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Determining the factors affecting investment decision on tanker industry: a case study on Bangladesh Shipping Corporation

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DETERMINING THE FACTORS AFFECTING INVESTMENT DECISION ON TANKER INDUSTRY

A CASE STUDY ON BANGLADESH SHIPPING CORPORATION

By

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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.

(Signature) 

(Date) 2019.09.24

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ABSTRACT

This paper aims to analyze the factors affecting Very Large Crude Carrier (VLCC) second-hand market and thereby creating an investment strategy for the tanker industry with an application for Bangladesh Shipping Corporation (BSC). The investment strategies for the second-hand tanker market is developed by (i) identifying which types of tankers are best to invest and (ii) ideal time to buy (invest) and sell (disinvest) in the tanker sales & purchase market. Ship investment is very important in the shipping industry mainly because of its uncertainty and capital intensiveness. Shipping is an international industry and numerous factors affect this business. It needs huge capital to acquire the vessels. In addition, operating costs of the shipping are higher than any other business and the shipowner has to pay fixed operating costs whether the ship is on a voyage or not. Moreover, the cost of capital, source of funds, debt-equity ratio may also affect the investment. As the shipping industry is unstable, the timing of investment is also very important for the shipowner. Therefore, the investor has to consider many things for investment in this volatile industry. The study utilizes (i) a simple Ordinary Least Squares (OLS) regression to identify various factors affecting the second-hand tanker prices, (ii) analyzes the best investment options within the tanker market by employing various investment appraisal methods and (iii) determines investment (and dis-investment) timing using slow and fast moving average (MA) technique. Results suggest that VLCC second-hand prices are not only significantly affected by the VLCC markets (such as new building prices, VLCC freight rates and VLCC sales volume) but also by commodity markets such as crude oil prices. It is also observed that larger tankers are more volatile than the smaller tankers which also generates higher return on investment.

Keywords: Tanker investment, Sales and Purchase market, Linear Regression, Moving Average, Bangladesh Shipping Corporation

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LIST OF ABBREVIATION

ADF	- Augmented Dickey and Fuller
AR	- Autoregressive
BCTI	- Baltic Clean Tanker Index
BDTI	- Baltic Dirty Tanker Index
BSC	- Bangladesh Shipping Corporation
CMC	- China National Machinery Import and Export Corporation
EMH	- Efficient Market Hypothesis
FDI	- Foreign Direct Investment
FOC	- Fixed Operating Cost
GDP	- Gross Domestic Product
IRR	- Internal Rate of Return
KPSS	- Kwiatkoski, Phillips, Schmidt and Shin
LIBOR	- The London Interbank Offered Rate
MA	- Moving Average
MAE	- Mean Absolute Error
MAPE	- Mean Absolute Percentage Error
MPK	- Marginal Productivity of Capital
NBP	- New Building Price
NPV	- Net Present Value
OB	- Order book
PP	- Philips and Perron
RMSE	- Root Mean Squared Error
ROA	- Real Option Analysis
SHP	- Second-hand Price
TC	- Time Charter
UNCTAD	- United Nations Conference on Trade and Development
US	- United States
VLCC	- Very Large Crude Carrier

CHAPTER ONE - INTRODUCTION

The main purpose of this study is to examine the factors which may affect the price of VLCC in the second-hand market. The research uses simple Ordinary Least Squares (OLS) regression to determine these factors. The required data are collected from the Clarkson Intelligence network database on a monthly basis. This paper also analyses all significant factors according to the results. Moreover, the study determines the proper timing for investment (purchase) and disinvestment (sale) in the sales and purchase market for VLCC using slow and fast moving average (MA). Furthermore, this paper calculates the Net Present Value (NPV) and Internal Rate of Return (IRR) of various tankers for Bangladesh Shipping Corporation (BSC) to identify the best option for this corporation on the basis of the higher NPV and IRR. The data used in this calculation are collected from the annual reports of BSC and the Clarkson Intelligence network database.

Ship investment is very sensitive due to its nature of uncertainty and huge capital involvement. Shipowners have to take a lot of factors into consideration for good investment. Firstly, regarding the source of finance, investors can manage money in many ways such as through debt ie loan from banks or other financial institutions and by investing own money, ie the equity, by issuing stock or bond. In terms of debt, the interest rate against the loan is considered to calculate the cost of the debt whereas beta, risk-free rate, and market return are needed to calculate the cost of equity. Secondly, as regards the length of the loan, if the length of the total debt period is long then the installment amount will be lower and the borrower can easily repay the debt. Thirdly, the timing of the investment and disinvestment is also important because the shipping market is uncertain and the market changes very quickly. As the shipping industry is volatile in nature, the shipowner has to take valuable as well as very hard decisions at the right time and this will create the opportunity to get huge profits from speculation on ship prices and at the same time it may also lead to large losses if the strategies are accomplished at a bad time of the cycle (Alizadeh, Trading strategies in the market of tankers, 2006). Finally, with respect to the selection of the vessel type, investors have to analyze all the investment opportunities to find the best option which has a higher rate of return.

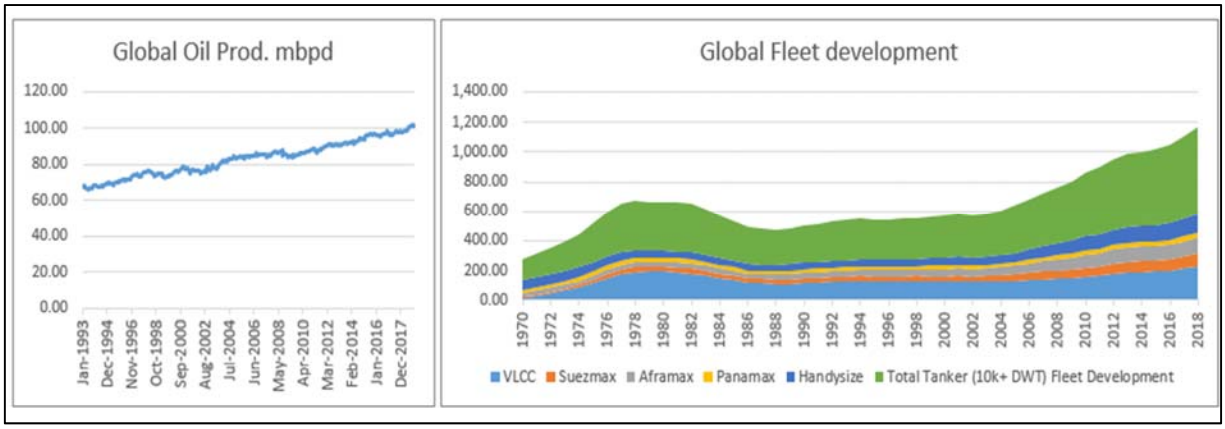

Figure 1. Global Oil Production and fleet development

From: Clarkson shipping intelligence

The demand for tanker market is growing day by day with the economic development as the industrial development is dependent on the oil industry (Veenstra, 2006). The global oil production in 1993 was about 67 million barrels per day which increased to about 101 million barrels per day at the end of 2018 (see Figure 1). The statistics imply that the global production of oil has increased by around 50% in 25 years. At the same time, global tanker vessel capacity has also increased every year. Figure 1 also shows the fleet development of various tankers where it is found that the total tanker in deadweight tonnage has increased by about 50% in the last 10 years.

1.1 Case Definition

Bangladesh Shipping Corporation (BSC) is a government-owned shipping organization that is responsible for transporting crude oil, product oil, edible oil, food grain, garments, tea, lather, processed food, fertilizer, chemical and container's goods between Bangladesh and other countries. BSC was established on 5 February 1972, just three months after independence by President Order number 10 (Bangladesh, 2007). The corporation is directed by the board of directors consisting of nine members and the Minister of Shipping is the Chairman of the board.

Figure 2 shows the source of income of BSC in the financial year 2017-18 in which it is found that almost half of the total income comes from the crude oil lighterage through two vessels namely Banglar Shourabh and Banglar Joyti. Both vessels are at high risk as they have already passed their expected life. So it is very urgent for the corporation to replace the vessels as it is the main source of revenue.

Source of Income	Income in 2017-18 (USD)
Lighterage	6,923,002
Address Commission	1,572,416
Service Charge	1,527,168
Rent revenue from BSC tower	547,360
Interest from deposit	3,824,571
Gain from sale of assets	593,184
Ohers (Bond, Scrap etc.)	255,492
Total	15,243,193

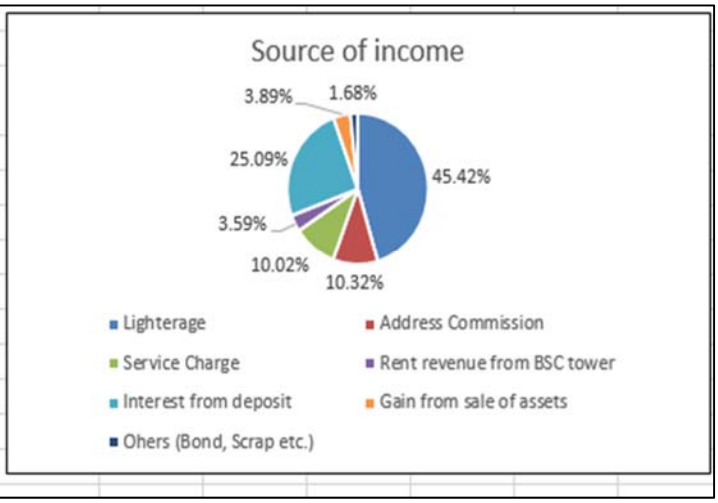

Figure 2. Source of income of BSC in 2017-18

From: Annual Report of BSC for 2017-18

Once the organization had 38 merchant ships but only 2 of them are available in the current fleet. After 1991, Bangladesh Shipping Corporation was able to acquire six new vessels this year meaning that it could not buy any vessel in the last 27 years. Almost all the vessels have passed their expected life.

In these circumstances, the government of Bangladesh is planning to acquire more vessels by 2021 including two mother tankers with a capacity of 100,000 to 125,000 tonnes due to the increasing demand for crude oil transport (Express, 2018). Moreover, the growth rates of imports and exports in the last ten years are 15.79% and 15.43% respectively (Roy, 2017). Therefore, Bangladesh Shipping Corporation (BSC) needs to set an investment strategy so that the investment decision can meet the growing demand for seaborne trade and be able to have optimal use of the vessels.

Figure 3 shows the freight earning of BSC from the financial year 2013-14 to 2017-18. By the year ended 30 June 2014, the freight earning was just over 10 million US dollars and 5 years later on 30 June 2018, the freight earning of the corporation decreased to around 7 million US dollars. Freight income decreased by about 30% in 5 years mainly due to the lack of seaworthy vessels.

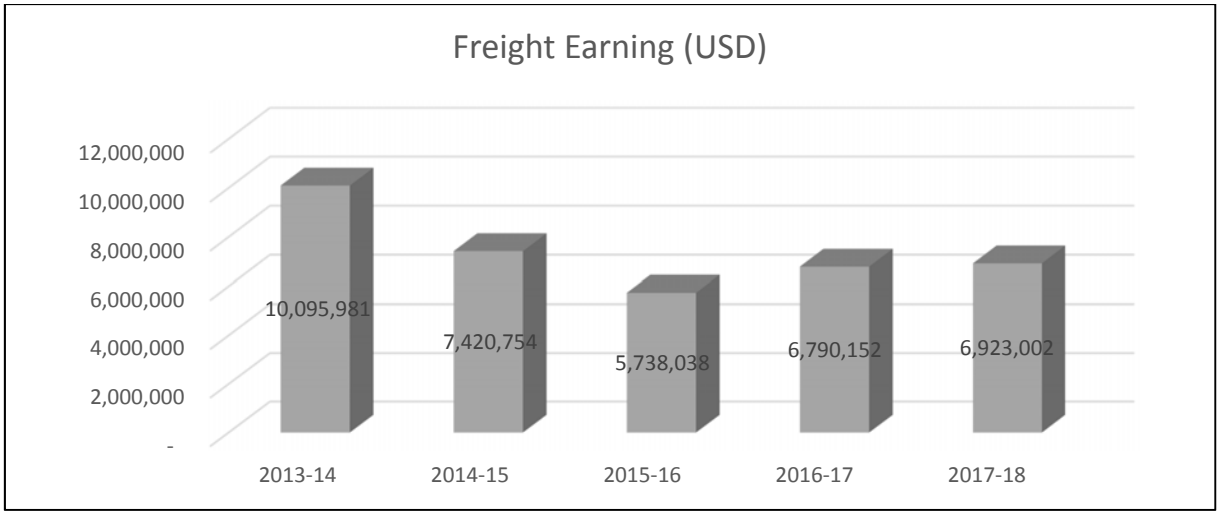

Figure 3. Freight earning of BSC for 5 years

From: BSC's Annual Reports

As a government-owned organization, BSC has the priority to transport all kinds of government cargo if it has the capacity to carry that cargo. Unfortunately, the corporation could not take this opportunity for the lack of vessels. BSC focuses on the tanker market mainly because of the growing consumption rate of oil in Bangladesh. Figure: 4 shows the oil consumption in Bangladesh from the year 2008 to 2018. According to this graph, the oil consumption in 2008 and 2018 was 77.115 and 175.694 barrels per day respectively, which implies an almost 128% increase in 10 years. This rapid increasing rate of oil consumption indicates the growing demand of the tanker market as there is no option other than to import by sea.

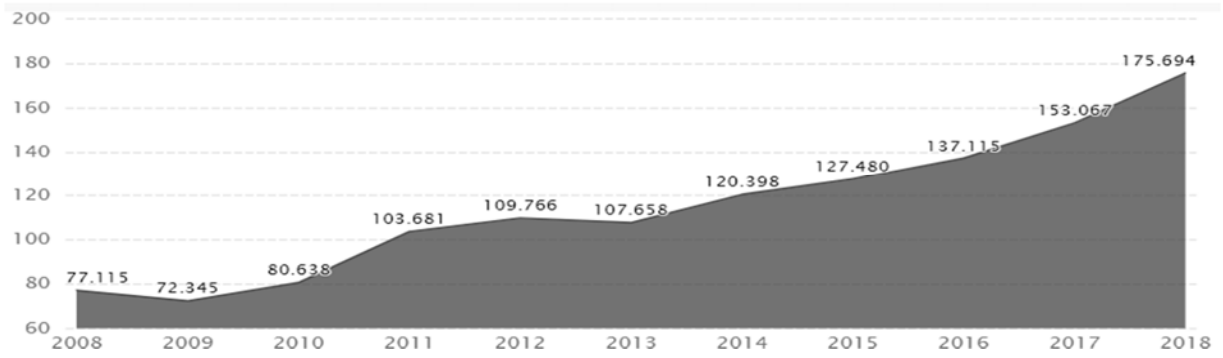

Figure 4. Oil consumption in Bangladesh

From: CEIC: Global Economic Data

1.2 Research Contribution

Firstly, the shipping market is uncertain and unpredictable compared to any other market in the world (Munim, 2017). Unlike other industries, it is very easy to open shipping business and exit from the market which creates a free and competitive market. Shipowners can earn a lot of money in the bullish market and lose in the bearish market. So, proper investment decision can save the ship owners to survive in this volatile market. Numerous factors can affect this industry and as a consequence of these factors, the market can be changed within a short time. This research tries to discover the factors which affect the second-hand price of VLCC (Very Large Crude Carrier).

Secondly, shipping is a highly capital intensive industry that needs huge capital to start a business. In addition, it needs a large amount of working capital to run the business. Whether the vessel is running on a voyage or not, ship owners need to pay fixed operating costs (FOC) such as manning, insurance, repair, and maintenance. In addition, as the shipping market is flexible and volatile, the proper timing of investment is also important in this sector. Therefore, this study contributes to detecting the timing of investment when the shipowners should buy, hold or sell their ships.

Finally, Bangladesh Shipping Corporation is a government-owned shipping organization and it has been struggling for a long time to survive in the market. Although it has both bulk carriers and tankers, the management is now mainly focused on acquiring more tankers as there is a huge volume of liquid cargos compared to bulk cargos. Therefore, the analysis of investment alternatives and choosing the right investment decision is very important in this risky business. This study also examines various investment options for BSC and analyses the pros and cons of these investments.

This research will help shipowners in many ways. They can set their investment strategies based on this research. It will also facilitate them to set a trading strategy based on the result in which points the tanker should buy and sell in the second-hand market. Bangladesh Shipping Corporation will be highly benefited from this research as it will help the organization to make investment decisions by choosing the best type of tanker.

1.3 Summery

The main objectives of this research are as follows:

- Determining the factors which may affect the investment decision on the tanker industry;
- Identifying the proper investment and disinvestment timing for VLCC in the sale and purchase market; and
- Choosing the best type of tanker investment for Bangladesh Shipping Corporation (BSC)

The paper uses different methods to get the results and make decisions, which are:

- A simple Ordinary Least Squares (OLS) regression technique is used to identify the factors affecting the second-hand tanker prices;
- Best tanker investment for Bangladesh Shipping Corporation is analyzed by calculating Net Present Value of various tanker sizes; and
- Fast and slow moving averages (MA) are used to identify the proper timing for purchase (investment) and sales (disinvestment) in the purchase and sales tanker market.

After using all the techniques following results have been found:

- The factors which may affect VLCC second-hand prices are New building price of the VLCC, time charter rate, crude oil price and total sales in volume;
- Very Large Crude Carrier is more profitable than small tanker for Bangladesh Shipping Corporation; and
- Purchase (investment) and sale (disinvestment) of a tanker depends on the difference between the slow and the fast moving average (MA) where a positive difference indicates a sell decision and a negative difference implies a buy decision.

1.4 Following chapters

This thesis is divided into six chapters. Chapter one is the introduction which is divided into three major sections. Firstly, this chapter described the importance of the investment decision in the shipping industry and the contribution of the tanker market in the global economy. Secondly, it discussed the background of Bangladesh Shipping Corporation (BSC) and the role of tankers in BSC's revenue. Lastly, the chapter discussed the research contribution of this study and its importance in the shipping industry.

The second chapter contains the literature review of previous scholars regarding various investment theories, investment decisions on the tanker market, investment timing, and financial risks in the shipping market. In addition, research gap also discussed at the end of this chapter. The third chapter has two parts. The first one is the analysis of data used in the research. The other one is the methodology which gives the steps that should be followed to find the factors affecting the price of the vessels. It also implies the method used for choosing investment decisions for Bangladesh Shipping Corporation.

The fourth chapter contains the empirical results of the research. The fifth chapter is the discussion where all the significant variables which may affect the price of the VLCC, are described. It also contains an explanation of the advantage and disadvantage of various investment options, and the limitation of the thesis. The sixth chapter contains the conclusion, recommendation, and the limitation of the thesis.

CHAPTER TWO - LITERATURE REVIEW

Clark (1917) in his study, introduced the simple accelerator theory with the simple accelerator model which depicts how the investment is connected with the change in outturn where the change in outturn might affect the change in investment (Clark, 1917). However, this model was later criticized by some scholars claiming that the assumption of the capital stock used in the model, was not realistic and ignored the price of capital equipment, interest rates, taxes and wages (Baddeley, 2002). (Goodwin, 1948) and later (Chenery, 1952), Goodwin (1948) and Chenery (1952) formulated the flexible accelerator model to mitigate the drawback and problem of the accelerator model. In the capital stock, (Chenery, 1952) also added reaction lags which present time difference between flexibility in demand and activity of new investment and was able to detect the lateness between decision and expenditure of investment. The expected profit theory of investment based on the subsidiary hypothesis of the accelerator theory emerged by Tsiang (1951) (Tsiang, 1951). The main concept of this theory is to consider the time value of the money by calculating the present value (PV) of the expected profit in the future (Kuh, 1963). Grunfeld (1960) later criticized this expected profit model and stated that profit cannot lead to investment expenditure in most cases and found the partial correlation between these two variables was insignificant for some corporations (Grunfeld, 1960). He suggested that the market value of the firm should be accounted for. A cash flow or liquidity theory was proposed as an alternative of the accelerator theory of investment and the expected profit theory (Meyer J. R., 1957) (Duesenberry, 1958), (Kuh, 1963), (Meyer J. R., 1964) (Anderson, 1964). The key concept of this theory is the level of investment is dominated by the cash flow and when there is a shortage of internal fund, external fund increases swiftly to balance the level of capital at the expected point (Jorgenson, 1968). However, the limitation of the cash flow theory is that some important factors such as the prices of the machinery and equipment and interest rate are not considered. The neoclassical theory is another model of investment which is based on the optimal accumulation of capital, where firms should use effectively production and labor force in such a way that the marginal productivity of capital (MPK) will be optimal. Chirinko (1993) criticized this theory stating that the neoclassical model was based on the distribution of delivery lags, which was not harmonious, and may not be optimal and the process of investment decision was considered as dynamic, not static (Chirinko, 1993). One of the most important theories of investment is the Q theory which has been developed

by James Tobin (Brainard, 1968), (Tobin, 1969) and (Tobin, 1978). According to this theory, the replacement value of the asset is compared to the market value of the company. The main concept of the theory is the market value of a company should roughly be equal to its replacement cost. The Q ratio measures the market value of a company compared to the replacement value of the firm's asset. Q theory is based on the theory that the market value of every company should roughly equal their replacement cost (Chirinko, 1993). If the total market value of a company is higher than the total asset value, the Q ratio will be more than one, which indicates the market is overvalued. On the contrary, when the market value is lower than the asset value, the Q ratio will be less than one, which means the market is undervalued. There are two different concepts of Q, one is average Q and the other is marginal Q. The average Q is the ratio of the total value of the firm to the replacement cost while the marginal Q is the ratio of the marginal unit of the capital to its replacement cost. Application of the Q model and the calculation of Q variable practically may be disputable. Various scholars offered different methods of calculation based on their research. For example, Peters (2017) considered intangible capital for computing the Q variable where total capital stock includes both the physical and intangible capital stock (Peters, 2017). Moreover, Hall (2001) computed the ratio as the value of ownership claims after deducting the book value of the inventory to the adjustment cost (Hall, 2001).

According to Graham (2001), large firms are using NPV and CAPM techniques for investment decision whereas small firms only rely on the payback period model. In addition, public companies use NPV and IRR whereas private corporations use the payback period for capital budgeting techniques. Most of the organizations considered firm risks than project risks in case of evaluation of new investment. Moreover, managements are concerned about stock price acceleration and earning per share for issuing equity while they consider credit ratings and financial flexibility in case of issuing debt. Regarding risk factors, large firms are more affected by foreign exchange risk while the interest rate is the main risk for small firms (Graham, 2001).

According to Alizadeh (2007), ship owners are not satisfied only from the day to day operation of the vessel but also seek return from capital gain which is generated by the appreciation of the assets. For this reason, the investor's expected return should be equal to the summation of expected earnings from the operation and expected gain from capital appreciation during the desired time. In addition, the future value of the earnings needs to convert in present value using the PV factor

to get accurate results (Alizadeh, Investment timing and trading strategies in the sale and purchase market for ships, 2007). In this study, the authors tried to determine the proper timing to make decisions for purchase and sale of a dry bulk carrier based on the relationship between price and earnings. Basically, MA (Moving Average) trading rules were used to identify the timing for purchase and sale of the ships in the second-hand market where positive difference and negative difference between the slow and fast Moving Average indicate sell and purchase decision respectively. To assess the performance of the strategies, transaction cost, operational income, and depreciation of the vessel were also considered. The same formula is used in another study of these authors for the tanker market (Alizadeh, Trading strategies in the market of tankers, 2006). Some other studies suggested real options analysis (ROA) such as NPV (Net Present Value) for future cash flow to fix ship prices which applied operational flexibility in ship management for buying and selling decisions and trading strategy (Dixit, 1994); (Bendall, 2005).

The formation of the price for vessels was also determined by the efficient market hypothesis (EMH) in the second-hand market. The main purpose of this test was to make extra profit based on market volatility. The opportunity of gaining money is created if the price of the vessel varies from its regular values in the market, so the trading strategy should be adapted to get benefits from this market. For example, the shipowner should buy the vessel when the price is lower than its rational value as the ship is underpriced compared to its future returns. On the contrary, chartering should be better than the purchase of the vessel when the price is higher than its fundamental value as it is overpriced compared to expected return (Kavussanos M. G., 2002).

According to Fan (2013), two fundamental decisions have to be taken in ship investment, ie one is the expansion decision and the other is the choice of ship type. In their study, the Binary logic model was applied for the expansion decision and the Nested logic model was applied for ship choice. The important factor for a shipping company is how it expands its capacity or what the optimal way to expand is; it may be ordering a new vessel or buying the second-hand one (Fan L. &., 2013). The study did not take the charter into the account but analyzed the impact of this. The profit maximization of a shipping company depends on the optimum utilization of existing ship capacity with optimal speed. If the shipping company cannot fully utilize its existing fleet, there is no reason to expand capacity. The company should take the decision to expand only if it can utilize its existing capacity and incremental benefit will be higher than the additional cost of new

investment including capital expenditure. In brief, expansion benefit will be the total savings from additional fixed cost, voyage cost, and annual capital cost. Regarding the choice of the ship, the empirical results found that ordering a new vessel is better than buying second-hand one although a new ship takes much time to build and the company loses money in the high freight market. However, it is also found that new building is better for a larger vessel whereas small vessels are available in the second-hand market (Fan L. &., 2013).

The recent study in this regard is (Celik Girgin, 2018), in which the authors reviewed the literature regarding the firm-level theories of investment and their application on ship investments. According to this study, the previous works of literature related to investment theory mostly focused on the relationship among various markets of the shipping industry such as new building, second hand, scrape and freight and their impacts on vessel price valuation and timing of entry and exit.

Kavussanos (1996) worked on the volatility of the price in the second-hand tanker market and various risks at different times for different ship sizes and tested by the ARCH model where he used "Modern Portfolio Selection Theory" of Markowitz (Markowitz, 1952). The research explicitly explained the high volatility of the market and the reason for such changes in the market, for example, the war between Iraq and Iran in the year 1979 and the oil crisis during the following year. The paper also analyzed the effect of such an incident on the price of the oil as well as the tanker and in the behavior of the shipowners during that period. Moreover, there was a positive relationship between the oil price and oil tanker price whereas a negative relationship between oil price and the fluctuation of second-hand tanker price changes (Kavussanos M. G., 1996).

Ghiorghe and Maria (2011) were working on the financial risk management in the maritime sector where they mentioned that the risks management deals with the factors which may affect the reduction in value of the shipping company and the value is determined by the future net cash flow. Most of the ship loans are plain vanilla term loans for both the new building and second-hand vessels, where the repayment amount consists of principle and interests and in most of cases the installments are equal. Borrowers get the benefit from a fixed interest rate if the rate is below the market rate. Moreover, floating interest is changing over time and reset at a predetermined time interval that maybe 3 months, 6 months or 12 months. Unlike fixed-rate, borrowers get benefitted from a floating interest rate if the rate is decreasing. One of the techniques to minimize interest

rate risk is hedging in the derivatives market which is called forward rate agreement where the rate is determined at the opening of the period (Ghiorghe, 2011)

Research Gaps and Contribution

The latest research regarding ship investment is (Celik Girgin, 2018) where the author reviewed the various investment theories of previous scholars. Alizadeh (2007) was working on investment timing but it was 13 years ago. Therefore, the research on this matter should be updated. Another study is (Fan L. &., 2016), where the authors mainly focused on the interrelationship among the newbuilding prices, second-hand prices and time charter rates in the container market. One research found related to this topic is (Merikas, 2008) in which the authors determined the price ratio (second-hand price over the newbuilding price) and investigated across various vessel sizes in the tanker industry. After this, no research has been done regarding the investment strategy of the tanker industry in the last 20 years.

Moreover, there is no research on the investment decision of the tanker market using Net Present Value (NPV) method. NPV is an important tool for making investment decisions. Furthermore, there is also no research on investment strategy on Bangladesh Shipping Corporation (BSC). Therefore, this research will help the corporation to make investment decisions based on the results.

CHAPTER THREE - DATA AND METHODOLOGY

3.1 Data

Monthly data series were collected from the Clarkson Intelligence network database for the time of August 1998 to February 2019. Different types of data series were selected for this study, which are supply and demand related and macro-economic factors. The second-hand price of a five year old VLCC was chosen as the dependent variable for this study. The study used data on one year time charter rate for VLCC, BDTI, BCTI, Trip charter rate, new building price, second-hand price of product oil tanker, order book, ship delivery, ship demolition, scrape price, average age of the vessel, sales, import and export. as the independent variables for analysis. In addition, variables related to macro-economic were also considered for analysis such as inflation, exchange rate, LIBOR, industrial production, oil production, crude oil price and bunker price (see Table 1). In this study, all data series are transformed into natural logarithms except vessel demolition, crude oil export, and inflation as they had zero or negative value in some months. Logarithm transformation leads to squeeze the higher values and stretch the lower values, which could help to make the distribution approximately normal.

Table 1. Explanatory variables

Categories of independent variables	Independent variables
Demand related variables	Global import, Sales, Crude oil trade, AG crude oil export, US crude oil import
Supply related variables	New building price of VLCC, New building price of oil tanker, New building price of Suezmax, Second-hand price of product oil tanker, Scrape price of tanker, Ship demolition, Order book of tanker, Delivery, Average age of the vessel
Market variables	Bunker price (MGO), Bunker price (IFO 380), Steel price
Commodity price variable	Brent crude oil price
Substitution/ complementary variables	Average earnings, Time charter rate, Trip charter rate
Baltic Indexes	Baltic dirty tanker index, Baltic clean tanker index
Macro-economic factors	Inflation, Global oil production, Crude oil production, Industrial production of China, LIBOR, Exchange Rate (Special drawing rights)

In addition, for calculating NPV and IRR of the investment, data were collected from the annual report of Bangladesh Shipping Corporation and the Clarkson Intelligence network. Current savings rate in Bangladesh is taken for Interest rate of deposit and interest rate of the loan is considered according to the contract between the Government of Bangladesh and the Government of China.

3.2 Methodology

In order to find the investment decision of Bangladesh Shipping Corporation for tankers in the changing market conditions, the study constructed a model. The aim of the model is to analyze the role of independent variables and how the dependent variable is affected by the change in any independent one. When an independent variable (X) is changed, the dependent variable (Y) will also be changed which can be expressed mathematically as follows:

Equation 1.

$$\frac{\Delta Y}{Y} = \frac{\Delta X}{X}$$

From the above equation, the hypothesis can be tested. The null hypothesis says that there is no change in the elasticity in the market, which may affect the investment decision of the organization. The concept of the null hypothesis is similar to "innocent until proven guilty". The alternative hypothesis states that the variables have significantly affected the investment decision. It can be expressed mathematically as follows:

Equation 2.

$$H_0: \beta_1 = 0$$

Equation 3.

$$H_1: \beta_1 \neq 0$$

The significance level, in this study, is set to 0.05.

Regression analysis is a process and a statistical tool concerned with the evaluation of the relationship between a dependent variable and independents or explanatory variables (Montgomery, 2012).

The general form of the regression analysis is given below:

Equation 4.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots\ldots + \beta_4 X_4 + \mu$$

Where:

- Y is the dependent variable;
- x is the independent variable;
- β_0 is the constant or intercept;
- $\beta_1, \beta_2, \beta_3$ and β_4 are slops or coefficients of the independent variables $X_1, X_2, X_3,$ and X_4 respectively. If β is zero, means change in X has no effect on change in Y, positive β indicates that increase in X leads to increase in Y, if β is negative, it implies that increase in X leads to decrease in Y;
- μ is the error term

According to this equation, the mean equation of this study is of the following form:

Equation 5.

$$SHP = \beta_0 + \beta_1 NBP + \beta_2 TC\ Rate + \beta_3 Brent\ Crude\ oil + \beta_1 Sales + \mu$$

Where:

SHP = Second-hand price of five years old VLCC in millions of US dollars;

TC Rate = Time charter rate on average for one year contract in US dollars per day;

NBP = New building price of VLCC in millions of US dollars;

Brent Crude = Brent crude oil price in US dollars;

Sales = Total VLCC sales volume

Unit Root Test

Unit root problems occur when the parameter in the variables, for example, mean and variance, change during shifter over time and generate spurious results. Basically, the common solution to this problem is taking the first difference in the logged data. In this study, the stationarity or the order of integration is selected by using Augmented Dickey and Fuller (Dickey, 1981), Phillips

and Perron (Phillips, 1988) and KPSS (Kwiatkowski, 1992) unit root test. Data frequency and lagged variation are needed for these tests. Monthly data and a maximum of 14 lags are used in this research. If the probability value is more than 5% in ADF and PP test, the null hypothesis is accepted, which indicates that the variable is non-stationary and has a unit root. In contrast, the variables are stationary when the Probability value is less than 5%. In the case of the KPSS test, if the test statistic is lower than the critical value at 5%, then the variable is considered stationary.

Multicollinearity (correlation) Table

Correlation is the tool that indicates and measures the fluctuation among variables. Two independent variables are considered as correlated when the correlation coefficient between them is more than 80% (Gujarati, 1999). Positive correlation means variables increase or decrease the same way in parallel whereas a negative correlation indicates the decrease of one variable as a consequence of the increase of others.

Running Ordinary Least Square (OLS)

T-Test and F-Test

T-stats states all variables whether they are significant or not while the F-test is done for the multiple hypothesis test where insignificant variables are removed one by one to ensure that any significant variable is not removed from the model. All explanatory variables were added for running the regression using a 5% significance level.

Cointegration Test

An error correction model is used in this study by testing for cointegration which was introduced by Engle and Granger (Hylleberg, 1990). If more than one series are cointegrated, then there may exist some common factors which may affect them; eventually, the series will adjust to equilibrium.

The following steps are taken for testing cointegration:

1) Determination of order of cointegration through conducting unit root analysis.
2) Estimation of long-run equilibrium relationship through cointegration regression and test for regression.

Cointegration test is possible only if the dependent variable is I(1) process and the dependent variable in this study is I(1), so a pair was created between dependent variable with each significant variables that are I(1) process because a pair with the variables with I(0) or I(2) could not be made. Then the residuals were saved for the unit root test. After doing the unit root test, the residuals that were I(0), were cointegrated.

Autoregressive Process (AR) and Moving Average Process (MA)

The autoregressive process is used for forecasting future value based on the past value whereas the moving average process is used based on the error of the past value. This model was applied in this research and examined the significance. If the AR or MA is lower than 5%, then the null hypothesis can be rejected and the alternative hypothesis accepted and become significant.

Residual Diagnosis:

Jarque Bera test is performed for testing the data whether it has normally distributed or not. If the value of probability is less than 5%, it is considered that the errors are not normally distributed and dummy variables should be added as a consequence to increase the probability value till becoming normally distributed (Brooks, 2019). The value of Kurtosis and Skewness obtained from this test where the Kurtosis value should be closed to three and Skewness value should be closed to zero. In addition, heteroscedasticity assumption was also done in this study to find if the model is homoscedastic or heteroscedastic. Moreover, the Breusch Godfrey test for serial correlation was also performed in this study. Based on the result of both Heteroscedasticity and Breusch Godfrey test, the following correction had to be made:

Table 2. Heteroscedasicity and Serial Correlation

Scenario	Heteroscedasticity	Serial Correlation	Correction
1	Homoscedastic	No serial correlation	None
2	Homoscedastic	Serial correlation	White
3	Heteroscedastic	No serial correlation	Newey West
4	Heteroscedastic	Serial correlation	Newey West

Stability Diagnosis

Ramsey (1969) introduced this test for testing linearity in the model (Ramsey, 1969). When the P-value in this test is more than 5%, then the null hypothesis can be accepted and it is considered that the model is linear. If the model is found not linear, then the model cannot be run.

Forecasting

As management makes the decision mostly for the long term, forecasting is needed for testing the accuracy of the model. Therefore, forecasting is used in EViews for testing the accuracy of the model. There are two methods used for forecasting, one is dynamic and the other is static. The main difference between the two forecasting models lies in the estimation of their procedure. In Dynamic forecasting, previous forecasted value is used to compute future value whereas the actual value is used for the next forecast in the Static forecasting model. Moreover, if the values of Mean Absolute Error (MAE), Mean Abs. percentage error (MAPE), Bias proportion and variance proportion are found close to zero in this test, then the model is considered accurate.

Net Present Value

Net Present Value of the investment is one of the most effective processes to make decision for investment. This method tells the net present value of the future cash flow (Discounted cash flow) of an organization through which management can take the decision whether the investment is profitable or not. Then the formula can be written as:

Equation 6.

$$\mathrm{NPV} = \frac{\mathrm{F}}{(1+\mathrm{i})^{\mathrm{n}}}$$

Where,

- F = Future cash flow;
- i = interest rate
- n = total number of periods in the future cash flow

A positive NPV (Net present value) indicates that future earnings from the project will be higher than the initial investment whereas a negative NPV indicates that future earnings will be lower than the project cost. Therefore, investors should invest if the NPV is positive. NPV of different

types of investment opportunities is calculated to select the most profitable option for Bangladesh Shipping Corporation.

Assumption:

1. The time charter rate of the tanker (38000dwt) is USD. 13,000.00 per day for the first year of operation which increases 1% per year. Moreover, for VLCC, the time charter rate is considered USD. 33,000.00 per day with 1% increases per annum.
2. The expenses of small tanker and VLCC are USD. 6,000 and USD. 10,000 respectively for the first year with a 2% increment every year.
3. The interest rate of deposit is 7% which is the savings rate in Bangladesh at present.
4. Share dividend on equity is considered 5% per annum.
5. The principle and interest on the loan were calculated as per the contract between the Chinese government and the Bangladesh government.

Internal Rate of Return

Internal rate of return (IRR) is also an important tool for calculating the profitability of projects. The IRR is a discount rate that makes the NPV of future cash flows of specific investment equal to zero. The formula of calculation of IRR is given below:

Equation 7.

$$\text{IRR} = \sum_{t-1}^{t} \frac{C_t}{(1+r)^t} - C_0$$

Where,

- t = Number of time periods;
- C_t = Net cash Inflow for the period t;
- C_0 = Total investment at the year 0;
- r = Discount rate

Generally, if the IRR of a project is greater than the cost of capital of that project, the management can accept the project and reject the project on the opposite situation. However, the internal rate

of return is an important method for investment decisions for management whether a particular investment is profitable or not, in some cases, IRR is not as reliable as NPV to take decisions.

Trading strategies

The aim of this exploration is to determine the timing for the purchase and sale of the vessels using fast (short-term) and slow (long-term) moving average of the price for VLCC. A simple MA (Moving Average) trading strategies in the second-hand ship market is used to determine the investment (buy) and disinvestment (sell) decision. When a short term MA crosses above long term MA, then it indicates to buy decision, and when the fast (short term) MA crosses below the slow (long term) period MA, then it indicates to sell decision.

CHAPTER FOUR - EMPIRICAL RESULTS

4.1 Descriptive statistics of the variables

Table 3. Descriptive statistics of the variables

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability	Observations
DEMO	344029.2	0.000	566171.300	2.565	11.359	989.960	0.000	247
EXP_CRUDE	0.359	0.200	0.424	1.263	3.342	66.837	0.000	247
INFL	0.024	0.023	0.010	-0.229	3.026	2.170	0.338	247
LOG_AG_CRUDE_EXP	2.830	2.849	0.109	-0.241	2.450	5.500	0.064	247
LOG_AVE_AGE	2.213	2.186	0.154	1.158	3.593	58.773	0.000	247
LOG_AVE_EARN	10.392	10.459	0.775	-0.328	2.828	4.736	0.094	247
LOG_BCTI	6.654	6.564	0.340	0.420	2.542	9.433	0.009	247
LOG_BDTI	6.857	6.754	0.366	0.697	2.903	20.082	0.000	247
LOG_BRENT_CRUDE	3.953	4.052	0.605	-0.535	2.573	13.665	0.001	247
LOG_BUNK_380	5.669	5.752	0.612	-0.401	2.353	10.931	0.004	247
LOG_BUNK_MGO	6.123	6.259	0.599	-0.595	2.571	16.470	0.000	247
LOG_DELI	0.757	0.781	0.521	-0.497	3.426	12.025	0.002	247
LOG_EXCH_SDR	0.368	0.374	0.066	-0.325	2.227	10.484	0.005	247
LOG_IMP	2.739	2.812	0.183	-0.555	1.776	28.088	0.000	247
LOG_IMP_CRUDE_US	1.874	1.987	0.267	-0.718	2.047	30.559	0.000	247
LOG_IP_CHN	2.368	2.398	0.410	-0.380	2.546	8.054	0.018	247
LOG_LIBOR	0.804	0.773	0.087	0.657	2.024	27.562	0.000	247
LOG_NBP	5.055	5.031	0.202	0.604	2.684	16.067	0.000	247
LOG_NBP_SUE	4.102	4.094	0.211	0.293	2.520	5.901	0.052	247
LOG_NBP_VLCC	4.546	4.538	0.236	0.348	2.365	9.148	0.010	247
LOG_OB_TANK	18.208	18.139	0.423	0.189	2.298	6.552	0.038	247
LOG_PRO_CRUDE	3.385	3.391	0.075	-0.475	2.566	11.213	0.004	247
LOG_PROD_OIL	4.457	4.453	0.090	-0.084	2.017	10.227	0.006	247
LOG_SALES	14.332	14.391	0.695	-0.690	4.222	34.946	0.000	247
LOG_SCR	2.514	2.712	0.530	-0.864	2.497	33.362	0.000	247
LOG_SHP_PROD	3.197	3.135	0.304	0.633	2.680	17.567	0.000	247
LOG_STEEL	11.539	11.611	0.275	-0.412	1.817	21.396	0.000	247
LOG_TC_RATE	10.480	10.404	0.396	0.225	2.089	10.628	0.005	247
LOG_TRIP_RATE	4.206	4.129	0.468	0.672	3.034	18.599	0.000	247

Notes: Mean and Median measure the central tendency; standard deviation measures the dispersion; skewness measures the degree of sharpness; kurtosis measures the degree of symmetry; Jarque- Bera measures the normality.

Table 3 shows the descriptive statistics of the variables which may affect the price of the second-hand vessels where the skewness measures the asymmetry and kurtosis measures the peakedness

or flatness of the distribution of the variables. The Jarque-Bera (Jarque, 1980) statistics were used to verify if a variable is normally distributed or not and the second to last column implies the probability of normal distribution where a high probability of a variable means normal distribution and low probability implies the opposite. By observing the probability of the table, it can be seen that almost all variables are not normally distributed, which indicates high volatility of the variables.

4.2 Unit Root Test

Table 4 shows the unit root test of the variables used in this study. If observing the table, among 30 variables, 8 variables (Vessel demolition, Inflation, Average age of the vessel, Average earnings, Baltic dirty tankers index, ship delivery, sales and trip charter rate) were found stationary at level in both Augmented Dickey and Fuller (Dickey, 1981) and Phillips and Perron (Phillips, 1988) unit root test. So there was no need to go for KPSS (Kwiatkowski, 1992) unit root test for stationarity.

The rest of the variables (AG crude oil export, Baltic clean tanker index, Brent crude oil price, price of the bunker MGO and 380cst, Exchange rate, inflation, import, crude oil import of US, industrial production of China, LIBOR, newbuilding price of oil tanker, newbuilding price of Suezmax, newbuilding price of VLCC, order book of tanker, global oil production, Scrap price, Second hand price of product oil tanker, steel production, crude oil production, crude oil export, and time charter rate) except three, were stationary at first difference. Three variables (Baltic clean tanker index, industrial production of China, crude oil export) were found stationary at a different level under Augmented Dickey and Fuller (Dickey, 1981) and Phillips and Perron (Phillips, 1988) unit root test, so KPSS (Kwiatkowski, 1992) unit root test was done for these three and found stationary at 1st difference.

Table 4. Unit Root Test

1. Variables	ADF			PP			KPSS			Stationary
	Level	1st Diff.	2nd Diff.	Level	1st Diff.	2nd Diff	Level	1st Diff	2nd Diff.	
DEMO	-5.109			-10.694						Level
EXP_CRUDE	-2.032	11.142		-3.405			1.140	0.357		1st Diff.
INFL	-3.165			-2.961						Level
LOG_AG_CRUDE_EXP	-2.230	17.246		-2.080	-17.369					1st Diff.
LOG_AVE_AGE	-3.128			-2.916						Level
LOG_AVE_EARN	-4.166			-4.050						Level
LOG_BCTI	-2.871	12.617		-3.163			1.138	0.047		1st Diff.
LOG_BDTI	-4.118			-3.346						Level
LOG_BRENT_CRUDE	-2.326	12.593		-2.449	-12.599					1st Diff.
LOG_BUNK_380	-2.154	10.541		-2.496	-10.233					1st Diff.
LOG_BUNK_MGO	-2.337	11.566		-2.466	-11.568					1st Diff.
LOG_DELI	-3.391			-14.727						Level
LOG_EXCH_SDR	-2.163	17.92		-1.993	-17.949					1st Diff.
LOG_IMP	0.074	-16.09		-0.078	-29.991					1st Diff.
LOG_IMP_CRUDE_US	-0.334	-22.83		-0.408	-25.484					1st Diff.
LOG_IP_CHN	-2.238	-11.16		-3.121			0.994	0.328		1st Diff.
LOG_LIBOR	-1.657	-8.710		-1.839	-8.941					1st Diff.
LOG_NBP	-1.634	-9.532		-1.543	-10.065					1st Diff.
LOG_NBP_SUE	-2.199	-5.159		-1.733	-9.915					1st Diff.
LOG_NBP_VLCC	-1.856	-4.936		-1.508	-9.303					1st Diff.
LOG_OB_TANK	-1.635	-5.935		-1.598	-12.547					1st Diff.
LOG_PRO_CRUDE	-1.937	-15.961		-1.904	-15.968					1st Diff.
LOG_PROD_OIL	-0.637	-13.723		-0.804	-17.888					1st Diff.
LOG_SALES	-7.548			-13.032						Level
LOG_SCR	-1.966	-15.439		-1.949	-15.450					1st Diff.
LOG_SHP_PROD	-1.335	-13.577		-1.602	-13.711					1st Diff.
LOG_STEEL	-1.294	-4.590		-1.491	-25.285					1st Diff.
LOG_TC_RATE	-2.264	-11.291		-2.080	-11.228					1st Diff.
LOG_TRIP_RATE	-4.761			-4.676						Level

4.3 Multicollinearity (Correlation) Table

Table 5 shows the correlation between the variables. By observing the statistics, it was found that the new building price of VLCC is highly correlated with the new building price of Suezmax (98%), second-hand price of product oil tanker (94%) and the order book of tankers (84%); Baltic clean tanker index is correlated with Baltic dirty tanker index (88%); average earning is correlated with trip charter rate (86%) and time charter rate (82%); Brent crude oil price is highly correlated with bunker price of MGO (99%) and that of 380cst (98%); Global oil production is correlated with AG crude oil export (85%). Consequently, 13 variables were removed from the model which are AG crude oil production, Average earnings of the tankers, Baltic Dirty Tanker Index, Bunker 380 cst price, Bunker MGO price, Crude oil import, New building price of Suezmax, New building price of tanker, Order book, crude oil production, Scrap price, Second-hand price of product oil tanker and steel price.

Table 5. Correlation

	DEMO	EXP_CRUDE	INFL	LOG_AG_CRUDE_EXP	LOG_AVE_AGE	LOG_AVE_EARN	LOG_BCTI	LOG_BDTI	LOG_BRENT_CRUDE	LOG_BUNK_380	LOG_BUNK_MGO	LOG_DELI	LOG_EXCH_SDR	LOG_IMP	LOG_IMP_CRUDE_US	LOG_IP_CHN	LOG_LIBOR	LOG_NBP	LOG_NBP_SUE	LOG_NBP_VLCC	LOG_OB_TANK	LOG_PRO_CRUDE	LOG_PROD_OIL	LOG_SALES	LOG_SCR	LOG_SHP_PROD	LOG_STEEL	LOG_TC_RATE	LOG_TRIP_RATE
DEMO	100%																												
EXP_CRUDE	27%	100%																											
INFL	20%	55%	100%																										
LOG_AG_CRUDE_EXP	-32%	-59%	-23%	100%																									
LOG_AVE_AGE	32%	72%	52%	-45%	100%																								
LOG_AVE_EARN	-35%	-3%	13%	3%	2%	100%																							
LOG_BCTI	-12%	14%	56%	-17%	10%	62%	100%																						
LOG_BDTI	-19%	10%	52%	-1%	13%	77%	88%	100%																					
LOG_BRENT_CRUDE	-30%	-57%	-27%	50%	-81%	-13%	-17%	-18%	100%																				
LOG_BUNK_380	-25%	-53%	-28%	48%	-78%	-21%	-24%	-25%	98%	100%																			
LOG_BUNK_MGO	-33%	-58%	-26%	53%	-81%	-8%	-13%	-13%	99%	98%	100%																		
LOG_DELI	-20%	-27%	-16%	10%	-28%	-2%	-6%	-3%	26%	27%	27%	100%																	
LOG_EXCH_SDR	-32%	-49%	-23%	22%	-69%	5%	-5%	-7%	77%	74%	78%	33%	100%																
LOG_IMP	6%	41%	53%	-64%	32%	40%	69%	56%	-41%	-47%	-39%	2%	-7%	100%															
LOG_IMP_CRUDE_US	3%	36%	47%	-65%	22%	35%	63%	48%	-32%	-38%	-31%	5%	2%	96%	100%														
LOG_IP_CHN	-16%	0%	27%	-36%	-17%	36%	59%	49%	8%	3%	8%	13%	35%	69%	72%	100%													
LOG_LIBOR	6%	45%	65%	-30%	71%	27%	51%	49%	-47%	-51%	-46%	-16%	-34%	59%	50%	23%	100%												
LOG_NBP	-47%	-47%	-9%	27%	-43%	40%	26%	25%	56%	47%	60%	28%	69%	14%	18%	29%	11%	100%											
LOG_NBP_SUE	-47%	-52%	-15%	33%	-52%	38%	22%	21%	64%	56%	68%	28%	70%	4%	9%	24%	-1%	98%	100%										
LOG_NBP_VLCC	-46%	-48%	-13%	27%	-49%	33%	19%	16%	64%	56%	67%	30%	74%	9%	14%	26%	3%	99%	98%	100%									
LOG_OB_TANK	-39%	-54%	-31%	16%	-53%	29%	6%	5%	54%	49%	57%	44%	66%	6%	14%	28%	-19%	84%	87%	85%	100%								
LOG_PRO_CRUDE	-40%	-57%	-29%	87%	-47%	1%	-27%	-13%	66%	63%	68%	21%	44%	-62%	-60%	-32%	-28%	48%	54%	51%	42%	100%							
LOG_PROD_OIL	-28%	-70%	-53%	85%	-61%	-18%	-47%	-34%	68%	69%	69%	18%	37%	-84%	-81%	-46%	-57%	29%	38%	33%	33%	88%	100%						
LOG_SALES	-12%	-38%	-11%	27%	-29%	16%	17%	23%	23%	20%	23%	5%	12%	-10%	-12%	17%	-14%	15%	19%	12%	12%	17%	24%	100%					
LOG_SCR	-37%	-73%	-34%	62%	-84%	1%	-9%	-7%	91%	88%	92%	29%	78%	-41%	-33%	8%	-47%	66%	74%	70%	65%	73%	76%	32%	100%				
LOG_SHP_PROD	-40%	-52%	0%	32%	-47%	43%	39%	35%	54%	44%	57%	22%	62%	19%	22%	39%	14%	94%	92%	91%	77%	44%	26%	22%	67%	100%			
LOG_STEEL	-27%	-70%	-51%	77%	-69%	-23%	-46%	-37%	81%	82%	81%	23%	52%	-78%	-73%	-32%	-59%	35%	45%	40%	41%	84%	96%	25%	84%	34%	100%		
LOG_TC_RATE	-39%	-14%	11%	2%	1%	82%	64%	68%	-6%	-16%	0%	10%	13%	47%	45%	37%	39%	67%	63%	59%	54%	9%	-16%	16%	12%	66%	-18%	100%	
LOG_TRIP_RATE	-28%	-3%	38%	12%	3%	86%	74%	91%	-7%	-14%	-2%	6%	6%	44%	38%	45%	36%	34%	31%	26%	20%	6%	-17%	23%	6%	42%	-21%	72%	100%

Note: The highlighted numbers imply the variables which have more than 80% correlation between each other.

4.4 T-Test and F-Test

Table 6. Ordinary Least Square (OLS)

Dependent Variable: D(LOG_SHP_VLCC)
Method: Least Squares
Date: 08/05/19 Time: 19:36
Sample (adjusted): 1998M09 2019M02
Included observations: 246 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.253	0.074	-3.392	0.001
LOG_AVE_AGE	0.0305	0.018	1.605	0.109
D(LOG_BCTI)	0.006	0.019	0.346	0.729
D(LOG_BRENT_CRUDE)	0.064	0.026	2.463	0.014
DEMO	5.832	4.547	1.283	0.200
LOG_DELI	-0.001	0.005	-0.106	0.916
D(LOG_EXCH_SDR)	-0.055	0.136	-0.406	0.685
INFL	-0.670	0.303	-2.217	0.027
D(LOG_IMP)	-0.030	0.057	-0.536	0.592
D(LOG_IP_CHN)	-0.015	0.013	-1.199	0.232
D(LOG_LIBOR)	-0.341	0.303	-1.123	0.263
D(LOG_NBP)	0.641	0.141	4.533	0
D(LOG_PRO_CRUDE)	0.032	0.149	0.215	0.830
LOG_SALES	0.011	0.003	2.903	0.004
D(LOG_TC_RATE)	0.129	0.030	4.226	0
LOG_TRIP_RATE	0.010	0.006	1.572	0.117
D(EXP_CRUDE)	-0.012	0.013	-0.981	0.328

R-squared	0.326	Mean dependent var	0.001
Adjusted R-squared	0.279	S.D. dependent var	0.041
S.E. of regression	0.035	Akaike info criterion	-3.812
Sum squared resid	0.277	Schwarz criterion	-3.570
Log likelihood	485.912	Hannan-Quinn criter.	-3.715
F-statistic	6.931	Durbin-Watson stat	2.050
Prob(F-statistic)	0		

Note: LOG_AVE_AGE is Average age of the vessels; D(LOG_BCTI) is Baltic Clean Tanker index; D(LOG_BRENT_CRUDE) is Brent crude oil price; DEMO is Demolition of tankers, LOG_DELI is total delivery of tanker; D(LOG_EXCH_SDR) is Exchange rate; INFL is the inflation rate; D(LOG_IMP) is global import; D(LOG_IP_CHN) is Industrial Production of China; D(LOG_LIBOR) is LIBOR rate; D(LOG_NBP) is New Building price of VLCC; D(LOG_PRO_CRUDE) is Crude oil production; LOG_SALES is Sales; D(LOG_TC_RATE) is Time charter rate; LOG_TRIP_RATE is Trip charter rate; D(EXP_CRUDE) is Crude oil export.

Up to the 5% significant level of probability value for each variable was considered. Table: 6 shows that all variables are insignificant except Brent crude oil, Inflation, NBP, Sales, and TC rate. Then insignificant variables that had the highest probability value were removed one by one. 11 variables which are Delivery, Crude oil production, Baltic clean tanker index, Exchange rate, Import, Crude oil export, LIBOR, Industrial production of China, Demolition, Trip charter rate, Inflation, were removed one after another.

Finally, after removing all insignificant variables, 4 variables are found significant which had less than 5% probability value (see Table 7); which are Brent crude oil price, New building price, Sales and Time charter rate. Furthermore, adjusted R-squared is increased slightly in the new model.

Table 7. Ordinary Least Square: Significant variables

Dependent Variable: D(LOG_SHP_VLCC)				
Method: Least Squares				
Date: 08/06/19 Time: 02:35				
Sample (adjusted): 1998M09 2019M02				
Included observations: 246 after adjustments				
Variable	Coefficien	Std. Error	t-Statistic	Prob.
C	-0.160	0.051	-3.159	0.002
D(LOG_BRENT_CRUDE	0.057	0.024	2.359	0.019
D(LOG_NBP)	0.567	0.124	4.586	0.000
LOG_SALES	0.011	0.004	3.166	0.002
D(LOG_TC_RATE)	0.140	0.027	5.247	0.000
R-squared	0.292	Mean dependent var		0.001
Adjusted R-squared	0.281	S.D. dependent var		0.041
S.E. of regression	0.035	Akaike info criterion		-3.861
Sum squared resid	0.291	Schwarz criterion		-3.789
Log likelihood	479.865	Hannan-Quinn criter.		-3.832
F-statistic	24.886	Durbin-Watson stat		2.038
Prob(F-statistic)	0			

4.5 Cointegration Test

The cointegration test is needed for examining the long-run relationship between the variables. It was found that residuals of second-hand price and Time charter rate is stationary at level both in the ADF and PP unit root test (see Table 8), which means that the trend of this pair moves together over time.

Table 8. Cointegration table

Paired Variables	By	ADF	PP	KPSS
		Level	Level	Level
SHP and Brent crude oil	t-statistic	-1.459	-1.653	0.446
	Prob.*	0.553	0.454	0.463
SHP and New Building price	t-statistic	-2.720	-2.786	0.786
	Prob.*	0.072	0.062	0.463
SHP and Time charter rate	t-statistic	-2.896	-2.877	0.429
	Prob.*	0.047	0.050	0.463

Table 9. Equation with error correction term

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.176	0.050	-3.529	0.001
D(LOG_BRENT_CRUDE)	0.059	0.024	2.496	0.013
D(LOG_NBP)	0.538	0.121	4.428	0.000
LOG_SALES	0.012	0.003	3.536	0.001
D(LOG_TC_RATE)	0.145	0.026	5.566	0.000
RESID_SHP_VLCC_TC_RATE(-1)	-0.045	0.013	-3.363	0.001
R-squared	0.324	Mean dependent var		0.001
Adjusted R-squared	0.310	S.D. dependent var		0.041
S.E. of regression	0.034	Akaike info criterion		-3.899
Sum squared resid	0.278	Schwarz criterion		-3.813
Log likelihood	485.527	Hannan-Quinn criter.		-3.864
F-statistic	23.022	Durbin-Watson stat		2.029
Prob(F-statistic)	0.000			

After getting stationary at level, the Error correction term was added in the equation (see Table 9). If observing the table, it can be seen that the adjusted R-squared has increased. In addition Akaike information criterion which estimates the quality of the statistical model has decreased to -3.89859, which means the model is better with lower value (Kimura, 2018).

4.6: Autoregressive Process (AR) and Moving Average (MA)

AR (1-5) and MA (1-5) were added in the equation and found all were insignificant (see Table 10).

Table 10. Autoregressive Process (AR) and Moving Average (MA) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.198	0.049	-4.001	0.000
D(LOG_BRENT_CRUDE)	0.070	0.023	3.021	0.003
D(LOG_NBP)	0.537	0.122	4.389	0.000
LOG_SALES	0.014	0.003	4.009	0.000
D(LOG_TC_RATE)	0.159	0.026	6.125	0.000
RESID_SHP_VLCC_TC_RATE(-1)	-0.025	0.010	-2.504	0.013
AR(1)	-0.125	0.502	-0.249	0.804
AR(2)	-0.397	0.407	-0.974	0.331
AR(3)	0.556	0.336	1.656	0.099
AR(4)	0.477	0.474	1.006	0.316
AR(5)	0.221	0.253	0.873	0.383
MA(1)	0.049	0.505	0.098	0.922
MA(2)	0.268	0.449	0.597	0.551
MA(3)	-0.652	0.314	-2.078	0.039
MA(4)	-0.476	0.474	-1.004	0.316
MA(5)	-0.261	0.263	-0.992	0.322

R-squared	0.379	Mean dependent var	0.001
Adjusted R-squared	0.337	S.D. dependent var	0.041
S.E. of regression	0.033	Akaike info criterion	-3.907
Sum squared resid	0.248	Schwarz criterion	-3.676
Log likelihood	486.853	Hannan-Quinn criter.	-3.814
F-statistic	9.138	Durbin-Watson stat	2.058
Prob(F-statistic)	0.000		

After removing one by one from 5 to 3, two AR and two MA were found becoming significant.

4.7: Residual diagnosis

4.7.1: Jarque Bera

Figure 5 shows the normality test where it can be found that the probability is 21% meaning the null hypothesis is accepted, indicating that residuals were distributed normally. So, there was no need to add dummy variables in this model.

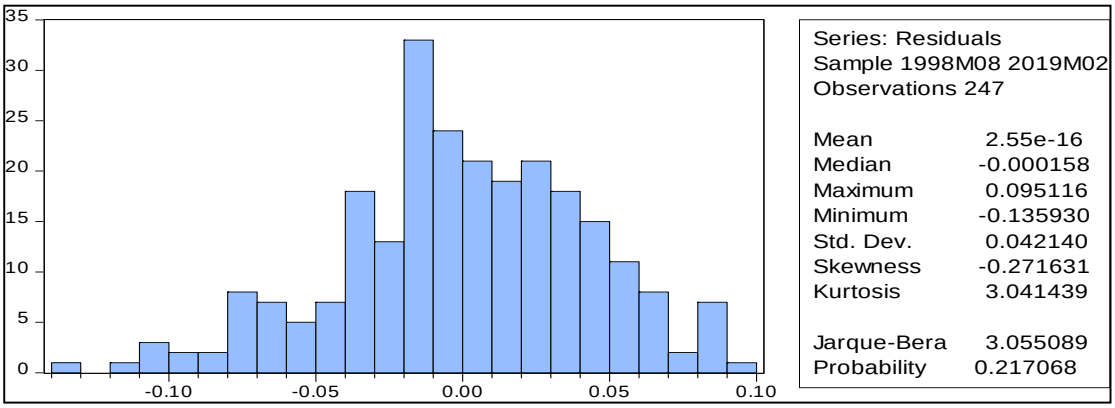

Figure 5. Jarque Bera Normality Test

4.7.2 Serial Correlation and Heteroscedasticity Assumption

Table 11 presents the result of the Heteroskedasticity test and Serial correlation test. It is mentioned that the model has no serial correlation and Heteroskedasticity is at the 5% level due to the rejection of the null-hypothesis. It means variance of the residuals or error terms are not constant and finite (Brooks, 2019). Moreover, the Breusch-Godfrey Serial Correlation LM Test shows that the probability value is more than five percent, which means the null hypothesis can be accepted, so there is no serial correlation. In this scenario, white correction has done as the model is heteroskedasticity and no serial correlation.

Table 11. Serial Correlation and Heteroskedasticity Test

Details	Null-hypothesis	F-Statistic	Pro. F	Prob. Chi-Square	Obs*R-squared
Breusch-Godfrey Serial Correlation LM Test	No serial correlation	0.599	0.052	0.864	8.845
			-14		
Homoscedasticity Test	Heteroskedasticity	3.22	0	0	70.136
			-27	-27	

4.8. Ramsey RESET Test

Table 12 implies Ramsey RESET test for linearity in which it was found that the probability is 27%, which indicates that the model is linear, so the variables are able to explain the dependent variable Second-hand price of VLCC.

Table 12. Ramsey RESET Test

Ramsey RESET Test			
	Value	df	Probability
F-statistic	1.313701	(2, 237)	0.2708
Likelihood ratio	2.712171	2	0.2577
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	0.003024	2	0.001512
Restricted SSR	0.275829	239	0.001154
Unrestricted SSR	0.272805	237	0.001151

4.9. Final Regression Model

Table 13. Regression Model

Dependent Variable: D(LOG_SHP_VLCC)
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)
Date: 08/20/19 Time: 02:57
Sample (adjusted): 1998M11 2019M02
Included observations: 244 after adjustments
Failure to improve likelihood (non-zero gradients) after 25 iterations
Coefficient covariance computed using outer product of gradients
MA Backcast: 1998M09 1998M10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.210	0.052	-4.025	0.000
D(LOG_NBP)	0.541	0.121	4.454	0.000
LOG_SALES	0.010	0.004	2.940	0.004
D(LOG_TC_RATE)	0.144	0.026	5.535	0.000
LOG_BRENT_CRUDE	0.016	0.007	2.347	0.020
RESID_SHP_VLCC_TC_RATE(-1)	-0.095	0.024	-3.953	0.000
AR(1)	-0.965	0.023	-42.165	0.000
AR(2)	-0.936	0.024	-39.822	0.000
MA(1)	1.019	0.010	97.549	0.000
MA(2)	0.979	0.008	118.137	0.000

R-squared	0.346	Mean dependent var	0.001
Adjusted R-squared	0.321	S.D. dependent var	0.041
S.E. of regression	0.034	Akaike info criterion	-3.908
Sum squared resid	0.264	Schwarz criterion	-3.764
Log likelihood	486.747	Hannan-Quinn criter.	-3.850
F-statistic	13.770	Durbin-Watson stat	1.962
Prob(F-statistic)	0.000		

Inverted AR Roots	-.48-.84i	-.48+.84i
Inverted MA Roots	-.51+.85i	-.51-.85i

Table: 13 shows the final model of regression which indicates that all variables are significant at the 5% level. The final regression model is as follows:

Y = -0.210 + 0.541 * NBP + 0.010 * SALES + 0.144 * TC RATE + 0.016 * BRENT CRUDE – 0.095 * RESID_TC_RATE - 0.095*AR(1) - 0.936*AR(2) + 1.019*MA(1) + 0.979*MA(2)

By observing the model, it can be seen that all variables have positive relationships with the SHP_VLCC. It has been revealed that NBP has the highest coefficient with 0.540830 followed by TC_RATE with 0.144347, BRENT_CRUDE with 0.015572 and SALES with 0.10391.

Significant variables

New Building Price

In the VLCC market, where huge capital is needed for buying second-hand vessels, newbuilding prices are mostly affected by the price of second-hand vessels. The main reason for this is for its capital intensiveness compared to other types of vessels. If observing the graph (see Figure 6), it can be seen that the second-hand price is strongly affected by the new building price of the vessel. In 2008, where the new building price peaked, second-hand prices would also go to the peak.

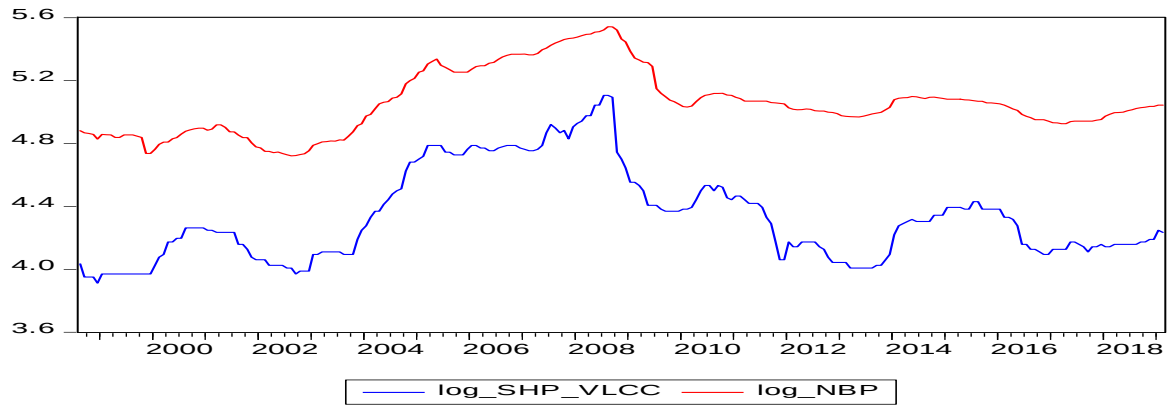

Figure 6. SHP Vs NBP

From: Clarkson shipping intelligence network

Time Charter Rate

It is a common phenomenon that when the charter rate is high, the ship owners want to purchase more ships to earn more profit. Therefore, the demand will be high, and consequently, the price will be higher. So the price of the vessel depends on the time charter rate. Although the time charter rate seems stable compared to second-hand price in the graph (see Figure 7), the direction of two lines is in parallel.

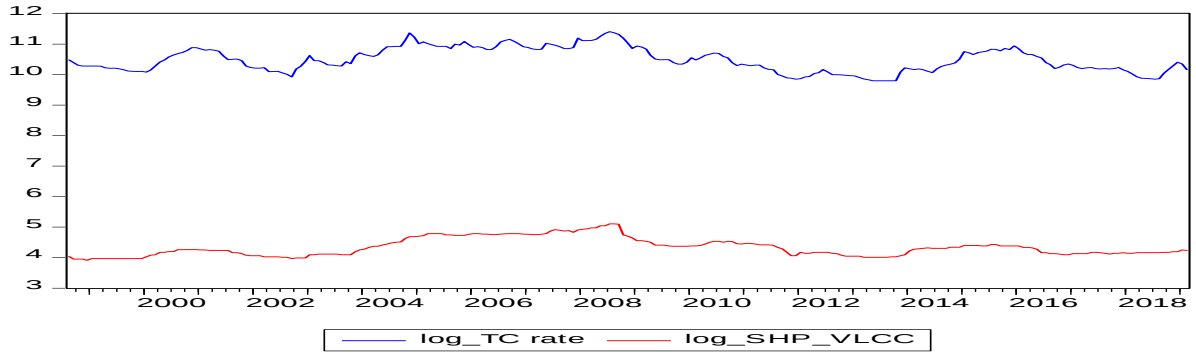

Figure 7. SHP vs TC Rate

From: Clarkson shipping intelligence network

Brent Crude Oil:

Commodity price is very important in any business. The price of the commodity is determined by the demand in the market. Crude oil is one of the main commodities in the tanker industry. If observing the graph (see Figure 8), there is a positive trend between these two variables before 2008, but negative after 2008.

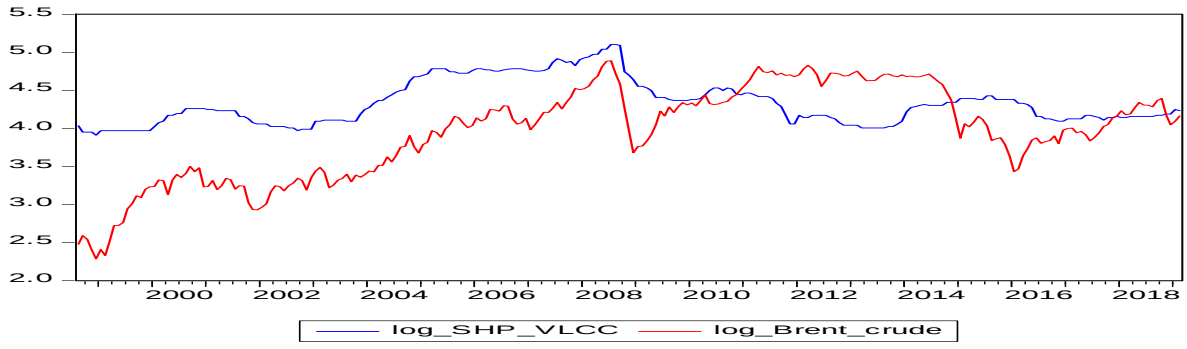

Figure 8. SHP vs Brent crude oil

From: Clarkson shipping intelligence network

Sales volume of tankers:

The total number of sales also may affect the price of VLCC. Figure 9 shows the log values of total tanker sales and the second-hand price of the VLCC in which sales decreased after 2008, negatively affecting the price of the ship.

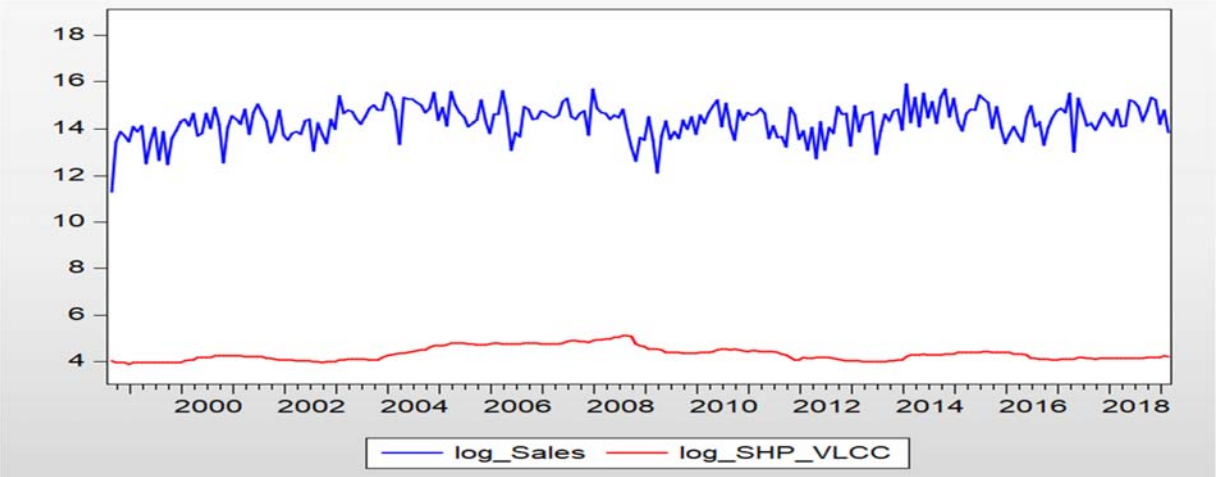

Figure 9. Sales vs Second-hand Price

From: Clarkson shipping intelligence network

4.10. Forecast Model

Figure 10, figure 11 and figure 12 present the Dynamic forecast, the Static forecast and the comparison between these two respectively. Total data series is divided into two parts for forecasting; one is in-sample period and the other is the out-of-sample period. The in-sample forecasting period starts from August 1998 and ends up in February 2017 and the duration of the out-of-sample is March 2017 to February 2019 which is approximately 10% of total samples. If comparing these two forecasts, the static forecast is more accurate than the dynamic forecast.

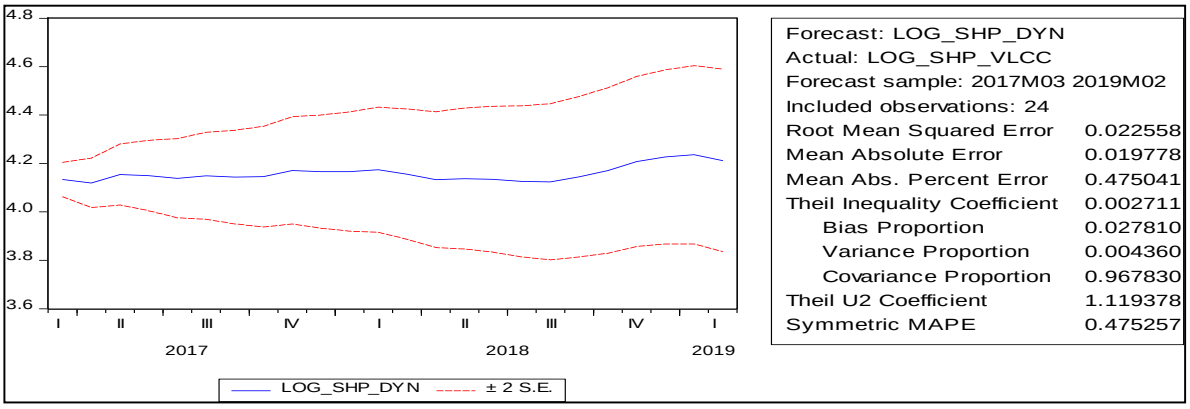

Figure 10. Dynamic Forecasting

If observing the static forecast (Figure 11), it can be seen that the second-hand ship price becomes low in the month of April and October in 2017. Then it starts increasing with some fluctuations and reaches a peak at the end of the sample. Basically, Root Mean Squared Error (RMSE) and Mean Absolute Error are used to measure the gap between values. However, according to Chai (2014), Root Mean Square Error is better to use than Mean Absolute Error when errors are normally distributed (Chai, 2014). Mean Absolute Percentage Error (MAPE) indicates the measurement of accuracy of forecasting which mostly depends on the loss function (De Myttenaere, 2015). The result obtained from RMSE is 0.020821, MAE is 0.016751, and MAPE is 0.402166, all of which are very close to the value zero indicating the model is acceptable. In addition, Theil's coefficient of inequality gives information about the accuracy of the method used in forecasting (Bliemel, 1973). If the value is very close to zero, it implies that the forecast is closer to the actual value (Ravi, 2017). It can also be seen that Biasness is much closer to zero (0.001191), indicating that only 0.001191 inaccuracies or there is no wrong in this forecast. Furthermore, variance proportion (0.000425) is less than covariance proportion (0.998384).

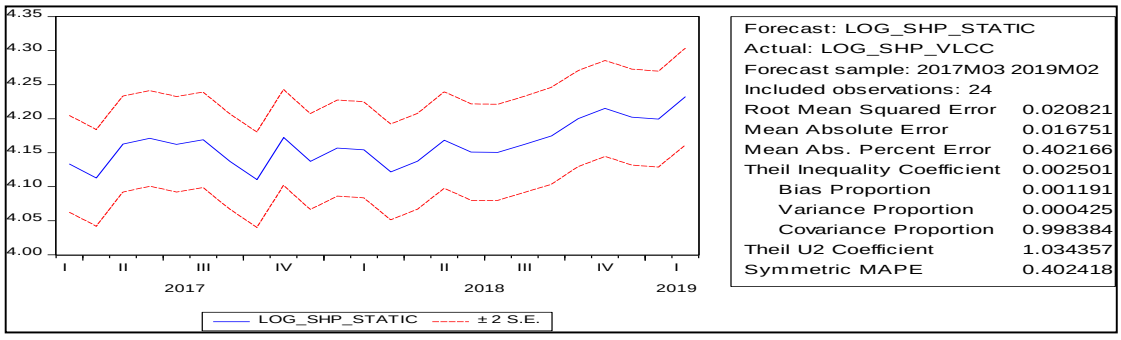

Figure 11. Static Forecasting

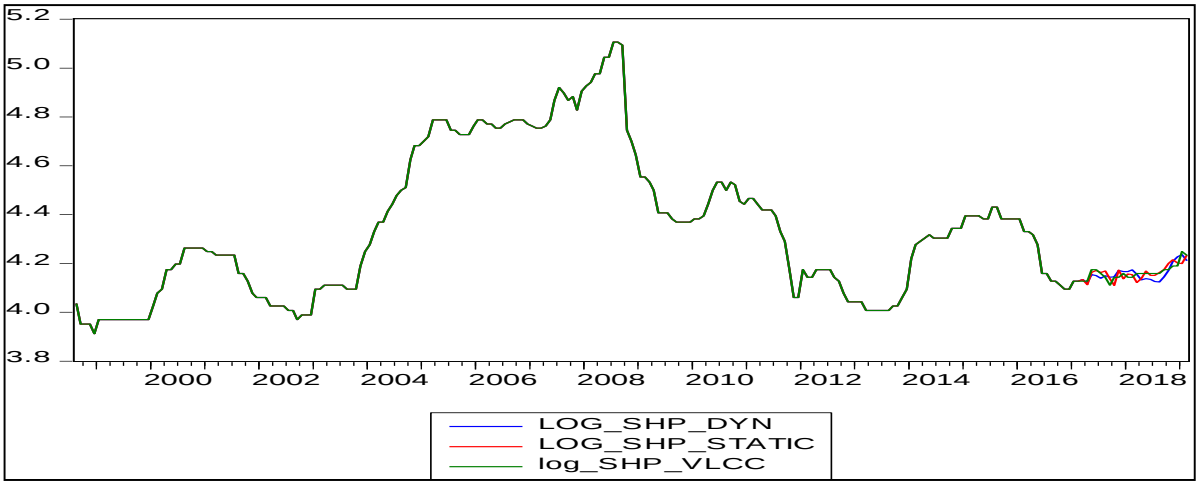

Figure 12. Dynamic and Static Forecasting

According to the graph (Figure 12), we can see that the red line (static forecast) goes much closer along with the green line (actual price of VLCC) meaning that the capability of forecasting is satisfactory.

4.11: Trading Strategies

In this research, the trading strategy is based on the difference between the price and its long-term mean, where fast (MA 1) and slow (MA 12) moving averages are used to find the timing of purchase and sale.

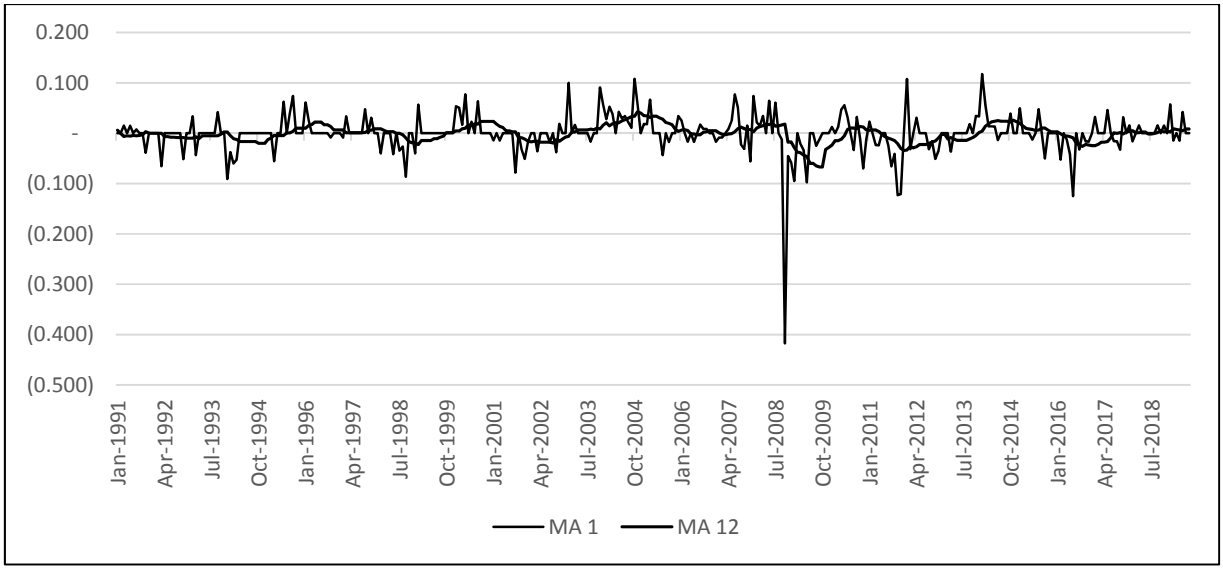

Figure 13. Plot of MA 1 and MA 12 of historical price of VLCC

Figure 13 shows the long-run and short-run moving average of the price of VLCC. The difference between the fast (MA 1) and slow (MA12) moving average was used as a determinant for the signals of buying and selling in the VLCC sales and purchase market. The point where MA 1 (Fast moving average) crosses above MA 12 (Slow moving average), indicates the signal that trend is changing direction to the upside, which means that this is a proper time to buy. On the contrary, the point where MA 1 crosses below MA 12, indicates the trend is changing direction to the downside, which means the time is ideal to sell.

4.12: Net Present Value and Internal Rate of Return of various investments

Table: 14 shows the Net present value for one tanker of the six vessels project of Bangladesh Shipping Corporation for 20 years. By observing the table, the cash inflow includes operating earnings and interests from deposits in which the one-year time charter rate is considered as operating income that increases 1% per year, and the current deposit rate (7%) in Bangladesh is considered as interest income from deposited money. Cash outflow includes principle amount of loan with a 5 year grace period, with 2% interest on loan, operational cost, which is estimated in US dollar 6,000 per day for the first year with a 2% increase per annum. Furthermore, cash outflow also includes a 5% share dividend on equity. By analyzing the table, the discounted present value becomes positive from the first year of the operation and it will continue to increase till the third year. The main reason behind that is the grace period terms in the contract and the leverage ratio

of the project. Almost all the money for the project was paid by the EXIM Bank of China against loans according to the contract between the government of Bangladesh and the government of China. In addition, interests and principal amounts on loans have to be paid after three years and five years respectively. In the twentieth year of the operation, the cumulative cash flow of the project will be US Dollar 20,945,817.00 and after converting to net present value it will be US Dollar 10,522,774. Moreover, the NPV of this project for 15 years was calculated, including the second-hand price of the vessel (see Table 16), where it was found that the cumulative cash flow will be USD. 23,829,007 and NPV will be USD. 11,923,626. IRR in both cases is around 78%. NPV for 20 years is slightly lower than that for 15 years and the main reason for that is the second-hand price of the vessels was added in cash inflow in the 15^{th} year.

Tables 15 and 17 show the calculation of NPV and IRR of VLCC for 20 years and 15 years respectively. Similar to a tanker of 38000dwt the cash inflow includes operational earnings and interest on deposit while cash outflow includes operational expenses, principle and interest on loan, and share dividend. It was found that the NPV will be USD. 90,316,417 for 20 years and 68,358,335 for 15 years. IRR is the same in both cases with just over 100%. Table 17 shows the calculation of NPV with 100% equity, where the NPV at 20^{th} years will be USD. 21,589,118 and IRR will be 3%.

By analyzing all the tables, it was found that small vessels should be sold in the second-hand market after 12 years, when the price will be higher compared to that of the freight rate. On the other hand, VLCC should be run in the operation as much as possible.

Table 14. Calculation of NPV and IRR of tanker (38000dwt) for 20 years

Year	Operating earnings	Interest from deposit	Cash inflow	Outstanding balance	Principle amount	Interest on loan	OPEX	Share dividend	Cash outflow	Net cash flow	Cumulative cash flow	Present value of cash flow	IRR
0				36,200,000								-2,594,550	
1	4,680,000		4,680,000	36,200,000	0		2,190,000	129,728	2,319,728	2,360,273	2,360,273	2,205,862	-14.98%
2	4,726,800	165,219	4,892,019	36,200,000	0		2,233,800	129,728	2,363,528	2,528,492	4,888,764	2,208,482	44.09%
3	4,774,068	342,213	5,116,281	36,200,000	0		2,278,476	129,728	2,408,204	2,708,078	7,596,842	2,210,598	66.72%
4	4,821,809	531,779	5,353,588	36,200,000	0	724,000	2,324,046	129,728	3,177,773	2,175,815	9,772,657	1,659,919	74.12%
5	4,870,027	684,086	5,554,113	36,200,000	0	724,000	2,370,526	129,728	3,224,254	2,329,859	12,102,515	1,661,157	77.71%
6	4,918,727	847,176	5,765,903	33,786,667	2,413,333	724,000	2,417,937	129,728	5,684,998	80,905	12,183,421	53,911	77.77%
7	4,967,914	852,839	5,820,754	31,373,333	2,413,333	675,733	2,466,296	129,728	5,685,090	135,664	12,319,085	84,485	77.83%
8	5,017,593	862,336	5,879,929	28,960,000	2,413,333	627,467	2,515,622	129,728	5,686,149	193,780	12,512,865	112,782	77.87%
9	5,067,769	875,901	5,943,670	26,546,667	2,413,333	579,200	2,565,934	129,728	5,688,195	255,475	12,768,340	138,962	77.90%
10	5,118,447	893,784	6,012,231	24,133,333	2,413,333	530,933	2,617,253	129,728	5,691,247	320,984	13,089,324	163,172	77.91%
11	5,169,632	916,253	6,085,884	21,720,000	2,413,333	482,667	2,669,598	129,728	5,695,325	390,559	13,479,883	185,552	77.93%
12	5,221,328	943,592	6,164,920	19,306,667	2,413,333	434,400	2,722,990	129,728	5,700,451	464,469	13,944,352	206,230	77.93%
13	5,273,541	976,105	6,249,646	16,893,333	2,413,333	386,133	2,777,450	129,728	5,706,644	543,002	14,487,354	225,327	77.94%
14	5,326,277	1,014,115	6,340,391	14,480,000	2,413,333	337,867	2,832,999	129,728	5,713,926	626,465	15,113,819	242,954	77.94%
15	5,379,539	1,057,967	6,437,507	12,066,667	2,413,333	289,600	2,889,658	129,728	5,722,319	715,187	15,829,007	259,217	77.94%
16	5,433,335	1,108,030	6,541,365	9,653,333	2,413,333	241,333	2,947,452	129,728	5,731,846	809,519	16,638,526	274,212	77.94%
17	5,487,668	1,164,697	6,652,365	7,240,000	2,413,333	193,067	3,006,401	129,728	5,742,528	909,837	17,548,363	288,031	77.94%
18	5,542,545	1,228,385	6,770,930	4,826,667	2,413,333	144,800	3,066,529	129,728	5,754,390	1,016,541	18,564,904	300,758	77.94%
19	5,597,970	1,299,543	6,897,513	2,413,333	2,413,333	96,533	3,127,859	129,728	5,767,453	1,130,060	19,694,963	312,471	77.94%
20	5,653,950	1,378,647	7,032,597	0	2,413,333	48,267	3,190,416	129,728	5,781,744	1,250,853	20,945,817	323,244	77.94%
										NPV		**10,522,774**	

Note: Loan amount: USD. 36200000; Equity: USD.2594550; TC rate: USD. 13000 with 1% increase per year; OPEX: 6000 with 2% increase per year; Interest on deposit: 7% (Current rate in Bangladesh); Share dividend: 5% on equity. Interest rate and grace period: As per contract between Government of China and Bangladesh for six vessels project.

Table 15. Calculation of NPV and IRR of VLCC for 20 years

Year	Operating earnings	Interest from deposit	Cash inflow	Outstanding balance	Principle amount	Interest on loan	OPEX	Share dividend	Cash outflow	Net cash flow	Cumulative cash flow	Present value of cash flow	IRR
0				63,900,000								-7,100,000	
1	11,880,000		11,880,000	63,900,000	0		3,650,000	355,000	4,005,000	7,875,000	7,875,000	7,359,813	3.66%
2	11,998,800	551,250	12,550,050	63,900,000	0		3,723,000	355,000	4,078,000	8,472,050	16,347,050	7,399,817	66.32%
3	12,118,788	1,144,294	13,263,082	63,900,000	0		3,797,460	355,000	4,152,460	9,110,622	25,457,672	7,436,981	88.46%
4	12,239,976	1,782,037	14,022,013	63,900,000	0	1,278,000	3,873,409	355,000	5,506,409	8,515,604	33,973,275	6,496,513	96.15%
5	12,362,376	2,378,129	14,740,505	63,900,000	0	1,278,000	3,950,877	355,000	5,583,877	9,156,628	43,129,903	6,528,549	99.53%
6	12,485,999	3,019,093	15,505,093	59,640,000	4,260,000	1,278,000	4,029,895	355,000	9,922,895	5,582,198	48,712,100	3,719,654	100.42%
7	12,610,859	3,409,847	16,020,706	55,380,000	4,260,000	1,192,800	4,110,493	355,000	9,918,293	6,102,414	54,814,514	3,800,276	100.86%
8	12,736,968	3,837,016	16,573,984	51,120,000	4,260,000	1,107,600	4,192,703	355,000	9,915,303	6,658,681	61,473,195	3,875,413	101.09%
9	12,864,338	4,303,124	17,167,461	46,860,000	4,260,000	1,022,400	4,276,557	355,000	9,913,957	7,253,505	68,726,700	3,945,426	101.20%
10	12,992,981	4,810,869	17,803,850	42,600,000	4,260,000	937,200	4,362,088	355,000	9,914,288	7,889,562	76,616,262	4,010,653	101.25%
11	13,122,911	5,363,138	18,486,049	38,340,000	4,260,000	852,000	4,449,330	355,000	9,916,330	8,569,720	85,185,982	4,071,412	101.28%
12	13,254,140	5,963,019	19,217,159	34,080,000	4,260,000	766,800	4,538,316	355,000	9,920,116	9,297,042	94,483,024	4,127,998	101.29%
13	13,386,681	6,613,812	20,000,493	29,820,000	4,260,000	681,600	4,629,083	355,000	9,925,683	10,074,810	104,557,834	4,180,688	101.30%
14	13,520,548	7,319,048	20,839,597	25,560,000	4,260,000	596,400	4,721,664	355,000	9,933,064	10,906,532	115,464,367	4,229,741	101.30%
15	13,655,754	8,082,506	21,738,259	21,300,000	4,260,000	511,200	4,816,097	355,000	9,942,297	11,795,962	127,260,329	4,275,399	101.31%
16	13,792,311	8,908,223	22,700,534	17,040,000	4,260,000	426,000	4,912,419	355,000	9,953,419	12,747,115	140,007,443	4,317,889	101.31%
17	13,930,234	9,800,521	23,730,755	12,780,000	4,260,000	340,800	5,010,668	355,000	9,966,468	13,764,288	153,771,731	4,357,421	101.31%
18	14,069,537	10,764,021	24,833,558	8,520,000	4,260,000	255,600	5,110,881	355,000	9,981,481	14,852,077	168,623,808	4,394,194	101.31%
19	14,210,232	11,803,667	26,013,899	4,260,000	4,260,000	170,400	5,213,099	355,000	9,998,499	16,015,400	184,639,207	4,428,391	101.31%
20	14,352,334	12,924,745	27,277,079	0	4,260,000	85,200	5,317,361	355,000	10,017,561	17,259,518	201,898,725	4,460,187	101.31%
											NPV	**90,316,417**	

Note: Loan amount: USD. 63900000; Equity: USD.7100000; TC rate: USD. 33000 with 1% increase per year; OPEX: 10000 with 2% increase per year; Interest on deposit: 7% (Current rate in Bangladesh); Share dividend: 5% on equity. Interest rate and grace period: As per contract between Government of China and Bangladesh for six vessels project.

Table 16. Calculation of NPV and IRR of tanker (38000dwt) for 15 years

Year	Operating earnings	Interest from deposit	Cash inflow	Outstanding balance	Principle amount	Interest on loan	OPEX	Share dividend	Cash outflow	Net cash flow	Cumulative cash flow	Present value of cash flow	IRR
0				36,200,000								-2,594,550	
1	4,680,000		4,680,000	36,200,000	0		2,190,000	129,728	2,319,728	2,360,273	2,360,273	2,205,862	-14.98%
2	4,726,800	165,219	4,892,019	36,200,000	0		2,233,800	129,728	2,363,528	2,528,492	4,888,764	2,208,482	44.09%
3	4,774,068	342,213	5,116,281	36,200,000	0		2,278,476	129,728	2,408,204	2,708,078	7,596,842	2,210,598	66.72%
4	4,821,809	531,779	5,353,588	36,200,000	0	724,000	2,324,046	129,728	3,177,773	2,175,815	9,772,657	1,659,919	74.12%
5	4,870,027	684,086	5,554,113	36,200,000	0	724,000	2,370,526	129,728	3,224,254	2,329,859	12,102,515	1,661,157	77.71%
6	4,918,727	847,176	5,765,903	33,786,667	2,413,333	724,000	2,417,937	129,728	5,684,998	80,905	12,183,421	53,911	77.77%
7	4,967,914	852,839	5,820,754	31,373,333	2,413,333	675,733	2,466,296	129,728	5,685,090	135,664	12,319,085	84,485	77.83%
8	5,017,593	862,336	5,879,929	28,960,000	2,413,333	627,467	2,515,622	129,728	5,686,149	193,780	12,512,865	112,782	77.87%
9	5,067,769	875,901	5,943,670	26,546,667	2,413,333	579,200	2,565,934	129,728	5,688,195	255,475	12,768,340	138,962	77.90%
10	5,118,447	893,784	6,012,231	24,133,333	2,413,333	530,933	2,617,253	129,728	5,691,247	320,984	13,089,324	163,172	77.91%
11	5,169,632	916,253	6,085,884	21,720,000	2,413,333	482,667	2,669,598	129,728	5,695,325	390,559	13,479,883	185,552	77.93%
12	5,221,328	943,592	6,164,920	19,306,667	2,413,333	434,400	2,722,990	129,728	5,700,451	464,469	13,944,352	206,230	77.93%
13	5,273,541	976,105	6,249,646	16,893,333	2,413,333	386,133	2,777,450	129,728	5,706,644	543,002	14,487,354	225,327	77.94%
14	5,326,277	1,014,115	6,340,391	14,480,000	2,413,333	337,867	2,832,999	129,728	5,713,926	626,465	15,113,819	242,954	77.94%
15	5,379,539	1,057,967	6,437,507	12,066,667	2,413,333	289,600	2,889,658	129,728	5,722,319	715,187	15,829,007	259,217	77.94%
								Second-hand price		8,000,000		2,899,568	77.95%
										NPV		**11,923,626**	

Note: Loan amount: USD. 36200000; Equity: USD.2594550; TC rate: USD. 13000 with 1% increase per year; OPEX: 6000 with 2% increase per year; Interest on deposit: 7% (Current rate in Bangladesh); Share dividend: 5% on equity. Interest rate and grace period: As per contract between Government of China and Bangladesh for six vessels project.

Table 17. Calculation of NPV and IRR of VLCC for 15 years

Year	Operating earnings	Interest from deposit	Cash inflow	Outstanding balance	Principle amount	Interest on loan	OPEX	Share dividend	Cash outflow	Net cash flow	Cumulative cash flow	Present value of cash flow	IRR
0				63,900,000								-7,100,000	
1	11,880,000		11,880,000	63,900,000	0		3,650,000	355,000	4,005,000	7,875,000	7,875,000	7,359,813	3.66%
2	11,998,800	551,250	12,550,050	63,900,000	0		3,723,000	355,000	4,078,000	8,472,050	16,347,050	7,399,817	66.32%
3	12,118,788	1,144,294	13,263,082	63,900,000	0		3,797,460	355,000	4,152,460	9,110,622	25,457,672	7,436,981	88.46%
4	12,239,976	1,782,037	14,022,013	63,900,000	0	1,278,000	3,873,409	355,000	5,506,409	8,515,604	33,973,275	6,496,513	96.15%
5	12,362,376	2,378,129	14,740,505	63,900,000	0	1,278,000	3,950,877	355,000	5,583,877	9,156,628	43,129,903	6,528,549	99.53%
6	12,485,999	3,019,093	15,505,093	59,640,000	4,260,000	1,278,000	4,029,895	355,000	9,922,895	5,582,198	48,712,100	3,719,654	100.42%
7	12,610,859	3,409,847	16,020,706	55,380,000	4,260,000	1,192,800	4,110,493	355,000	9,918,293	6,102,414	54,814,514	3,800,276	100.86%
8	12,736,968	3,837,016	16,573,984	51,120,000	4,260,000	1,107,600	4,192,703	355,000	9,915,303	6,658,681	61,473,195	3,875,413	101.09%
9	12,864,338	4,303,124	17,167,461	46,860,000	4,260,000	1,022,400	4,276,557	355,000	9,913,957	7,253,505	68,726,700	3,945,426	101.20%
10	12,992,981	4,810,869	17,803,850	42,600,000	4,260,000	937,200	4,362,088	355,000	9,914,288	7,889,562	76,616,262	4,010,653	101.25%
11	13,122,911	5,363,138	18,486,049	38,340,000	4,260,000	852,000	4,449,330	355,000	9,916,330	8,569,720	85,185,982	4,071,412	101.28%
12	13,254,140	5,963,019	19,217,159	34,080,000	4,260,000	766,800	4,538,316	355,000	9,920,116	9,297,042	94,483,024	4,127,998	101.29%
13	13,386,681	6,613,812	20,000,493	29,820,000	4,260,000	681,600	4,629,083	355,000	9,925,683	10,074,810	104,557,834	4,180,688	101.30%
14	13,520,548	7,319,048	20,839,597	25,560,000	4,260,000	596,400	4,721,664	355,000	9,933,064	10,906,532	115,464,367	4,229,741	101.30%
15	13,655,754	8,082,506	21,738,259	21,300,000	4,260,000	511,200	4,816,097	355,000	9,942,297	11,795,962	127,260,329	4,275,399	101.31%
								Second-hand price		30,000,000		10,873,381	101.31%
											NPV	**68,358,335**	

Note: Loan amount: USD. 63900000; Equity: USD.7100000; TC rate: USD. 33000 with 1% increase per year; OPEX: 10000 with 2% increase per year; Interest on deposit: 7% (Current rate in Bangladesh); Share dividend: 5% on equity. Interest rate and grace period: As per contract between Government of China and Bangladesh for six vessels project.

Table 18. Calculation of NPV and IRR of VLCC with 100% equity

Year	Operating earnings	Interest from deposit	Cash inflow	Outstanding balance	Principle amount	Interest on loan	OPEX	Share dividend	Cash outflow	Net cash flow	Cumulative cash flow	Present value of cash flow	IRR
0				0								-71,000,000	
1	11,880,000		11,880,000	0	0		3,650,000	3,550,000	7,200,000	4,680,000	4,680,000	4,373,832	-94%
2	11,998,800	327,600	12,326,400	0	0		3,723,000	3,550,000	7,273,000	5,053,400	9,733,400	4,413,835	-72%
3	12,118,788	681,338	12,800,126	0	0		3,797,460	3,550,000	7,347,460	5,452,666	15,186,066	4,451,000	-53%
4	12,239,976	1,063,025	13,303,001	0	0	0	3,873,409	3,550,000	7,423,409	5,879,591	21,065,657	4,485,512	-39%
5	12,362,376	1,474,596	13,836,972	0	0	0	3,950,877	3,550,000	7,500,877	6,336,094	27,401,752	4,517,548	-29%
6	12,485,999	1,918,123	14,404,122	0	0	0	4,029,895	3,550,000	7,579,895	6,824,227	34,225,979	4,547,271	-22%
7	12,610,859	2,395,819	15,006,678	0	0	0	4,110,493	3,550,000	7,660,493	7,346,185	41,572,164	4,574,835	-17%
8	12,736,968	2,910,051	15,647,019	0	0	0	4,192,703	3,550,000	7,742,703	7,904,317	49,476,480	4,600,384	-13%
9	12,864,338	3,463,354	16,327,691	0	0	0	4,276,557	3,550,000	7,826,557	8,501,135	57,977,615	4,624,054	-10%
10	12,992,981	4,058,433	17,051,414	0	0	0	4,362,088	3,550,000	7,912,088	9,139,326	67,116,941	4,645,970	-7%
11	13,122,911	4,698,186	17,821,097	0	0	0	4,449,330	3,550,000	7,999,330	9,821,767	76,938,708	4,666,251	-5%
12	13,254,140	5,385,710	18,639,850	0	0	0	4,538,316	3,550,000	8,088,316	10,551,533	87,490,242	4,685,007	-4%
13	13,386,681	6,124,317	19,510,998	0	0	0	4,629,083	3,550,000	8,179,083	11,331,916	98,822,157	4,702,342	-2%
14	13,520,548	6,917,551	20,438,099	0	0	0	4,721,664	3,550,000	8,271,664	12,166,435	110,988,592	4,718,353	-1%
15	13,655,754	7,769,201	21,424,955	0	0	0	4,816,097	3,550,000	8,366,097	13,058,858	124,047,450	4,733,131	0%
16	13,792,311	8,683,321	22,475,633	0	0	0	4,912,419	3,550,000	8,462,419	14,013,213	138,060,663	4,746,760	0%
17	13,930,234	9,664,246	23,594,481	0	0	0	5,010,668	3,550,000	8,560,668	15,033,813	153,094,476	4,759,320	1%
18	14,069,537	10,716,613	24,786,150	0	0	0	5,110,881	3,550,000	8,660,881	16,125,269	169,219,745	4,770,885	2%
19	14,210,232	11,845,382	26,055,614	0	0	0	5,213,099	3,550,000	8,763,099	17,292,515	186,512,260	4,781,525	2%
20	14,352,334	13,055,858	27,408,193	0	0	0	5,317,361	3,550,000	8,867,361	18,540,832	205,053,092	4,791,303	3%
										NPV		**21,589,118**	

Note: Equity: USD.71000000 (100%); TC rate: USD. 33000 with 1% increase per year; OPEX: 10000 with 2% increase per year; Interest on deposit: 7% (Current rate in Bangladesh); Share dividend: 5% on equity. Interest rate and grace period: As per contract between Government of China and Bangladesh for six vessels project.

CHAPTER FIVE - DISCUSSION

In this study, the factors which are affecting the investment decision for the tanker industry are identified by the linear regression model using monthly data from 1998 to 2019. This study applied 29 independent variables that were collected from Clarkson Shipping Intelligence Network to find the most significant factors that will affect the investment decision for the tanker industry. In addition, various calculations of investment with different ship types and different criteria have been done using Net Present Value (NPV) and Internal Rate of Return (IRR) method to find out the best option of investment for Bangladesh Shipping Corporation.

5.1 Significant Factors

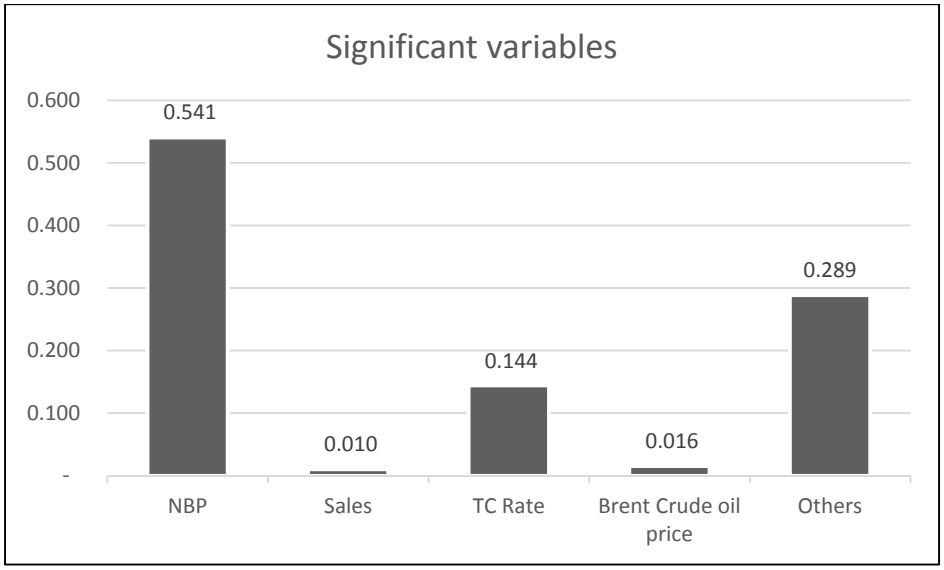

Figure 14. Coefficient of the significant variables

New Building Price:

The most important factor which affected the second-hand price is the new building price of the vessel with the coefficient of 0.541 meaning if the new building price of the tanker increases 1 unit then the second-hand price of VLCC increases 0.541 unit or 54.1 %. If looking at the scatter plot of new building prices, there is a strong relationship between new building prices and second-hand

prices. When the market is high then both the new building and the second-hand price is increasing and the price is decreasing in the low market for both cases.

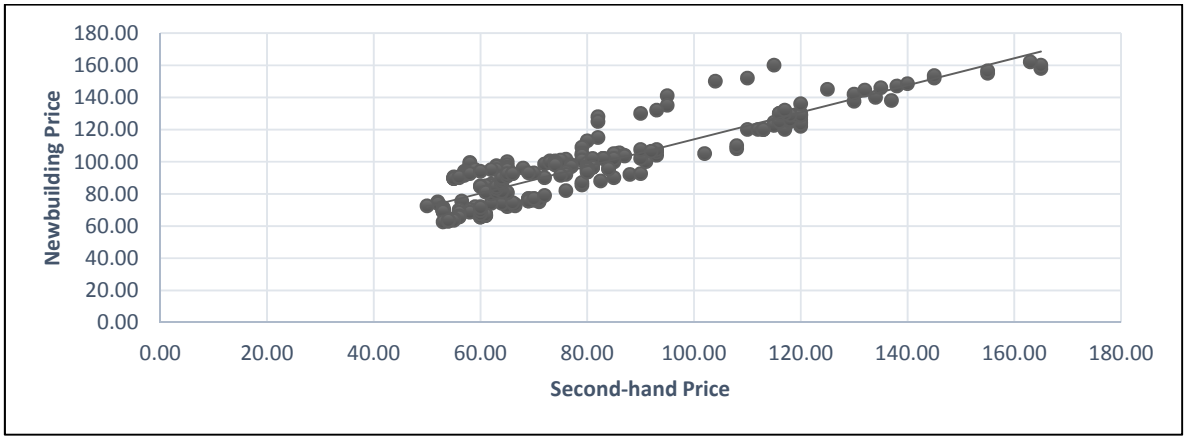

Figure 15. Second-hand price vs New building price (Scatter plot)

Moreover, both variables are supply related and these increase when the demand of the market is higher than the supply. For example, if there is huge cargo in the market compared to the capacity of the vessel, then shipowners tend to add more vessels in the fleet to generate money. However, second-hand vessel prices are more volatile than the newbuilding prices. The main reason behind that is second-hand vessels can be acquired within a very short time and earn money through operation whereas the new building vessel acquisition process is very long and for most of the cases it needs more than two years to build. So when the market is very high, the shipowner tends to buy a second-hand ship rather than building a new one so that he can enter the bullish market where the freight rate is higher.

Time Charter Rate

The second-hand price of the vessel also depends on the freight market. The correlation coefficient is 0.144 which means the second-hand vessel price increases 14.4 % when time charter rate raises 1 unit. If observing the scatter plot of SHP and TC rate (see Figure 16), there is a positive trend between these two variables.

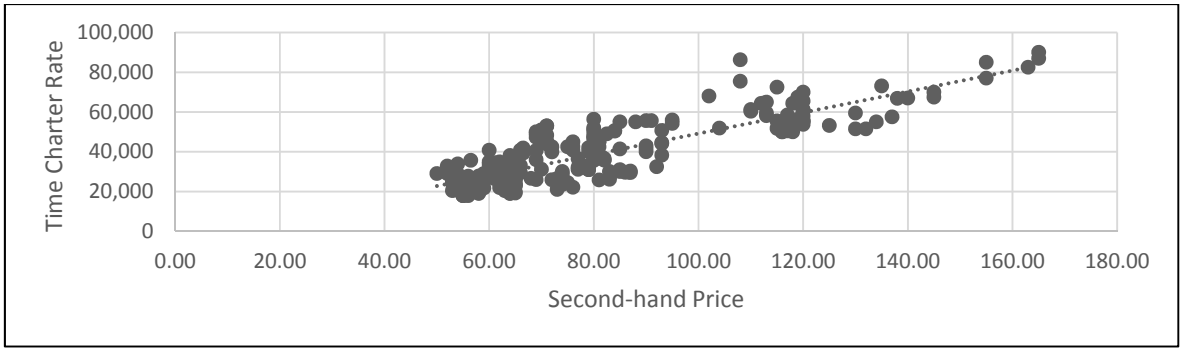

Figure 16. TC rate vs Second-hand price (Scatter Plot)

Figure: 17 shows the time charter rate from August- 2002 to April- 2019. If analyzing the graph, the freight rate became higher in 2004 and 2008. In 2004, the annual growth rate in China was 10.1% and 7.9% for that of India. In addition, the growth rate of the USA was 3.8% in that year.

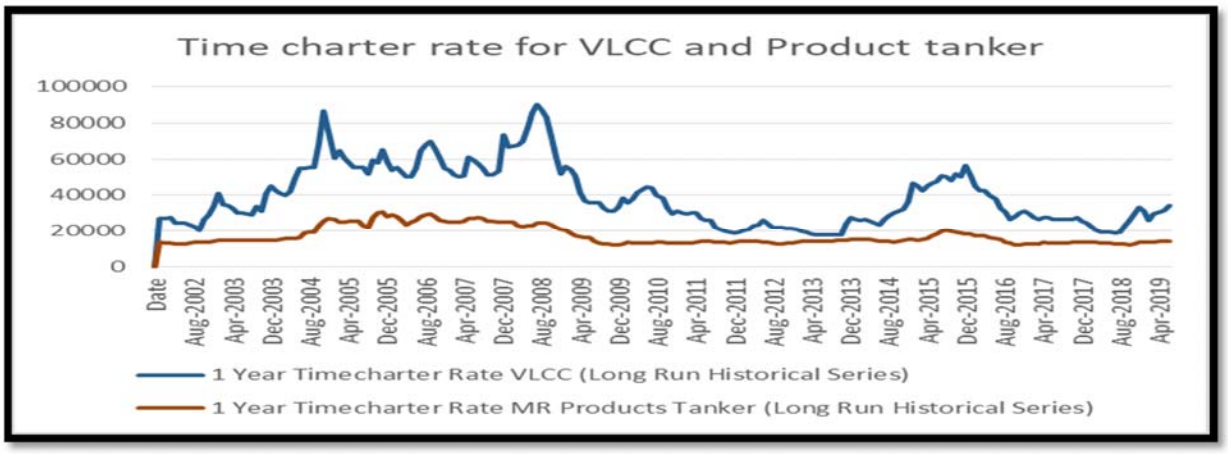

Figure 17. Time charter rate for VLCC and Product tanker

In July- 2008, the freight rate of VLCC was at a peak with USD. 90,000 per day and the main reason for that was China hosted the Olympic Games, which were held in the following month from 8- August 2008 to 24- August 2008. After that, the freight rate decreased sharply and at the month of December in the same year, it became USD. 51,875 per day; about 42% reduced in 6 months. Seaborne trade was seriously affected by the global recession in that period. Although the global recession started in 2007, the freight rate had not been affected by this till August- 2008. The reason for this is the contribution of China to seaborne trade because of the Olympic Games. It can also be seen that TC rate of a large vessel is more volatile than that of small ones. Likewise freight rates and, the prices of the large vessel are also more volatile than those of small vessels.

Brent Crude Oil

Crude oil has played an important role in the world economy as well as the tanker industry as it is one of the major commodities for tankers (Wei, 2010). So the price of crude oil may affect the price of the ship. The graph (see Figure 18) shows that there is a positive relationship between Brent crude oil and second-hand price.

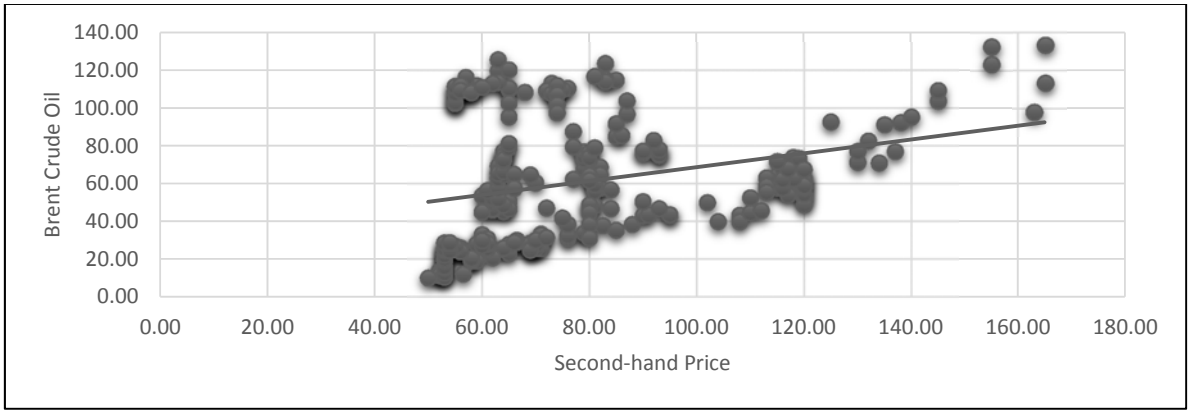

Figure 18. Brent Crude Oil vs Second-hand Price (Scatter Plot)

Figure 19 shows the US crude oil export for the last 20 years. By observing the graph it can be seen that crude oil export for the US increases gradually after 2005, which indicates that demand for crude oil has increased since 2005. If export is increasing, seaborne trade is also increasing. Consequently, freight, as well as the price of the vessels, may increase.

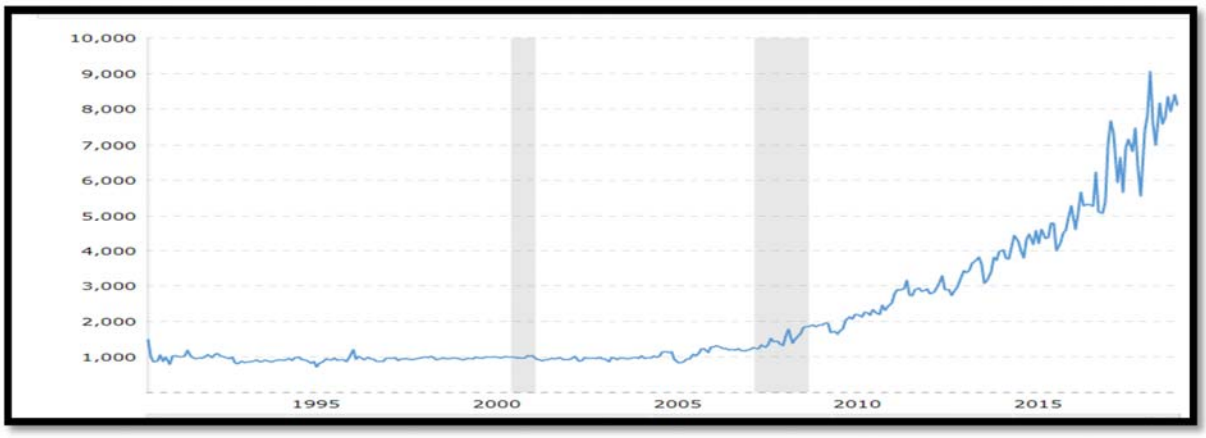

Figure 19. US crude oil export

From: U.S. Energy information Administration

Sales

Sales of tankers (In volume) was also found significant in this research. Total sales depend on the demand of the market. If the demand is high in the market, then sales increased, and consequently the price will be higher whereas the price will be lower when the sales decreased.

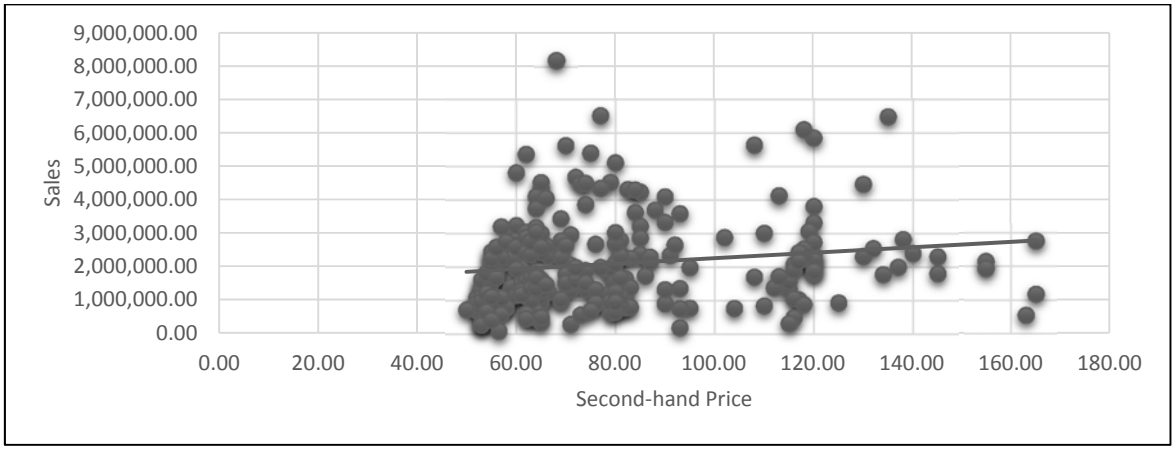

Figure 20. Sales vs Second-hand price (Scatter Plot)

5.2 Investment decision for Bangladesh Shipping Corporation

As a government organization, Bangladesh Shipping Corporation has the priority to carry all the government cargo. Accordingly, BSC has contracted with Bangladesh Petroleum Corporation (BPC) to carry crude oil but due to not owning a mother tanker, the corporation chartered mother tankers and lost a huge amount of money. BSC earns only 2.5% of the total freight as address commission and the rest of the freight is paid to the shipowner of the mother tanker.

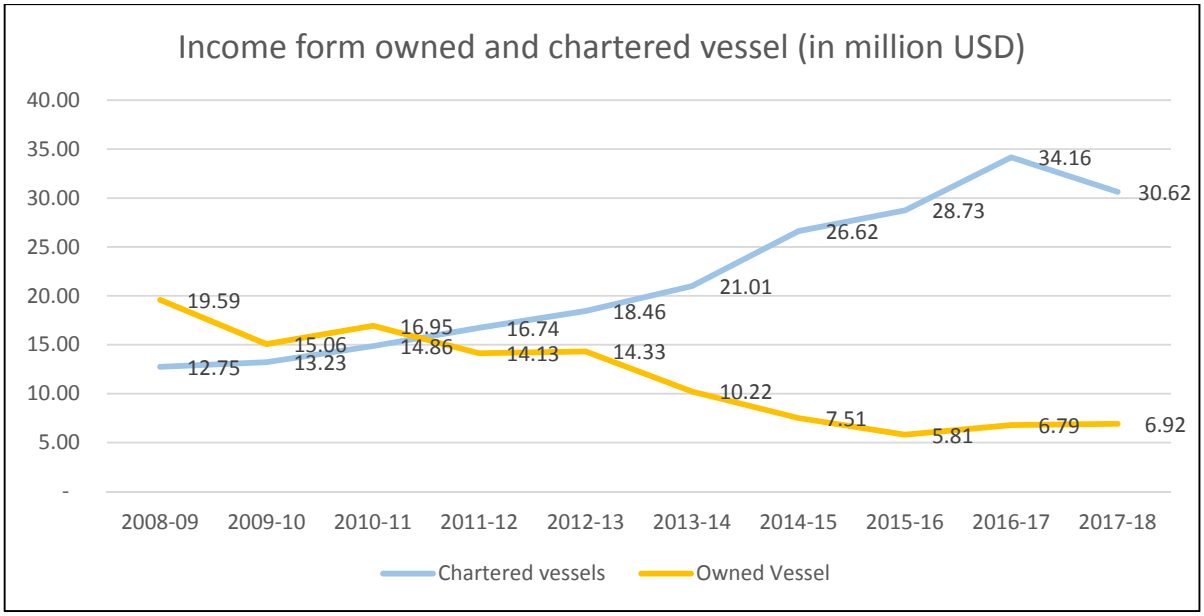

Figure 21. Income from owned and chartered vessel

Source: Annual reports of BSC

Figure: 21 shows the revenue of the BSC earned from owned and chartered vessels in 10 financial years from 2008-09 to 2017-18. By observing the graph, it was found that income from the owned vessels was 19.59 million US dollars while chartered vessels' revenue was 12.75 million US dollars. However, in 2017-18 owned vessels' income decreased to 6.92 million US dollars whereas chartered vessels' income increased to 30.62 million US dollars. During this decade, owned vessels' revenue was reduced by almost 65%; on the contrary, chartered vessels' revenue was raised by about 140%. These statistics imply how important it is to purchase the mother tanker for the corporation. Moreover, there were 13 vessels in the 2012-13 financial year, but after 5 years, in the 2017-18 financial year, only 2 of them have remained in the fleet, ie 11 vessels were sold in the scrap market within 5 years (see Table 19).

Table 19. Sale of BSC's Vessels

Sl. No.	Name of the Vessels	Date
1	Banglar Robi	23.10.2013
2	Banglar Mookh	28.10.2013
3	Banglar Gourab	30.10.2013
4	Banglar Urmi	04.11.2013
5	Banglar Maya	19.01.2014
6	Banglar Doot	23.09.2015
7	Banglar Moni	23.09.2015
8	Banglar Mamata	19.11.2015
9	Banglar Kallol	02.05.2016
10	Banglar Kakoli	15.05.2016
11	Banglar Shikha	11.09.2017

Furthermore, management had no option but to scrap those vessels as they had passed their economic life. On the one hand, those vessels could not earn enough money through operations, on the other hand, the corporation had to pay fixed operating costs of those vessels. Consequently, the corporation made operating loss (see Figure 22). By observing the graph, it is found that the corporation able to make profit after scrapping the vessels.

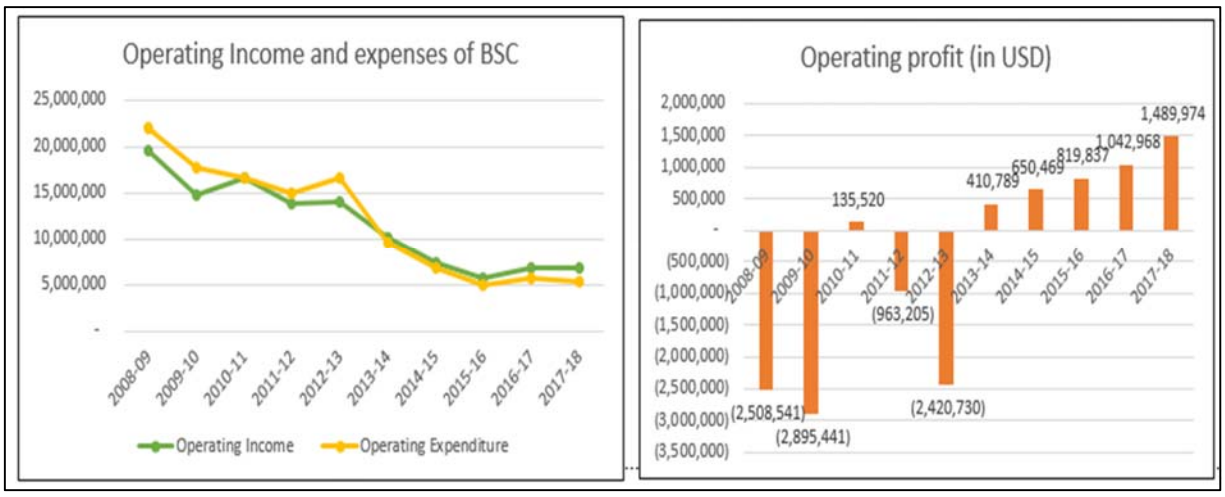

Figure 22. Income, Expenses and profit/loss from the operation of BSC vessels

From: Annual reports of BSC

Considering all the facts, BSC issued shares in the stock market in the 2011-12 financial year and collected about 38 million US dollars (Bangladesh taka 3137 million) from the capital market to acquire a mother tanker. The corporation failed to buy the tanker, but it constructed a multi-storied building for commercial use and was able to earn approximately USD. 750,000 by rent hire per year. Although this is not the main business of a shipping company, as shipping is uncertain, it will be effective to meet working capital when the market is down.

Bangladesh Shipping Corporation bought six new vessels in 2019, but there is no mother tanker in this list. However, the corporation is also planning to acquire more vessels in its fleet. So proper investment decision is very important for the corporation to survive in the competitive market. In this research, various investment options have been calculated to find the best alternative (see Table 20).

Table 20. NPV and IRR of various vessels

Sl. No.	Tanker type	Number of years	Debt ratio	NPV (in USD.)	IRR
1	Oil tanker (38000 dwt)	20	90%	10,522,774	77.94%
	VLCC	20	90%	90,316,416	101.31%
	Oil tanker (38000 dwt)	15	90%	11,923,626	77.95%
	VLCC	15	90%	68,358,335	101.31%
	VLCC	20	0%	21,589,118	2.63%

By analyzing the table, it was found that the NPV of VLCC is higher than an oil tanker of 38,0000 dwt for both the calculations of 15 and 20 years. However, small tankers are better for short-run whereas large vessels are profitable in the long-run. It is also found that NPV will be higher when debt ratio is higher than equity ratio. Nevertheless, it depends on the interest rate of the loan. As a government organization, Bangladesh Shipping Corporation (BSC) has the opportunity to get loans with low-interest rates from the government, but it is not possible for a private organization. Shipowners tend to get as much money as possible from loans. If the interest rate is very high, the shipowner has to pay much money against the capital cost, so it may be a burden for the shipowner. Therefore, a fund manager of a shipping company always bear in mind the cost of capital of any

investment. NPV is effective for investment decisions because it considers the opportunity cost of the investment. The money that, is obtained after 10 years, is not the same value at present. So the opportunity cost of the investment, which means the discounting factor, has to be considered. As the shipping market is volatile and capital intensive by nature, proper investment decision is very important in this sector.

5.3 Limitations of the thesis

According to (Wachtel, 2003), Finance is closely related to the world's GDP. Although global GDP (Gross Domestic Products) can play a vital role in ship investment decisions, as it implies the overall condition of the world economy, no monthly data of GDP growth was obtained. If observing the graph (see Figure 23), the annual growth of the world's GDP had decreased rapidly from 2007 till 2009. Consequently, the freight rate and price of the vessels also declined.

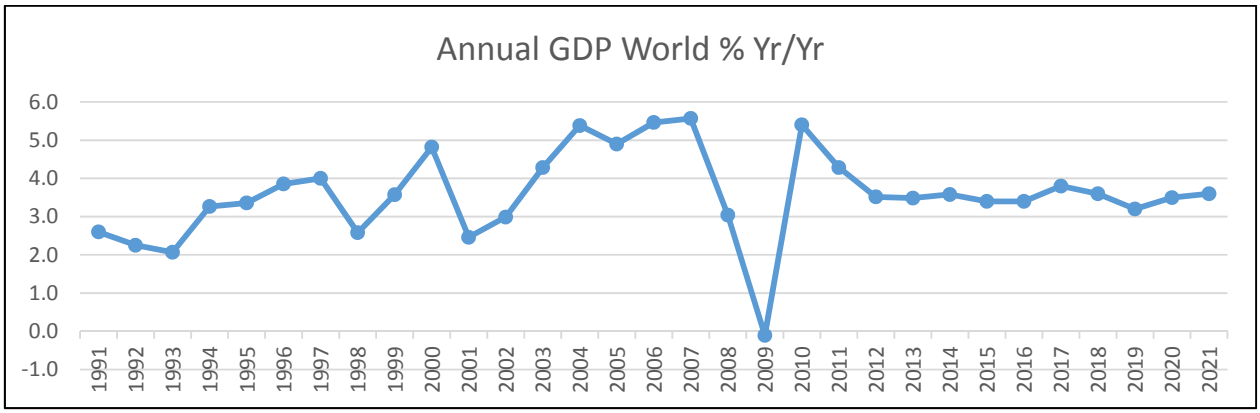

Figure 23. World's GDP growth

From: Clarkson shipping intelligence network

Another macro-economic factor that can be affected on ship investment is FDI (Foreign Direct Investment). FDI plays an important role in the economic growth of the world (see Figure 24), but no monthly data on this variable was found. Similar to GDP, FDI also declined sharply from 2007 to 2009, and again fell in 2014. So, FDI can also be a significant factor in the tanker investment.

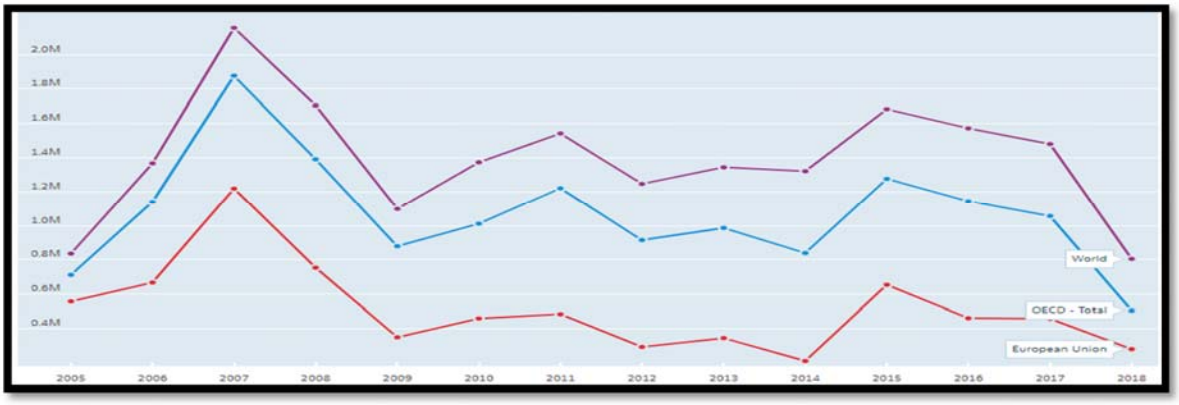

Figure 24. Foreign Direct Investment

From: OECD Data

Bunker is the major element of the ship's running costs. So bunker cost can affect the freight rate as well as ship price. But, we could not consider the bunker price and removed from the model because it was correlated with the crude oil price. In the tanker industry bunker is the voyage cost whereas crude oil is the commodity. Figure 25 shows the bunker price in Singapore Port where the bunker price was at a peak in the middle of 2008. The price and freight rate of vessels were also higher during that time. After July 2008, bunker price decreased rapidly and consequently, vessel price was also reduced.

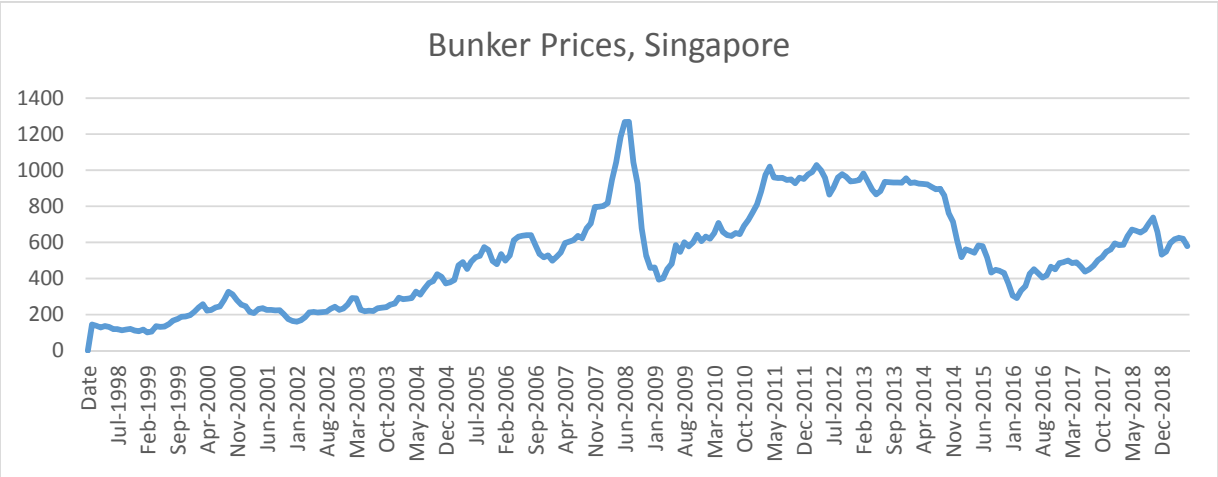

Figure 25. Bunker Prices

From: Clarkson shipping intelligence network

CHAPTER SIX - CONCLUSION

In the shipping world, where the effects of the global economy and, equilibrium of demand and supply make the market unpredictable, investment and trading strategies are very important to survive in this competitive market. The research study tried to discover the major factors which may affect the investment decision of the tanker industry and examined the various investment opportunities to select the best tanker investment for Bangladesh Shipping Corporation. Moreover, this research also analyzed the trading strategies of the tanker industry where the ideal timing of the purchase and sale of the vessel in the VLCC market can be found.

It is clear from this study that newbuilding prices, freight rates, prices of crude oil and sales significantly affect the second-hand price of the VLCC. In addition, this research examines the timing of purchase and sale of the vessel using slow (long term) and fast (short term) moving average (MA). It was found that a positive difference between these two MA lines indicates to sell whereas a negative difference implies to buy. Furthermore, the study calculated different investment opportunities for Bangladesh Shipping Corporation, where it is found that a large tanker is more profitable than the smaller one as the NPV and IRR of the large tanker are higher than the small tanker as the price of large tankers is more volatile compared to that of small tankers. Moreover, it should keep a large tanker in the fleet as far as it can run in the operation whereas in some cases, it is better to sell small tankers in the second-hand market after 15 years. Furthermore, Bangladesh Shipping Corporation has chartered mother tankers for a long time to transport crude oil for the country and the demand of this cargo is increasing day by day. Therefore, the corporation needs to invest in this sector to maximize its profit.

Proper investment decision is very important for the shipping industry for two main reasons: one is the high level of volatility in the market and the other is the industry needs huge capital to run the business. Bangladesh Shipping Corporation is planning to acquire more vessels as they could not purchase any vessel in the last 28 years. Six vessels (three tankers and three bulk carriers) have been added in the current year. More than 90% of the total investment amount has been financed by the Chinese government against a loan. As the corporation is planning to acquire more vessels by 2021, this is the right time to analysis the investment alternatives, so that the corporation can get the highest return on the investment and contribute to the country’s economy.

However, the main limitation of this research is that no monthly data of some important variables was found, which may affect the price of the VLCC such as GDP growth and foreign trade investment (FDI). Moreover, the research could not calculate the cost-benefit analysis for Panamax, Suezmax, and Aframax due to time constraints. Finally, considering the mentioned limitation of this research and the importance of investment strategy on the tanker industry, further research is necessary to get more accurate results.

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REFERENCES

Alizadeh, A. H. (2006). Trading strategies in the market of tankers. *Maritime policy & Management*, 33(2), 119-140.

Alizadeh, A. H. (2007). Investment timing and trading strategies in the sale and purchase market for ships. *Transportation Research Part B: Methodological*, 41(1), 126-143.

Anderson, W. H. (1964). *Corporate finance and fixed investment: an econometric study.* Division of Research, Graduate School of Business Administration, Harvard University.

Baddeley, M. C. (2002). Investment in an uncertain world. *Zagreb International Review of Economics & Business*, 5(2), 1-21.

Bangladesh, A. S. (2007). *Banglapedia: national encyclopedia of Bangladesh.* Dhaka: Asiatic Society of Bangladesh.

Bendall, H. B. (2005). Bendall, H. B., & SShip investment under uncertainty: Valuing a real option on the maximum of several strategies. *Maritime Economics & Logistics*, 19-35.

Bliemel, F. (1973). Theil's forecast accuracy coefficient: A clarification. *Journal of Marketing Reserch*, Vol. 10 pp. 444-446.

Brainard, W. C. (1968). Pitfalls in financial model building. *The American Economic Review*, 58(2), 99-122.

Brooks, C. (2019). *Introductory econometrics for finance.* Cambridge university press.

Celik Girgin, S. K. (2018). A critical review of the literature on firm-level theories on ship investment. *Financial Studies*, 6(1), 11.

Chai, T. &. (2014). Root mean square error (RMSE) or mean absolute error (MAE)?–Arguments against avoiding RMSE in the literature. *Geoscientific model development*, 7(3), 1247-1250.

Chenery, H. B. (1952). Overcapacity and the acceleration principle. *Econometrica: Journal of the Econometric Society*, 1-28.

Chirinko, R. S. (1993). Business fixed investment spending: Modeling strategies, empirical results, and policy implications. *Journal of Economic literature*, 31(4), 1875-1911.

Clark, J. M. (1917). Business acceleration and the law of demand: A technical factor in economic cycles. *Journal of political economy*, 25(3), 217-235.

De Myttenaere, A. G. (2015). Using the Mean Absolute Percentage Error for Regression Models. In Proceedings. *Presses universitaires de Louvain*, p. 113.

Dickey, D. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, 1057-1072.

Dixit, A. K. (1994). *Investment under uncertainty.* New Jersey: Princeton university press.

Duesenberry, J. S. (1958). *Business cycles and economic growth.* New York: McGraw-Hill Book Company.

Express, T. F. (2018, November 21). BSC plans to procure two mother vessels. *The Financial Express*.

Fan, L. &. (2013). Analyzing ship investment behaviour in liner shipping. *Maritime Policy & Management*, 40(6), 511-533.

Fan, L. &. (2016). Analysis of structural changes in container shipping. *Maritime Economics & Logistics*, 18(2), 174-191.

Ghiorghe, B. &.-M. (2011). Consideration on the Financial Risks in the Shippin Industry. *Analele Universitatii Maritime Constanta*, 12(15).

Goodwin, R. M. (1948). *Secular and Cyclical Aspects of the Multiplier and the Accelerator. Income, Employment and Public Policy.* New York: Norton.

Graham, J. R. (2001). The theory and practice of corporate finance: Evidence from the field. *Journal of financial economics*, 60(2-3), 187-243.

Grunfeld, Y. (1960). *The determinants of corporate investment.* University of Chicago Press.

Gujarati, D. N. (1999). *Essentials of econometrics (Vol. 2).* Singapore: Irwin/McGraw-Hill.

Hall, R. E. (2001). The stock market and capital accumulation. *American Economic Review*, 91(5), 1185-1202.

Hylleberg, S. E. (1990). Seasonal integration and cointegration. *Journal of econometrics*, 44(1-2), 215-238.

Jarque, C. M. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics letters*, 6(3), 255-259.

Jorgenson, D. W. (1968). A comparison of alternative theories of corporate investment behavior. *The American Economic Review*, 58(4), 681-712.

Kavussanos, M. G. (1996). Price risk modelling of different size vessels in the tanker industry using autoregressive conditional heterskedastic (ARCH) models. *Logistics and Transportation Review*, 32(2), 161.

Kavussanos, M. G. (2002). Efficient pricing of ships in the dry bulk sector of the shipping industry. *Maritime Policy & Management*, 29(3), 303-330.

Kimura, K. &. (2018). Minimization of Akaike's information criterion in linear regression analysis via mixed integer nonlinear program. *Optimization Methods and Software*, 33(3), 633-649.

Kuh, E. (1963). *Capital stock growth: a microeconomic approach.* North-Holland Publ.

Kwiatkowski, D. P. (1992). Kwiatkowski, D., Phillips, Testing the null hypothesis of stationarity against the alternative of a unit root. *Journal of econometrics*, 54(1-3), 159-178.

Markowitz, H. (1952). Portfolio selection. *The journal of finance*, 7(1), 77-91.

Merikas, A. G. (2008). Modelling the investment decision of the entrepreneur in the tanker sector: choosing between a second-hand vessel and a newly built one. *Maritime Policy & Management*, 35(5), 433-447.

Meyer, J. R. (1957). *The investment decision: An empirical study.* Cambridge, MA: Harvard University Press.

Meyer, J. R. (1964). *Investment decisions, economic forecasting, and public policy.* Boston: Division of Research, Harvard Business School.

Montgomery, D. C. (2012). *Introduction to linear regression analysis.* John Wiley & Sons.

Munim, Z. H. (2017). Forecasting container shipping freight rates for the Far East–northern Europe trade lane. *Maritime Economics & Logistics*, 19(1), 106-125.

Peters, R. H. (2017). Intangible capital and the investment-q relation. *Journal of Financial Economics*, 123(2), 251-272.

Phillips, P. C. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335-346.

Ramsey, J. B. (1969). Tests for specification errors in classical linear least□squares regression analysis. *Journal of the Royal Statistical Society: Series B (Methodological)*, 31(2), 350-371.

Ravi, V. P. (2017). Financial time series prediction using hybrids of chaos theory, multi-layer perceptron and multi-objective evolutionary algorithms. *Swarm and Evolutionary Computation*, 36, 136-149.

Roy, R. K. (2017, September 22). Cover Blue Economy. *Daily Sun*.

Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of money, credit and banking*, 1(1), 15-29.

Tobin, J. (1978). Monetary policies and the economy: the transmission mechanism. *Southern economic journal*, 421-431.

Tsiang, S. C. (1951). Accelerator, theory of the firm and the business cycle. *The Quarterly Journal of Economics*, 65(3), 325-341.

Veenstra, A. W. (2006). Contributions to maritime economics—Zenon S. Zannetos, the theory of oil tankship rates. *Maritime Policy & Management*, 33(1), 61-73.

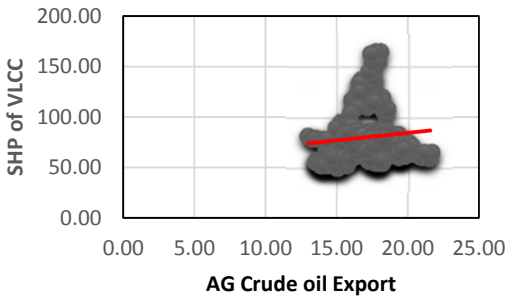
Wachtel, P. (2003). How much do we really know about growth and finance? *Economic Review-Federal Reserve Bank of Atlanta*, 88(1), 33-48.

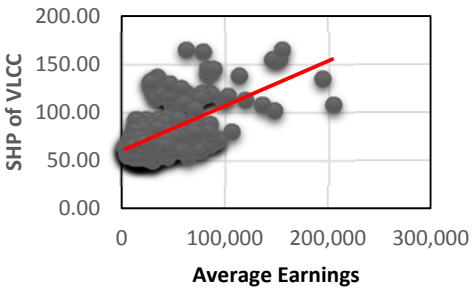
Wei, Y. W. (2010). Forecasting crude oil market volatility: Further evidence using GARCH-class models. *Energy Economics*, 32(6), 1477-1484.

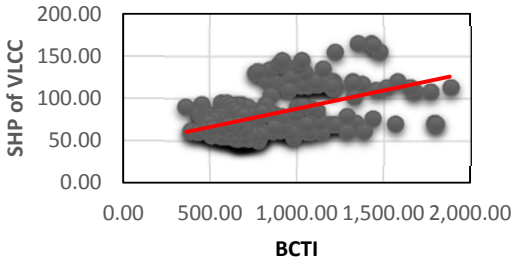
APPENDIX

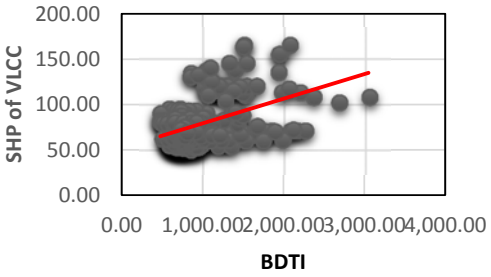
Appendix A: Scatter Plots

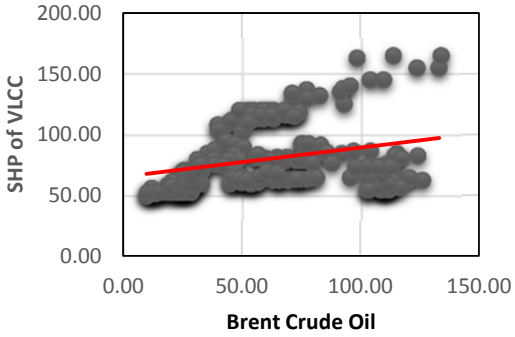
Possitive Correlation variables

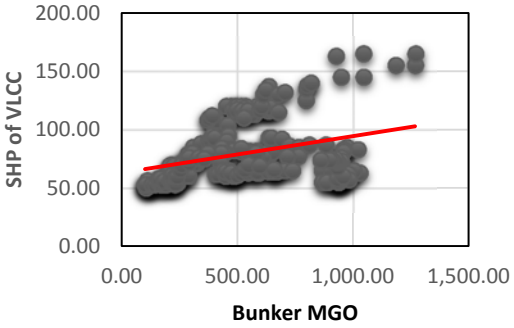


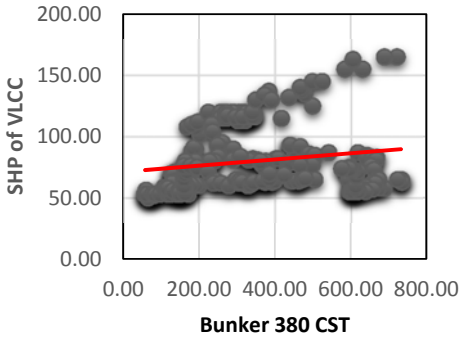








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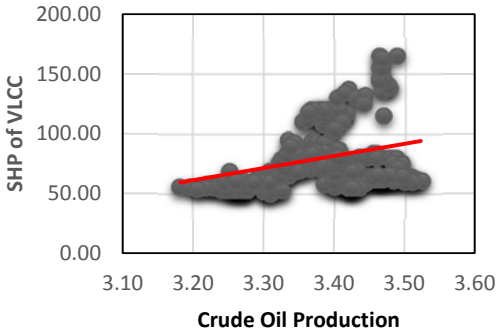
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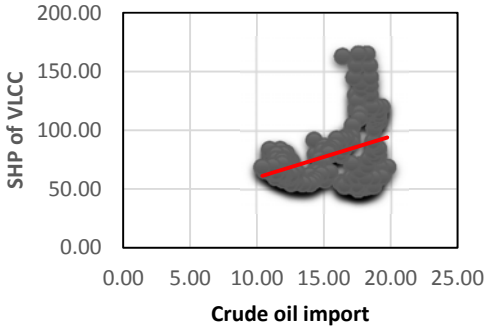
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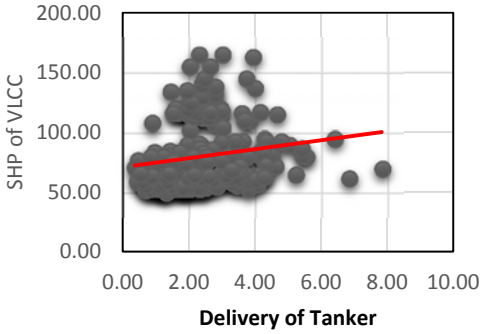
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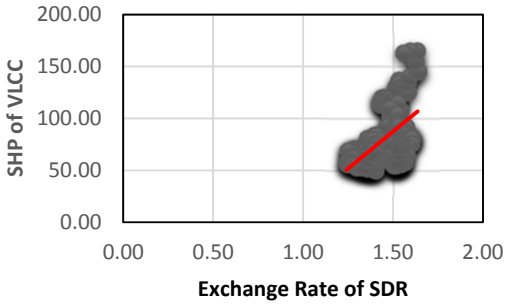
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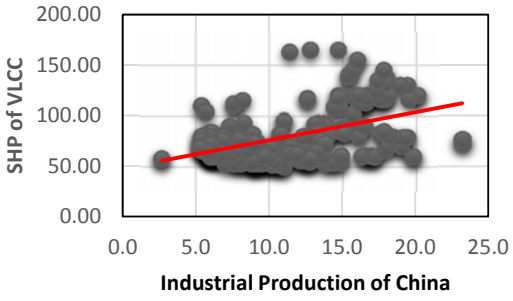
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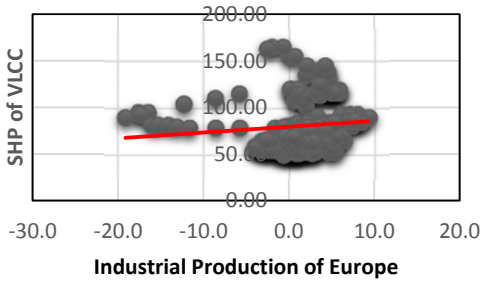
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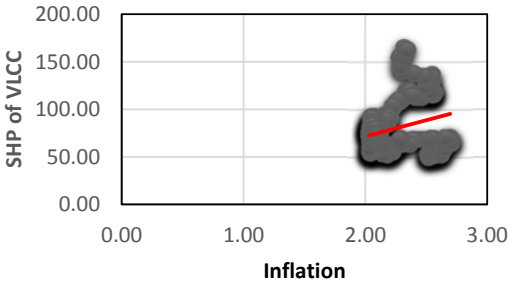
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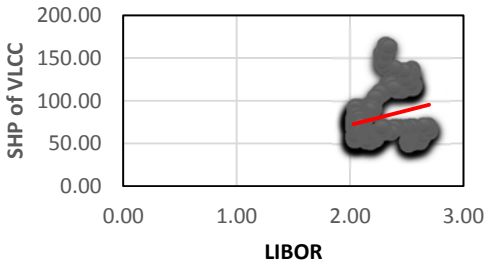
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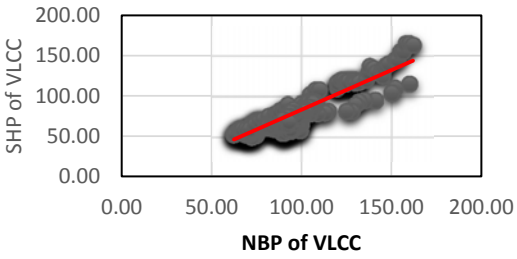
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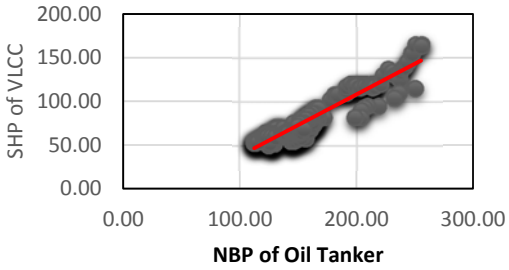
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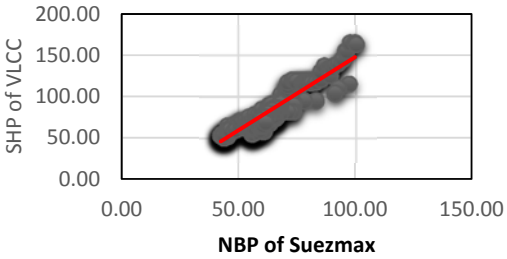
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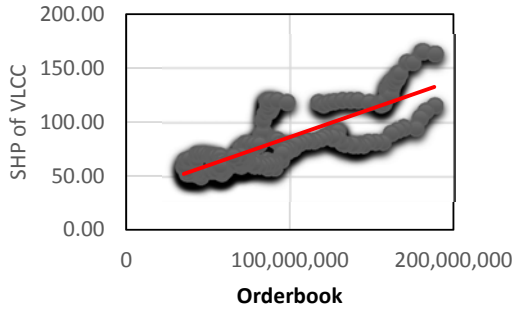
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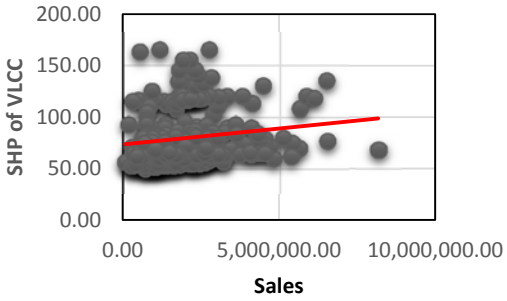
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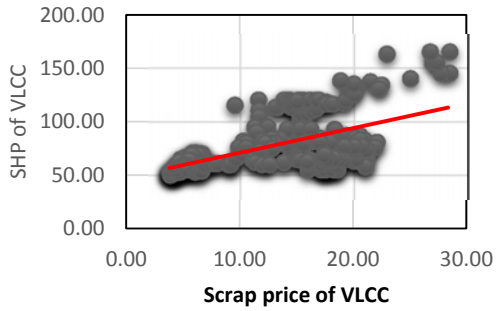
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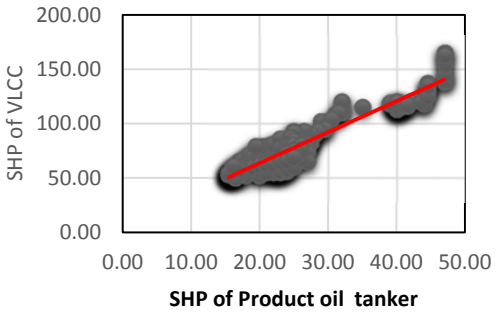
Scrap price of VLCC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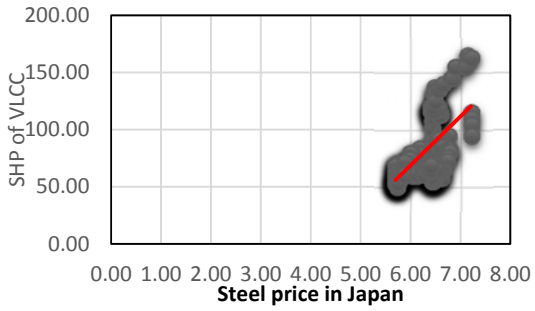
SHP of Product oil tanker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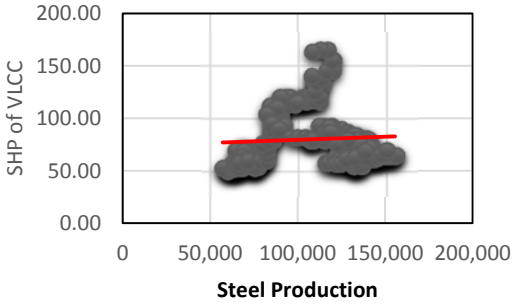
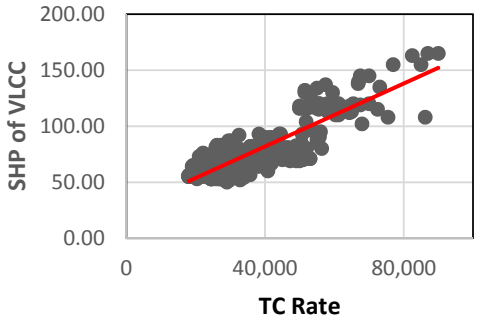
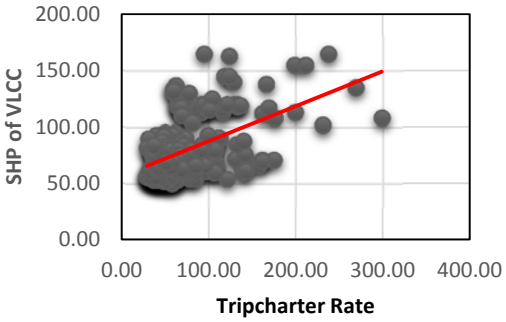
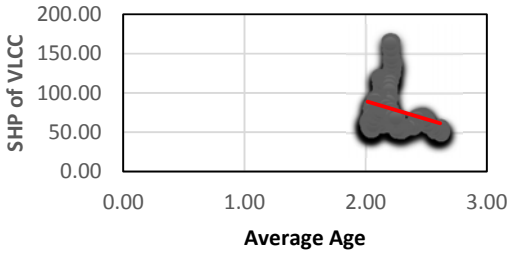
0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00
Steel price in Japan

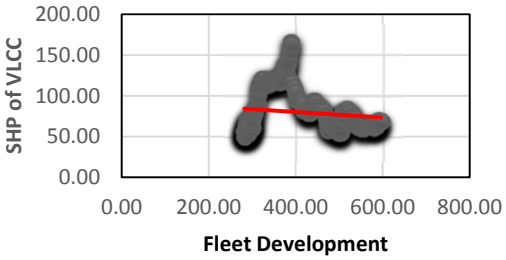

200.00
150.00
100.00
50.00
0.00
SHP of VLCC
0
50,000
100,000
150,000
200,000
Steel Production

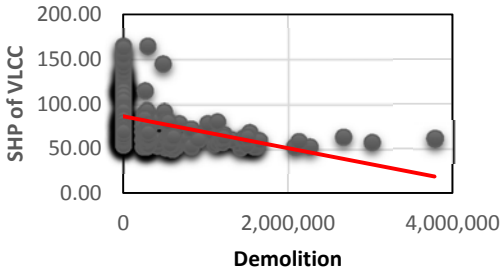


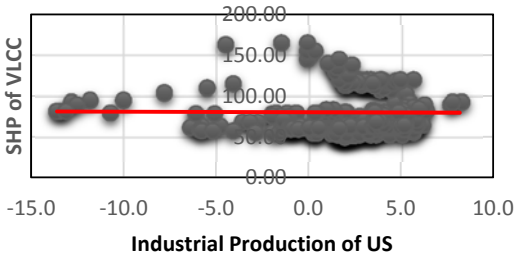


Negative Correlation Variables









Appendix B: Amortization Schedule for the six vessels project of Bangladesh Shipping Corporation (BSC)

Revised Amortization Schedule

Name of Project: Procurement of Six (06) new vessels (three(03) new product Oil Tanker and three (03) new Bulk Carrier of about 39,000 DWT Each.

Total Investment (Tk.) : 163715.15 Lac
Loan proportion (Tk.) : 152766.00 Lac
Loan Period : 20 years with grace period 5 years.
Rate of Investment : 2.00%

In RMB : 1,200,000,000
(One Thousand and Two Hundred Million RMB)

(Taka in Lac)

year	Beginning Principal Amount	Yearly Fixed Amount to be paid (Principal)	Yearly interest to be paid	Total payment (Principal + interest)	Ending Principal Balance
1	2	3	4	5=(3+4)	6=(2-3)
*1	152,766.00	-	471.07	471.07	152,766.00
*2	152,766.00	-	1,204.98	1,204.98	152,766.00
*3	152,766.00	-	2,496.92	2,496.92	152,766.00
4	152,766.00	-	3,055.32	3,055.32	152,766.00
5	152,766.00	-	3,055.32	3,055.32	152,766.00
6	152,766.00	10,184.40	3,055.32	13,239.72	142,581.60
7	142,581.60	10,184.40	2,851.63	13,036.03	132,397.20
8	132,397.20	10,184.40	2,647.94	12,832.34	122,212.80
9	122,212.80	10,184.40	2,444.26	12,628.66	112,028.40
10	112,028.40	10,184.40	2,240.57	12,424.97	101,844.00
11	101,844.00	10,184.40	2,036.88	12,221.28	91,659.60
12	91,659.60	10,184.40	1,833.19	12,017.59	81,475.20
13	81,475.20	10,184.40	1,629.50	11,813.90	71,290.80
14	71,290.80	10,184.40	1,425.82	11,610.22	61,106.40
15	61,106.40	10,184.40	1,222.13	11,406.53	50,922.00
16	50,922.00	10,184.40	1,018.44	11,202.84	40,737.60
17	40,737.60	10,184.40	814.75	10,999.15	30,553.20
18	30,553.20	10,184.40	611.06	10,795.46	20,368.80
19	20,368.80	10,184.40	407.38	10,591.78	10,184.40
20	10,184.40	10,184.40	203.69	10,388.09	0.00
	Total:	**152,766.00**	**34,726.17**	**187,492.17**	

*(1) Pre delivery interest and fees has been added to the interest amount(col-04) in first 03 years ,details of which are attached.

Appendix C: Income Statement of Bangladesh Shipping Corporation (BSC) for the financial year 2017-18

BANGLADESH SHIPPING CORPORATION

Statement of Profit or Loss and Other Comprehensive Income

For the year ended 30th June, 2018

Particulars	Notes	Amount In Taka	
		30th June, 2018	30th June, 2017
Revenue			
Freight Revenue	21	574,609,155	563,582,639
Service Revenue	22	257,265,450	257,930,508
		831,874,605	**821,513,147**
Operating Expenses			
Fleet Expenses (Direct)	23	(518,984,229)	(516,543,148)
Fleet Expenses (Indirect)	24	(56,100,352)	(28,406,221)
Operating Profit		**256,790,024**	**276,563,778**
Other Income	25	433,310,450	343,918,496
Administrative Expenses	26	(551,539,896)	(515,318,277)
Financial Expenses	27	(10,581,932)	(9,139,739)
Net Profit Before Tax		**127,978,646**	**96,024,258**
Income Tax		(31,994,661)	(24,006,064)
Deferred Tax	17	29,173,829	14,548,148
Net Profit After Tax		**125,157,813**	**86,566,341**
Earning Per Share	30	**0.82**	**0.62**

These financial statements should be read in conjunction with the annexed notes

Secretary | Executive Director (Finance) | Managing Director

Signed in terms of our annexed report of even date.

Ahmed Zaker & Co.
Chartered Accountants

Mahfel Huq & Co.
Chartered Accountants

Dated : 08 OCT 2018