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The Impact of Freight Rates on The Stock Prices of US Listed Shipping Companies

by

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1 Abstract

The purpose of this paper is to investigate and present the impact of freight rates on the stock prices of shipping companies. In our research, we are focusing on this particular impact on US listed shipping companies during the five-year period between January 2015 and December 2019. We are going to examine whether there is any kind of relation between stock prices returns and shipping freight rates in order to provide further information to the existing bibliography of shipping stock prices forecasting. By taking into consideration previous literature, we are observing that there is a strong relation between these two, although it is highlighted the fact that besides freight rates there are a lot of other factors enhancing the volatility that shipping stocks are experiencing. We are going to take the existing research a step further by estimating the level of repercussion of freight rates on the stock prices and also we are going to consider other important variables that due to their substance contain the ability to explain in a significant proportion the latter. In order to implement the scope of the aforementioned discussion we use various databases to collect the relevant data. We conduct our analysis with the assistance of statistical tools from where we derive our results. The main findings we extracted from the previous procedure agree with the existing literature and more specifically result in an important and meaningful interconnection inside our data set. We believe that our thesis topic is of high interest for people willing to invest in the shipping sector as well as for listed shipping companies in order to evaluate and display a degree of determination on their stock prices fluctuations. Furthermore, another party that would be highly interested is that of shipping analysts, who can use our research as an additional perspective to obtain a better view upon the so much discussed topic of freight rates capacity to influence shipping stocks. Finally, information extracted from our paper on how shipping stock returns behave during a significant time period will be of high value for people that are going to undertake important financial decisions in the shipping sector.

2 Introduction

Shipping industry is characterized as a highly capital-intensive industry. One major attribute of shipping companies is that about 90% of their assets are tangible. The cost of a new-building or second-hand vessel may exceed USD 100 million. Vessels can be liquidated in a relatively flexible manner for the appropriate amount of capital, depending on the prevailing conditions. For this reason, one can understand the importance of constant financing and the different ways to obtain it. Even though the nature of this industry contains high risks, it provides those that decide to invest in it with very high returns. To be more specific, high risks include the volatility of freight rates, the cyclicality nature of the sector and the fact that it is an international industry which is affected by global political and economic factors e.g., the closure of the Suez Canal in the 1950s and 1960s, Global Financial Crisis of 2008 etc.

One way to raise capital in order for a shipping company to realize a particular project or an investment is by deciding to go public through an IPO (Initial Public Offering) and offering part of their ownership by selling stocks to potential investors on one or more of the stock exchanges around the world. New York, Oslo, Hong Kong, Singapore, and Stockholm are all used for public offerings of shipping stocks. The advantage of the capital markets is that once the company is known and accepted by the financial institutions, it offers wholesale finance and a quick and relatively inexpensive way of raising very large sums of money. However, most shipping companies are too small to require funding on this scale and can end up spending a great amount of time and money, raising sums that could be obtained more easily from a commercial bank. In short, the capital markets are not a source of finance to be dabbled in. They are a lifestyle that must be entwined and that is not in every case simple, given the volatile characteristics of the shipping business. As of today, there are 170 shipping companies that have gone public while at the same time, most of the shipping companies decide to remain private. In 2007 there were 181 public shipping companies with a market capitalization (the number of issued shares multiplied by the market value per share) of $315 billion. Shipping and trade are highly interdependent and because of the observed growth in seaborne trade during the last century, it has led to the expansion of the shipping sector and other activities around the industry such as insurance, shipbuilding, shipbroking, shipping finance. It is estimated that the shipping industry contributes the wide majority of the volume of world trade in commodities and manufactured products.

3 World Fleet & Seaborne Trade

The purpose of the next two chapters is to describe the evolution, the overall conditions, and the basic determinants of the shipping industry. Based on that, we can approach our topic's issue in a much more precise way, as well as acquiring a better understanding of the utilities of terms such as the freight rates and shipping stocks.

In continuation to the above, all three main sectors (tankers, dry bulk carriers, containerships) are experiencing severe growth in volume terms in the last three decades.

3.1 Tanker Sector

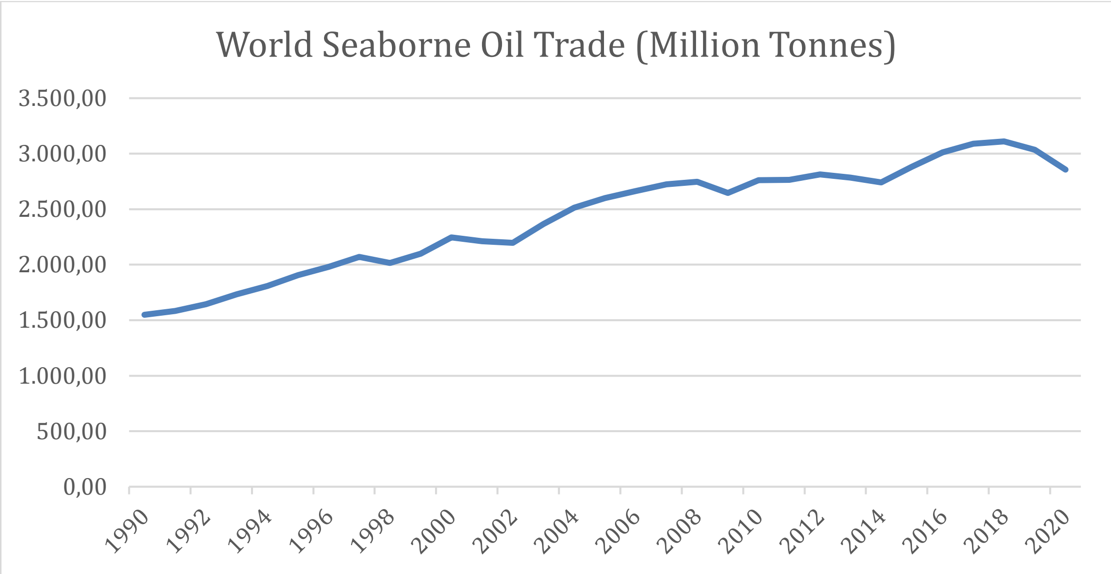

Figure 1: World Seaborne Oil Trade (Million Tonnes)
Source: Clarkson's SIN

To begin with, in the tanker sector we are going to present its evolution over the last 30 years with relevant data exported from Clarkson's SIN database. As one can understand from watching the graph in Figure 1, which depicts the total world seaborne oil trade measured in million tonnes, it is obvious that there is a constant rise of the amounts of oil transported around the world. During these 30 years we can also indicate several ups and downs because of global events and shocks coming to the most recent one of the coronavirus pandemic where oil price fell to the remarkably low level of 11.26 $ per barrel in 21 of April 2020 and also presenting negative prices in the case of West Texas Intermediate (WTI) contracts.

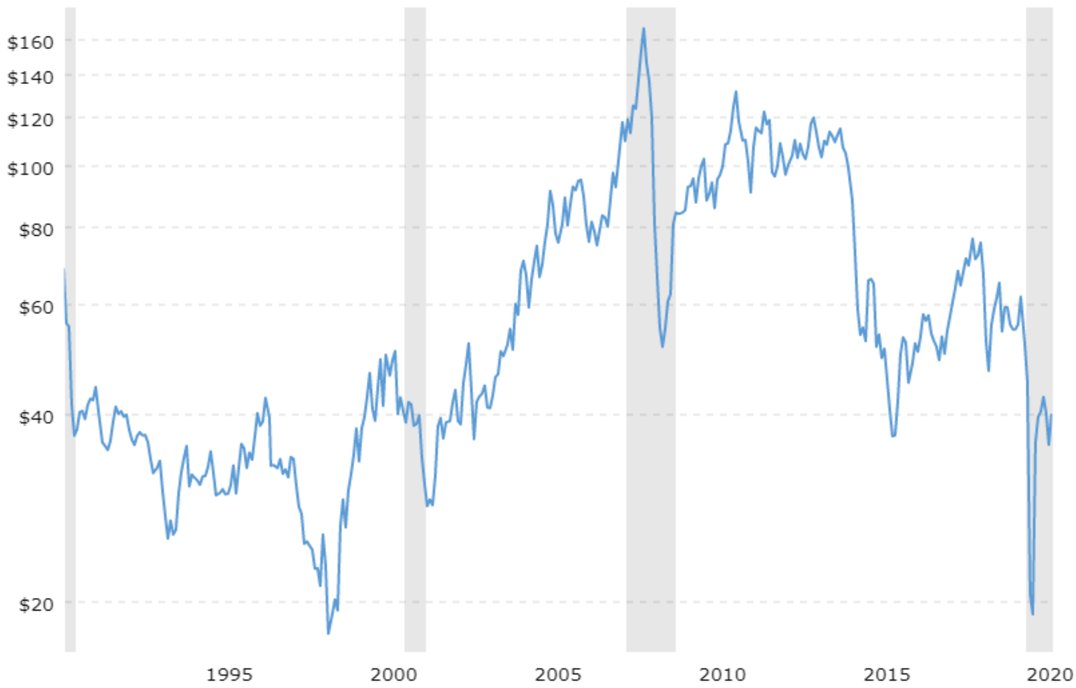

Figure 2: Crude oil price per barrel (1990 – 2020)
Source: Macrotrends

Figure 3: Crude oil price per barrel drop on April 21,2020
Source: Macrotrends

Such an event was the first time that has ever been recorded. This is happening due to the fact that an oil futures contract price decreases to below zero levels. This occurrence is mainly based to the futures' factors such as the spot price, as well as the cost of storing the physical commodity on settlement of the futures contract (known as the cost of carry). This happened because the coronavirus caused demand for oil to halt, while supply cuts from the Organization of the Petroleum Exporting Countries (OPEC) weren't scheduled to come into effect until 1 May 2020, which was after the expiry date for May 2020 futures. Demand for oil was hit from the coronavirus pandemic while at the same time the oil price war between Russia and Saudi Arabia was intense. Supply deficiency of oil resulting from the Organization of the Petroleum Exporting Countries (OPEC) actions was not expected to come into effect until the first of May of 2020, which was after the expiry date for May 2020 futures.

As it can be observed in Figure 1, in 1990, the total volume of seaborne oil trade was 1,549.02 million tonnes and it is notable that just ten years later there was a vast increase of the aforementioned seaborne transported product of about 35%. This is by far the largest increase both in volume terms and in percentage terms during a ten-year time period compared with the 23% of the first decade of the millennium as well as of the second decade growth which is 9%.

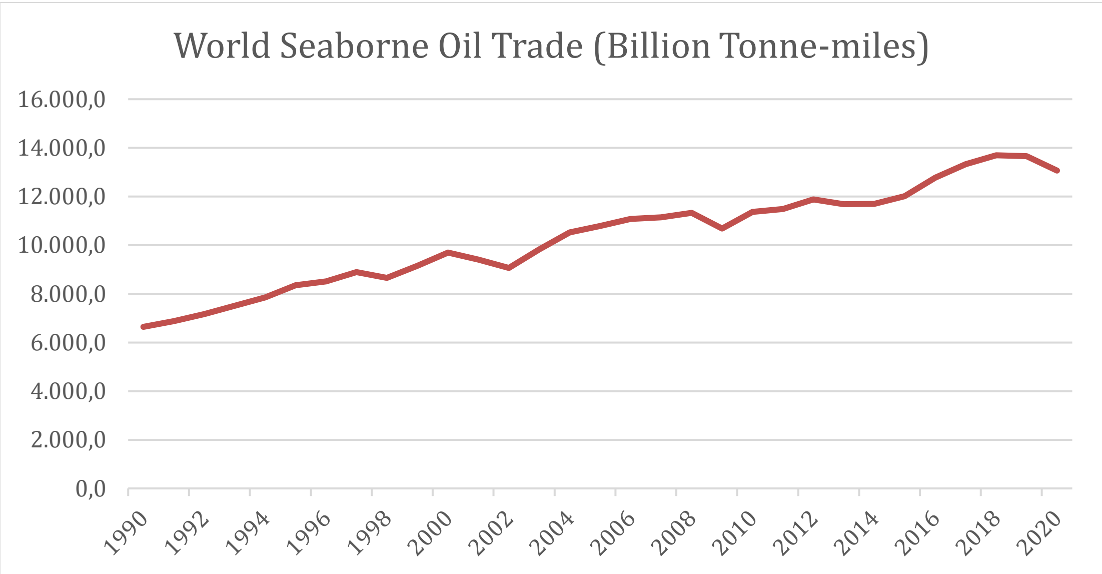

Figure 4: World Seaborne Oil Trade (Billion Tonnes)
Source: Clarkson's SIN

As far as the total world seaborne oil trade measured in billion tonne miles is concerned, we notice that the exact same trend is taking place and it is important to state that as we can observe from 1990 and the 6,642.1 billion tonne miles transported that year, the amount was a bit more than doubled and more specifically 13,695.3 billion tonne miles in year 2018.

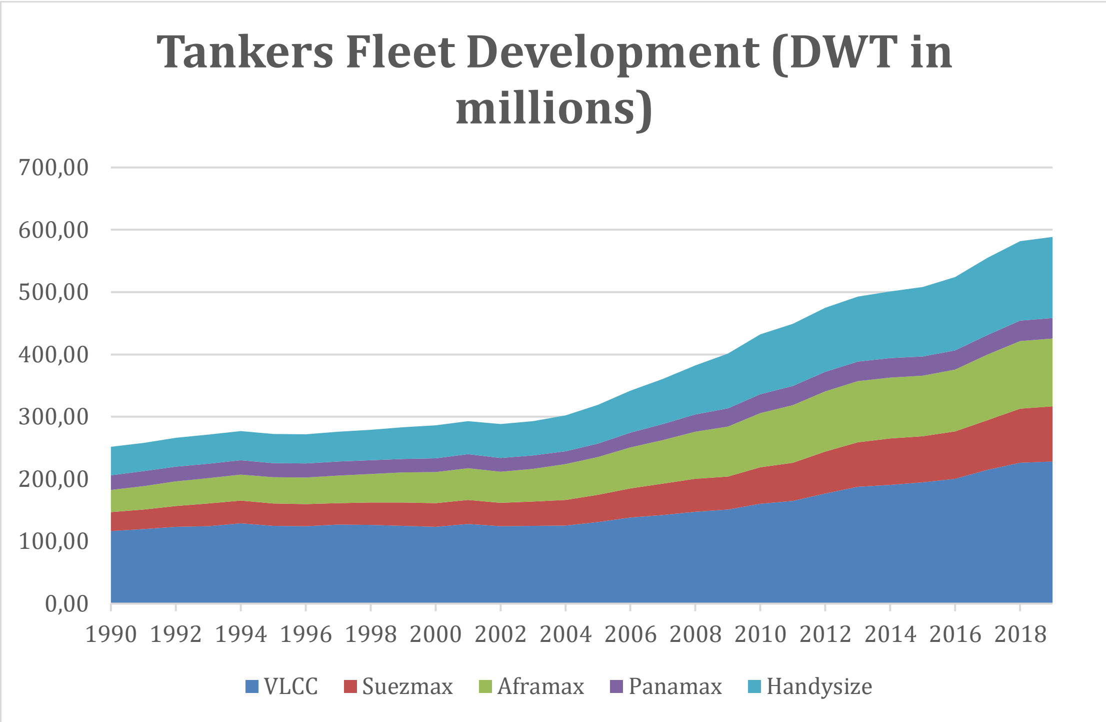

Figure 5: Tankers Fleet Development (DWT in millions)
Source: Clarkson's SIN

While the situation in the world seaborne trade of oil was as we described previously, it was expected that the supply side of the equilibrium would adjust accordingly through the examined period in order to achieve the balance between demand for seaborne transportation and supply of vessels. In order to be more specific, we are presenting the fleet development of the main vessel types composing the tanker sector (VLCC, Suezmax, Aframax, Panamax, Handysize) for the same time period as we examined for the seaborne oil trade. As we can observe from the graph in Figure 5, we notice that each one of the previously mentioned vessel types are following the exact same trend during the three decades. There is a constant increase in terms of DWT (Deadweight) capacity in all of them, but such increases are of different significance. We can also extract information such as the numbers of each vessel type where the Handysize ones are on top of this list because of the flexibility they provide and the greater number of ports they can call. As we move into bigger sized vessels, we notice that their number decreases analogically.

3.2 Dry Bulk Sector

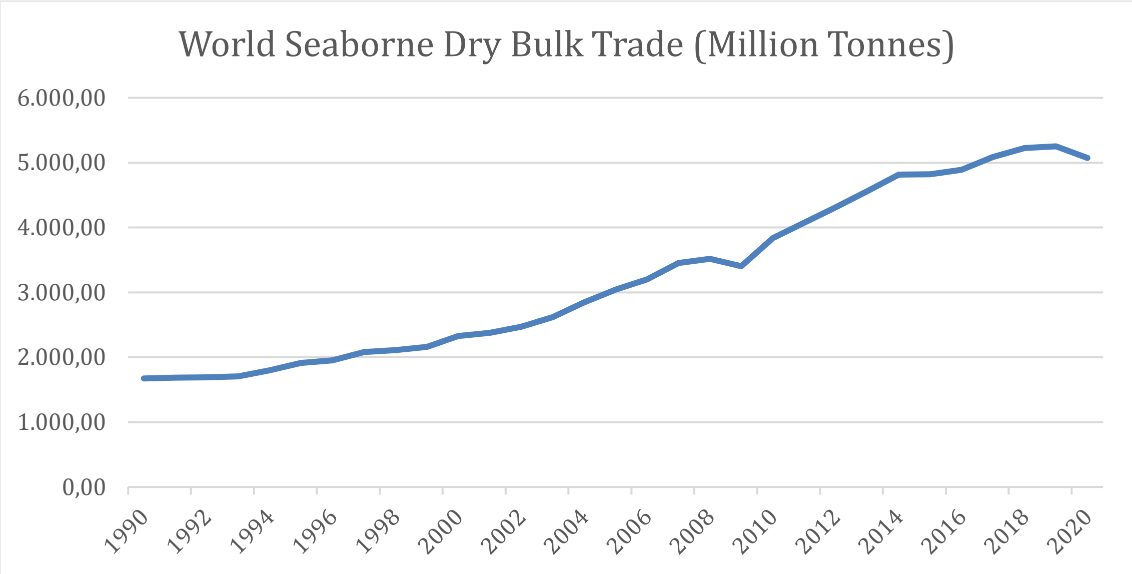

Figure 6: World Seaborne Dry Bulk Trade (Million Tonnes)
Source: Clarkson's SIN

Furthermore, focusing now on the dry bulk sector, we are again going to use data downloaded from Clarkson's SIN database. As in the tanker sector, we can observe from Figure 6 where total dry bulk seaborne trade is presented during the three decades between 1990 and late 2020 that there is also a positive change in terms of million tonnes transported. In the dry bulk sector, the upward direction as it is seen in this figure seems to contain a greater stability except for the 2008 global economic crisis which has affected shipping transportation in its whole. Later on, the surge in dry bulk seaborne transportation seems to regain its rise in much smoother way up until early 2019 and the coronavirus pandemic. In this occasion, and similarly to the tanker sector regarding the decade where seaborne dry bulk trade is experiencing its highest surge both in volume terms and percentage terms we observe that the total world seaborne dry bulk trade in 1990 accounted for 1,673.36 million tonnes and at the end of the decade in 1999 was 2,098.32 million tonnes representing a positive proportional change of 35%. The following decade starting in 2000 is also experiencing exceptional growth both in volume terms and percentage terms as far as the seaborne dry bulk trade is concerned despite the fact that the global financial crisis took place inside this time period. To be more specific, in 2000 world seaborne dry bulk trade accounted for 2,245.08 million tonnes reaching 2,645.25 million tonnes at the end of the decade in 2009 and amid the financial crisis. During the final decade and bearing in mind all the difficulties that came up throughout this period it is logical that although seaborne dry bulk trade displays growth signs, it is also presenting the lowest amount of growth both in volume and percentage terms with the latter being 12.58%. The exact amount of world dry bulk seaborne trade in 2010 was 2,762.89 million tonnes while in 2019 the same number became 3,035.53 million tonnes.

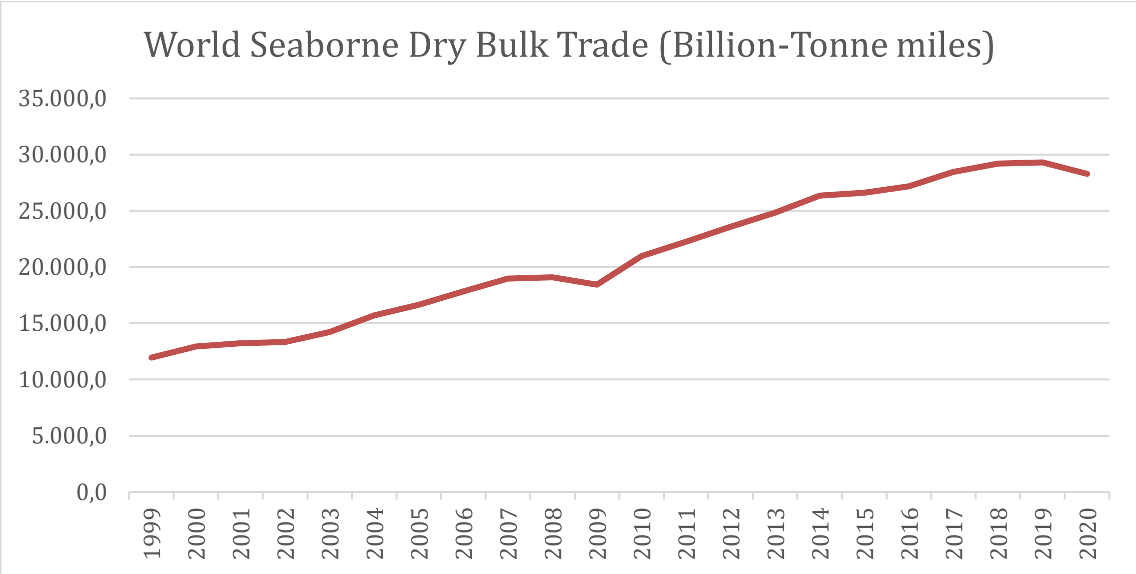

Figure 7: World Seaborne Dry Bulk Trade (Billion Tonne-miles)
Source: Clarkson's SIN

As far as the total world seaborne dry bulk trade measured in billion tonne miles is concerned, we are going to start our study here from 1999 due to the fact that there is no data for the first decade for the examined time period. Based on the Figure 7 and starting from 1999, we notice that the exact same trend is taking place and it is important to state that as we can observe from 1999 and the 11,944.1 billion tonne miles transported that year, the amount was a bit less than tripled and more specifically 29,305 billion tonne miles in year 2019.

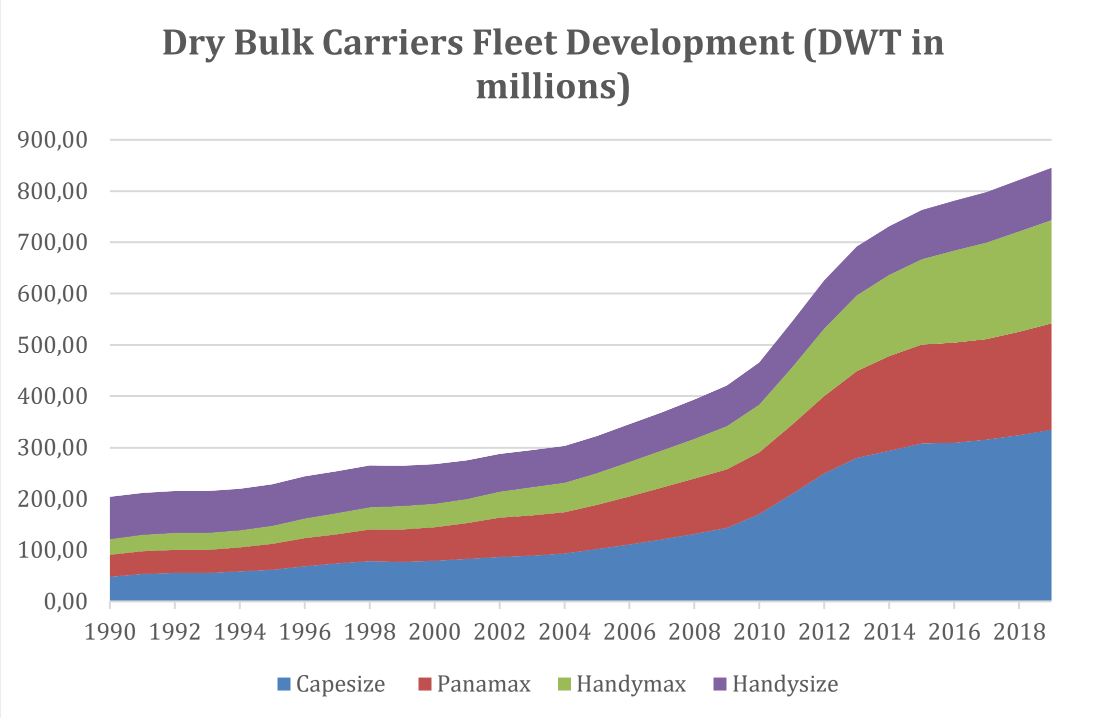

Figure 8: Dry Bulk Carriers Fleet Development (DWT in millions)
Source: Clarkson's SIN

While the situation in the world seaborne dry bulk trade was as we presented above, it was expected that the supply side of the equilibrium would adjust accordingly through the examined period in order to achieve the balance between demand for seaborne transportation and supply of vessels, just like the situation that was observed in the tanker sector. In order to be more specific, we are presenting in Figure 8 the fleet development of the main vessel types composing the dry bulk sector (Capesize, Supramax, Panamax, Handymax, Handysize) for the same time period as we examined for the seaborne oil trade. We observe a steady increase in all vessel types with a steep increase in 2009 which can be addressed to the fact that China entered the WTO in 2001, while the upcoming years excess demand for the transported commodities and as a consequence for shipping transportation was created. Again, we can observe that dry bulk vessels follow the same pattern with tankers in terms of fleet sizes because of flexibility issues among other factors as well.

3.3 Container Sector

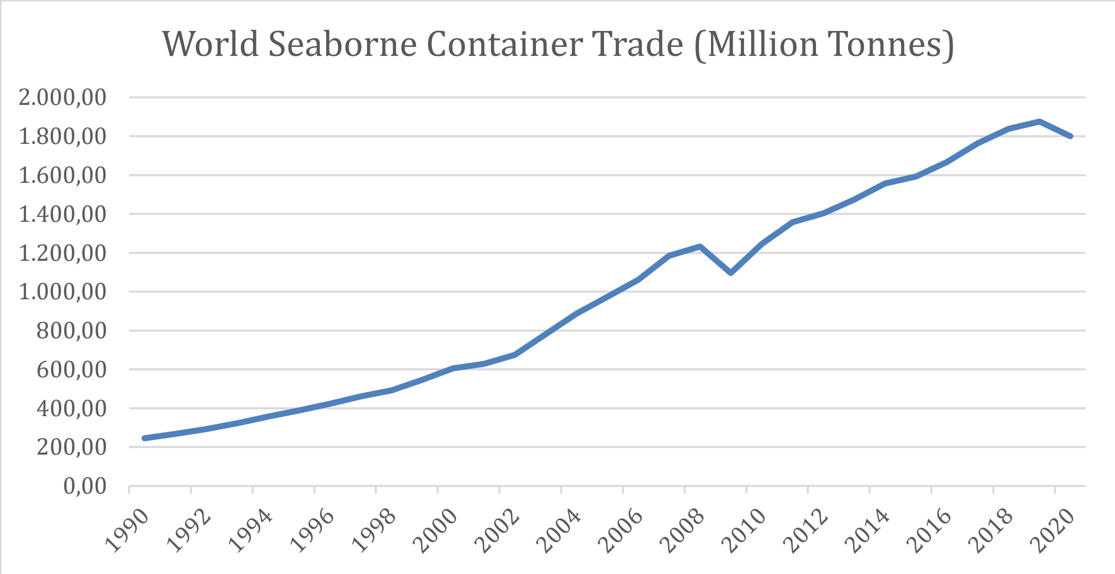

Figure 9: World Seaborne Container Trade (Million Tonnes)
Source: Clarkson's SIN

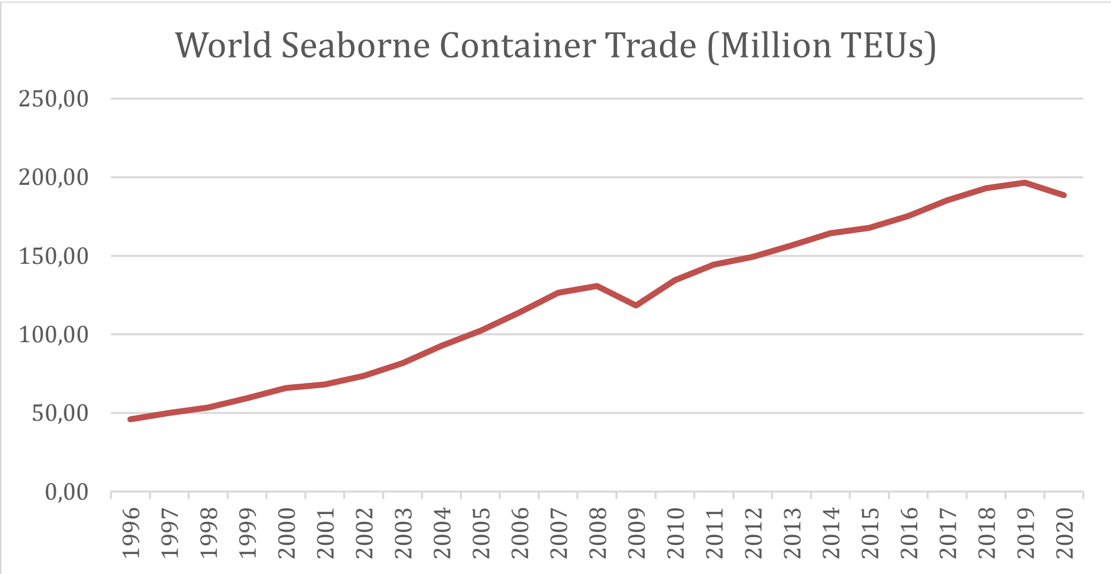

Figure 10: World Seaborne Container Trade (Million TEUs)
Source: Clarkson's SIN

Last but not least, we are going to focus on the container sector. Similarly, to the previous two sectors we have here as well extracted our data by using Clarkson's SIN database. The main difference regarding the type of data we have downloaded for this sector is that we included another unit of measurement which one can argue is the most important one regarding the container sector and that is the TEUs (Twenty foot equivalent unit) while in some cases FEUs (Forty foot equivalent unit). Demand for manufactured products which are the main component transported via TEUs, but of course not the only one, is experiencing the most severe growth compared to the other two main sectors. More specifically, in the containers sector an astonishing increase of 632% regarding million tonnes transported with this type of vessel is observed, while at the same time the proportional increase in million tonnes for the dry bulk and the tanker sector is 203% and 84% respectively. As one can see from Figure 9 and Figure 10, this tremendous difference is not portrayed when total world seaborne container trade is measured in million TEU's transported, despite the shortage of data until 1996.

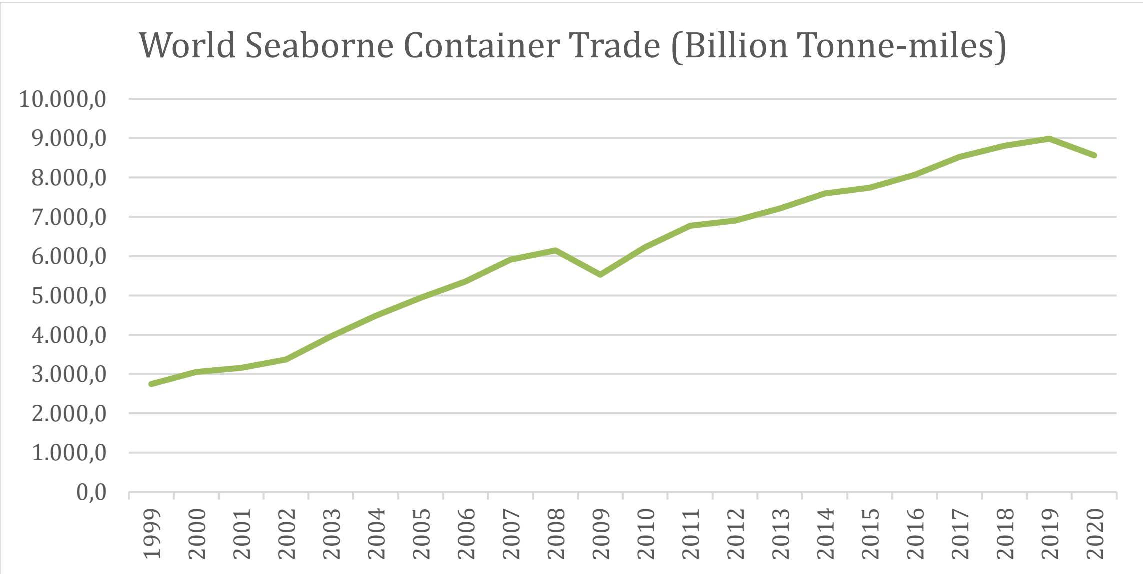

Figure 11: World Seaborne Container Trade (Billion Tonne-miles)
Source: Clarkson's SIN

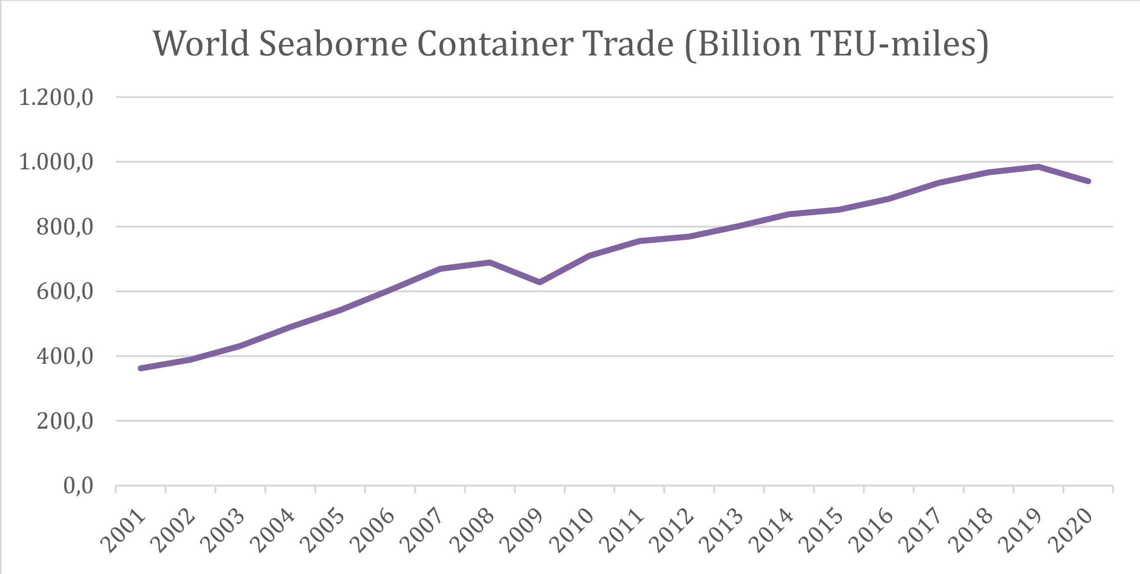

Figure 12: World Seaborne Container Trade (Billion TEU-miles)
Source: Clarkson's SIN

As far as the total world seaborne container trade measured in billion tonne miles is concerned, we are going to start our study here from 1999 due to the fact that there is no data for the first decade for the examined time period. So, starting from 1999 we notice that the exact same trend is taking place and it is important to state that as we can observe from 1999 and the 2,745.8 billion tonne miles transported that year, the amount was a bit less than tripled and more specifically 8,984.5 billion tonne miles in year 2019.

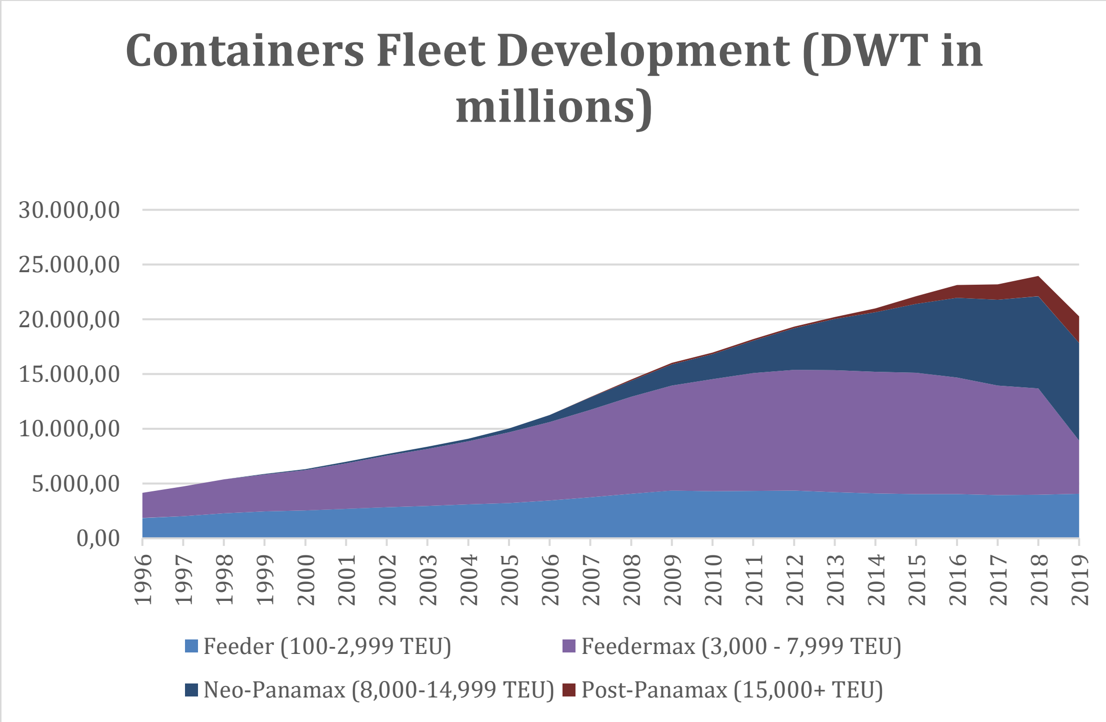

Figure 13: Containers Fleet Development (DWT in millions)
Source: Clarkson's SIN

In Figure 13 we are presenting the evolution of containerships fleet development during the past three decades by analyzing four main vessel types (Feeder, Feedermax, Neo Panamax, Post Panamax). It is no different for this sector as well, holding to the effort of supply and demand forces to achieve an equilibrium through this upward surge. In recent years, it has also been observed another trend which tends to make shipping companies and shipyards create bigger vessels achieving even greater economies of scale. What can be also derived from the last figure is that there is a trend where new and bigger vessel types are making their appearance and distracting the general balance in the sector.

4 Supply & Demand Forces in Shipping

Freight rates are the source of income for shipping companies and as already mentioned, the excess volatility they present can affect the survival of each company through recession periods. There are two aspects that are responsible for this volatility and these are the supply and demand factors appearing in the shipping industry. To be more specific, demand for seaborne trade is a derived demand for the commodities transferred around the world to places where they are needed the most. In contrast to demand, shipping supply is determined by the investment decisions of market agents. Of course, there are much more factors that pose an influence on freight rates, which also belong to the supply and demand categories such as seasonality, cyclicality, sentiment etc. that are going to be analyzed further below.

Demand	Supply
1. The world economy	1. World fleet
2. Seaborne commodity trades	2. Fleet productivity
3. Average haul	3. Shipbuilding production
4. Random shocks	4. Scrapping and losses
5. Transport costs	5. Freight revenue

Figure 14: Ten Variables in the Shipping Market Model
Source: Stopford, M., Maritime Economics, 3rd Edition (2009)

Amidst the many factors posing influence on the maritime industry, we need to distinguish the main determinants of supply and demand forces in shipping aiming to shape this particular equilibrium. Regarding the demand side of the equilibrium, the main factors explaining this demand for maritime transportation consists of the following. Initially, the first variable we are going to refer to is the world economy, with the rest of them being the seaborne commodity trade, the average haul, random shocks, and the cost of transportation. On the other hand, there are five variables one must consider in order to explain supply forces as well as it was for the demand side. More specifically, these variables are the capacity of the world fleet, the fleet productivity, the shipbuilding market, the scrap market, and the freight revenue generated from the operation of vessels.

The most feasible way to get all these factors together and measure the extent of their influence on shipping markets is through freight rates. Revenue generated by the operation of vessels reflects in the most informative and explanatory way the efforts to achieve and satisfy a balance between the two market forces.

For the fleet development variable as well as the world seaborne trade we have already conducted an extensive description of their variance throughout a long time period while we have highlighted their individual importance when it comes to extracting information on the prevailing circumstances of the shipping industry which affect the equilibrium.

4.1 Demand Module

The world economy, through business cycles and regional growth trends, determines the broad volume of goods transported by sea. It is basically referring to the global economic system which incorporates all economic activity conducted between nations as well as within nations, including production, consumption, trade of goods and services etc. The most used tool in order to have a clear measure of the world's economic activity is the Gross Domestic Product (GDP). GDP is a monetary measure of the market value of all the final goods and services produced in a specific time period. In addition to this, as pointed out by Martin Stopford (2009), there is a high correlation between seaborne trade and GDP.

The average haul is a measure which expresses the demand for shipping by focusing on the distance over which the goods are transported. Thus, it is more accurate to measure the demand for shipping services by ton miles instead of just measuring the deadweight capacity of cargoes transported since it avoids considering the distance that vessels travel and their efficiency levels.

Random shocks refer to unpredictable changes that affect major factors of production either in a positive or negative manner. Due to the fact that in most cases it is almost impossible to predict them before occurring, the consequences from their existence are immense. A great example of such a shock is the global financial crisis of 2008 which shook the fundamentals of the world economy as we knew it until then. Other examples of such shocks can be wars, natural disasters, evolutionary inventions, political events etc.

The final variable in the demand module is the transportation costs. This variable is referring to the continuous need for developing economies of scale. Sea transportations produces the greatest numbers when it comes to that, due to the fact that the huge capacity being offered by oceangoing vessels reduces the cost for transporting a specific amount of cargo to the minimum compared to any other source of transportation. Therefore, demand for shipping is experiencing such high levels and as already mentioned contributes to about 90% of global cargo transportation.

4.2 Supply Module

For the supply side, it is of great importance to determine fleet productivity standards. What this means is simply the percentage at which vessels are being utilized. To be more specific, it is highly common for vessels sailing with less than the 100% of their capacity used. To that end, it is added the fact that many vessels are unable to find a backhaul cargo either due to the capacity of their trade, the prevailing circumstances in the market, the vessel's size as well as other factors. Nowadays, mainly with technological assistance, there has been an effort to maximize this utilization although it remains a difficult task.

For the next supply side variables which are the shipbuilding and scrapping markets, we need to state the interconnection between them and the world fleet capacity. As one can understand, world fleet capacity consists of the number and the capacity of already existing vessels. It is adjusted through vessel subtractions occurring from the demolitions of vessels as well as from the unfortunate event of vessel losses, while it increases through the shipbuilding market from the realization of vessel orders to new vessels after the mandatory lag period between the construction process and their delivery.

5 Vessel Segmentation

In the maritime industry professionals have developed a scale in order to distinguish between different vessels based on factors such as the type of the commodity to be transported, the DWT (Deadweight Tonnage) of the vessel, loading and discharging acceptable port dimensions (berth size and depth, shore equipment etc.) and the ability of the vessels to transit Panama and Suez Canal. The main sectors based on the nature of commodities transported are the Tanker sector, the Dry Bulk sector and finally the Container sector. Each one of these categories contains a variety of sub-sectors in order to satisfy demand for transporting particular commodities and calling more sophisticated and specialized ports. So, although there is some market segmentation, these markets are not isolated compartments. Investors have the ability to move their investment from one market sector to another while supply and demand inhomogeneity in one part of the market soon diffuses across to other sectors.

We are going to demonstrate the main vessel characteristics and briefly analyze each ship segment and sub sectors below:

5.1 Tanker Sector

Tankers are vessels which are constructed to carry crude oil and various oil products. Such vessels include large piping systems for cargo handling and are able to perform loading and discharge on their own. Some technical characteristics to be mentioned are among others the service speed which has a range of between 12 and 17 knots and the main engine power which varies between 2000 and 65000 HP.

We will analyze further the tanker sub sectors below:

- <u>Handysize Tankers</u>

  Handysize Tankers deadweight tonnage range is from 10,001 to 45,000. The main commodities that are transported are oil products.

- <u>Panamax Tankers</u>

  Panamax Tankers deadweight tonnage range is from 45,001 to 80,000. The main commodities that are transported are oil products. The main difference with Handysize Tankers is that Panamax Tankers have the ability to transit through the Panama Canal.

- Aframax Tankers

  Aframax Tankers deadweight tonnage range is from 80,001 to 120,000. The main commodities that are transported are crude oil products.

- Suezmax Tankers

  Suezmax Tankers deadweight tonnage range is from 120,001 to 200,000. The main commodity that is transported is crude oil.

- Very Large Crude Oil Carriers (VLCC)

  Very Large Crude Oil Carriers (VLCC) deadweight tonnage range is from 200,001 to 320,000. The main commodity that is transported is crude oil.

5.2 Dry Bulk Sector

Dry Bulk carriers are vessels whose main purpose is the transportation of bulk cargo, such as grains, steam and coking coal, iron ore, steel coils and cement, in its cargo holds. They are constructed with single deck, topside tanks and hopper tanks in cargo spaces, which is intended to carry dry cargoes in bulk and includes types such as ore and combination carriers. Some technical characteristics to be mentioned are among others the service speed which has a range of between 12 and 17 knots and the main engine power which varies between 2000 and 65000 HP, while they can be distinguished from the large hatches on main deck and for some types of vessels cranes for self-unloading.

We will analyze further the dry bulk sub sectors below:

- Handysize

  Handysize deadweight tonnage range from 10,000 to 40,000. The main commodities transferred with this type of vessel are composed from a variety of bulk cargo types and are ideal for short shipping.

- Handymax

  Handymax deadweight tonnage range is from 40,001 to 50,000. The main commodities transferred with this type of vessel are mainly cargos which include iron ore, coal, fertilizer grain, bauxite, alumina and grain.

- Supramax

  Supramax deadweight tonnage range is from 50,001 to 60,000.

- Panamax

  Panamax deadweight tonnage range is from 60,001 to 80,000. The main commodities transferred with this type of vessel are the same with those of the Handymax vessel but the reason for the creation of this category is to distinguish the maximum size of a vessel which is able to transit through the Panama Canal. In 2016 there was a new category created, the Neo-Panamax vessel (80,000 dwt - 120,000 dwt) which was the maximum size of a vessel to transit the new locks of the Panama Canal.

- Capesize

  Capesize deadweight tonnage range is from 80,001 and above. The main commodities transferred with this type of vessel are mainly iron ore, coal and grain because of the vast amounts of cargo they can transfer.

5.3 Container Sector

Container vessels are high speed vessels due to the fact that the range of service speed is between 20 and 27 knots. Moreover, another important technical characteristic is the main engine power range which is from 20000 HP to 80000 HP. They include large hatches on the main deck. Their hull is slender compared to the previous two ship sectors. This sector is also called as liner shipping because of the tight schedule they are following and the discrete number of ports they are calling.

We will analyze further container sub sectors below based on the TEU capacity:

- Feeder

  Feeder TEU capacity range is from 100 to 2,999 TEU capacity.

- Feedermax

  Feedermax TEU capacity range is from 3,000 to 7,999.

- Neo-Panamax

  Panamax TEU capacity range is from 8,000 to 14,999.

- Post Panamax

  Post Panamax TEU capacity range is from 15,000 and above.

6 The Baltic Exchange

Baltex (Baltic Exchange) is a privately owned company founded in 1744 and is located in London, UK, while at the same time there are more offices in the rest of the world in almost every continent but more specifically in Europe, the United States and across Asia. It is an independent organization whose purpose is to provide daily freight market prices and maritime shipping cost indices which can be useful to different members of the shipping industry. It is widely regarded as the largest international shipbroking marketplace. It is important to mention the fact that over the last two decades the published indices have been extended to 53 dry bulk and tanker routes from data derived by the so-called panelists which are basically the biggest shipbroking houses around the world.

Baltex publishes daily 7 different indices which refer to different segments regarding the wet and dry bench-marked time-charter and voyage routes:

- **Baltic Dry Index (BDI)**

  The Baltic Dry Index (BDI) is a composite of the dry bulk time charter averages of the Capesize (40%), Panamax (25%), Supramax (25%) and Handysize (10%) indices.

The main routes of the BDI are the sum the ones of its composed indices.

- **Baltic Capesize Index (BCI)**

  Baltic Capesize Index (BCI) for Capesize vessels of 172,000 mt dwt, based on 12 routes.

- **Baltic Panamax Index (BPI)**

  Baltic Panamax Index (BPI), for Panamax vessels of 74,000 mt dwt, based on 4 routes.

- **Baltic Supramax Index (BSI)**

  Baltic Supramax Index (BSI) for Supramax size vessels of 52,454 mt dwt, based on 11 routes.

- **Baltic Handysize Index (BHSI)**

  Baltic Handysize Index (BHSI), for Handysize vessels of 28,000 mt dwt based on 6 routes.

When it comes to the tanker sector the Baltic Exchange publishes the following two indices on a daily basis.

- **Baltic Dirty Tanker Index (BDTI)**

  The BDTI publishes information regarding freight rates of vessels carrying crude oil and more specifically for VLCC, Suezmax and Aframax vessels while using a mix of routes for these vessels.

- **Baltic Clean Tanker Index (BCTI)**

  The BCTI publishes information regarding freight rates of vessels carrying oil products and more specifically for Aframax, Panamax and Handysize vessels while using a mix of routes for these vessels as well.

- **Baltic LNG Tanker Index (BLNG)**

  Liquified Natural Gas (LNG) assessments launched in 2019.

Regarding the container sector, there is the China Containerized Freight Index (CCFI) which is sponsored by the Ministry of Communications of PRC, formulated by Shanghai Shipping Exchange and first published on April 13th, 1998. This index contains 14 shipping lines based on the three major principles of typicality, relativity, and regional layout. Again, the information is being derived from a group of 22 panelists consisting of 22 prestigious major shipping companies with large market share. To the previous indexes another one was introduced in April 2018 with the Baltic Exchange announcing a global container index (FBX). Based on the above information, it is safe to say that this particular index is the most representative one for the global container industry.

6.1 The Baltic Dry Index (BDI)

In 1985, the Baltic Exchange introduced the Baltic Freight Index (BFI) which is an index based on the weighted average of 11 different routes covering a variety of cargoes. The BFI operated for the next 14 years up until November 1, 1999 when it was replaced by the BDI (Baltic Dry Index) which is prevailing to the current date. From the first of March in 2018 the BDI weights of the composed vessel types indices changed to the following ratios of time-charter assessments: 40% Capesize, 30% Panamax and 30% Supramax and will no longer include the Handysize time-charter average. Despite the fact that external research ended up to the fact that each vessel's type contribution to the dry bulk market would be 40%, 25%, 25% and 10% for the Capsize, Panamax, Supramax and Handysize vessels respectively, it does not make any statistical difference which weights should one use when calculating the BDI.

7 Literature Review - Empirical Evidence

It is widely approved that the most important factor from which the highest risk in the shipping industry is derived, is the freight rate risk, and for this reason it is important for people interested in the industry to understand and consider the statements of the previous chapters. The volatility of freight rates is significantly affecting the decisions regarding investments in the shipping market. Therefore, it is necessary to understand this mechanism to provide long run and stable business operations.

In the case of Amir H. Alizadeh a, Gulnur Muradoglu (2014), they investigated the ability of shipping freight rates to predict movements in the US and international stock market due to the fact that they contain information about the global economic activity which is interrelated with international trade. They have taken into account previous study from Hong and Stein (1999) which stated that the shipping industry can be characterized as one that adapts slowly to changes based on the diffusion hypothesis of information and thus, shipping freight rates are a trustworthy variable for the prediction of stock market direction. Amir H. Alizadeh a, Gulnur Muradoglu (2014) tested the significance of BDI changes as an explanatory variable on stock returns of various sectors and company sizes over the period from February 1989 until October 2013 on a monthly basis by conducting several regression analyses. Results derived indicate that freight rates have a positive relation with stock returns across many sectors and are a better explanatory variable for stock returns than oil prices, which were also tested through the same regression process. Such results provide us informative indication for our research since we are going to use the Baltic Dry Index as one of our explanatory variables.

Furthermore, T. Syriopoulos and E. Roumpis (2009) have devised a study by collecting daily and weekly data from 17 shipping companies operating in different sectors for the time period between December 2002 to December 2007, in order to examine whether company and sectoral fundamentals pose influence on shipping stock volatility. In order to accomplish that, they followed the Value at Risk (VaR) methodology and more specifically Parametric and Non-Parametric VaR analysis. They have concluded that the prices of shipping stocks are immensely responding to volatilities both in the stock and shipping markets. This study comes to add to the existing literature and support the existence of a relationship between the stock and freight markets.

Yuting Gonga, Kevin X. Lib, Shu-Ling Chenc, Wenming Shic (2020) are underlying the interdependence between the stock market and the shipping freight rates. To be more specific, they are examining the effects of the trade war between the two biggest exporters and importers which are the USA and China (USA is the biggest importer of China and consequently China is the biggest exporter for the USA - according to the Atlas database). In order to support their claim, they have gathered data from the BDI, the Dow Jones Industrial Average Index (DJIA) and the Shanghai Composite Index (SCI) and they took into consideration the time period between January 2002 to June 2019 on a weekly basis. They have conducted an analysis on the contagion risk by using the dynamic tri-variate MRS-copula and the VaR model. Their results enhance a better understanding of the powerful dependence between freight rates and stock markets while they are also making a reference on the need to have a composed shipping index for all sectors. To that end, we are trying to approach this limitation in our own study by integrating several sector freight indices despite conducting research for different time periods and purposes.

Another perspective regarding the determinants of shipping stock returns is approached by Grammenos CTH, Marcoulis SN (1996). In their analysis they included data from 19 shipping companies listed in four stock exchanges for a five-year time period (January 1989 to December 1993). Similarly to our paper, the reason for examining a short time period of five years is because most of the companies have not been listed to the related stock exchanges for more than five years. They follow the Fama - MacBeth methodology to address the aforementioned issue and test whether the factors which they decided to embed and analyze in their model are presenting significant effects on stock returns performance. The factors composing their model and more specifically the company's stock market beta, financial leverage and dividend yield are characterized based on existing finance literature as some of the various determinants of stock performance. A noteworthy and highly interesting alternation to their model is the addition of the average age of the fleet variable. Findings of this study state that a positive relation between stock returns with stock market beta and financial leverage, while a negative relation between the average age of the fleet and dividend yield exists. Finally, it is underlined that out of the four variables, the ones that present a greater explanatory power on stock returns are the average age of the fleet and the financial leverage. In this particular paper, the authors follow a similar approach to the one we are going to follow in terms of dealing with such limitations as well as the examination of explanatory power of specific variables on shipping stock returns.

In continuation to the aforementioned study, Ahmed A. El-Masry , Mojisola Olugbode & John Pointon (2010) investigate in their research the impact of exchange rates, interest rates and oil prices on stock returns derived from a sample from 143 shipping companies from 16 countries during the time period from April 1997 to September 2005. In order to examine the combined impact of interest rates and exchange rates on the stock returns, they have created a multi-factor OLS model which includes as dependent variables the stock returns and as independent variables: the short term return depicted through the 3-month Treasury bills interest rates, the long term return depicted through the 10-year Government bond interest rates, the proportional change in the oil price and the return on the domestic market portfolio. Having performed the regression analysis via the aforementioned model they have concluded to the following findings. Exposure of stock returns to exchange rate and interest rates is of low significance due to the adoption of effective hedging strategies while at the same time an oil price increase detonates a positive reaction to stock returns but for the minority of shipping firms for which it is significant. Specific limitations are also embedded in this approach such as ignoring variables representing political turmoil etc. Not every variable is considered significant when it comes to explaining movements of stock returns and such research provides important information to distinguish these variables and even examine this claim for a future time period and under different circumstances.

An important factor which is also crucial for our research is to analyze findings from the scope of freight rates. Kevin X. Li, Yi Xiao, Shu-Ling Chen, Wei Zhang, Yuquan Du & Wenming Shi (2018) focused their study on freight rate behaviors by collecting a data set composed by freight indices such as the BDI, BDTI, BCTI and CCFI for a time period from January 2002 to March 2018 on a weekly basis. By performing Granger causality tests, they demonstrate the existence of one-way causality from dry bulk and clean tanker freight rate returns to dirty tanker and container freight rate returns respectively. Therefore, these results underline the fact that dry bulk and clean tankers freight rates are significant to the forecasting of dirty tanker and container freight rates respectively. Another parameter examined in their study is the existence of volatility persistence in each freight market individually. They performed univariate GARCH models to capture this volatility persistence where the BCTI appeared to have the smallest one. Information derived from this particular study form the expectations for the freight indices coefficients used in our findings later on this paper.

8 Methodology

Up to now we have described some key elements of the maritime transportation industry and we discussed many factors which pose an influence and formulate the shipping sector as we know it today. The last few decades there has been a great number of researches with each one of them offering valuable information for people interested in the shipping cluster either they are looking from the inside of it or from the outside. In our study we try to determine significant explanatory factors of shipping companies' stock returns and in order to achieve that we will create a multi-factor model. So as to select the appropriate independent variables we take into consideration the factors that drive supply and demand forces in the shipping industry (Stopford, 2009). Furthermore, by taking into consideration previous studies and their findings we distinguish certain significant variables to include in our model which evidently contain explanatory power on shipping stock returns.

Regarding the selection of the variables in our model we base an important part of this process on previous studies trying to investigate the determinants of stock returns volatility. An example of such a study is Amir H. Alizadeh a, Gulnur Muradoglu (2014) from where we can derive the conclusion that the Baltic Dry Index (BDI) is a significant variable in the process of explaining shipping stock returns. By taking it a step further, due to the fact that we analyze companies from the three main sectors of the shipping industry (dry bulk carriers, tankers, containers), we incorporate in our model the BDI and in addition to that, respective indices of the aforementioned sectors which are the BDTI, BCTI and CCFI. Such an approach has been realized by Kevin X. Li, Yi Xiao, Shu-Ling Chen, Wei Zhang, Yuquan Du & Wenming Shi (2018) in their attempt to determine the interdependencies of the different indices for their respective shipping segments. By taking into consideration their outcome, we are expecting the pairwise BDI-BDTI and BCTI-CCFI to affect the stock prices in the same direction. Based on the aforementioned, we expect the freight rate indices to have a positive impact on the stock returns.

According to Sharpe (1983) one of the factors that are affecting the stock performance of companies is the stock's beta with the S&P index. Amir H. Alizadeh a, Gulnur Muradoglu (2014) are including such indices (S&P 400, S&P 500, S&P 600) in order to determine factors that are affecting the volatility of stock returns. The S&P 500 is a stock market index that tracks the stocks of 500 large-cap U.S. companies. It represents the stock market's performance by reporting the risks and returns of the biggest companies. Investors use it as a strong indication of the overall market. This index variable is useful for our analysis since our sample consists of shipping companies that are listed in the US stock exchange (NYSE, NASDAQ). Due to the nature of this index, we expect a positive relation between the stock returns and S&P 500.

Finally, we signify the importance of incorporating a variable in our model which captures and assesses the value of a company. Such a variable is the book to market ratio. The book to market ratio compares a company's book value to its market value. Both, Fama and French (1992) and Lakonishok, Shleifer, and Vishny (1994) reported that there is a strong correlation between book to market ratio and stock's future performance while they also indicate it as a popular return predictor. This predictive ability of book to market ratios seems to derive from the relationship between book value and future earnings. Thus, we conclude that including book to market ratio as a predicting variable is important for our model.

The calculation of the book value-to-market ratio is based on the following formula:

$$\text{Book-to-market ratio} = \text{book value of firm} / \text{market value of firm} \quad (1)$$

Based on (1) we understand that as the book to market ratio increases, the stock price of the company becomes undervalued. Likewise, the opposite stands for when the book to market ratio decreases. So, having said all the above, we conclude that there is a negative correlation between this ratio and the stock return and consequently we expect a negative impact on the stock returns as the book to market ratio increases.

In continuation to the above and in order to estimate the impact of freight rates in combination with the book to market ratio and the S&P 500 Index we are going to use the following multi-factor model:

$$SR_{ij} = c + \beta_1 BMR_{ij} + \beta_2 SP_{ij} + \beta_3 BDI_{ij} + \beta_4 BDTI_{ij} + \beta_5 BCTI_{ij} + \beta_6 CCFI_{ij} + U_{ij}, \quad (2)$$

$$(i=1, 2, ..., 27, j=1, 2, ...,60)$$

Where, SR_{it} is the Stock Prices Log Returns for the i firm in month j, c is the constant, BMR_{it} is the Book to Market Ratio Log Returns for the i firm in month j, SP_{ij} is the S&P 500 Log Returns for the firm i in month j, BDI_{ij} is Baltic Dry Index (BDI) Log Returns for firm i in month j, $BDTI_{ij}$ is the Baltic Dirty Tanker Index (BDTI) Log Returns for the firm i in month j, $BCTI_{ij}$ is the Baltic Clean Tanker Index (BCTI) Log Returns for the i firm in month j, $CCFI_{ij}$ is the China Containerized Freight Index (CCFI) Log Returns for the firm i in month j and U_{it} are the Residuals for the firm i in the month j.

Furthermore, our next step is to ensure that our variables are stationary. In order to do that use the first logarithmic differences for each one of them as shown in (2). The calculation of first logarithmic difference is provided in (3). By doing so, we are certain that their statistical properties (ex., variance, autocorrelation, etc.) are constant over time. Logarithms, in particular, which we make use of are important because they are more interpretable. To be more accurate, changes in a log value are relative (percent) changes on the original scale. To verify our claim, we conduct unit root tests.

$\text{Log return}_t = \text{Log}(P_t) - \text{Log}(P_{t-1})$ (3)

Moreover, we have to verify that there is no sign of multicollinearity between the independent variables. To do so, we perform the correlation tests between them. By considering table (17) in the empirical analysis section below we ensure that the criteria of multicollinearity are not met in our model.

At this point, we are confident enough that the multi-factor model (2) will provide significant and appropriate results for our analysis.

Due to the nature of our data sample, we use a panel data set in order to perform the regression analysis. We perform two regression analysis, the Random Effect regression model (GLS Regression) and the Fixed Effect regression model. Obviously, we cannot use the results derived from both of these models and consequently we have to find ways to end up with the one providing the more suitable results. To achieve that, we perform the Breusch & Pagan test and Hausman test.

Finally, after deciding on which is the most appropriate model, we focus on the results that came up. To substantiate the previous sentence, starting with the R Square, it is a measure expressed as a percentage and portrays the proportion to which our model is explaining the changes of the dependent variable. Furthermore, the F test is depicting whether our model is statistically significant or not. Moreover, the coefficients that are calculated and portrayed are expressing the changes of the dependent variable based on changes from each one of the independent variables separately. In addition to this, the p-values that are accompanying these coefficients are suggesting the existence of statistically significance.

9 Data

In order to create our econometric model, we are going to use as our dependent variable the stock prices log returns. In addition to this, for the set of independent variables we decide to include the following. First of all, we are going to integrate in the model the already mentioned indices; the Baltic Dry Index (BDI), the Baltic Dirty Tanker Index (BDTI), the Baltic Clean Tanker Index (BCTI) and the China Containerized Freight Index (CCFI) in order to encapsulate the effect of freight rates on our dependent variable. Furthermore, the next independent variables we are going to include in our model are the Standard and Poor's 500 (S&P500) and the Book to Market Ratio of the 27 listed shipping companies. The time period we take into consideration to collect data for the aforementioned variables, starts in January 2015 up until December 2019 on a monthly basis and are collected from the following databases: Clarkson's SIN, Thomson Reuters "Eikon" and Yahoo! Finance.

The core of our model is the listed in the US stock exchange (NYSE, NASDAQ) shipping companies. In order to identify them, we use sources such as "Capital Link" and "Tradewinds" where we derive relevant information. Such sources provide lists including the shipping companies from all sectors that are US listed. Initially the gathering of our data is from January 2000 up until December 2019 for 71 companies operating in the maritime industry. For our research we decide to work with companies owning either a fleet of bulkers, tankers, containers or a mixed one which includes the combination of the previous three types. Our next step in order to evaluate which of the aforementioned companies are satisfying the above criteria is to consider the official websites of each one of them and verify the domain that they are specializing in. To be more specific, in our dataset there are Offshore Service Vessel Companies as well as companies operating a fleet of cruise ships which we decide not to include. After taking all the above into consideration, our initial sample of 71 is reduced to 37. Since January 2000 there are many companies which have entered NYSE (New York Stock Exchange) or NASDAQ (Nasdaq Stock Market) at a different point in time. Therefore, our goal is to use those that provide data for at least the last 5 years in order to have a significant number of observations. All these criteria lead us to run our econometric model with data derived from 27 shipping companies.

Having said all the above, we are now going to present the shipping companies that we are taking into consideration for our analysis by categorizing them based on their fleet. In addition to this, to examine the fleet composition and its evolution over the given time period we based our analysis on the annual reports provided by the websites of the shipping companies of our data sample.

Table 1.
Fleet Composition of the Tanker Sector Shipping Companies (No of vessels)

Company Name	Vessel Type	Year				
		2015	2016	2017	2018	2019
Ardmore*	Handysize	**9**	**6**	**6**	**6**	**6**
	Panamax	**15**	**21**	**22**	**21**	**19**
DHT Holdings Inc.*	VLCC	**18**	**21**	**26**	**27**	**27**
KNOT Offshore Partners*	Panamax	**2**	**2**	**2**	**2**	**2**
	Aframax	**3**	**3**	**3**	**3**	**3**
	Suezmax	**5**	**7**	**11**	**11**	**11**
Navios Maritime Acquisition*	Handysize	**2**	**2**	**2**	**2**	**5**
	Panamax	**28**	**26**	**26**	**26**	**28**
	VLCC	**8**	**8**	**7**	**12**	**10**
Nordic American Tankers*	Suezmax	**26**	**33**	**33**	**23**	**23**
Scorpio Tankers Inc.*	Handysize	**14**	**14**	**14**	**14**	**21**
	Panamax	**46**	**42**	**55**	**57**	**74**
	Aframax	**17**	**11**	**35**	**38**	**42**
Teekay Tankers Ltd.*	Handysize	**0**	**2**	**0**	**0**	**0**
	Aframax	**21**	**21**	**26**	**26**	**26**
	Suezmax	**22**	**22**	**28**	**30**	**29**
	VLCC	**1**	**1**	**1**	**1**	**1**
Tsakos Energy Navigation Ltd*	Handysize	**6**	**6**	**6**	**6**	**6**
	Panamax	**15**	**17**	**17**	**17**	**17**
	Aframax	**11**	**15**	**20**	**20**	**22**
	Suezmax	**14**	**14**	**15**	**15**	**15**
	VLCC	**0**	**1**	**2**	**2**	**2**

Notes: * indicates companies that are listed to NYSE

Table 2.
Fleet Composition of the Dry-Bulk Sector Shipping Companies (No of vessels)

Company Name	Vessel Type	Year				
		2015	2016	2017	2018	2019
Diana Shipping Inc.*	Panamax	30	30	32	28	24
	Capesize	18	18	18	18	17
Eagle Bulk Shipping Inc.**	Handymax	1	1	0	0	0
	Supramax	43	39	37	34	30
	Panamax	0	1	10	13	20
Genco Shipping & Trading Inc.*	Handysize	18	15	15	15	15
	Handymax	6	2	1	1	1
	Supramax	21	21	21	21	21
	Panamax	12	10	10	10	10
	Capesize	13	13	13	13	13
Globus Maritime Ltd.**	Supramax	4	4	4	4	4
	Panamax	1	1	1	1	1
Golden Ocean Group**	Supramax	1	1	1	1	1
	Panamax	25	25	31	30	30
	Capesize	28	31	46	46	39
Safe Bulkers*	Panamax	32	35	36	37	37
	Capesize	3	3	3	4	4
Scorpio Bulkers*	Panamax	36	49	56	57	58
Seanergy Maritime**	Supramax	2	2	2	0	0
	Capesize	6	8	9	10	10
Star Bulk Carriers Corp**	Handymax	1	0	0	0	0
	Supramax	9	9	10	11	17
	Panamax	38	38	40	62	63
	Capesize	21	19	21	34	36
Navios Maritime Holdings*	Handysize	2	2	2	2	2
	Supramax	15	17	14	10	4
	Panamax	21	26	27	25	27
	Capesize	19	21	21	19	15

Notes: * indicates companies that are listed to NYSE
** indicates companies that are listed to NASDAQ

Table 3.
Fleet Composition of the Container Sector Shipping Companies (No of vessels)

Company Name	Vessel Type	Year				
		2015	2016	2017	2018	2019
Costamare*	Feeder	**16**	**16**	**17**	**17**	**11**
	Feedermax	**28**	**25**	**27**	**28**	**31**
	Neo-Panamax	**16**	**22**	**26**	**28**	**28**
Danaos Corp*	Feeder	**11**	**11**	**11**	**11**	**11**
	Feedermax	**31**	**31**	**31**	**31**	**31**
	Neo-Panamax	**17**	**17**	**17**	**17**	**21**
Matson*	Feeder	**22**	**24**	**21**	**21**	**17**
	Feedermax	**0**	**0**	**0**	**1**	**2**
Global Ship Lease*	Feeder	**8**	**8**	**8**	**13**	**13**
	Feedermax	**6**	**6**	**6**	**18**	**25**
	Neo-Panamax	**4**	**4**	**4**	**7**	**7**

Notes: * indicates companies that are listed to NYSE

Table 4.
Fleet Composition of Mixed Fleet Shipping Companies (No of vessels)

Company Name	Vessel Type	Year				
		2015	2016	2017	2018	2019
Ship Finance International Ltd*	Handysize	**2**	**2**	**2**	**2**	**2**
	Aframax	**2**	**2**	**2**	**2**	**2**
	Suezmax	**4**	**4**	**2**	**2**	**2**
	VLCC	**12**	**10**	**8**	**3**	**5**
	Handysize	**7**	**7**	**7**	**7**	**7**
	Supramax	**5**	**5**	**5**	**5**	**5**
	Panamax	**2**	**2**	**2**	**2**	**2**
	Capesize	**8**	**8**	**8**	**8**	**8**
	Feeder	**4**	**4**	**4**	**10**	**11**
	Feedermax	**9**	**9**	**9**	**16**	**19**
	Neo-Panamax	**7**	**7**	**7**	**14**	**14**
	Post-Panamax	**0**	**2**	**2**	**4**	**4**
Capital Product Partners LP**	Handysize	**6**	**6**	**6**	**0**	**0**
	Panamax	**14**	**15**	**15**	**0**	**0**
	Suezmax	**4**	**4**	**4**	**0**	**0**
	Capesize	**1**	**1**	**1**	**1**	**1**
	Feedermax	**6**	**5**	**5**	**5**	**5**
	Neo-Panamax	**4**	**5**	**5**	**5**	**8**
Euroseas**	Handymax	**1**	**1**	**0**	**0**	**0**
	Panamax	**4**	**3**	**5**	**0**	**0**
	Feeder	**10**	**8**	**10**	**10**	**13**
	Feedermax	**0**	**0**	**1**	**1**	**6**
Performance Shipping Inc.[1]**	Aframax	**0**	**0**	**0**	**0**	**4**
	Feedermax	**13**	**12**	**10**	**4**	**1**
Teekay Corp[2]*	Total Fleet	**186**	**180**	**193**	**149**	**154**

Notes: * indicates companies that are listed to NYSE
** indicates companies that are listed to NASDAQ
1: Diana Containership Inc. was renamed to Performance Shipping Inc. in 2018
2: Teekay Tankers Ltd. and Teekay LNG Partners LP are incorporated in Teekay Corp

For all the aforementioned companies we collect the relevant monthly stock prices. We use them as well as the dividends paid by the companies during the examined period in order to create the variable of stock price returns.

Another variable we decide to include in our model is the Book to Market ratio of the 27 listed companies. The components of this ratio are the Book and Market values. The reason behind the decision to include this variable in our model is because through the market value component, it provides an indication on the size of our sample units. A company's Market Value offers a meaningful insight for investors' perceptions about its business prospects. The other component in this ratio is the book value. Book Value is considered important because it represents a clear picture of a company's worth. It is determined by taking into consideration real company data and not hypothetical ones. This means that investors and market analysts get a precise idea of the company's actual worth.

Furthermore, another variable that we include is the S&P 500 Index. It is a stock market index that tracks the stocks of 500 large-cap U.S. companies in NYSE and NASDAQ. The Standard & Poor's 500 Index is used by investors as a strong indication of the overall market. The central advantage of using the S&P 500 as a benchmark is the wide market breadth of the large-cap companies included in the index. For a company to be included in the S&P 500 Index it must satisfy a list of specific criteria concerning the headquarters geographical position, market cap, percentage of outstanding shares available for public trading etc. It represents the stock market's performance by reporting the risks and returns of the biggest companies. The central advantage of using the S&P 500 as a benchmark is the wide market breadth of the large-cap companies included in the index. For a company to be enlisted in the S&P 500 Index it has to satisfy a list of specific criteria concerning the headquarters geographical position, market cap, percentage of outstanding shares available for public trading etc.

Regarding the final variables which can better represent the influence of freight rates on our dependent variable we need to decide between using the 1-year time charter rates for each vessel segmentation or the respective Baltic indices. The advantage of using the 1-year time charter rates, instead of spot rates, is that they are less volatile and consequently we can derive better indications about the time period that we are going to examine. In addition to this, inside a time charter contract the sentiment of the direction of the market regarding its underlying period is considered and expressed with either a drop or an increase in the freight rates. Moreover, seasonal factors that appear throughout a considerable time period are usually considered in a time charter contract. However, in order to avoid multicollinearity issues which existed between the 1-year time charter rates of many different vessel segments we had to reject them and focus on the data derived from Baltic Indices. As pointed out by Erdogan et al. (2013), there were noteworthy data overflows between the shipping freight and stock markets, pinpointing that the stock market indices display more efficient price discovery function in chartering contracts while on the other hand time charter rates could better price financial assets. To be more specific, we conclude to the following indices: Baltic Dry Index (BDI), Baltic Clean Tanker Index (BCTI), Baltic Dirty Tanker Index (BDTI) and China Containerized Freight Index (CCFI). Baltic indices are one of the most widely considered as global benchmarks and as leading indicators to world economy and the world trade of different types of commodities. Furthermore, they are considered as leading indicators of global economic health. They provide significant importance to the broader market in general, as demand for them can help predict future economic activity. Besides, it is evidently proved that most of the world trade is covered by the shipping industry. So, if the Baltic indices present an increasing trend, it suggests a satisfying demand for shipping, an indicator that global trade and the economy will experience a proportional direction.

10 Results

10.1 Descriptive Statistics

The descriptive statistics of the stock prices log returns for the 27 companies (categorized by their operating sector) are presented in the Tables 5-8.

Table 5.

Descriptive Statistics of Tanker Sector Shipping Companies

	N	Mean	Std. Deviation	Skewness	Kurtosis
Ardmore	**60**	**-0,002024**	**0,0502993**	**-0,581**	**0,412**
DHT Holdings Inc	**60**	**0,000902**	**0,0405466**	**-0,459**	**1,934**
KNOT Offshore Partners	**60**	**-0,000838**	**0,0345838**	**-0,623**	**0,746**
Navios Maritime Acquisition	**60**	**-0,013291**	**0,0758964**	**-0,902**	**5,297**
Nordic American Tankers	**60**	**-0,005091**	**0,0680315**	**0,004**	**2,427**
Scorpio Tankers Inc	**60**	**-0,005736**	**0,0551321**	**-0,263**	**0,295**
Teekay Tankers Ltd	**60**	**-0,003793**	**0,0580276**	**0,288**	**1,697**
Tsakos Energy Navigation Ltd	**60**	**-0,003324**	**0,0444492**	**-0,867**	**2,141**

By taking a closer look at Table 5 we can observe the Descriptive Statistics of the Tanker Sector Companies. To begin with, all companies have 60 observations as we can notice from the first column (monthly data for 5 years). In the second column the results of the mean values are presented for all the 8 shipping companies operating in this specific sector where it is easily noticed that they all have negative values except for DHT Holding Inc. Moreover, in the third column the results of the standard deviation are displayed where they do not seem to deviate significantly between each other. Furthermore, regarding the Skewness we observe that 4 shipping companies are presenting symmetrical results (skewness value range between [-0.5,0.5]) and 4 of them have moderately skewed results (skewness value range between [-1,-0.5] and [0.5,1]). Finally, regarding the kurtosis we observe that none of them is normally distributed (kurtosis=3), while 1 of them are presenting leptokurtic (kurtosis value greater than 3) which means that their distribution is longer and heavy tailed, and the rest are presenting platykurtic (kurtosis value lower than 3) which means that their distribution is shorter and light tailed.

Table 6.

Descriptive Statistics of Dry-Bulk Sector Shipping Companies

	N	Mean	Std. Deviation	Skewness	Kurtosis
Diana Shipping Inc	**60**	**-0,005566**	**0,0569788**	**-0,883**	**4,539**
Eagle Bulk Shipping Inc	**60**	**-0,030078**	**0,1159102**	**-0,603**	**3,804**
Genco Shipping & Trading Ltd	**60**	**-0,018403**	**0,0914073**	**-0,157**	**0,279**
Globus Maritime Ltd	**60**	**-0,033126**	**0,2056457**	**1,295**	**4,206**
Golden Ocean Group	**60**	**-0,009848**	**0,0691555**	**-0,409**	**-0,124**
Safe Bulkers	**60**	**-0,006029**	**0,0943822**	**-0,934**	**3,251**
Scorpio Bulkers	**60**	**-0,008961**	**0,0975861**	**-1,713**	**8,650**
Seanergy Maritime	**60**	**-0,034284**	**0,1213278**	**-1,836**	**7,962**
Star Bulk Carriers Corp	**60**	**-0,007382**	**0,0928634**	**-0,041**	**0,254**
Navios Maritime Holdings Inc	**60**	**-0,016148**	**0,1087412**	**0,188**	**1,055**

By taking a closer look at Table 6 we can observe the Descriptive Statistics of the Dry-Bulk Sector Companies. To begin with, all companies have 60 observations as we can notice from the first column (monthly data for 5 years). In the second column the results of the mean values are presented for all the 10 shipping companies operating in this specific sector where it is easily noticed that they all have negative values. Moreover, in the third column the results of the standard deviation are displayed, where they all appear to be close between each other except for Globus Maritime Ltd., where the standard deviation value is a lot higher. Furthermore, regarding the Skewness we observe that 4 shipping companies are presenting symmetrical results (skewness value range between [-0.5,0.5]), 3 of them have moderately skewed results (skewness value range between [-1,-0.5] and [0.5,1]) , while the outcome of the rest is highly skewed (skewness value lower than -1 and greater than 1). Finally, regarding the kurtosis we observe that none of them is normally distributed (kurtosis=3), while 6 of them are presenting leptokurtic (kurtosis value greater than 3) which means that their distribution is longer and heavy tailed, and the rest are presenting platykurtic (kurtosis value lower than 3) which means that their distribution is shorter and light tailed.

Table 7.
Descriptive Statistics of Container Sector Shipping Companies

	N	Mean	Std. Deviation	Skewness	Kurtosis
Costamare Inc	**60**	**-0,004444**	**0,0572979**	**-0,184**	**-0,200**
Danaos Corp	**60**	**-0,015355**	**0,0787479**	**0,220**	**0,054**
Matson	**60**	**0,001210**	**0,0387005**	**-0,315**	**-0,126**
Global Ship Lease	**60**	**-0,010172**	**0,0850782**	**0,430**	**3,007**

By taking a closer look at Table 7 we can observe the Descriptive Statistics of the Container Sector Companies. To begin with, all companies have 60 observations as we notice from the first column (monthly data for 5 years). In the second column the results of the mean values are presented to be negative for all the shipping companies operating in this specific sector except Matson. Moreover, in the third column the results of the standard deviation are displayed, where all of them are varying between the same range. Furthermore, regarding the Skewness we observe that all 4 shipping companies are presenting symmetrical results (skewness value range between [-0.5,0.5]). Finally, regarding the kurtosis we observe that Global Ship Lease results are significantly close to be regarded as normally distributed (kurtosis=3), while the rest 3 are presenting platykurtic (kurtosis value lower than 3) which means that their distribution is shorter, and light tailed.

Table 8.
Descriptive Statistics of Mixed Fleet Shipping Companies

	N	Mean	Std. Deviation	Skewness	Kurtosis
Ship Finance International Ltd	**60**	**0,000177**	**0,0298555**	**-0,979**	**2,802**
Capital Product Partners LP	**60**	**-0,007491**	**0,0415771**	**0,109**	**0,251**
Euroseas	**60**	**-0,013445**	**0,0990776**	**0,171**	**1,375**
Performance Shipping Inc	**60**	**-0,084064**	**0,2587012**	**-3,030**	**15,499**
Teekay Corp	**60**	**-0,016345**	**0,0908167**	**-1,776**	**7,981**

By taking a closer look at Table 8 we can observe the Descriptive Statistics of the Mixed Fleet Companies. To begin with, they have 60 observations as we can observe from the first column (monthly data for 5 years). In the second column the results of the mean values are presented where all of them are negative except for Ship Finance International Ltd. Moreover, in the third column the results of the standard deviation are displayed, where they are varying between the same range except for Performance Shipping Ltd which has a much higher value than the rest of them. Furthermore, regarding the

Skewness we observe that 2 of them are presenting symmetrical results (skewness value range between [-0.5,0.5]), Ship Finance International Ltd results are moderately skewed results (skewness value range between [-1, -0.5] and [0.5,1]), while the outcome of Performance Shipping Inc is highly skewed (skewness value lower than -1 and greater than 1). Finally, regarding the kurtosis we observe that none of them is normally distributed (kurtosis=3), but they are presenting platykurtic (kurtosis value lower than 3) which means that their distribution is shorter and light tailed, except Performance Shipping Ltd which results are presenting leptokurtic (kurtosis value greater than 3) which means that their distribution is longer and heavy tailed.

In continuation to the above, in Table 9 are presented the descriptive statistics of all the independent variables.

Table 9.
Descriptive Statistics of Independent Variables and Unit Root Tests

	N	Mean	Std. Deviation	Skewness	Kurtosis	Unit Root Test*	
						Statistic	p-value
BV To MV Ratio	**1620**	**0,001842**	**0,1204260**	**-1,711**	**26,566**	**-19.4973**	**0.0000**
S&P 500	**60**	**0,004003**	**0,0150253**	**-0,643**	**1,093**	**-23.1268**	**0.0000**
BDI	**60**	**0,003021**	**0,0876992**	**-0,012**	**0,042**	**-18.6327**	**0.0000**
BDTI	**60**	**0,003715**	**0,0601905**	**0,944**	**3,356**	**-16.1270**	**0.0000**
BCTI	**60**	**0,000797**	**0,0590355**	**0,791**	**1,429**	**-21.4543**	**0.0000**
CCFI	**60**	**-0,001466**	**0,0184978**	**-0,588**	**-0,382**	**-21.5170**	**0.0000**

Notes: * Levin-Lin-Chu unit-root test

By taking a closer look at Table 9 we can observe the Descriptive Statistics of the independent variables of our multi-factor model. To begin with, we have to underline that the number of observations is 60 (monthly data for 5 years) for all of them except for Book to Market Value Ratio where we notice an amount of 1620 observations. The reason that this occurs is that it includes the monthly data for 5 years for all the 27 companies of our sample. In the second column the results of the mean values are presented where they are all positive except for the CCFI. Moreover, in the third column the results of the standard deviation are displayed, where the value of Book to Market Value Ratio is they highest one which can be justified by the large amount of observations compared to the rest variables. In the meantime, the rest of them are not deviating between them. Furthermore, regarding the Skewness we observe that only BDI is presenting symmetrical results (skewness value range between [-0.5,0.5]), 4 of them have moderately skewed results (skewness value range between [-1,-0.5] and [0.5,1]) , while the outcome of the Book to Market Ratio is highly skewed (skewness value lower than -1 and greater than 1). Finally, regarding the kurtosis we observe that none of them is normally distributed (kurtosis=3), while 2 of them are presenting leptokurtic (kurtosis value greater than 3) which means that their distribution is longer and heavy tailed, and the rest 4 are presenting platykurtic (kurtosis value lower than 3) which means that their distribution is shorter and light tailed.

It has been previously stated that we calculate the log returns of our variables in order to ensure the existence of stationarity so that we get reliable and accurate results from the regression that we perform in the next chapters. To verify such claims and after taking into consideration the fact that we are working with panel data, which is strongly balanced, we perform the Levin-Lin-Chu unit root test. This test examines the hypothesis test where the null hypothesis (Ho) claims that the panel data contains unit roots while the alternative hypothesis (Ha) states that the panel data is stationary. The results of the test for each variable separately can be observed in Table 9. In all cases the p-value is 0.000, thus we reject the null hypothesis (Ho) and the claim that the panel data contains unit roots over the alternative hypothesis (Ha) and the claim that panel data is stationary. So, starting our claim of existence of stationarity is verified.

10.2 Correlations

Having ensured that our panel data does not include unit roots, the next step is to ensure that there are not pairwise highly correlated variables or in other words, to ensure that there is no multicollinearity. In order to do that we calculate the correlation coefficients of our independent variables and the results can be observed in Table 10. We observe that none of the pairwise correlations satisfy the multicollinearity criteria since none of the coefficients calculated exceeds the value of 0.7.

Table 10.
Correlation Coefficients

	BVToMV Ratio Log Returns	SP500 Log Returns	BDI Log Returns	BDTI Log Returns	BCTI Log Returns	CCFI Log Returns
BVToMVRatio LogReturns	**1.0000**					
SP500 Log Returns	**-0.2149** (0,000)	**1.0000**				
BDI Log Returns	**-0.1180** (0,000)	**-0.1117** (0,000)	**1.0000**			
BDTI Log Returns	**0.0495** (0,0462)	**-0.1227** (0,000)	**0.0572** (0,0213)	**1.0000**		
BCTI Log Returns	**-0.0175** (0,4814)	**-0.2079** (0,000)	**0.1074** (0,000)	**0.5700** (0,000)	**1.0000**	
CCFI Log Returns	**0.0357** (0,1508)	**-0.0120** (0,6284)	**-0.3768** (0,000)	**-0.1711** (0,000)	**-0.0326** (0,1896)	**1.0000**

Note: p-values in parenthesis

10.3 Regression Analysis

In the previous chapters we have ensured the stationarity of our variables and presented evidence which eliminates the existence of multicollinearity. Thus, we can now proceed to the performance of the regressions analysis.

First of all, with the assistance of Stata we declare that our dataset is formulated as panel data. So, we follow the necessary steps in order to come up to precise and accurate results. To be more specific, we perform two different regression models: the regression model with random effects (GLS Regression) and the regression model with fixed effects. Then, in order to decide which is the most appropriate to interpret, we conduct the Breusch & Pagan test and the Hausman test.

10.3.1 Fixed Effects Regression

We are beginning our regression analysis with the Fixed Effects regression model. In such models the systematic effects are considered fixed or nonrandom.

First, in order to test for the existence of heteroskedasticity we perform a Breusch-Pagan / Cook-Weisberg test. This test performs a hypothesis test where the null Hypothesis (Ho) is the existence of homoscedasticity while the alternative hypothesis (H1) is the existence of heteroskedasticity. The outcome of this particular test is presented in Table 11 below:

Table 11.
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance // Variables: fitted values of StockPricesLogReturns	
	chi2(1) = 86.94 Prob>chi2 = **0.0000**

We observe a p-value of 0.000 and thus we reject the null hypothesis over the alternative one. So, there is heteroskedasticity and the fixed effects regression model is estimated with heteroskedasticity consistent standard errors (Eicker–Huber–White standard errors).

Moreover, another test that has to be performed before the regression analysis is this of the autocorrelation. To examine the existence of autocorrelation we use the Breusch-Godfrey LM test which performs the hypothesis test where the null hypothesis (Ho) is the lack of autocorrelation while the alternative hypothesis (H1) is the existence of autocorrelation. The outcome of this test is presented in Table 12 below:

Table 12.
Breusch-Godfrey LM test for autocorrelation

Ho: no serial correlation	
	Lags(p) = 1 chi2(1) = 27.233 df = 1 Prob>chi2 = **0.0000**

By taking into consideration the above we conclude that we reject the null hypothesis over the alternative hypothesis and so that there is autocorrelation. Because of that, the standard errors are clustered at the company level.

Finally, we examine the hypothesis of whether our residuals are normally distributed or not. To do that, we will use the Shapiro-Wilk which performs such a hypothesis test where the null hypothesis (Ho) supports that the residuals are normally distributed while the alternative hypothesis (Ha) supports that this is not the case. The results of this test are presented in Table 13 below:

Table 13.
Shapiro-Wilk W test for normal data

Variable: r (residuals)	
	W = 0.64948 Prob>z = **0.0000**

Since we observe that p-value is below 0.05 we conclude that the residuals are not normally distributed. However, due to the fact that our data sample is relatively extensive the reliability of the models is not compromised.

The outcome of the fixed-regression model analysis is presented in Table 19 and we proceed to the presentation of the results.

We observe an R-Square of 38.68% which means that the model can estimate this proportion of the changes that occur on the dependent variable, which in our case is the Stock Prices Log Returns, by changing the independent variables by one unit.

We can also claim the significance of our model as the p-value for the overall model is equal to 0.000 which is less than the 0.05 significance level.

Having concluded that our model is statistically significant, we proceed to take a closer look on the impact of our independent variables over the dependent one separately.

Book to Market Value Ratio Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.000 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the Book Value to Market Value Ratio Log Returns by one unit, the Stock Prices Log Returns are going to change by -0.4666296. So, we can conclude that there is a negative impact on the Stock Prices Log Returns.

S&P 500 Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.000 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the S&P 500 Log Returns by one unit, the Stock Prices Log Returns are going to change by 0.7842214. So, we can conclude that there is a positive impact on the Stock Prices Log Returns.

Baltic Dry Index (BDI) Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.028 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the Baltic Dry Index (BDI) Log Returns by one unit, the Stock Prices Log Returns are going to change by 0.0762335. So, we can conclude that there is a positive impact on the Stock Prices Log Returns.

Baltic Dirty Tanker Index (BDTI) Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.042 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the Baltic Dirty Tanker Index (BDTI) Log Returns by one unit, the Stock Prices Log Returns are going to change by 0.0879457. So, we can conclude that there is a positive impact on the Stock Prices Log Returns.

Baltic Clean Tanker Index (BCTI) Log Returns do not have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.902 which is more than the significance level of 0.05. By keeping all the other variables stable and changing the Baltic Clean Tanker Index (BCTI) Log Returns by one unit, the Stock Prices Log Returns are going to change by -0.0038008. So, we can conclude that there is a negative impact on the Stock Prices Log Returns.

China Containerized Freight Index (CCFI) Log Returns do not have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.195 which is more than the significance level of 0.05. By keeping all the other variables stable and changing the China Containerized Freight Index (CCFI) Log Returns by one unit, the Stock Prices Log Returns are going to change by -0.1143688. So, we can conclude that there is a negative impact on the Stock Prices Log Returns.

10.3.2 Random Effects GLS Regression

We continue our regression analysis with the Random regression model. In such models some of the parameters (effects) that define systematic components exhibit some form of random variation.

First, in order to test for the existence of heteroskedasticity we perform a Breusch-Pagan / Cook-Weisberg test. This test performs a hypothesis test where the null Hypothesis (Ho) is the existence of homoscedasticity while the alternative hypothesis (H1) is the existence of heteroskedasticity. The outcome of this particular test is presented in Table 14 below:

Table 14.
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance // Variables: fitted values of StockPricesLogReturns	
	chi2(1) = 86.94 Prob>chi2 = **0.0000**

We observe a p-value of 0.000 and thus we reject the null hypothesis over the alternative one. So, there is heteroskedasticity and the fixed effects regression model is estimated with heteroskedasticity consistent standard errors (Eicker–Huber–White standard errors).

Moreover, another test that has to be performed before the regression analysis is this of the autocorrelation. To examine the existence of autocorrelation we use the Breusch-Godfrey LM test which performs the hypothesis test where the null hypothesis (Ho) is the lack of autocorrelation while the alternative hypothesis (H1) is the existence of autocorrelation. The outcome of this test is presented in Table 15 below:

Table 15.
Breusch-Godfrey LM test for autocorrelation

Ho: no serial correlation	
	Lags(p) = 1 chi2(1) = 27.233 df = 1 Prob>chi2 = **0.0000**

By taking into consideration the above we conclude that we reject the null hypothesis over the alternative hypothesis and so that there is autocorrelation. Because of that, the standard errors are clustered at the company level.

Finally, we examine the hypothesis of whether our residuals are normally distributed or not. To do that, we will use the Shapiro-Wilk which performs such a hypothesis test where the null hypothesis (Ho) supports that the residuals are normally distributed while the alternative hypothesis (Ha) supports that this is not the case. The results of this test are presented in Table 16 below:

Table 16.
Shapiro-Wilk W test for normal data

Variable: r (residuals)	
	W = 0.64948 Prob>z = **0.0000**

Since we observe that p-value is below 0.05 we conclude that the residuals are not normally distributed. However, due to the fact that our data sample is relatively extensive the reliability of the models is not compromised.

The outcome of the random-effects regression model analysis is presented in Table 19 and we proceed to the presentation of the results.

We observe an R-Square of 38.68% which means that the model can estimate this proportion of the changes that occur on the dependent variable, which in our case is the Stock Prices Log Returns, by changing the independent variables by one unit.

We can also claim the significance of our model as the p-value for the overall model is equal to 0.000 which is less than the 0.05 significance level.

Having concluded that our model is statistically significant, we proceed to take a closer look on the impact of our independent variables over the dependent one separately.

Book Value to Market Value Ratio Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.000 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the Book Value to Market Value Ratio Log Returns by one unit, the Stock Prices Log Returns are going to change by -0.4668568. So, we can conclude that there is a negative impact on the Stock Prices Log Returns.

S&P 500 Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.000 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the S&P 500 Log Returns by one unit, the Stock Prices Log Returns are going to change by 0.7837782. So, we can conclude that there is a positive impact on the Stock Prices Log Returns.

Baltic Dry Index (BDI) Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.001 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the Baltic Dry Index (BDI) Log Returns by one unit, the Stock Prices Log Returns are going to change by 0.0761886. So, we can conclude that there is a positive impact on the Stock Prices Log Returns.

Baltic Dirty Tanker Index (BDTI) Log Returns have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.025 which is less than the significance level of 0.05. By keeping all the other variables stable and changing the Baltic Dirty Tanker Index (BDTI) Log Returns by one unit, the Stock Prices Log Returns are going to change by 0.087984. So, we can conclude that there is a positive impact on the Stock Prices Log Returns.

Baltic Clean Tanker Index (BCTI) Log Returns do not have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.924 which is more than the significance level of 0.05. By keeping all the other variables stable and changing the Baltic Clean Tanker Index (BCTI) Log Returns by one unit, the Stock Prices Log Returns are going to change by -0.0038476. So, we can conclude that there is a negative impact on the Stock Prices Log Returns.

China Containerized Freight Index (CCFI) Log Returns do not have a statistically significant impact on the Stock Prices Log Returns as we can observe a p-value of 0.313 which is more than the significance level of 0.05. By keeping all the other variables stable and changing the China Containerized Freight Index (CCFI) Log Returns by one unit, the Stock Prices Log Returns are going to change by -0.0160715. So, we can conclude that there is a negative impact on the Stock Prices Log Returns.

10.3.3 Breusch & Pagan Test

Having discussed the results from each regression models the next step is to choose which one is more appropriate in order to derive the most accurate conclusions for our analysis. In order to do that, we are going to perform a Breusch & Pagan test. This test examines the following hypothesis test:

H_o: There are no random effects in the regression model

H_1: There are random effects in the regression model

By performing the Breusch & Pagan test we notice a p-value of 0.000 which is less than the significance level of 0.05. Thus, reject the null hypothesis (H_o) and so we can assume that there are random effects in the regression model.

Table 17.
Breusch and Pagan Lagrangian multiplier test for random effects

	chibar2(01) = **40.51** Prob > chibar2 = **0.0000**

10.3.4 Hausman Test

In order to have even stronger indications on the regression model we are going to focus on we are going to conduct the Hausman test. What is practically suggested by the null and the alternative hypothesis in Table 18 is the following:

H_o: The Random Effect regression model is the appropriate model

H_1: The Fixed Effect regression model is the appropriate model

By taking a closer look to the results of the Hausman test we observe a p-value (Prob>chi2) of 1.000 which is more than the significance level of 0.05. Thus, we fail to reject the null hypothesis (H_o). So, we conclude that the Random Effects regression model is the most appropriate.

Table 18.
Hausman Test

Test: Ho: difference in coefficients not systematic	
	chi2(6) = 0.13 Prob>chi2 = **1.0000**

10.3.5 Final Regression Model

The next step is to focus on the variables that are proven to have a statistically significant impact on the stock prices based on the regression model performed above.
Thus, we will omit the two variables that do not seem to have a statistical significance (BCTI and CCFI) and perform another regression analysis including only the four variables that are affecting stock prices in a statistically significant way (Book To Market Ratio, S&P 500, BDI, BDTI).
This modification of the independents variables leads equation (2) to be transformed into the following multi-factor model:

$$SR_{ij} = c + \beta_1 BMR_{ij} + \beta_2 SP_{ij} + \beta_3 BDI_{ij} + \beta_4 BDTI_{ij} + U_{ij}, \quad (4)$$

$$(i=1, ..., 27, j=1,2, ...,60)$$

By taking into consideration the procedure followed above, we will again use the results derived from the random effects regression model, which are presented in Table 19.

By taking a closer look in Table 19 we observe that the signs of the coefficients are not changing, and their values have increased. However, a small change has been observed to the R-Square from 0.3868 to 0.3864 which can be justified by the decrease of independent variables from six to four. Finally, we should underline that all variables are presented to have an impact on stock returns of greater statistically significance and more specifically the BDI and BDTI which p-value has reduced to 0.000 and 0.004 respectively.

Table 19.
Regression Models

Dependent Variable: Stock Prices Log Returns			
Variables	Fixed-Effects Regression Model	Random-Effects Regression Model	Final Regression Model
Constant	**-0.0160737 (0.0007277) p-value = 0.000**	**-0.0160715 (0.0033024) p-value = 0.000**	**-0.0160006 (0.0032753) p-value = 0.000**
Book to Market Ratio Log Returns	**-0.4666296 (0.0762151) p-value = 0.000**	**-0.4668568 (0.0761554) p-value = 0.000**	**-0.4664135 (0.0760558) p-value = 0.000**
S&P 500 Log Returns	**0.7842214 (0.1341095) p-value = 0.000**	**0.7837782 (0.1341212) p-value = 0.000**	**0.7969581 (0.128728) p-value = 0.000**
BDI Log Returns	**0.0762335 (0.0327681) p-value = 0.028**	**0.0761886 (0.032792) p-value = 0.020**	**0.0851881 (0.0317625) p-value = 0.007**
BDTI Log Returns	**0.0879457 (0.0410866) p-value = 0.042**	**0.087984 (0.0410841) p-value = 0.032**	**0.0914583 (0.0355976) p-value = 0.010**
BCTI Log Returns	**-0.0038008 (0.0305843) p-value = 0.902**	**-0.0038476 (0.0305661) p-value = 0.900**	**-**
CCFI Log Returns	**-0.1143688 (0.0859996) p-value = 0.195**	**-0.1143836 (0.0860119) p-value = 0.184**	**-**
R-Square	**0.3868**	**0.3868**	**0.3864**
F-Statistic	**66.13 p-value = 0.000**	**396.79 p-value = 0.0000**	**383.52 p-value = 0.0000**
No of Companies	**27**	**27**	**27**
No of Observations	**1620**	**1620**	**1620**

Note: Robust Standard Errors in parentheses (heteroskedasticity consistent standard errors)

Robust Standard Errors adjusted for 27 clusters in Company ID (autocorrelated)

Robust Standard Errors are not normally distributed

10.4 Discussion of Results

At this point, we summarize and discuss the findings of the previous process. To that end, we take under consideration the Breusch Pagan and Hausman tests and thus we focus only on the results derived from the Random Effects model. We are going to discuss below the results portrayed in the respective table.

To be more specific, regarding the coefficient of the BDI variable, we can observe that our expectations of their impact on the stock returns before conducting the regression analysis with that of the final results are identical. Such impact is positive and also statistically significant. Thus, this outcome is in line with the theory and similarly to the case of Amir H. Alizadeh a, Gulnur Muradoglu (2014) where they find results indicating that freight rates have a positive relation with stock returns across many sectors and are a significant explanatory variable for stock returns. Furthermore, we observe a positive coefficient of the BDTI variable which again is satisfying our expectations. We have to mention that this variable is also statistically significant. Based on the referenced study of Kevin X. Li, Yi Xiao, Shu-Ling Chen, Wei Zhang, Yuquan Du & Wenming Shi (2018) we formed our expectations regarding the pairwise outcomes of the indices. More specifically, they found out that BDI and BCTI are significant for the forecasting of BDTI and CCFI respectively. In our case, we observe that BDI and BDTI are presenting a positive impact on the stock returns while the BCTI and CCFI have a negative one. Regarding the last two variables, this negative impact they both pose on stock returns is portrayed by the negative signs of both of their coefficients. In addition to that, it has to be stated the fact that both of these indices are not explaining stock returns volatility in a statistically significant way. This outcome is not in line with our expectations based on the examined literature. The reason behind this insignificance in terms of explaining our dependent variable and the negative relation between them, it is highly likely to stem from the following argument. To be more specific, the BCTI is the most representative measure for the overall conditions in the clean tanker market. As we can observe from the sample of the shipping companies we selected, clean tankers represent a relatively small proportion of their combined fleet. Similarly to the BCTI, the CCFI is the most appropriate index when it comes to measure the overall prevailing conditions in the container sector. By again consulting the sample with the shipping companies, we observe that yet again, container vessels are also a relatively small proportion of the combined fleet composition (4 out of 27 are directly operating in the container sector and 4 out of 27 operate a mixed fleet).

In addition to this, we now focus on the S&P 500 variable. We observe a statistically significant positive impact on shipping stock returns, which is evidently proved from the positive sign of its coefficient. Compared to all of the rest variables, this coefficient is by appearing to have the greatest impact by far. This particular outcome is again in line with the theory and our expectations as S&P 500 is a very indicative measure of the performance of the US listed companies as it reports their risks and returns, and it provides a clear picture of the overall market. It has already been stated in previous studies by Sharpe (1983) and Amir H. Alizadeh a, Gulnur Muradoglu (2014) that this specific variable is of an important explanatory power on the changes of stock returns.

Finally, as far as the Book to Market ratio is concerned, we observe a negative sign of the coefficient which underlines an impact of such direction to the stock returns. Such impact is statistically significant. We expected this outcome since we have already described the negative relation between the book to market ratio and stock returns. We have made this claim since the market value is created from the outstanding shares times the share price and due to the fact that it is the denominator of this ratio.

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11 Conclusion

The main goal of our thesis, after presenting some of the major aspects inside the shipping industry, is to analyze, investigate and clarify the degree of which the freight rates affect the stock prices of the shipping companies listed in the US Stock Exchange. After conducting meticulous and extensive research, we settle on including certain variables which capture some key aspects of our final pooled sample of listed shipping companies matching our predefined criteria. To be more specific such variables are the Book to Market Value Ratio and some of the most recognized indices which are the Standard & Poor's 500 Index (S&P500), Baltic Dry Index (BDI), Baltic Dirty Tanker Index (BDTI), Baltic Clean Tanker Index (BCTI), the China Containerized Freight Index (CCFI). From our analysis we conclude that only the first four variables are affecting in a statistically significant way the shipping stock returns of the 27 US listed companies' sample. Such impact is positive except for the Book to Market value ratio. Furthermore, our regression model has a R-Square of 0,3864 which means that 38.64% of the changes of the dependent variables are explained by our independent variables. So, our variables included in our regression model do not explain all the changes of the Stock Returns of the shipping companies as there are other factors that play an important role in the determination of their final figures (ex. macroeconomic factors like GDP, Seaborne Trade etc.).

With our dissertation we provide additional information to the existing literature on shipping stocks returns relation with freight rates. Thus, it is of high interest to people willing to invest in the shipping sector as well as for listed shipping companies aiming to raise capital through equity markets. Furthermore, this particular research shall be interesting to shipping analysts in order to obtain a better view of the impact of freight rates on the stock prices of shipping companies. Moreover, information extracted from this analysis on how shipping stock returns behave on several market conditions will be of high value for people that are going to undertake important financial decisions.

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Capital Link

Clarkson's Shipping Intelligence Network (SIN)

Macrotrends

The Baltic Exchange

Thomson Reuters "Eikon"

Tradewinds

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