10/08/13 Time: 17:33
Sample (adjusted): 2 141
Included observations: 140 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	414.8879	38.63012	10.74001	0.0000
DBCTI	1.352181	0.391581	3.453135	0.0007
DBKRPC	-2.159750	0.940408	-2.296609	0.0232
DPSCPC	-1.111241	0.848061	-1.310331	0.1923
FLEET	-3.283568	0.491467	-6.681155	0.0000
POIL_IMP	42.92668	12.41534	3.457551	0.0007

R-squared	0.319933	Mean dependent var	267.7286
Adjusted R-squared	0.294557	S.D. dependent var	103.6491
S.E. of regression	87.05554	Akaike info criterion	11.81288
Sum squared resid	1015541.	Schwarz criterion	11.93895
Log likelihood	-820.9017	Hannan-Quinn criter.	11.86411
F-statistic	12.60786	Durbin-Watson stat	0.428243
Prob(F-statistic)	0.000000		

Table 4.29 MR Model, 3rd Regression Results

Dependent Variable: PA_FRET
Method: Least Squares
Date: 10/03/13 Time: 20:43
Sample (adjusted): 2 141
Included observations: 140 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	317.9970	28.32271	11.22763	0.0000
DBCTI	1.492181	0.275018	5.425767	0.0000
DBKRPC	0.263422	0.691090	0.381169	0.7037
DPSCPC	0.864875	0.618189	1.399045	0.1641
FLEET	-2.590008	0.349825	-7.403733	0.0000
POIL_IMP	50.75586	8.736746	5.809469	0.0000
DMY1	228.7338	19.38928	11.79692	0.0000

R-squared	0.667671	Mean dependent var	267.7286
Adjusted R-squared	0.652679	S.D. dependent var	103.6491
S.E. of regression	61.08448	Akaike info criterion	11.11110
Sum squared resid	496264.7	Schwarz criterion	11.25818
Log likelihood	-770.7770	Hannan-Quinn criter.	11.17087
F-statistic	44.53438	Durbin-Watson stat	0.934431
Prob(F-statistic)	0.000000		

Fig 4.12 MR Model, Normality Result

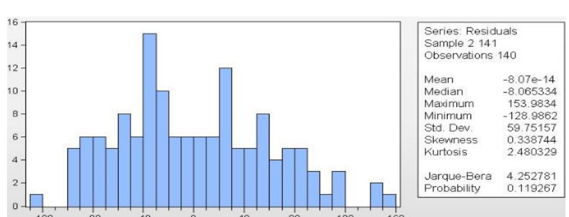


Table 4.30 MR model, No Heteroscedasticity Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.903096	Prob. F(6,133)	0.4948
Obs*R-squared	5.480484	Prob. Chi-Square(6)	0.4838
Scaled explained SS	4.536339	Prob. Chi-Square(6)	0.6045

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/08/13 Time: 17:37
Sample: 2 141
Included observations: 140

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8026.216	4461.536	1.798980	0.0743
DBCTI	-80.44558	43.29106	-1.858249	0.0653
DBKRPC	31.68178	109.3952	0.289608	0.7726
DPSCPC	-112.2007	96.34019	-1.164631	0.2463
FLEET	-14.06226	55.58672	-0.252979	0.8007
POIL_IMP	171.7452	1367.735	0.125569	0.9003
DMY1	-2290.659	2839.120	-0.806820	0.4212

R-squared	0.039146	Mean dependent var	7090.708
Adjusted R-squared	-0.004200	S.D. dependent var	9565.941
S.E. of regression	9586.011	Akaike info criterion	21.22270
Sum squared resid	1.22E+10	Schwarz criterion	21.36979
Log likelihood	-1478.589	Hannan-Quinn criter.	21.28247
F-statistic	0.903096	Durbin-Watson stat	1.474562
Prob(F-statistic)	0.494812		

Table 4.31 MR model, Serial Correlation Results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	9.510021	Prob. F(10,123)	0.0000
Obs*R-squared	61.04547	Prob. Chi-Square(10)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/08/13 Time: 17:29
Sample: 2 141
Included observations: 140
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.09321	23.55959	1.107541	0.2702
DBCTI	0.310194	0.240564	1.289444	0.1997
DBKRPC	-0.200460	0.585644	-0.342291	0.7327
DPSCPC	-0.094231	0.518868	-0.181608	0.8562
FLEET	-0.057010	0.290529	-0.196228	0.8448
POIL_IMP	-7.397131	7.452201	-0.992610	0.3228
DMY1	-28.99963	15.91770	-1.821848	0.0709
RESID(-1)	0.569207	0.087814	6.481929	0.0000
RESID(-2)	0.053701	0.099315	0.540718	0.5897
RESID(-3)	-0.117215	0.102067	-1.148404	0.2530
RESID(-4)	0.231025	0.096636	2.390685	0.0183
RESID(-5)	0.027498	0.098646	0.278753	0.7809
RESID(-6)	-0.098684	0.099447	-0.992326	0.3230
RESID(-7)	0.272277	0.094621	2.877565	0.0047
RESID(-8)	-0.160055	0.099195	-1.613536	0.1092
RESID(-9)	-0.060766	0.100438	-0.605005	0.5463
RESID(-10)	0.154020	0.088419	1.741928	0.0840

R-squared	0.436039	Mean dependent var	-7.79E-14
Adjusted R-squared	0.362678	S.D. dependent var	61.68723
S.E. of regression	49.24642	Akaike info criterion	10.74495
Sum squared resid	298300.8	Schwarz criterion	11.10215
Log likelihood	-735.1465	Hannan-Quinn criter.	10.89010
F-statistic	5.943763	Durbin-Watson stat	1.844640
Prob(F-statistic)	0.000000		

Table 4.32 MR model, significant level after adding lagged value

Dependent Variable: PA_FRET
Method: Least Squares
Date: 10/05/13 Time: 15:48
Sample (adjusted): 2 141
Included observations: 140 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	36.07773	16.32939	2.209374	0.0289
LPA_FRET	0.786670	0.030777	25.56026	0.0000
DBCTI	2.267308	0.119799	18.92591	0.0000
DBKRPC	1.065621	0.297286	3.584498	0.0005
DPSCPC	0.589515	0.260825	2.260190	0.0254
POIL_IMP	15.92627	3.884871	4.099561	0.0001
FLEET	-0.408220	0.168749	-2.419096	0.0169
DMY1	74.85153	9.254697	8.087950	0.0000

R-squared	0.940464	Mean dependent var	267.7286
Adjusted R-squared	0.937306	S.D. dependent var	103.6491
S.E. of regression	25.95239	Akaike info criterion	9.405850
Sum squared resid	88905.52	Schwarz criterion	9.573944
Log likelihood	-650.4095	Hannan-Quinn criter.	9.474158
F-statistic	297.8755	Durbin-Watson stat	1.925251
Prob(F-statistic)	0.000000		

Table 4.33 MR model, No Serial Correlation Results after adding lagged values

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.914212	Prob. F(2,130)	0.4034
Obs*R-squared	1.941761	Prob. Chi-Square(2)	0.3787

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/05/13 Time: 15:48
Sample: 2 141
Included observations: 140
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.563257	16.99947	-0.150785	0.8804
LPA_FRET	0.005625	0.032867	0.171141	0.8644
DBCTI	-0.014416	0.120538	-0.119596	0.9050
DBKRPC	0.012782	0.305237	0.041877	0.9667
DPSCPC	0.042349	0.262925	0.161070	0.8723
POIL_IMP	-0.288853	3.952009	-0.073090	0.9418
FLEET	0.021999	0.174257	0.126243	0.8997
DMY1	0.666227	9.273958	0.071838	0.9428
RESID(-1)	0.027948	0.093560	0.298714	0.7656
RESID(-2)	-0.119352	0.092006	-1.297221	0.1969

R-squared	0.013870	Mean dependent var	8.92E-14
Adjusted R-squared	-0.054401	S.D. dependent var	25.29047
S.E. of regression	25.96927	Akaike info criterion	9.420454
Sum squared resid	87672.42	Schwarz criterion	9.630572
Log likelihood	-649.4318	Hannan-Quinn criter.	9.505840
F-statistic	0.203158	Durbin-Watson stat	1.993146
Prob(F-statistic)	0.993438		

The MR spot freight rate model = 36.07 + 0.78*LPA_FRET + 2.26*DBCTI + 1.06*DBKRPC + 0.59*DPSCPC + 15.92*POIL_IMP – 0.04*FLEET + 74.85DMY!

The equation coefficient of determination is equal to 95% which is good sign, that the model can explain the freight rates perfectly. The main independent variable is the product oil import, which has a positive impact on the sea freight. The freight rates will increase by 15.92 units relatively to the increase of the product oil import. The demand for the commodity is increasing in the Asian market. Therefore, this finding is another proof of the growth of demand for seaborne oil imports into China and India. In addition, the tightness in the product oil imports was created by limited refining capacity. Other independent variables like bunker price also affects MR freight rates by 1.06 units, as the bunker price consists of the major operation cost. Increase in fleet size has a negative impact to the freight rate by 0.04 units. Furthermore, the scrap price has positive affects by 0.59 units. The Baltic Clean Tanker Index can explain the behavior of the MR freight rate by 2.26 units.

Generally, the oil freight market benefits from crisis, such as weather deterioration or political unrest in the production area. But the law of supply and demand prevailed in the market. The model shows that the scrap price positively predicts the freight rates, but fleet size development has a negative relation to freight rates. On the other hand, the demand for the commodity represented by product imports has a big positive impact on MR freight rates. The feature of the Medium range tanker enables her to handle different types of cargoes, which cause a big advantage on freight rate steadiness.

The reduction level of scrap ships and more investment in new build ships are due to positive freight rates gaining from this segment of oil tanker vessels. The behavior of the product market is highly driven by industrial production. In addition to other factor such as the seasonal affects. For example, in 2006, there was unexpected season, so freight rates declined by 50 percent at the beginning of October compared with the month of October the previous year. For instance, freight rates for MR cargo went down at the end of the month from WS 210 to WS170 for the MEG – Japan route. But the product market was stable during the same period in Atlantic region. At the end of December again MR freight increased from WS 235 to WS 370 (Fearnleys, 2007 P.32). Moreover, freight rates steadiness of MR product tanker is related to the ability to accommodate different types of cargoes at the same time. In addition, the MR tanker is not a specialized tanker, therefore, the tanker has the opportunity to load another cargo at the discharge port or adjacent ports with minimum probability to sail long ballast voyage like other big tankers.

Table 4.34 MR Model, Ramsey Test

Ramsey RESET Test
Equation: UNTITLED
Specification: PA_FRET C LPA_FRET DBCTI DBKRPC DPSCPC POIL_IMP FLEET DMY1
Omitted Variables: Powers of fitted values from 2 to 8

	Value	df	Probability
F-statistic	1.991379	(7, 125)	0.0613
Likelihood ratio	14.80163	7	0.0388

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	8919.786	7	1274.255
Restricted SSR	88905.52	132	673.5266
Unrestricted SSR	79985.73	125	639.8858
Unrestricted SSR	79985.73	125	639.8858

LR test summary:

	Value	df
Restricted LogL	-650.4095	132
Unrestricted LogL	-643.0087	125

Unrestricted Test Equation:
Dependent Variable: PA_FRET
Method: Least Squares
Date: 10/12/13 Time: 10:20
Sample: 2 141
Included observations: 140

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	161.4703	332.2031	0.486083	0.6279
LPA_FRET	2.925198	22.80188	0.128287	0.8981
DBCTI	8.423748	65.71402	0.128188	0.8982
DBKRPC	3.855909	30.90464	0.124768	0.9009
DPSCPC	2.431381	17.10311	0.142160	0.8872
POIL_IMP	58.37012	461.9466	0.126357	0.8997
FLEET	-1.433260	11.86260	-0.120822	0.9040
DMY1	288.3702	2170.497	0.132860	0.8945
FITTED^2	-0.066206	0.455553	-0.145332	0.8847
FITTED^3	0.000635	0.003766	0.168598	0.8664
FITTED^4	-3.36E-06	1.82E-05	-0.185137	0.8534
FITTED^5	1.07E-08	5.29E-08	0.201574	0.8406
FITTED^6	-2.00E-11	9.14E-11	-0.218499	0.8274
FITTED^7	2.02E-14	8.63E-14	0.234614	0.8149
FITTED^8	-8.51E-18	3.42E-17	-0.248461	0.8042

R-squared	0.948437	Mean dependent var	267.7286
Adjusted R-squared	0.940438	S.D. dependent var	103.6491
S.E. of regression	25.29596	Akaike info criterion	9.400124
Sum squared resid	79985.73	Schwarz criterion	9.715300
Log likelihood	-643.0087	Hannan-Quinn criter.	9.528202
F-statistic	157.7638	Durbin-Watson stat	1.892254
Prob(F-statistic)	0.000000		

4.6 VLCC Three Year Time-Charter Model

According to Harwood, (2006) the drivers of volatilities in the financial market are not only economic but also exogenous factors such as war and terrorism. Therefore, ship owners seek an alternative to manage risk and maximize revenues which is how the derivative market developed. However, due to lack of derivative data, the 3-year time charter model will be used as secure measures by ship owners for steady income.

The 3 year time-charter model is compiled from the following independent variables; the Baltic Dirty Tanker Index (DBDTI), bunker price (DBKR), China industrial production (DIND_CH), Japan industrial production (DIND_JP), price of new build (DNBPC), price of second hand ship (DSHPC), price of scrap (DSCPC), fleet size (FLEET), Japan crude oil import (JP_IMP).). Correlation Table (Table 4.35) shows no high correlation between the independent variables. The first regression indicates only two significant variables the (DIND_JP) at 10% significance level and (JP_IMP) below 5% (Table 4.34). But the F-test implies that all independent variables are jointly significant. In addition, the Wald test hypothesis was not rejected (Table 4.36).P-Value 0.12 indicates that the other independent variables are jointly zero. The findings show the model compliance with the assumption of normality (Fig 4.13) and no heteroscedasticity (Table 4.37). However, the coefficient of determination is too low and the no serial correlation null hypothesis was rejected (Table 4.37). There is evidence of serial correlation. Therefore, a lagged value was added to the model. Afterward, the required tests were performed (Table 4.39) But the null hypothesis for normal distribution is rejected (Fig 4.14). Therefore, a dummy variable was added to the model. The final findings (Table 4.39), were the model complied with the all assumptions; R^2=0.98, the residual are normally distributed (Fig 4.15), no heteroscdasticity (Table 4.40) and no autocorrelation (Table 4.41). In addition, the outcome of Ramsey test was positive (Table 4.42).Therefore; the model is consistent and can predict the 3 year time-charter rate of the VLCC.

Table 4.35 VLCC 3-Year Time-Charter Model, First Regression Results

Dependent Variable: VLC_3TC
Method: Least Squares
Date: 10/04/13 Time: 20:53
Sample (adjusted): 2 138
Included observations: 136 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10407.91	15530.46	0.670161	0.5040
DBDTI	-16.38254	22.83001	-0.717588	0.4743
DBKR	-68.13623	105.7587	-0.644261	0.5206
DIND_CH	0.039346	0.042764	0.920078	0.3593
DIND_JP	-0.008510	0.005162	-1.648622	0.1017
DNBPC	426.9013	431.8238	0.988601	0.3248
DSCPC	-130.0042	111.0630	-1.170545	0.2440
DSHPC	109.5646	240.3085	0.455933	0.6492
FLEET	25.04242	60.91157	0.411128	0.6817
JP_IMP	6582.104	2093.642	3.143853	0.0021

R-squared	0.225185	Mean dependent var	38796.32
Adjusted R-squared	0.169841	S.D. dependent var	10422.87
S.E. of regression	9496.597	Akaike info criterion	21.22594
Sum squared resid	1.14E+10	Schwarz criterion	21.44011
Log likelihood	-1433.364	Hannan-Quinn criter.	21.31297
F-statistic	4.068819	Durbin-Watson stat	0.265382
Prob(F-statistic)	0.000133		

Table 4.36 VLCC 3-Years' Time-Charter Model, Correlation Table

	Correlation					
	JP_IMP	DBDTI	DIND_CH	DIND_JP	DNBPC	DSCPC
JP_IMP	1.000000	0.040764	0.005920	-0.048585	0.401263	0.135384
DBDTI	0.040764	1.000000	0.013706	-0.041023	0.085229	0.003148
DIND_CH	0.005920	0.013706	1.000000	0.007483	-0.019095	-0.007220
DIND_JP	-0.048585	-0.041023	0.007483	1.000000	0.066933	0.505716
DNBPC	0.401263	0.085229	-0.019095	0.066933	1.000000	0.042043
DSCPC	0.135384	0.003148	-0.007220	0.505716	0.042043	1.000000

Table 4.37 VLCC 3-Years' Time-Charter Model, Wald test

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.634424	(7, 126)	0.1316
Chi-square	11.44097	7	0.1205

Null Hypothesis: C(2)=0, C(3)=0, C(4)=0, C(5)=0, C(6)=0, C(7)=0, C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	-16.38254	22.83001
C(3)	-68.13623	105.7587
C(4)	0.039346	0.042764
C(5)	-0.008510	0.005162
C(6)	426.9013	431.8238
C(7)	-130.0042	111.0630
C(8)	109.5646	240.3085

Restrictions are linear in coefficients.

Figure 4.13 VLCC 3-Years' Time-Charter Model, Normality Results

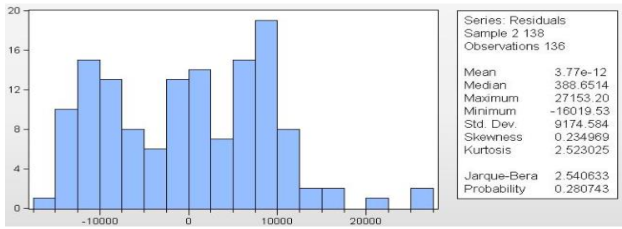


Table 4.38 VLCC 3-Years' Time-Charter Model, No Heteroscedasticity Results

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.291525	Prob. F(9,126)	0.2478
Obs*R-squared	11.48659	Prob. Chi-Square(9)	0.2438
Scaled explained SS	7.508124	Prob. Chi-Square(9)	0.5844

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/04/13 Time: 21:03
Sample: 2 138
Included observations: 136

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-92973185	1.68E+08	-0.554622	0.5801
DBDTI	-88506.97	246423.4	-0.359166	0.7201
DBKR	-1325705.	1141542.	-1.161328	0.2477
DIND_CH	-487.7882	461.5840	-1.056770	0.2926
DIND_JP	59.03393	55.71874	1.059499	0.2914
DNBPC	-3380766.	4661037.	-0.725325	0.4696
DSCPC	-1099818.	1198797.	-0.917435	0.3607
DSHPC	923977.1	2593851.	0.356218	0.7223
FLEET	75815.21	657469.7	0.115314	0.9084
JP_IMP	45788328	22598438	2.026172	0.0449

R-squared	0.084460	Mean dependent var	83554078
Adjusted R-squared	0.019065	S.D. dependent var	1.03E+08
S.E. of regression	1.03E+08	Akaike info criterion	39.79940
Sum squared resid	1.32E+18	Schwarz criterion	40.01357
Log likelihood	-2696.359	Hannan-Quinn criter.	39.88643
F-statistic	1.291525	Durbin-Watson stat	0.790831
Prob(F-statistic)	0.247836		

Table 4.39 VLCC 3-Years' Time-Charter Model, Serial Correlation Results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	19.71936	Prob. F(10,58)	0.0000
Obs*R-squared	60.27228	Prob. Chi-Square(10)	0.0000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/08/13 Time: 19:29
Sample: 9 126
Included observations: 78
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	36074.48	12806.18	2.816958	0.0066
DBDTI	659.6614	1739.993	0.379117	0.7060
DBKR	-9567.837	8005.138	-1.195212	0.2369
DIND_CH	177.8092	246.0797	0.722568	0.4728
DIND_JP	-97.70485	176.2248	-0.554433	0.5814
DNBPC	-212.2362	362.5031	-0.585474	0.5605
DSCPC	93.63842	68.73612	1.362288	0.1784
DSHPC	458.7391	216.0540	2.123261	0.0380
FLEET	-161.1753	55.54501	-2.901706	0.0052
JP_IMP	-3562.309	1489.186	-2.392118	0.0200
RESID(-1)	0.546680	0.143192	3.817810	0.0003
RESID(-2)	0.257921	0.142924	1.804603	0.0763
RESID(-3)	0.072619	0.151406	0.479630	0.6333
RESID(-4)	0.201629	0.152520	1.321981	0.1914
RESID(-5)	-0.086775	0.167253	-0.518823	0.6059
RESID(-6)	-0.074643	0.160350	-0.465498	0.6433
RESID(-7)	0.108919	0.175822	0.619484	0.5380
RESID(-8)	0.058779	0.170438	0.344872	0.7314
RESID(-9)	0.279865	0.152161	1.839269	0.0710
RESID(-10)	-0.043117	0.141999	-0.303646	0.7625

R-squared	0.772722	Mean dependent var	-1.39E-11
Adjusted R-squared	0.698268	S.D. dependent var	7949.498
S.E. of regression	4366.668	Akaike info criterion	19.81794
Sum squared resid	1.11E+09	Schwarz criterion	20.42223
Log likelihood	-752.8998	Hannan-Quinn criter.	20.05985
F-statistic	10.37861	Durbin-Watson stat	1.165138
Prob(F-statistic)	0.000000		

Figure 4 .14 VLCC 3Yrs'T/C Model, Non-Normality, after adding Lagged Values

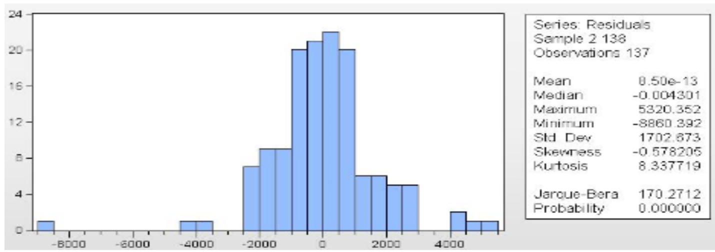


Table 4.40 VLCC 3Yrs'T/C Model, Regression Results after adding Lagged Values

Dependent Variable: VLC_3TC
Method: Least Squares
Date: 10/05/13 Time: 16:35
Sample (adjusted): 9 126
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1307.934	3064.992	-0.426733	0.6709
LVLC_3TC	0.985145	0.018041	54.60589	0.0000
DBDTI	1900.852	460.5208	4.127613	0.0001
DBKR	-1966.594	2215.731	-0.887560	0.3780
DIND_CH	-83.09533	67.18261	-1.236858	0.2205
DIND_JP	36.93443	46.96092	0.786493	0.4344
DNBPC	66.61533	94.61843	0.704042	0.4838
DSHPC	239.7454	55.36241	4.330472	0.0001
FLEET	10.21476	13.83245	0.738464	0.4628
JP_IMP	115.6466	379.9914	0.304340	0.7618
DMY1	5886.012	990.8598	5.940308	0.0000

R-squared	0.980698	Mean dependent var	41087.50
Adjusted R-squared	0.977817	S.D. dependent var	8464.003
S.E. of regression	1260.618	Akaike info criterion	17.24663
Sum squared resid	1.06E+08	Schwarz criterion	17.57898
Log likelihood	-661.6184	Hannan-Quinn criter.	17.37967
F-statistic	340.4168	Durbin-Watson stat	1.724258
Prob(F-statistic)	0.000000		

Fig 4.15 VLCC 3Yrs T/C Model, Normality Results after adding dummy variable and lagged values

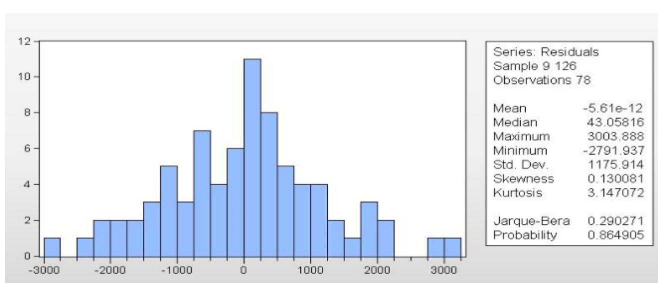


Table 4.41 VLCC 3Yrs'T/C Model, No Heteroscedasticity adding lagged values and dummy variable

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.308243	Prob. F(10,67)	0.2443
Obs*R-squared	12.74224	Prob. Chi-Square(10)	0.2384
Scaled explained SS	10.09306	Prob. Chi-Square(10)	0.4324

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/05/13 Time: 16:44
Sample: 9 126
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6327139.	4799488.	1.318295	0.1919
LVLC_3TC	35.86723	28.25049	1.269614	0.2086
DBDTI	857585.9	721132.1	1.189222	0.2386
DBKR	-3987692.	3469626.	-1.149315	0.2545
DIND_CH	-101790.6	105201.6	-0.967576	0.3367
DIND_JP	-107547.7	73536.37	-1.462510	0.1483
DNBPC	215013.9	148163.5	1.451193	0.1514
DSHPC	-48640.31	86692.31	-0.561068	0.5766
FLEET	-22361.54	21660.31	-1.032374	0.3056
JP_IMP	-845106.3	595030.6	-1.420274	0.1602
DMY1	506629.2	1551593.	0.326522	0.7450

R-squared	0.163362	Mean dependent var	1365045.
Adjusted R-squared	0.038491	S.D. dependent var	2013132.
S.E. of regression	1974008.	Akaike info criterion	31.95907
Sum squared resid	2.61E+14	Schwarz criterion	32.29142
Log likelihood	-1235.404	Hannan-Quinn criter.	32.09211
F-statistic	1.308243	Durbin-Watson stat	2.377343
Prob(F-statistic)	0.244312		

Table 4.42 VLCC 3Yrs'T/C Model, No Serial Correlation Hypothesis Test Results

Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.668021	Prob. F(10,57)	0.7489
Obs*R-squared	8.182386	Prob. Chi-Square(10)	0.6110

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/05/13 Time: 16:35
Sample: 9 126
Included observations: 78
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2164.953	3318.963	-0.652298	0.5168
LVLC_3TC	0.007309	0.021344	0.342441	0.7333
DBDTI	427.0728	507.3906	0.841704	0.4035
DBKR	-863.8930	2542.802	-0.339741	0.7353
DIND_CH	-12.05598	77.11770	-0.156332	0.8763
DIND_JP	25.44249	50.44768	0.504334	0.6160
DNBPC	22.42459	112.3499	0.199596	0.8425
DSHPC	-61.11525	65.40771	-0.934374	0.3541
FLEET	10.20636	14.96372	0.682074	0.4980
JP_IMP	140.1541	432.1742	0.324300	0.7469
DMY1	-414.0446	1234.227	-0.335469	0.7385
RESID(-1)	0.123471	0.158250	0.780225	0.4385
RESID(-2)	-0.104975	0.166671	-0.629830	0.5313
RESID(-3)	-0.108996	0.168082	-0.648469	0.5193
RESID(-4)	0.033266	0.170165	0.195493	0.8457
RESID(-5)	-0.438527	0.164729	-2.662115	0.0101
RESID(-6)	-0.196163	0.176875	-1.109047	0.2721
RESID(-7)	-0.249257	0.187085	-1.332319	0.1881
RESID(-8)	-0.085751	0.177959	-0.481857	0.6318
RESID(-9)	0.101217	0.187450	0.539968	0.5913
RESID(-10)	-0.093563	0.184619	-0.506790	0.6143

R-squared	0.104902	Mean dependent var	-5.61E-12
Adjusted R-squared	-0.209167	S.D. dependent var	1175.914
S.E. of regression	1293.060	Akaike info criterion	17.39221
Sum squared resid	95304170	Schwarz criterion	18.02671
Log likelihood	-657.2963	Hannan-Quinn criter.	17.64622
F-statistic	0.334010	Durbin-Watson stat	2.072468
Prob(F-statistic)	0.995672		

The 3 years' time-charter model= -1307 +0.98*LVLC_3TC + 1900.852*DBDTI – 83.09*DIND_CH + 36.93*DIND_JP +65.61*DNBPC +239.74*DSHPC +10.21*FLEET + 115.64*JP_IMP + 5896.01*DMY1

. In the VLCC model adjusted R^2 is equal to 0.98 which means that the model fitness is good enough to explain the freight rates. The industrial production of Japan has a positive impact on long duration freight rates. The rapid growth and manufacturing increases in Japan have positive impacts on VLCC trade by 36units. In addition, Japan import increases. the new build price also has positive effects by 65units on the time-charter freight rate movement. On the other hand, the active fleet has positive affect on freight rate movement. This indicates that the demand side is highly driving the freight rate routes to Japan. despite of the fleet oversupplied. Empirical results indicate that Japan oil imports are increases. Consequently, Japan relies on crude oil as the safest source of energy. BDTI which has positive correlation with freight rates so its behavior clearly predicted the freight rates market trend. The other positive variable is the second hand value which has a highly positive impact on the time-charter freight rates movement. And that explains the value of the ship at the end of the contract.

Table 4.43 3 Years' Time-Charter Model, Ramsey Test

Ramsey RESET Test
Equation: UNTITLED
Specification: VLC_3TC C LVLC_3TC DBDTI DBKR DIND_CH DIND_JP DNBPC DSHPC FLEET JP_IMP DMY1
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.153873	66	0.8782
F-statistic	0.023677	(1, 66)	0.8782
Likelihood ratio	0.027977	1	0.8672

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	38182.60	1	38182.60
Restricted SSR	1.06E+08	67	1589157.
Unrestricted SSR	1.06E+08	66	1612856.
Unrestricted SSR	1.06E+08	66	1612856.

LR test summary:

	Value	df
Restricted LogL	-661.6184	67
Unrestricted LogL	-661.6044	66

Unrestricted Test Equation:
Dependent Variable: VLC_3TC
Method: Least Squares
Date: 10/12/13 Time: 10:12
Sample: 9 126
Included observations: 78

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-652.1982	5262.493	-0.123933	0.9017
LVLC_3TC	0.955124	0.195943	4.874510	0.0000
DBDTI	1842.944	597.3658	3.085119	0.0030
DBKR	-1875.577	2309.099	-0.812255	0.4196
DIND_CH	-78.57116	73.78838	-1.064818	0.2908
DIND_JP	35.74212	47.93727	0.745602	0.4586
DNBPC	67.24973	95.40457	0.704690	0.4834
DSHPC	232.2631	73.99227	3.139018	0.0025
FLEET	9.952386	14.03829	0.708946	0.4809
JP_IMP	100.9218	394.5708	0.255776	0.7989
DMY1	5712.286	1506.990	3.790526	0.0003
FITTED^2	3.82E-07	2.48E-06	0.153873	0.8782

R-squared	0.980705	Mean dependent var	41087.50
Adjusted R-squared	0.977489	S.D. dependent var	8464.003
S.E. of regression	1269.904	Akaike info criterion	17.27191
Sum squared resid	1.06E+08	Schwarz criterion	17.63448
Log likelihood	-661.6044	Hannan-Quinn criter.	17.41705
F-statistic	304.9624	Durbin-Watson stat	1.726657
Prob(F-statistic)	0.000000		

The different models represent the uncertain situation of the oil tanker spot freight market. It is obvious that different routes have different circumstances; relatively freight rates are subject to the route that the vessel has been serviced. Basically, the freight rates market depends on the interaction of supply and demand. Demand is represented by the Gross domestic product which is highly related to the industrial production of a certain country. Supply is represented by the ships speed and active fleet utilized for transport the oil commodity. But other factors such as the distance between loading and discharging ports, if the distance is longer more bunker fuel is needed to be consumed, therefore, freight rates increased relatively. Other unpredictable variables cannot be calculated such as war, piracy and political unrest. On the other hand, weather represents an important factor for short term fluctuation of freight rates when demand for commodities increased in a specific area. In addition, foreign exchange rates are reflected in freight rates fluctuation. Moreover, collisions in congested areas such as, the Suez Canal, the Panama Canal or the Straits of Bosporus have a considerable impact on delaying vessel arrivals to destination and, therefore, create unreliability over sea freight.

The empirical results suggest that the fleet size has a positive impact on the 3 year time-charter. The freight differs from other spot freight rates with a negative sign. Moreover, the outcomes from the comparison between the Ras Tanura-LOOP route and Ras Tanura-Chiba roué, the findings suggest a high positive impact of the BDTI on the Ras Tanura-Chiba route which indicates a better future trade in this particular route. On the other hand, the 3 year time charter model has normal distribution at the first regression results. On the contrary, it has negative sign on the other spot freight rates, as they are characterized with non-normality at first regression. The spot voyages model, especially the VLCC models required more Dummy variables to obtain normal distribution. That is a good indication of the existence of seasonality. On the other hand, seasonality is an important issue in the cyclical effects of the freight market. Demand might be increased or decreases due to the seasonality effects. Consequently, its influence the freight rates (Kavussanos and Visvikis, 2006, p.51). Therefore, the importance of diversification in trade routes is highly recommended, in addition to the diversification in tanker sizes. In addition, it is wise to secure long term contracts in order to get steady cash flow. Empirical results (see Table 4.43) indicate that the freight rate volatility is clearly sensitive to positive or negative effects across tanker routes. There are indications of different return among tanker routes TD3, TD5, TD9. On the other hand, freight volatilities characterized with slow shift from low volatility to high volatility compared with the quick tendency of shifting from high volatility to low volatility. In other words, low volatility or trough state lasts longer than high volatility state when freight is at a peak. According to Kavussanos and Visvikis (2006) the freight rates in the tanker sub-sectors characterized with significant seasonal patterns. Table (4.43) shows monthly freight fluctuation at particular month compared to the average over the sample period.

Table 4.44 Different Tanker Freight Rate Response to Other Shipping Market

	MR	Aframax	Suezmax	VLCC TD1	VLCC TD3
BDTI/BCTI	+ 0.15	+ 0.31	+ 0.15	+ 0.40	+ 93.00
New Build		+ 2.89	+ 5.44	+ 5.47	+ 7.76
Sec. Hand		-0.001	+ 1.35	+ 0.92	+ 0.35
Fleet	-0.40		- 2.06	- 0.04	- 0.06
N. A. oil P.		-4.28		-2.46	
Jap. Imp.					22.08
Dmy1	+ 74.85	+27.33	+ 66.29	+ 27.37	+71.00
Dmy2			+ 67.76	+ 41.29	+ 48.47

Table 4.45 Seasonality in Tanker Freight Rate Series

Month	Coef.	VLCC	Suezmax	Aframax	Handysize
Constant	β_0	0.004 (0.350)	0.004 (0.443)	0.003 (0.347)	0.002 (0.239)
January	β_1	-0.110 (-2.933)			
February	β_2	-0.067 (-1.695)	-0.049 (-2.034)	-0.030 (-1.900)	
March	β_3				
April	β_4		-0.048 (-2.056)	-0.041 (-2.662)	-0.059 (-2.701)
May	β_5				
June	β_6	0.105 (2.951)			
July	β_7			-0.052 (-3.068)	
August	β_8				
September	β_9				
October	β_{10}				
November	β_{11}	0.066 (1.847)	0.105 (4.321)	0.110 (4.725)	0.077 (4.894)
December	β_{12}			0.033 (1.832)	

Source: Kavussanos and Visvikis (2006, p.55)

Chapter.5 Conclusion

Generally, the industrial production of Japan, China, India, Europe, the USA and other OECD countries, which represent the main consumer and demand for oil, as well as the oil tanker fleet size and new buildings which represent the supply of the tonnage are the main drivers that lead freight rates to fluctuate over the different types of oil tankers. On the other hand, freight rates show high correlation with BDTI and BCTI.

Although, the used models gives a good estimation of future freight rates trends, further achievement may be carried out considering that the effect of an increase in oil price will increase the operating costs. On the other hand, important issues such as consuming countries rushing to buy oil in order to secure their reserve during political unrest, war or any other forces will hinder and delay the supply of oil. Adversely, industrial countries might move towards searching for alternative sources of energy. Therefore, demands for oil might decrease. Consequently, freight rates will also decrease.

The oil tanker market is affected in the region where the ships are utilized such as tankers serving US coast, so the freight rates fluctuate in proportion to the industrial production and the oil production from North America. In addition, the presence of competition between two tankers segments, the Suesmax and the Aframax are observed specially in the routes serving the demand of the USA and Europe. On the other hand, Handy size oil tankers demand change in proportion to OECD countries, such as Japan and South Korea. In addition, the oil tanker market is affected by the availability of the tonnage; by knowing the size and number of the active fleet then the new build can be added and the scrapped tanker ships subtracted. Therefore, it is possible to predict the tanker availability. Hence, the future oil tanker freight can be predicted by using the existing tonnage as the explanatory variable. In addition, the prevailing spot freight rates give a good estimation for the future of the long duration time charter contract for the VLCC.

In shipping like any other market, the return is more important and freight rates represent the cash income for ship owners. However, freight rates are determined by supply and demand rules. On the other hand, time charter freight is determined through the negotiations between owners and charterers. According to Stopford (2008) the best strategy for ship owners is to charter the ships for long term at the peak of the freight rates and operate in spot voyages at trough. In addition, ship owners can adjust their fleet sizes by purchase the ships at cheap price and operate them at the lowest cost. Hence, the timing of investment is critically important. On the other hand, some ship owners argues that the rules for best decisions are possibly generalized in the rational model, even though a rational model is impossible as a reason of human incapability and the need and lack of information. When the market is high, investors especially ship owners' responses are very active about the order for new build ships based on the belief that the peak market will last for a long duration. Other investors and ship owners have the same thought and they place order for building new ships. As a result, shipping markets will be oversupplied when the ordered ships enter the market. Therefore, advanced information technology should be utilized. For example, the parameters effect in the regression model and the useful use to forecast the shipping market. The required step to make the model reliable is that all parameters of the independent variable which influence on freight rates behavior should be interrelated and the independent variables should affect the freight rate market. In addition, tonnage demand and supply are the main factors that drive the market to be continually volatile as a reason of unexpected phenomenon. Another important step is to form a short term freight rate model with the influence of the major issues that changes the market such as sudden rise in commodity price or unexpected cargo increase or decrease.

The negotiations of the time charter market are heavily affected by the spot market. Since the shipping market as a whole is painfully influenced by the financial crisis as the demand decreased concurrent with oversupplied tonnage and falling freight rates which is inevitable. Therefore, the time charter model needs more work to be improved as auseful forecast tool for the short and long term. However, the shipping company can avoid freight rate fluctuation and secure future earning by implementing chartering policy with more focus on long range time charters.

The shipping market is an international industry which is exposed to several risks, such as operation risk, financial risk and market risk. Therefore, ship owners should develop and implement a highly efficient risk management program in order to protect a firm financial stand and respond to the historical market volatility. The precautionary measures of a risk management program are highly recommended, by utilizing information to forecast the market future. In addition, utilizing of the derivatives market through the use of future and forward agreements is an effective tool to hedge market exposures. On the other hand, bunker price fluctuation is a major issue for ship operating cost. Therefore, appropriate risk management should be considered and utilized to manage bunker price volatility. Futures contract or swap contracts are good policy to hedge bunker price in connection with the contract of affreightment (COA). Moreover, the duration of bunker hedging will be similar to the COA duration.

In conclusion, maritime companies have to seek multiple risk management aids to survive in high volatile and competitive markets. The empirical results shows that the companies using the diversified strategy; different tanker sized serving different routes with different charter duration have the opportunity to survive crisis or a recession periods. In other words, the freight rate and bunker price fluctuations are the most significant risk factors for ship owners. Therefore, traditional risk management includes diversifying in different market segments and entering into long term time charters in order to secure a stable return, In addition, recent risk management methods and the use of the derivatives market are recommended to reduce potential losses. Moreover, applications of these strategies can reduce volatility of the cash flow and reduce the probability of bankruptcies.

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