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WHAT DRIVES THE STOCK RETURNS OF MARITIME COMPANIES

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Introduction

Shipping is a global industry and its prospects are closely tied to the level of economic activity in the world. The maritime shipping industry is fundamental to international trade because it is the only practicable and cost-effective means of transporting large volumes of basic commodities and finished products over long distances. During the last 30 years the shipping industry has been through the biggest revolution, since the first steel ships were built 130 years ago, supporting international trade and globalization.

The recent world economic growth driven primarily by China has led to a substantial growth in global trade. This growth led to the enormous increase of freight rates, which in term gave boost for new investments in the global shipping market.
Investments, which reflect the increased number of Maritime Companies that choose "to go public" and trade in the world's biggest Stock Exchanges.

But what are the criteria that need to be considered by an investor who wants to include shipping companies' stocks in his portfolio? In other words, what factors determine the stock returns of maritime companies?
The answer to this question will be the objective of this study. We will try to investigate the behaviour of the stock returns of listed shipping companies (emphasizing on the Greek participation) and determine the factors that affect their movement by tracing statistical important variables (micro- & macroeconomic) that enable us and investors to interpret the shipping stock returns framework.
An econometric model will be used for this purpose, in order to examine if specific variables may be used not only in the interpretation of stock returns movement but also in the prediction of future prices contradicting the weak form efficiency hypothesis of the markets.
The variables selected for testing reflect micro & macroeconomic factors that are closely related to the shipping industry, through the transactions of trading (Freight Rates Indices , exchange rates , oil & commodity prices). A detailed analysis of these variables and their economic relationship with the shipping stock returns is provided in specific chapter later in this paper.

The behavioural analysis of the stocks returns of the companies engaged in shipping industry is considered to be a great challenge, taking into account the highly international nature of the industry & the complex, volatile & perfectly competitive environment in which it operates. Volatility is the main characteristic not only in respect of the industry but also from the point of the stock returns, since as we will see in detail through the relevant study, shipping companies profits are positive correlated to the "upwards and downfalls" of freight rates.

In our sample test, we selected all Greek shipping companies listed in the US Stock Exchange Markets (21) and a number of the largest foreign ones (8). The reason for targeting on Greek companies, was to highlight the significant market share that Greece owns worldwide in relevant industry, since the Greek owned fleet remains the first in the world. The sample period ran from 1 January 2002 to 31 December 2008.

In order to achieve our goal and give feedback to all potential investors and operators in shipping market to reduce investment risk and increase profitability respectively, we should first get an overall understanding of the industry and its elements, since shipping is a complex industry and the conditions which govern its operations in one sector do not necessarily apply to another.

For this purpose an overview of shipping industry disaggregated to the three main subsectors (Dry Bulk Shipping Market, Tanker Market & Containerships Market) is provided in the second chapter of this study, where in the first one we give a brief historical review of the most significant developments in the international shipping industry till latest progress . In chapter three we provide an analysis of the freight market and the freight indices, which will be later incorporated into our multi factor model developed in chapter six. We continue with chapter four and the literature review over the macro and microeconomic variables that have been examined by a number of studies for their significant impact on international shipping stock returns. In chapter five we give a brief description of the companies' operation , fleet and strategy, the stocks of which have been included in our model. Chapter six includes our methodology and data description, where in chapter 7 we end our thesis by summarizing our results and reach a final general conclusion concerning our objective to detect significant explanatory factors for the shipping stock returns.

Chapter 1 – Historical review of International Maritime – the "Shipping Cycles"

Shipping history reveals the main characteristic of Shipping industry, "the market cycles". These cycles reflect unexpected peaks in the freight market, resulting to massive & sudden profits, which are then replaced by deep recession deriving from the cutting of rates.

But what is the economic mechanism that generates the cycles and causes ship-owners to fluctuate between the decisions of the acquisition or disposal of vessels?

According to Hampton (1986, p.19), "starting with a growing economy and a depressed shipping market, freight rates rise with an increase in transport demand. Rising freight rates increase the earnings of ship-owners who respond to a more favourable investment climate by bidding up the price of second hand ships and by ordering new ships. The orderbook builds until rates crest. At the peak there is a slowing of economic growth and freight rates decline. The delivery of vessels into a falling market helps to depress rates further. Low freight rates discourage ordering and encourage layup and demolition of ships. Eventually the excess supply reduces until it approaches a balance with demand. Then the cycle is ready to begin again. An entire regular cycle of this type might take about three to four years from trough to trough".

The mechanism described above, corresponds to the model known to the economists as the "cobweb model". Based on Vassilis C.Mavron & Timothy N.Phillips (Mathematics for Economics and Finance, p.270), " ..the "cobweb model" is an economic model for analysing periodic fluctuations in price, supply and demand that oscillate towards equilibrium. It is assumed that the quantities involved change only at discrete time intervals and that there is a time lag in the response of suppliers to price changes".

The relevant description by all means applies to shipping sector, which is a highly volatile market, with a significant timing gap between demand and supply, since by nature, merchant ships take long time (approximately one to five years) to build depending on the type of vessel and the state of the orderbook held by the shipyards. This means that, by the time the new ship will be ready and available for "sail", demand may have been dropped in such levels (due to a number of possible factors that are described later in other sections) that would be considered more effective and profitable not to operate the ship.

In the following paragraphs, we come across recorded cycles in the international shipping history starting from the period marked by the opening of Suez Canal in 1869. Apart from this technological development, political events had a positive impact on the freight market, during the 1st decade of the 19th century. According to Martin Stopford (Maritime Economics), the South African War & the Franco-German War, created the needs for increased demand over shipping tonnage. The prosperous era continued with the overcapacity of ships reaching its peek on the 1929. Then the Wall Street crash pushed world economy to the edge, sinking the whole shipping market to deep depression.

The period after the World War II (1947-1956), was a period of increased demand, mainly due to the rapid growth of seaborne trade influenced, by the political events in Korea and the shortage of shipbuilding capacity as a result of the destruction of the Japanese and German yards during the war. In 1956 the problems in the Middle East led to the closure of the Suez Canal contributed to the outweigh increase in tanker and dry cargo freight rates, since the ships had to go a much longer journey around the Cape.

The reopening of the canal in April 1957 along with the overall economic depression in 1958 , deteriorated the freight rates levels, a situation that continued for almost 10 years, confirming the fact that the World economic activity is by far the most important single influence on the demand for sea transport.

Once again in 1967, the market took advantage of the closure of Suez Canal, there was plenty of demand for ships and the fleet grew rapidly. During this period, ship owners engaged in long term time charter contracts (over 15 years) with charterers from oil and steel sector. Banks financed the fleet expansion taking as security the long term Charter Party agreements.

After two decades of continuous growth there was a fall in the mid 1970s. This downturn was triggered by the oil crisis of October 1973, which affected the growth of tanker demand. According to Clarckson research, the fleet grew to 350 million dwt in 1977, but demand could not follow, and reached 250 million dwt, resulting to a significant imbalance and a supply/demand gap. Prices collapsed and the crisis in tanker market was followed by the crisis in the dry bulk sector, since the owners of

tanker ships found more profitable to convert them to bulk carriers. This led also to oversupply in dry market and decline of rates. The recession bottomed out in 1986.

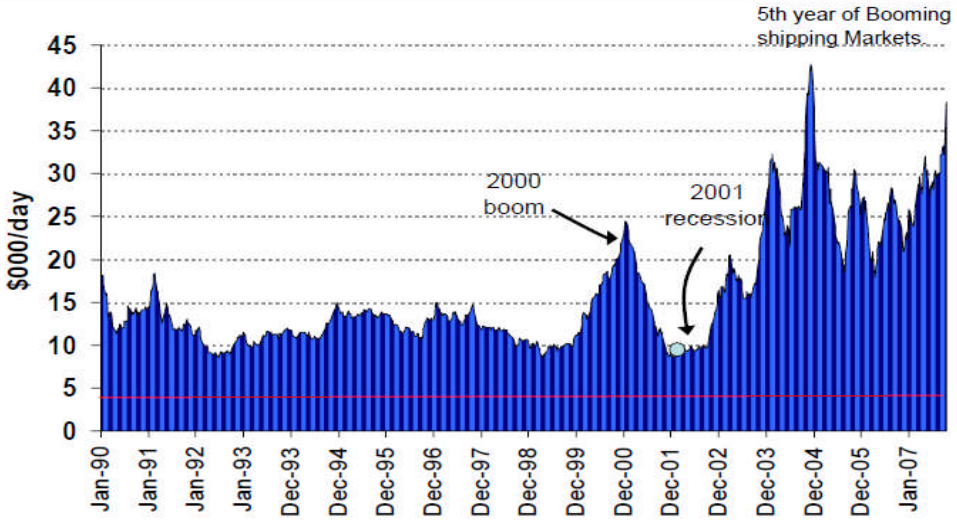


Figure 1. **The Clarcksea Index 1990-2007 (tankers, bulkers, container,gas)**

(Clarckson Research , COSCO Summit Tienjin 1st November 2007).The Clarksea Index. shows the average earnings for tankers, bulk carriers, containerships and gas.The figure shows that during 90s an average of $11,000 per day dominated the market. Later in 1990-2000, recovering from the Asian crisis, rate peaked to $25,000 in average, where during the dot.com crisis the index surged ahead to a new peak of $42,700 in November 2004.

During 1990s China started to grow rapidly. The merchant fleet expansion grew slower than demand, compared to the previous decade of oversupply, lower freight rates and overall depression. The gap between demand and supply was extinguished, with demand being the leader thereafter due to the developments in China economy.

However, this sign of prosperity was snowed under by the following crisis, financial crisis of 1991, the 1997 Asia financial crisis and the 2001 “dot com” crisis.

The financial crisis of 1997 caused a deep fall in industrial activity, especially in Asia. The next business cycle came in 2001 , which was caused by the financial crisis accompanied by the internet stock bubble.

The figure above shows the average earnings for the four shipping segments (tankers, bulkers, containers and gas), which reflect the impact of the abovementioned crisis.

For a period of six years (2002-2008), shipping industry was enjoying excessive returns, as a result of the extraordinary strong average global economic growth of 5 percent, which has resulted in a tonnage demand growth of 8 percent on average for the total world merchant shipping (Platou annual report 2009). Freight rates , newbuilding and seconhand prices reached record high-levels. As shown in the figure

below, seaborne trade was estimated at 8,02 billion of tons goods loaded, implying a 33 percent volume increase from 2000.

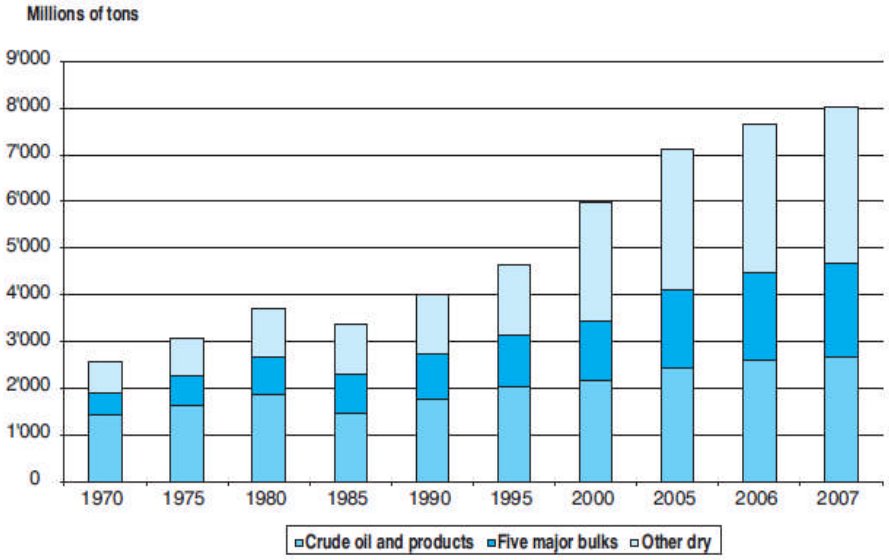


Figure 2 . International seaborne trade from 1970 to 2007 (Source: UNCTAD Review of Maritime Transport).

The figure shows the volume increase in seaborne trade per millions of tons loaded for a period from 1970 to 2007. The tons loaded are distinguished between the main categories of products shipped; crude oil and products, five major bulks (iron ore, grain, bauxite/alumina and phosphate) and other dry cargo.

During the relevant period (2000-2007), orderbook (orders for newbiuldings) has exceptionally increased, reaching high records in 2007, as derives from the relevant figure 3 below.

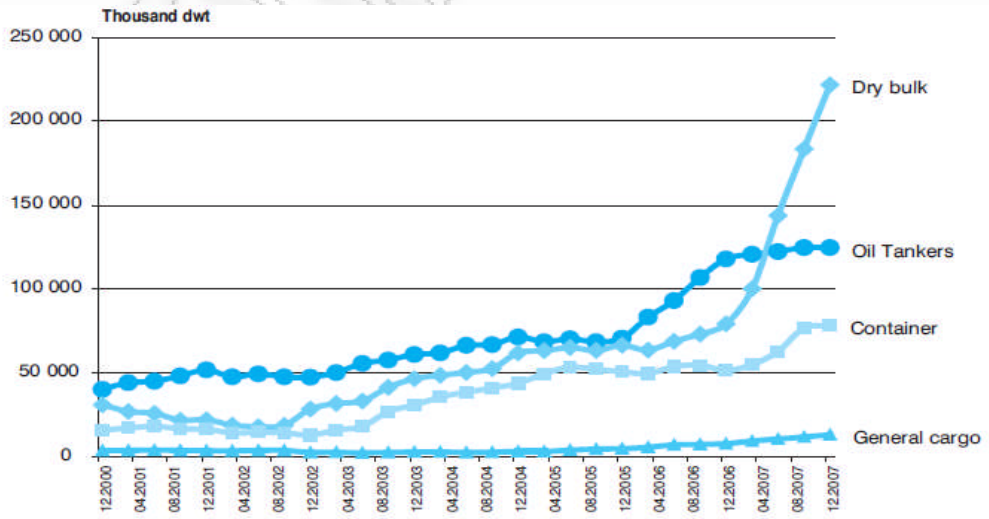


Figure 3 . World Tonnage on order measured in thousand of dwt, 2000-2007 (for ships f 100GT and above) (Source: Compiled by the UNCTAD secretariat on the basis of data supplied by Lloyd's Register - Fairplay

In 2008 world economic activity took a dramatic turn, which influenced severely all industries, including the shipping sector. The financial disorder that emerged in USA in summer 2007 and led in 2008 and 2009 to the most serious financial crisis since the Great Depression of 1929, had dramatically affected the shipping market during the second half of 2008.

The impact of liquidity crisis has been reflected on the massive drop in demand for new tonnage particularly for dry bulk and containerships. Demand could no longer absorb the extreme strong expansion of orderbook of previous period and deliveries of new buildings left aside. The imbalance between supply and demand due to the fleet overcapacity, which exceeds the requirements, pushed freight rates down and lowered owners' desire for new orders. This, along with the fact that the financial crisis has put restrictions over financing newbuilding projects, creates a reverse trend in order to correct overcapacity. But supply will take time to adjust, and especially now taking into account the sequence of problems in the banking world.

The overall consideration is that we are in the middle of the next shipping crisis and looks particularly severe since it has been accompanied by another crisis in financial world. The timing of recovery is extremely uncertain, since nobody knows how long it will take supply to adjust.

Chapter 2 – Shipping sectors overview & the Freight Market

Shipping market is categorised into the following three sectors, based on the type of services rendered by the charterers since *it is the type of commodity* that determines which type of ship the charterer (cargo owner or shipper) requires for the transportation of his/her cargo. Any change in the trade pattern for that commodity is reflected in the demand and freight rates for different types of vessels with different size and particulars and different sea routes.

The three subsectors are:

- The Dry Bulk Market
- The Tanker Market
- The General Cargo Market / Containerships

2.1 The Dry Bulk Shipping Market

Dry bulk shipping was developed as a result of the need for the movement of large quantities of the major and minor bulk commodities, such as coal, iron ore, wheat and other "loose" cargo. These are transferred through large cargo vessels, the bulk carriers.

The major and minor commodities transferred through bulk carriers are the following:

Coal: There are two principal types of coal: steam (or thermal) coal and coking (or metallurgical) coal. The main exporters of coal are Australia, South Africa, Indonesia, United States, Colombia, Canada, and China. The main importers of coal are Europe, Japan, South Korea, Taiwan, China, India, and the Middle East. The coking coal market is closely linked to demand from integrated steel makers who use coking coal in blast furnaces to make pig iron which, in turn, is converted into steel.

Steam coal is mainly used in the production of electricity, and the transportation of steam coal is the backbone of the Capesize and Panamax markets. Increases in steam coal demand have been significant, as both developed and developing nations require increasing amounts of electric power.

Iron Ore. Until the start of the 1990s, when it was overtaken by the combined steam and coking coal sectors, iron ore was the largest drybulk trade. It remains, however, the primary employer of the largest ships in the drybulk fleet. Used principally as the primary raw material in steel making, iron ore imports are dominated by Europe, Japan, China, South Korea, and the United States. The primary exporters of iron ore are Brazil, Australia and India. Other significant exporters include Canada, Sweden, South Africa, Venezuela, Mauritania, Peru and Chile.

Grain. The principal exporters of grain are Canada, United States, Europe, Australia, and South America. The principal importers are Japan, South Korea, China, South East Asia, the Middle East, North Africa, and Europe. Grain production is subject to both growing conditions and natural disasters which affect crop yields and demand patterns.

Minor Bulk Cargoes: Minor bulk cargoes include steel products, forest products, agricultural products, bauxite and alumina, phosphates, petcoke, cement, sugar, salt, minerals, scrap metal, and pig iron. Minor drybulk cargoes are not a major component of Capesize or Panamax carrier demand, although Panamax vessels also transport cargoes such as bauxite, phosphate rock, sulphur, fertilizers, various other ores and minerals and agribulks.

Dry bulk shipping is divided into four different sectors according to the cargo carrying capacity of the vessels. These are :

- handysize (30,000 dwt)
- handymax (45,000 dwt)
- panamax (65,000 dwt)

and capezize (120,000 dwt and over)

• *Handysize*. Vessels in this sector are the smallest [under 30,000 dwt] and carry finished products and minor bulk cargoes, although, increasingly, vessels in this sector are now more limited to trading regionally and in coastal waters.

• *Handymax and Ultra-Handymax*. Vessels in this category range in size from [30,000 to 45,000] dwt and are often equipped with cargo loading and unloading gear, such as cranes, which makes them well suited to call at ports that either are not equipped with

gear for loading or discharging of cargo or have draft restrictions. These vessels can trade on worldwide routes carrying a variety of major and minor bulk cargoes.

• *Panamax*. These vessels range in size from [45,000 to 65,000] dwt and are designed with the maximum width that will allow them to travel fully-loaded through the Panama Canal. They are also often engaged in many major international trade routes that do not involve transit through the Panama Canal. Panamax bulk carriers are mainly used to transport major bulk cargoes, such as coal and grain and, to a lesser degree, iron ore, as well as a number of minor bulk cargoes, such as bauxite, petroleum coke, some fertilizers and fertilizer raw materials, and various minerals.

• *Capesize*. These vessels, which are [120,000 dwt and over], are the largest size of drybulk carriers. Capesize vessels typically carry relatively low value cargoes for which large cargo lot sizes are of primary importance. Consequently, Capesize vessels are mainly used to transport iron ore or coal and, to a lesser extent, grains, primarily on long-haul routes. These vessels are not capable of traversing the Panama Canal due to their size and, therefore, lack the flexibility of smaller vessels.

The above categories in which the dry bulk sector is distinguished are summarized in the following (Table 1) along with the associated cargo types and routes that the relevant vessels trade in.

Class of Bulk Carriers	**Commodities (percentage of total shipments)**				
	Iron Ore	**Coal**	**Grain**	**Bauxite & Alumina**	**Phoshate Rock**
Capesize	**70%**	**45%**	**7%**	-	-
Panamax	**22%**	**40%**	**43%**	**45%**	**20%**
Handumax and Handysize	**8%**	**15%**	**50%**	**55%**	**80%**
Major Routes					
	Iron Ore	**Coal**	**Grain**	**Bauxite & Alumina**	**Phoshate Rock**
Capesize (120,000 dwt and over)	► Brazil to West Europe & Japan	► Australia to Far East, Japan & West Europe	► Argentina and River Plate to Near East, & East Europe		
	► W. Australia to West Europe & Japan	► South Africa to West Europe and Far East			
Panamax (65,000 dwt)	► Brazil to West Europe & Japan	► N.America to Japan & W.Europe	► N.America to Far East, W. Europe & Near East		
	► Australia to West Europe & Japan	► Australia to Far East, Japan & West Europe			
Handumax and Handysize (45,000 dwt) & (30,000 dwt)	► India to Japan & Korea	► S. Africa to Far East & Europe	► Australia to Far Japan & Middle East	► Caribbean to North America & W. Europe	► Morocco to W.Europe
	► Canada to USA & Japan		► N.America to Africa & West Europe	► West Africa to W. Europe & Japan	► Russia to W. Europe
	► Liberia & Mauritania to West Europe			► Australia to Japan & West Europe	► The US to Japan & West Europe

Table 1. **Different size vessels with their respective cargo and routes**
(Costas TH.Grammenos, "The Handbook of Maritime Economics and Business)

2.2 The Tanker Shipping Market

Tankers are vessels designed to carry liquid cargo in bulk. Liquid cargo includes mainly crude oil and refined oil products. However tank ships are also engaged in the transfer of other products such as chemicals, wine and other food oils. Since crude oil is the largest seaborne commodity, the tanker market is by far the largest part of shipping industry, constituting approximately 40% of the world's merchant fleet.

The behaviour of tanker market can be understood only through the review and monitoring of economic development in the oil industry. The tanker demand is influenced and strictly determined by the world oil production and demand.
Oil transportation needs are born due to the fact that oil is produced in regions of little demand (Saudi Arabia, Iran, Kuwait, e.t.c). As a result crude oil and other refined products must be transported to the consumption centres (United States, Japan,EU, e.t.c). Tankers are the vessels used for matching the *supply* and *demand* for oil.

Tanker *demand* is expressed in "ton-miles" and is measured as the product of

(a) the amount of cargo transported in tankers, multiplied by

(b) the distance over which this cargo is transported.

Tonnage of oil shipped is primarily a function of global oil consumption, which is driven by economic activity as well as the long-term impact of oil prices on the location and related volume of oil production. Tonnage of oil shipped is also influenced by transportation alternatives such as pipelines.

The distance over which oil is transported is the more variable element of the ton-mile demand equation. It is determined by seaborne trading and distribution patterns, which are principally influenced by the locations of production and the optimal economic distribution of the production to destinations for consumption. Seaborne trading patterns are also periodically influenced by geo-political events that divert tankers from normal trading patterns, as well as by inter-regional oil trading activity created by oil supply and demand imbalances.

Tanker Supply

The supply of product tankers is a function of new product tanker deliveries, scrapping and conversion and loss of tonnage. The level of newbuilding orders is primarily a function of newbuilding prices in relation to current and anticipated charter market conditions. Typically, delivery of a product tanker occurs within 18 to 36 months after ordering.

There are two basic types of oil Tankers according to the service they provide:

- *The crude tankers*, which serve the transportation of crude oil from its point of extraction to the refineries.
- *The product tankers*, which are designed to carry refined products (petrochemicals) from refineries to consumption centres.
- *The liquefied gas carriers*, which are tankers designed to ship Liquified Natural Gas (LNG) and Liquefied Petroleum Gas (LPG). LNG is mainly produced from dedicated gas fields, whereas LPG is the gas produced as a by-product of oil wells.

Furthermore, tankers are classified according to their capacity in the following categories:

Class	Size in dwt
General Purpose tanker	10,000 - 24,999
Medium Range tanker	25,000 - 44,999
LR1 (Large Range 1)	45,000 - 79,999
LR2 (Large Range 2)	80,000 - 159,999
VLCC (Very Large Crude Carrier)	160,000 - 319,999
LCC (Ultra Large Crude Carrier)	320,000 - 549,999

Petroleum Tankers Types					
Class	**Length**	**Beam**	**Draft**	**Typical Min DWT**	**Typical Max DWT**
Seawaymax	226 m	24 m	7.92 m	10,000 DWT	60,000 DWT
Panamax	294.1 m	32.3 m	12 m	60,000 DWT	80,000 DWT
Aframax				80,000 DWT	120,000 DWT
Suezmax			16 m	120,000 DWT	200,000 DWT
VLCC (Malaccamax)	470 m	60 m	20 m	200,000 DWT	315,000 DWT
ULCC				320,000 DWT	550,000 DWT

2.3 The General Cargo Market / Cargo liners - Containerships

Container shipping, the main subsector of Cargo liners market, is responsible for the seaborne movement of a wide range of goods from one part of the world to another in a unitized form, representing an important and increasingly significant part of the global seaborne movement of goods.

The supply of cargo liners aims to satisfy the demand needs created by the general cargo trade. As general cargoes are defined the cargoes that comprise of a number of goods, each of which is not traded in quantities adequate to utilise, as a single cargo, the whole transport capacity of a regular size ship.

The majority of goods conveyed through containerships relate mainly to manufactured products from heavy and smaller industry on behalf of a multiplicity of individual shippers, compared to the bulk cargoes that relate mainly to raw materials usually from one specific shipper running a regular scheduled service.

A limited number of players participate in the relevant market, mainly due to the increased capital requirements. These have also developed logistics terminals in various ports in order to serve loading and unloading needs.

In the following (Table 2), we have summarized the 10 top container shipping companies based on the TEU capacity of 2006 (where TEU is defined as the Twenty-foot Equivalent Unit, used to describe the capacity of containerships and container terminals).

Top 10 container shipping companies in order of TEU capacity, 1st January 2006			
Company	**TEU capacity**	**Market Share**	**Number of ships**
A.P Moller Maersk Group	1,900,000+	18.20%	600+
Mediterranean Shipping Company S.A	865,890	11.70%	376
CMA CGM	507,954	5.60%	256
Evergreen Maritime Corporation	477,911	5.20%	153
Hapag - Lloyd	412,344	4.50%	140
China Shipping Container Lines	346,493	3.80%	111
American President Lines	331,437	3.60%	99
Hanjin - Senator	328,794	3.60%	145
COSCO	322,326	3.50%	118
NYK Line	302,213	3.30%	105

Table 2 :(Source : "Liner market shares BRS report for Alphaliner. January 2006)

With regard to the General Cargo market fleet, the following types of vessels exist:

- *Containerships* , for containers transportation
- *Multi Purpose Vessel / Carrier* , a newer version of general cargo ship with holds designed for container stowage. The holds generally have tween decks and containers can be stacked and lashed on to the hatch covers. The MPP is still capable of carrying breakbulk cargoes, and bulk cargoes. Some are also equipped with tanks for liquid cargoes. It generally also has its own cranes and derricks, sometimes with heavy lift capability.
- *General Cargo Liners*, this older type of cargo ship generally carry cargo that is too large to be carried in a container
- *Ro-Ros*, are used to carry motor vehicles
- *Barge Carriers (or Lash ships)* , for carrying floating cargo
- *Reefers*, are designated to carry frozen cargo

Based on their TEU capacity general cargo vessels are categorised as follows

Type of Vessel	**TEU Capacity**	**Speed (knots)**
Feeder	100-499	13.8
Feedermax	500-999	16.4
Handy	1000-1999	18.5
Sub-Panamax	2000-2999	20.8
Panamax	3000-3999	22.2
Post-Panamax	>4000	24.0

Chapter 3 – The Freight Market & the Freight Indices

Freight is defined as the price paid to a shipowner for the transportation of a cargo from one specific port to another, or in other words, the quantity of money a shipper or consumer will exchange for a unit of shipping services. Additionally, the *freight market* can be determined as the place where the buyers and sellers of shipping services come together to strike a deal. (Grammenos, 2002) In his book , ("The handbook of Maritime Economics and Business"), Costas Th. Grammenos identifies the following four sectors :

- *The Voyage Charter Market*, where a shipowner is paid freight on the basis of moving cargo from a loading port to a discharge port. Normally per ton of cargo. The shipowner is responsible for paying both operating costs and voyage costs.
- *The Contract of Affreightment Market (C.O.A)*, where the movement of cargo on a regular basis is contracted.
- *The Time Charter Market*, where the shipowner hires out a ship for a specified period of time. The shipowner is responsible for providing the crew and paying ship operating expenses while the charterer is responsible for paying the operating expenses and additional operating insurance.
- *The Bareboat Charter Market*, where the shipowner is usually paid a fixed amount of charter hire for a certain period of time during which the charterer is responsible for the operating and voyage costs of the ship, as well as for the management of the ship, including crewing. A bareboat charter is also known as a 'demise charter' or a 'time charter by demise.'

The freight market is a highly competitive market and the rates (freight rates) at which a vessel can be chartered can change radically in a period of few months or even days. As in other competitive markets, rates (prices), are determined through the interaction of *supply* and *demand*.

Equilibrium in shipping world is rather seldom. The main problem, as the majority of economists engaged in shipping economics and shipping analysts explain, is the timing gap between the order of new ships and their delivery from the shipbuilding yards to the owners.

In general, there are two main factors that determine the freight rates:

a) increased number of vessels for limited cargo volume

b) shortage of sea transport capacity

To be more specific, when under capacity of ships is recorded in the market , the freight rates are increased and as a result even ships which are close to the end of their useful life become capable to earn higher rates than they really worth.

Accordingly in periods of oversupply, there are too many ships for limited cargo capacity. As a result laid up tonnage rises (ships not in active service) and freight rates collapse.

Unpredictability is a common problem of the mechanism of supply and demand in shipping industry. The problem is reflected on the increased number of order books when the market is at its top, which is then followed by decreased freight rates with the delivery of the vessels. The result is that ship owners had to deal with negative NPV, derived from the mismatch between the huge initial costs of acquisition (advances paid for vessels under construction in yards, which in most of the times accompanied with enormous financing obligations) and the disappointing future inflows, since the vessels will be chartered under lower Charter rates.

Since we have gained an understanding over the mechanism of Freight rates and the market in which they are determined, we can proceed with a brief presentation of the *Freight Indices*. The freight indices, which are distinguished into further indices based on the different shipping sectors, are financial tools that have been developed for monitoring each freight market. They measure the freight rates of different vessels sizes across different international routes. Freight indices are categorised in a way similar to the categorisation of shipping markets, depending on the size of the vessel, the type of the cargo carried, the route and the delivery period.

The Freight indices are published by Baltic Exchange, a global maritime organisation which provides daily shipping market information. Their values are reported once every day and they are determined by the individual daily quotes of the panellists, the member companies of the Exchange.

Baltic Dry Index (BDI)

The **Baltic Dry Index** (BDI) which continues the established time series of the **Baltic Freight Index** (BFI) was introduced on November 1, 1999. BDI is published daily from the Baltic Exchange in London which is comprised from companies related to

bulk-shipping industry, shipbrokers, shipowners etc. Baltic Dry Index is a composite of three indices which measure different sizes of bulk carriers.

- ***The Baltic Handymax Index (BHMI) (replaced by the Supramax Index in 2006)***

  The **Baltic Handymax Index** (BHMI), was published on October 2, 2000, to reflect the changes in the dry bulk carriers market. It replaced the Baltic Handy Index (BHI), introduced on January 7, 1997. The BHMI is based on bulk carriers of 45,500 tones dwt, and comprises of six typical Time Charter routes weighted to take account of their importance.

  In January 2006 the Baltic Supramax Index (BSI) superseded the BHMI as part of the general evolution of ship types. The BSI comprises of six typical Time Charter routes, weighted to take account of their importance.

Baltic Handymax Index Routes

Route	Route Description	Weighting
HS1	Skaw - Passero trip Recalada - Rio de Janeiro	12.5%
HS2	Skaw - Passero trip Boston - Galveston	12.5%
HS3	Recalada - Rio de Janeiro trip Skaw - Passero.	12.5%
HS4	US Gulf trip via US Gulf or NCSA to Skaw - Passero	12.5%
HS5	SE Asia trip via Australia to Singapore - Japan	25%
HS6	S Korea - Japan via NOPAC to Singapore-Japan	25%

(source: Clarcksons website)

Baltic Supramax Index Routes

Route	Route Description	Weighting
S1A	Antwerp - Skaw Trip Far East	12.5%
S1B	Canakkale Trip Far East	12.5%
S2	Japan - SK / NOPAC or Australia rv	25%
S3	Japan - SK Trip Gib - Skaw range	25%
S4A	US Gulf - Skaw-Passero	12.5%
S4B	Skaw-Passero - US Gulf	12.5%

(source: Clarcksons website)

- ***Baltic Panamax Index (BPI)***

  The **Baltic Panamax Index** (BPI) was published on December 21, 1998 and is an indicator for grains and minerals demand for Panamax type bulk carrier vessels (50,000 – 80,000 tones dwt). The BPI comprises four typical Time Charter routes, weighted to take account of their importance.

Baltic Panamax Index Routes

Route	Route Description	Size mt	Weighting
P1A_03	74000mt Transatlantic RV	74,000	25%
P2A_03	74000mt SKAW-GIB/FAR EAST	74,000	25%
P3A_03	74000mt Japan-SK/Pacific/RV	74,000	25%
P4_03	74000mt FAR EAST/NOPAC/SK-PASS	74,000	25%

(source: Clarcksons website)

- ***Baltic Capesize Index (BCI)***

  The **Baltic Capesize Index** (BCI), was published from Baltic Exchange on April 26, 1999. This index roads the cost on the largest of the dry bulk ships, the Capesize vessels. These vessels are those in excess of 80,000 dwt and primarily carry coal and iron ore. The BCI comprises ten typical Time Charter routes, weighted to take account of their importance.

Baltic Capesize Index Routes

Route	Route Description	Size mt	Weighting
C2	160000lt Tubarao - Rotterdam	160,000	10%
C3	150000mt Tubarao - Beilun/Baoshan	150,000	15%
C4	150000mt Richards Bay - Rotterdam	150,000	5%
C5	150000mt W Australia - Beilun/Baoshan	150,000	15%
C7	150000mt Bolivar - Rotterdam	150,000	5%
C8_03	172000mt Gibraltar/Hamburg trans Atlantic RV	172,000	10%
C9_03	172000mt Continent/Mediterranean trip Far East	172,000	5%
C10_03	172000mt Pacific RV	172,000	20%
C11_03	172000mt China/Japan trip Mediterranean/Cont	172,000	5%
C12	150000mt Gladstone - Rotterdam	150,000	10%

(source: Clarcksons website)

For the calculation of BDI initially was used the average rate of BHI, BPI and BCI. Since January 1, 2007 the computation of the BDI derives from the weighted average rate of the four (4) time charter routes of BHMI, the weighted average rate of the four

(4) time charter routes of BPI and from the weighted average rate of the four (4) time charter routes of BCI.

As we have mentioned before, the above indices are based on professional assessments made by a panel of international ship broking companies. This panel is comprised by the following companies (Panelists):

Acropolis Chartering & Shipping Inc, Arrow Chartering (UK) Ltd, Banchero-Costa & C s.p.a., Barry Rogliano Salles (London), Braemar Seascope Ltd, Clarksons, Fearnleys A/S, Galbraith's Ltd, G F I Brokers Ltd, E A Gibson Shipbrokers Ltd, Howard Houlder (Dry Cargo) Ltd, Howe Robinson & Co Ltd, ICAP Hyde, Ifchor SA, John F Dillon & Co, Lawrence (Chartering) Ltd, LSS SA, Maersk Broker (UK) Ltd, Neo Chartering, Optima Chartering, Thurlestone Shipping Ltd, Simpson Spence & Young Ltd, Yamamizu Shipping Co Ltd, Clarksons Melbourne ,Doric Shipbrokers S.A., HSBC Shipping Services, Rigel Shipping, Ildo Chartering Corporation, Lightship Chartering A/S, Vogemann

Baltic Dirty Tanker Index (BDTI) and Baltic Clean Tanker Index (BCTI)

Until today the tankers' market is described by two indices. The Baltic Dirty Tanker Index (BDTI) which describes the routes of tankers regarding the crude oil and the Baltic Clean Tanker Index (BCTI) which describes the routes of tankers regarding the petrochemicals' cargoes. Both indices are published from the Baltic Exchange organization. The calculation of both indices is made by multiplying the average price of each route with a relevant route factor.

The two indices differ in the number of routes, ten for the BDTI and six for the BDCI. The main factors that affect routes' selection from the Baltic Exchange are the global coverage, the representation of each market, the transparency and the commercial balance. The average price of each route is calculated from the Baltic Exchange in collaboration with the Panelists. The Panelists are big shipping agents, which make estimation for the price ($/ton) of each route. The Baltic Exchange combines these estimations and calculates the average price for each route. The importance of each route depends mainly on the empirical knowledge of the personnel in the Baltic Exchange rather than on mathematical computations.

The Panelists that modulate this index are:

A C M Shipping Ltd, Barry Rogliano Salles, Bassoe (PF) A/S & Co, Braemar Seascope Ltd, Capital Shipbrokers Ltd, Clarksons, Eastport Chartering Pte Ltd, Fearnleys A/S, Galbraith's Ltd, E A Gibson Shipbrokers Ltd, Island Shipbrokers, Mallory Jones Lynch Flynn & Assoc. Inc, McQuilling Brokerage Partners Inc, Odin Marine, Simpson Spence & Young Ltd

Baltic Dirty Tanker Index (BDTI)

The index derives from the equal contribution of each of the below routes. In other words, each route puts in the index a percentage of 6.25%.

Baltic Dirty Tanker Index Routes

Route	Route description	Size mt	Following indicative routes form the basis
TD1	280000mt ME Gulf to US Gulf	280000	Ras Tanura to LOOP
TD2	260000mt ME Gulf to Singapore	260000	Ras Tanura to Singapore
TD3	250000mt ME Gulf to Japan	250000	Ras Tanura to Chiba
TD4	260000mt W Africa to US Gulf	260000	O.S Bonny to Loop
TD5	130000mt W Africa to USAC	130000	O.S Bonny to Philadelphia
TD6	135000mt Black Sea / Med	135000	Novorossiyk to Augusta
TD7	80000mt North Sea to Cont	80000	Sullom Voe to Wilhelmshaven
TD8	80000mt Kuwait - Singapore(Crude/DPP Heat 135F)	80000	Mena al Ahmadi to Singapore
TD9	70000mt Caribs to US Gulf	70000	Puerto la Cruz to Corpus Christi
TD10D	50000mt Caribs to USCA - Double hull vessel	50000	Aruba to New York
TD11	80000mt Cross Med	80000	Banias to Lavera
TD12	55000mt ARA to US Gulf	55000	Antwerp to Houston
TD14	Trial - 80000mt SE Asia to EC Australia	80000	Seria to Sydney
TD15	Trial - 260000mt West Africa to China	260000	Zaffiro and Bonny to Ninqbo
TD16	Trial - 30000mt Black Sea to Mediterranean	30000	Odessa to Augusta

(source: Clarcksons website)

Baltic Clean Tanker Index (BCTI)

The index derives from the equal contribution of each of the below routes (16.67%).

Baltic Clean Tanker Index Routes

Route	Route Description	Size mt	Following Indicative Routes form the Basis
TC1	75000mt Middle East Gulf - Japan	75000	Ras Tanura to Yokohama
TC2_37	37000mt Continent to USAC	37000	Rotterdam to New York
TC3_38	38000mt Caribbean - USAC	38000	Aruba to New York
TC4	30000mt Singapore to Japan	30000	Singapore to Chiba
TC5	55000mt Middle East to Japan	55000	Ras Tanura to Yokohama
TC6	30000mt Algeria/Euromed	30000	Algeria/Euromed

(source: Clarcksons website)

We have already mentioned the cyclical patterns that define the maritime economy, and the complex mechanism through which freight rates are determined through the interaction of supply and demand. During the review over the recorded shipping cycles, Martin Stopford has identified ten key influences on the shipping market, five of them determine the shipping demand and the remaining five the supply. But before starting to analyse these factors, it would be appropriate to refer to the "cobweb theorem" that has been already mentioned earlier in the introduction section.

Based on James McConville, the cobweb model describes a situation in which the amount currently supplied is dependent on the level of price, freight rate, set in some previous period.

As Hicks highlights, (Hicks ,J.R Value and Capital -2nd edition-, London Oxford University Press. 1953 p 117), "The current supply of a commodity depends on not so much upon what the current price is as upon what entrepreneurs have expected it to be in the past. It will be those past expectations that, whether right or wrong, which mainly govern current output; the actual current price has a relatively small influence".

The cobweb model applies in the shipping freight market, as follows:
The equilibrium in shipping market is not established simultaneously after a change in demand, due to the fact that supply takes time to adjust. The reason behind this delay, is nothing else but the time needed for a vessel to be delivered from the yard.
As a result when responding to a change in demand, shipowners will increase, or decrease the tonnage offered (new buildings) upon the expectation of freight changes as based on previous experience.

- ***Factors affecting the Shippping supply and demand model (Stopford 1988)***

As mentioned in previous sections, shipping is a highly volatile market, where prices (i.e freight rates), can be determined only by the interaction between supply and demand.
A change in demand and supply of ships leads to a shortage or surplus of tonnage causing significant imbalances. When D>S, freight rates increase and investments are boosted (increased ordering). Equally, when S>D (supply outweighs the demand), competition drives freight rates down, pushing shipowners to scrap unprofitable ships.

With regard to the *demand* the following determinants have been identified :

1) The World Economy
2) Seaborne commodity trades
3) Average haul
4) Transport costs
5) Political events

And with regard to the *supply* :

1) The World fleet
2) Shipbuilding output
3) Scrapping and losses
4) Fleet performance
5) Operating environment

Based on the relevant factors, which have been also adopted by Grammenos and other shipping engaged economists, we will establish our expectations regarding the factors that can be used in determining the stock returns of maritime companies in our econometric model later in the relevant section.

Demand

1) The World Economy

The close relationship between world economy and sea trade derives from the demand for sea transport that is generated from the need for the import of raw materials used in manufacturing industry or in the trade of manufactured products.

The empirical analysis shows that economic business cycles are major determinants of shipping industry performance. As Dr Martin Stopford indicates, positive correlation exists between economic business cycles and shipping industry trends.

As already described briefly in the introduction section, business cycles have defined the movement in shipping sector, and this is obvious through the review of the recorded economic cycles of 1991 , 1997 and 2001.

However, with regard to *industria*l business cycles, two cycles are identified with China playing the leading role.

The first was the financial crisis in Asia during 1997 and 1999, which caused a deep fall in industrial activity as shown also in the Figure below.

The next cycle took place in 2001 caused, as described above, by the financial crisis and the "dot.com crisis". China grew through this one, but the rest of the world slowed dramatically. This lead to an increase in the ships overcapacity, which was steadily being absorbed by China's industrial growth. In 2003/04 the movement changed and the economy grew fast.

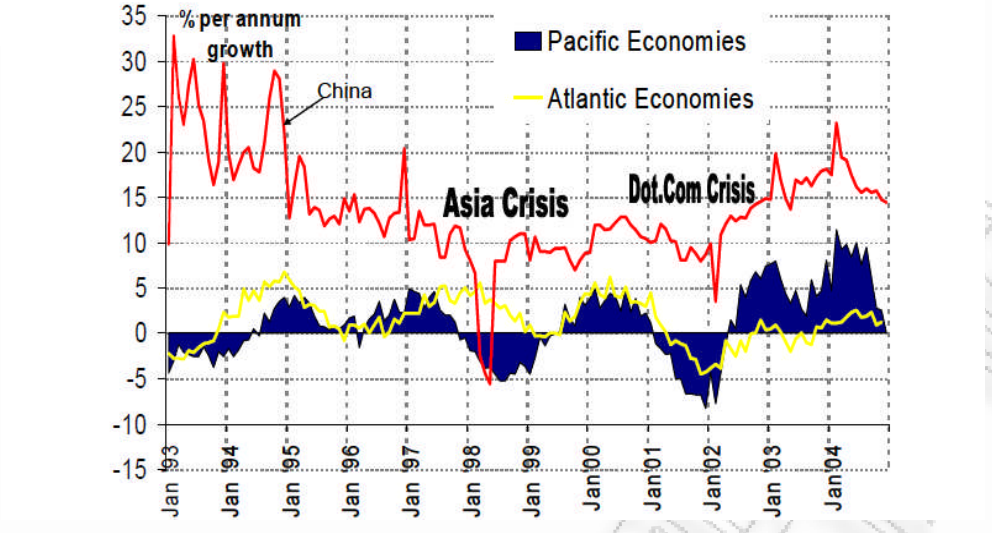


Figure 4 (Industrial cycles showing China, Pacific & Atlantic, Clarckson Research,2005)

The above trends are pretty clear in case of tanker market, three tankers spikes recorded in the 90s coincided with peaks in the rate of industrial growth in the major economic regions.

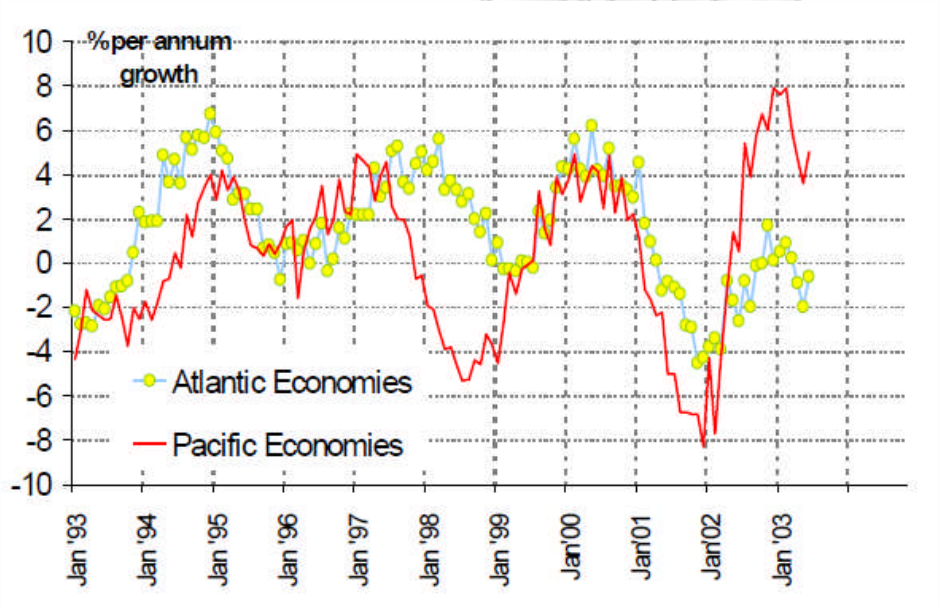


Figure 5:("Tanker Market Prospects -2003 and beyond , Martin Stopford/ Intertanko Maritime London Conference 17 September 2003)

The figure shows the year on year growth rate of industrial production in Atlantic and Pacific economies. In 1997 both economies peaked in the first quarter but Asian crisis created huge concerns for the future resulting to the most depressed year in shipping in 1999. Unexpected boom recorded in 2000 (unexpected because it was expected that Asia would need 2-3 years to recover).In 2003, the underlying driver of tanker freights was once again the industrial economy reflecting mainly the developments in Asia, with China being the leader of all.

Another point which reflects the influence of world economy, is that in periods of depletion, where domestic raw materials are in shortage, countries turn to foreign products by increasing the demand for sea trade transactions.

However, in the last three decades, it is the surging economy that has primed the shipping market. A key part of this economic drive has come from China, which has boosted demand for containership and dry-bulk shipping in order to satisfy its industrial production needs.

This positive correlation between global economic growth and world seaborne trade is outlined in figure 4 that follows, where seaborne dry and oil trade seems to "chase" the world output.

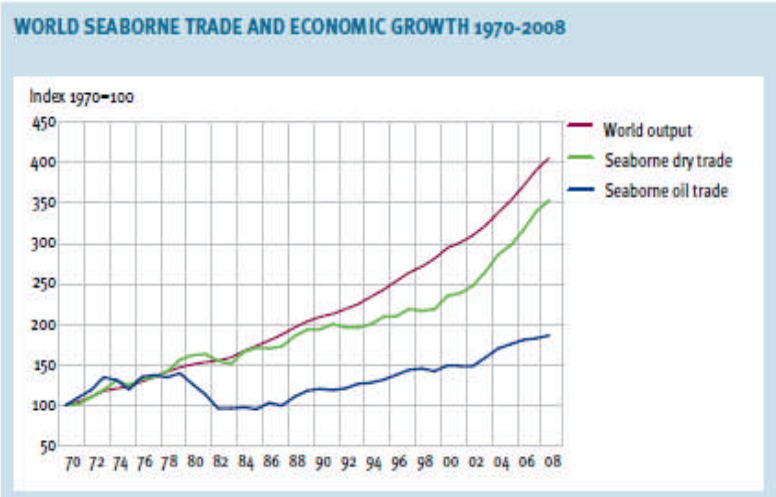


Figure 6: World seaborne trade and economic growth 1970-2008 (Source: Platou Annual Review 2009, p.6)

A significant driver for this correlation, is the fact that world's manufacturing has been outsourced to China, while most of the consumption takes place in the West. As a result an effective seaborne transport system was necessary in order to match production with consumption and vice versa.

2) Seaborne Commodity Trades

Apart from world economy and world industrial growth which is considered to be the prime driving force, shipping demand is also determined by the commodity trades. The major seaborne commodity trades include ; oil and oil products, five dry bulks

(iron ore, coal, grain, bauxite/alumina and phosphate) and other dry cargoes. The Table 3 below, outlines the developments in seaborne commodity trades since 1970s. Commodity trades volumes are influenced by :

a) *seasonality patterns*, reflected in the demand for various commodities such as crude oil and agricultural products
b) *stock building*, reflecting the anticipation of companies for decreased future prices

Year	Oil			Iron ore	Coal	Grain[a]	Five main dry bulks[b]	Other dry cargoes	World total
	Crude	Products	Crude plus products						
1970	5 597	890	6 487	1 093	481	475	2 049	2 118	10 654
1980	8 385	1 020	9 405	1 613	952	1 087	3 652	3 720	16 777
1990	6 261	1 560	7 821	1 978	1 849	1 073	5 259	4 041	17 121
2000	8 180	2 085	10 265	2 545	2 509	1 244	6 638	6 790	23 693
2001	8 074	2 105	10 179	2 575	2 552	1 322	6 782	6 930	23 891
2002	7 848	2 050	9 898	2 731	2 549	1 241	6 879	7 395	24 172
2003	8 390	2 190	10 580	3 035	2 810	1 273	7 464	7 810	25 854
2004	8 795	2 305	11 100	3 444	2 960	1 350	8 139	8 335	27 574
2005	9 239	2 510	11 749	3 918	3 113	1 686	9 119	8 730	29 598
2006	9 495	2 635	12 130	4 192	3 540	1 822	9 976	9 341	31 447
2007	9 685	2 755	12 440	4 790	3 750	1 857	10 827	9 665	32 932

Table 3: The World seaborne trade in ton-miles from 1970-2007 (Source: Fearnleys Review, various issues)

The table above displays the world-seaborne trade measured in billions of ton-miles.

a : Includes wheat, maize, barley, oats, rye, sorghum and soya beans

b : Includes iron ore, coal, grain, bauxite/alumina and phosphate

The last column of world's total trades reveals a steady growth in volume of total trades over the three decades

3) Average haul

Average haul is determined as the tonnage of cargo shipped multiplied by the average distance. As a result it is clear that the larger the required distance over which the cargo is shipped, the greater the shipping demand.

4) Transport costs

Over the last decades major developments in shipbuilding technology has enabled the construction and operation of more efficient and cost-cutting vessels.

This has contributed to the increased demand for shipments and in overall growth of shipping sector.

5) Political events

Geopolitical environment is a crucial element of the factors that affect demand in a sudden and unexpected manner. Such events include mainly local wars and other political and economic incidents which have a major impact in shipping not directly but through their indirect consequences. Some examples of relevant incidents revealed through history review performed by Martin Stopford in "Maritime Economics" are the following:

- The Korean war
- The Suez crisis
- The Six Day War between Israel and Egypt
- The 1979 Iran Revolution

Supply

1) The World fleet.

The first determinant of supply function is considered to be the world merchant fleet, the growth of which is determined by the scrapping and deliveries of vessels. The key characteristic of the shipping supply with regard to the world fleet factor, is the fact that supply takes long time to adjust and response to changes in demand. The reason for that is that ships take approximately five years to build and delivered in order to cover demand needs.

For example in the early 1960s the oil tankers fleet was significantly expanding, the completion of which took approximately twenty years to achieve. However during this period of time, demand for oil transport rose extensively , which combined with the shortage of tanker capacity led to record orders for new ships. However, the delivery of vessels found demand and consequently freight rates in downturn.

1) Shipbuilding output

Shipbuilding market represents an important and strategic industry in a number of countries around the world, with extreme numbers of funds capacity going around in order to meet construction needs. Since orderbooks are made based on future demand estimations, the world shipbuilding market suffers from over-capacities and depressed prices.

2) Scrapping and losses

The rate of growth of merchant fleet is determined by the equilibrium established between the rate of the delivery of new vessels and the rate of deletions from the world fleet, reflected by the *scrapping* (meaning the sale of a ship as scrap metal) and the losses (number of ships lost at sea due to severe accidents). Four factors are identified to have an impact on scrapping , these are a) the age of the fleet, b)the technical obsolescence, c) scrap prices and 4) market expectations

3) Fleet performance and productivity

Fleet productivity is one of the most important variables in determining transport capacity, since the volume of cargo that can be transported by a given number of ships can vary based on : a) the mean operating speed, b) the deadweight utilization and c) the loaded days at sea.

4) Operating environment

The environment in which ships operate play a significant role in the determination of shipping capacity. For example safety and environmental legislation set rules and standards that ships need to comply with and in many cases can strongly impact the transport capacity.

Chapter 4 – Literature review

As already discussed earlier in the introduction section, the purpose of this study is to identify factors that can be used in order to determine the drivers of the stock returns of shipping companies.

A number of relevant studies have been performed for the determination of stock returns drivers in economic sectors other than shipping by using multi-factor models, starting with King in 1966. Another characteristic example is the attempt of Sharpe (1983) to discover factors for share price returns by searching for statistical important variables in case of stock's beta, the dividend yield, the size of the firm and eight sector membership variables. Additionally Saunders and Yourougou (1990) and Isimbadi (1994) employed also multi factor models in order to test the sensitivity of returns to a set of macroeconomic factors.

Fama and Macbeth (1973) along with Black, Jensen and Scholes (1972) focused on the impact of share's market betas. The factor of dividend yield is introduced by Litzenberger and Ramaswamy (1982) indicating a positive relationship between dividend yield and returns. Moreover Bhandari (1988) examines the effect of debt to equity ratio reflecting the significance of leverage.

With regard to shipping sector, a limited number of studies have been developed over the determinants of stock returns of maritime companies. The reason for this shortage is due to the fact that studies are subjected to certain limitations, referring mainly to the limited number of available data since a relatively small number of shipping companies (even smaller for Greek ones) have been listed for more than 10 years in various stock exchange markets.

This was a difficulty that C.Th.Grammenos and S.N Marcoulis had to face in 1996 in their study *"A cross section analysis of stock returns: The case of shipping firms"*.

In the relevant study, Grammenos and Markoulis, attempt to investigate factors that determine share price performance by analysing the determinants of the cross-section of expected stock returns of 19 shipping companies listed in the US, Norway, Stockholm and London exchange markets for the period 1989-1993.

In their methodology they include variables already introduced in similar studies in other economic sectors as described above. These include:

a) Stock market beta
b) Financial leverage, which is measured it two ways. One as the fraction of (Book value of Total assets – Book Value of Equity) to Market Value of

Equity based on Bhandari point of view and one as a more traditional and usual type of measurement of (Book value of Total assets – Book Value of Equity) to Book Value of Equity measured at accounting year ends.

c) dividend yield , and

d) the annual average age of the fleet. The relevant variable was introduced for the very first time in the history of these type of studies. Two measures were used. The first one was the average age of a company's fleet and the second was calculated on a per vessel deadweight basis.

Based on these selected variables, they use the cross-sectional regression approach of Fama and Macbeth (1973), by estimating the following equation :

$$\tilde{r}_{it} = \tilde{\gamma}_{0t} + \tilde{\gamma}_{1t} BETA + \tilde{\gamma}_{2t} LEVER + \tilde{\gamma}_{3t} AGE + \tilde{\gamma}_{4t} DY + \tilde{e}_{it}$$

Where i= 1,……..N. The coefficients were estimated through OLS and have been also adjusted for heteroskedasticity.

The results of relevant study are summarised in the following paragraph regarding each one of the variables used in the equation:

- According to CAPM, there is a positive relationship between stocks betas and returns (since the higher the risk the investor takes the higher the return) something that seems to apply in case when cross sectional returns are regressed on beta on its own. However when cross sectional returns are regressed on beta and all the remaining variables the results are far different. As a result, they conclude that beta can only in a low level explain the movement in stock returns.
- In case of financial leverage, significant coefficients were obtained with regard to the use of the book value leverage measure. The coefficients indicated a positive relationship between debt to equity and returns. This can be interpreted through the following: if financial leverage (debt) is increased this automatically means higher risk that owners have to deal with. In order to compensate for this risk, they ask for higher returns. Another possible explanation derives from the "signalling theory", based on which, the increased leverage might reflect company's strategy to persuade the public (market) for its ability to retain high levels of debt, which in turn interpreted to positive expectations for future cash flows which consequently lead to

the appreciation of current prices and to higher returns. It is worth mentioning that, due to the fact that the relevant study has been applied in a five year period and no shipping cycle could be detectible in such a short time, it is inevitable to ignore the volatile environment and the consequences of financial leverage during the "hard" times of a financial crisis.

- With reference to the average age of the fleet, a negative and statistically significant relationship with cross-sectional returns is identified, meaning that the younger fleet earns more. Three reasons are mentioned for explaining this relationship. First it is the fact that ships need to comply with a number of environmental laws and regulations, a requirement that only the new vessels are able to conform with. Second, it is clear that charterers will choose to charter younger vessels in respect of more efficient and faster shipments. Finally, older vessels face the disadvantage of high operating (running) cost reflecting not only the vessels daily operating expenses (which include wages, insurances, lubricants, repairs and maintenance expenses, e.t.c) but also the depreciation of its usefulness.
- Negative and significant coefficient was obtained through the regression of cross-section returns on the dividend yield. This contradicts to the literature described above. In the regression, the significant negative coefficients imply that although the relevant shipping companies recorded the lowest returns, they paid the highest dividend yield. This contradiction is in line with the results of Black and Scholes studies, which found that companies should plan their dividend policy regardless any impact on the stocks returns.

Ending their study, they conclude that two factors considered to be more important and found to have a more explanatory power for the returns than the others, the book value of leverage and the average age of the fleet. However they are not limited to these factors bur suggest that there should be a variety of other significantly explanatory factors, such as the shipping freight markets, management decisions and other.

In our attempt, we will try to include the results from Grammenos and Markoulis study in our regression and focus also in their conclusion that other factors such as the shipping freight markets could be used to determine stock returns movement.

A more important contribution to the efforts in determining the factors that can have a significant explanatory power over shipping stock returns, was made in 2002 with the study of Grammenos and Arkoulis " *Macroeconomic Factors and International Shipping stock returns"*.

Their goal in this paper is to examine if significant relationships exist between macroeconomic variables and shipping stock return internationally. In their analysis they interact several global macroeconomic factors with the returns of 36 shipping companies listed in ten different stock exchange markets around the world for the period from December 1989 to March 1998.

The macroeconomic variables that are introduced through their study are selected by having in mind the ten factors that Stopford had identified (see detailed analysis provided in section 3 of this study) as the determinants of the shipping supply and demand equilibrium.

As a result the following macroeconomic variables are incorporated in their multifactor regression

$$R_i - R_f = f(WdRET, UdG10FX, UTLP, UdOIL, UdG71P, LAYUP)$$

a) *the industrial production*, which is reflected in the returns on the world equity market portfolio and more specific the excess return on the world equity market (WdRET), which is the monthly logarithmic return of the Morgan Stanley Capital International World Equity Index (MSCI) in excess of the risk free rate (r_f). The explanatory power of relevant index has been proved already by Harvey, who noticed its significance by testing the returns of the 22 countries that participate in its construction

b) *the foreign exchange risk (UdG10FX)*, is another factor that has been broadly investigated for its ability to explain stocks returns. Relevant studies have been developed where the foreign exchange variable has been incorporated, such as the studies of Ferson and Harvey (1994) and Ziobrowski and Ziobrowski (1995) which reveal a positive relationship between foreign exchange risk and equity returns. Since shipping is an international oriented market, the volatility of foreign exchange rates should not be ignored.

   With his study, McConville supports the impact that exchange rates have on shipping, mainly through the mechanism of freight rates. More specific, since freight rates are traded in US dollars, an appreciation or depreciation of US$ would increase or decrease respectively freight rates levels. Moreover,

movements in exchange rates may affect shipping in general in respect of demand. To be more specific, increase or decrease in exchange rates could make the imports and exports cheaper, resulting to an increase in shipping demand due to the low-cost shipments.

c) *global inflation (UTLP)*, along with foreign exchange risk discussed above, reflects the participation of internationality that defines the shipping market.
d) *oil prices (UdOIL)*, mirror the influence of oil trade in the world economic growth, first through the supply and demand for seaborne trade and second through the impact on the vessels running costs. The influence in seaborne trade is obvious through the historical review over the two oil crisis of 1973 and 1979. In both periods, the sharp increase of oil prices resulted to a significant decline in freight rates. Additionally oil is a vital element of vessel's operating cost reflected in the prices of fuel, bunkers and lubricants. Any changes (increase) in oil prices would have a negative impact on costs and thus on the profitability of shipping companies and their stock returns.
e) *Industrial production (UdG71P)* is considered to have a positive relationship with returns, a consideration that coincides also with the impact of industrial business cycles over shipping, an issue that has been already discussed in previous section. Industrial production is the key parameter determining the demand for seaborne trade and the correlation between industrial growth and returns is expected to be positive.
f) *Laid up tonnage (LAYUP)*, is the final variable and strongly related to the supply and demand model. When economy is at its peak and demand for shipments increases, laid up tonnage declines and freight rates increase. On the other hand in periods of recession and overcapacity of unemployed vessels laid up tonnage increases and freight rates collapse.

The results of the regression, suggests a negative relationship between oil prices and returns and laid up tonnage and returns. A positive relationship is identified with respect to the foreign exchange variable. Unanticipated result was the findings for industrial production and global inflation, which seem to have no effect on the stock returns.

Chapter 5 - Companies' Profile

Following information have been mainly obtained from the web site of "Capital Link" and from the individual web sites of each of the examined companies.

5.1 Tanker Market Companies

Top Ships Inc. (www.toptankers.com)

Top Ships Inc is listed on the NASDAQ National Market under the symbol "TOPS". The company is engaged in liquid and petroleum cargoes and in dry bulk cargoes. Its fleet currently consists from 12 Hundymax double hull tankers and 5 dry bulk carriers the chartering, operational and technical management of which is made by Top Tanker Management Inc., a wholly owned subsidiary company. Top Ships' strategy is focused on optimising return on its investments and maximizing shareholder value by:

- Diversifying its fleet in different sectors and size segments.
- Return driven acquisitions of vessels.
- Maintaining a fleet profile that is best equipped to optimize trading opportunities.
- Following a balanced fleet deployment strategy.
- Expanding its fleet through selective return, as well as vessel specification, driven acquisitions.
- Developing its expanding and dynamic presence in the shipping market and maintaining enduring relationships with major charterers and traders.

StealthGas Inc. (www.stealthgas.com)

StealthGas Inc is listed on the NASDAQ Global select Market and is trading under the symbol "GASS". The company activates in the liquefied petroleum gas (LG)

market. Its vessels mainly operation is to carry petroleum and petrochemical products in liquefied form like butane, butadiene, isopropane, propylene and vinyl chloride monomer. StealthGas owns 45 LPG carriers, 39 of which are currently under operation and 6 are under construction, with a total carrying capacity of 176,999 cbm. The company ranks in the first place international in owned vessels in the 3,000 to 8,000 cbm LPG carrier segment which reflects its mainly strategic focus.

Aegean Marine Petroleum Network Inc (www.ampni.com)

Aegean Marine Petroleum Network Inc. is listed on the New York Stock Exchange (NYSE) under the symbol “ANW”. The company obtains products from refineries, oil producers, and traders and resells them to various customers across all shipping sectors. Aegean has presence in 14 markets, including Vancouver, Montreal, Mexico, Jamaica, West Africa, Gibraltar, U.K., Northern Europe, Piraeus and Patras (Greece), the United Arab Emirates and Singapore. The main strategy of the company for the future is to increase its market share in current shipping locations but also to expand its operations to other locations.

Aries Maritime Transport Ltd. (www.ariesmaritime.com)

Aries Maritime Transport Limited is listed on the NASDAQ Global Market under the symbol “RAMS”. The company transports petroleum products such as gasoline, jet fuel and diesel fuel also transports a range of finished and semi-finished goods. The previous are performed by a fleet of five double-hulled MR tankers, four double-hulled Panamax tankers and three container vessels. Aries' operating strategy is focused on implementing a period charter approach, in an effort to generate stable cash flow and limit earnings volatility

Capital Product Partners L.P. (www.capitalpplp.com)

Capital Product Partners L.P. is listed on the NASDAQ Global Market under the symbol “CPLP”. The company operates on the tanker market and its fleet currently includes 18 modern vessels, comprising 15 MR tankers, two small product tankers and one Suezmax crude oil tanker. All vessels are under medium to long-term charters to BP Shipping Limited, Morgan Stanley Capital Group Inc., Overseas Shipholding Group, Shell International Trading & Shipping Company Ltd., and Trafigura Beheer B.V.

Omega Navigation Enterprises Inc. (www.omeganavigation.com)

Omega Navigation Enterprises Inc. is trading on the NASDAQ National Market under the symbol "ONAV". The company operates on the tanker market and its fleet currently includes eight double hull product tankers with a carrying capacity of 512,358 dwt. Omega’s strategy is based on the following principles

- Generate stable cash flows through time charters.
- Strategically expand the size of its fleet.
- Maintain and grow a high quality fleet of vessels.

Tsakos Energy Navigation Ltd. (www.tenn.gr)

Tsakos Energy Navigation Ltd. is listed on the New York Stock Exchange (NYSE) under the symbol “TNP”. The company is one of the leaders in the tanker sector and its fleet comprises from 3 VLCC, 10 Suezmax, 8 Aframax, 3 Aframax LR, 7

Panamax, 6 Handymax MR, 8 Handysize MR and 1 LNG. According to Tsakos' strategy, the factors that *distinguish* the company *from the other public tanker companies are the following:*

- *Modern and high quality fleet*
- *Diversified fleet*
- *Stability throughout industry cycles*
- *Industry recognition*
- Significant leverage from its relationship with Tsakos Shipping

Teekay LNG Partners L.P (www.teekaylng.com)

Teekay LNG Partners L.P. is trading on the New York Stock Exchange (NYSE) under the symbol "TGP". This partnership was established from Teekay Corporation in order to expand its operation in the LNG and LPG sector. The major objective is to provide high class LNG, LPG and crude oil marine transportation services under long term and fixed rate agreements with chief energy companies. Its fleet today is comprised from fifteen LNG carriers, two LPG carriers and eight Suezmax crude oil tankers.

OSG America L.P. (www.osgamerica.com)

Moving Energy with Integrity

OSG America L.P. is trading on the New York Stock Exchange (NYSE) under the symbol "OSP". The company is the largest operator of U.S. Flag product carriers and ocean-going barges transporting refined petroleum products, based on barrel-carrying capacity. The majority of the company's vessels are trading through the routes of U.S. Gulf, U.S. Gulf to the East Coast and West Coast of the United States, from Alaska to the U.S. West Coast and within the Delaware Bay. The company operates a fleet of twenty two vessels (product carriers an d barges).OSG growth strategy is to:

- Be the market leader in all shipping segments in which it competes
- Optimize its fleet in order to maximize *Return On Invested Capital* in all shipping cycles
- Set the Gold Standard of technical management and
- Maintain financial flexibility in order to expand existing businesses and enter new markets.

Torm (www.torm.com)

Torm is listed on the Copenhagen Stock Exchange under the symbol "TORM.CO" and on the NASDAQ under the symbol "TRMD". On the frames of this paper we will focus on the NASDAQ stock market. The company is one of the leaders in the transportation of refined oil products and a significant member in the dry bulk market. Torm operates a fleet of more than 130 modern vessels, principally through a pooling cooperation with other respected shipping companies who share company's commitment to safety, environmental responsibility and customer service. The vision of the company is to be the most profitable player in the shipping business through the quality of its people, ships and practices.

DHT Maritime (www.dhtankers.com)

DHT Maritime is trading on the New York Stock Exchange (NYSE) under the symbol "DHT". The company's fleet consists of three very large crude carriers (VLCC), two Suezmax and four Aframax tankers. DHT's fleet principally operates on international routes and had a combined carrying capacity of 1,656,921 dwt and a weighted average age of 8.7 years. The company intends to follow a strategy of

providing shareholders with a constant and visible dividend policy and also position the Company to use its incremental cash flow to fund future growth opportunities.

Frontline Ltd (www.frontline.bm)

Frontline Ltd is trading on the New York Stock Exchange (NYSE) under the symbol "FRO". Company's main operation is the transportation of crude oil products and materials like coal and iron ore. The company operates a fleet of fourty six very large crude carriers (VLCC), thirty Suezmax and eight Suezxam Obo carriers (OBO). Frontline's business strategy is primarily based upon the following principles:

- emphasising operational safety and quality maintenance for all of its vessels
- complying with all current and proposed environmental regulations
- outsourcing technical operations and crewing
- achieving low operational costs of vessels
- achieving high utilisation of its vessels
- competitive financing arrangements and
- develop relationship to main charterers.

5.2 Dry Bulk Market Companies

Euroseas Ltd (www.euroseas.gr)

Euroseas Ltd is trading on the NASDAQ Global Market under the symbol "ESEA".The company operates in dry bulk and container shipping sector. Euroseas is managed by the Eurobulk Ltd, an affiliated ship management company which is

responsible for the technical and commercial management of the vessels. The company currently owns a fleet of 16 vessels, 3 Panamax drybulk carriers, 1 Handymax drybulk carrier, 1 handysize drybulk carrier, 3 Intermediate container ship, 5 Handysize container ships, 2 Feeder container ships and a multipurpose dry cargo vessel. Its business strategy is focused on maximizing the shareholders' returns from the carefully and reliably operation of its current vessels and from the strategic acquisition of new drybulk and container vessels. Summarizing, the main strategies of the company is to:

- Renew and Expand its Fleet.
- Maintain Balanced Employment of its fleet.
- Operate a Fleet in Two Sectors (drybulk and container).
- Optimize Use of Financial Leverage.

OceanFreight Inc. (www.oceanfreightinc.com)

Ocean Freight Inc. is listed on the NASDAQ Global Market where it trades under the symbol "OCNF". The company operates in the dry bulk shipping sector and is specialized in the acquisition of high quality second-hand vessels and their deployment in medium and long term charters. OceanFreight currently owns a fleet of 13 vessels, consisting of 1 Capesize bulk carrier, 8 Panamax bulk carriers, 1 Suezmax tanker and 3 Aframax tankers with a total carrying capacity of 1,170,633 dwt.

DryShips Inc. (www.dryships.com)

DryShips Inc. is trading on the NASDAQ Global Market under the symbol "DRYS". The company operates in the drybulk sector and its fleet comprises of 42 vessels, 7 Capesize, 29 Panamax, 3 Supramax and 4 newbuilding drybulk vessels with a combined deadweight tonnage of approximately 3.3 million tons, 2 ultra deep water semi-submersible drilling rigs and 4 ultra deep water newbuilding drillships.

DryShips' strategy is focused on maximizing returns for its shareholders while at the same time ensuring its vessels adhere to the highest safety and environmental standards.

Eagle Bulk Shipping, Inc. (www.eagleships.com)

Eagle Bulk Shipping, Inc. is trading on NASDAQ National Market under the symbol "EGLE". It is the largest U.S based owner of Handymax dry bulk vessels and its fleet comprises from 22 Supramax class vessels and 3 Handymax vessels with a total capacity of 1,295,753 dwt. The company's strategy is to charter its fleet primarily pursuant to one- to three-year time charters to allow them to take advantage of the stable cash flow and high utilization rates that are associated with medium- to long-term time charters.

FreeSeas Inc. (www.freeseas.gr)

FreeSeas Inc. is listed on the NASDAQ Global Market under the symbols "FREE". The company operates on the dry bulk sector through the ownership of seven Handysize and two Handymax vessels. FreeSeas' strategy is focused on the following principles:

- Continue to grow through fleet expansion and accretive transactions
- Maintain a focus on the handysized and handymax segment
- Cultivate a healthy balance sheet with appropriate leverage
- Expand relationships with first-class partners
- Consistently strive for the highest standards in fleet maintenance and safety
- Always seek to enhance shareholder growth and value

Paragon Shipping Inc. (www.paragonship.com)

Paragon Shipping Inc. is trading on the NASDAQ Global Market under the symbols "PRGN". The company operates in dry bulk market and its fleet is trading worldwide carrying a wide range of cargoes as coal, iron ore, steel, grain etc. Currently Paragon owns a fleet of seven Panamax, two Supramax and three Handymax vessels with a total capacity of 765,137 deadweight tons. The company's strategy is focused on delivering shareholder value by maximising returns on its investments while at the same time ensuring its vessels adhere to the highest safety and environmental standards.

Safe bulkers (www.safebulkers.com)

Safe bulkers is trading on the New York Stock Exchange (NYSE) under the symbol "SB". The company provides drybulk transportation services, transporting coal, grain and iron ore along worldwide shipping routes. The company currently owns five Panamax, three Kamsarmax and five Post-Panamax drybulk carriers with total capacity of 1,061,900 dwt.

Seanergy Maritime Holdings Corp. (www.seanergymaritime.com)

Seanergy Maritime Holdings Corp. is trading on the NASDAQ Global Market under the symbol "SHIP". The company is the successor of Seanergy Maritime Corp. and is engaged in the carrying of dry bulk cargoes with a fleet of two Panamax, two Supramax and two Handysize dry bulk carriers with a combined cargo-carrying capacity of 316,676 dwt.

. **Star Bulk Carriers Corp. (www.starbulk.com)**

Star Bulk Carriers Corp. is trading on the Global Market under the symbol “SBLK”. The company provides worldwide seaborne transportation solutions in the dry bulk sector by operating a fleet of four Capesize and eight Supramax dry bulk vessels with an average age of approximately 10.1 years and a combined cargo carrying capacity of 1,106,253 DWT.

Navios Maritime Partners L.P. (www.navios-mlp.com)

Navios Maritime Partners L.P. is listed on the New York Stock Exchange (NYSE) under the symbol “NMM”. The company has been formed by Navios Maritime Holdings Inc. and it operates in dry bulk cargo market by a fleet of nine modern Panamax vessels and one modern Capesize vessel with a total carrying capacity of 702,600 dwt. Its vessels are chartered out under long-term time charters with an average remaining term of approximately 4.6 years to a strong group of charterers.

Diana Shipping Inc. (www.dianashippinginc.com)

Diana Shipping Inc. is trading on the New York Stock Exchange (NYSE) under the symbol “DSX”. The company operates in the transportation of dry bulk cargoes including iron ore, coal and grain. Diana currently owns a fleet of thirteen Panamax vessels and six Capesize vessels. Diana’s main objective is to:

- manage and expand its fleet in a manner that will enable it to enhance shareholder value.
- pursue an appropriate balance of short-term and long-term time charters.
- maintain a strong balance sheet with low leverage.
- maintain low cost, highly efficient operations.

Navios Maritime Holdings Inc. (www.navios.com)

Navios Maritime Holdings Inc. is listed on the New York Stock Exchange (NYSE) under the symbol “NM”. Navios operates mainly in the transport of dry bulk commodities through a fleet of 18 owned bulk carriers vessels and 18 leased (Chartered-in Fleet) dry bulk vessels. Furthermore the company owns and operates the largest bulk terminal in Uruguay -- one of the most successful and prominent operations of its kind in South America. From time to time Navios may be required to offer certain owned Capesize and Panamax vessels to Navios Maritime Partners L.P. for purchase at fair market value according to the terms of the Omnibus Agreement.

Excel Maritime Carriers Ltd (www.excelmaritime.com)

Excel Maritime Carriers Ltd is listed on the New York Stock Exchange (NYSE) under the symbol “EXM”. The company operates on the bulk carriers sector and provides worldwide transportation services to products such as iron ore, coal and grains. Excel owns a fleet of 40 vessels and, together with 7 Panamax vessels under bareboat charters, operates 47 vessels (21 Panamax, 14 Kamsarmax, 2 Supramax, 5 Handymax and 5 Capesize vessels) with a total carrying capacity of approximately 3.9 million DWT. The company’s motto is "to provide a world class shipping service, meeting the individual requirements of our Clients, while adding value and sustaining growth of the organization on behalf of the shareholders and operating safely and efficiently with regard to employees and the environment"

Genco Shipping & Trading Limited (www.gencoshipping.com)

Genco Shipping & Trading Limited is trading on the New York Stock Exchange (NYSE) under the symbol “GNK”. The company operates in the drybulk shipping

industry and its major business is the transportation of iron ore, coal, grain, steel products and other drybulk cargoes along worldwide shipping routes. The fleet of the company is comprised of five Capesize, eight Panamax, four Supramax, six Handymax and eight Handysize drybulk carriers, with an aggregate carrying capacity of approximately 2,226,500 dwt. The business strategy of the company is to maintain and increase the high quality of its fleet in order to comply with charterer requirements and subsequently to enable the payment of dividends to shareholders.

5.3 Containership Market Companies

Danaos Corporation (www.danaos.com)

Danaos Corporation is trading on the New York Stock Exchange (NYSE) under the symbol "DAC". The company is between the largest in the container shipping market and charters its vessels to the world's prime liner companies including Maersk, CMA-CGM, Yang Ming, China Shipping, Hanjin, MSC, ZIM, Hyundai Merchant Marine Co. and United Arab Shipping Co. Its fleet currently comprises from 40 container vessels with an aggregate capacity of 161,680 TEU. Danaos' mainly strategy is to grow its business, increase earnings and maximize value for its shareholders by pursuing the following strategies:

- Provide a high level of customer service.
- Maintain a diverse portfolio of charters.
- Actively acquire newly built and secondhand vessels.
- Continue to invest in larger containerships and deploy them under long-term charters.

Horizon Lines, Inc. (www.horizonlines.com)

Horizon Lines Inc. is trading on the New York Stock Exchange (NYSE) under the symbol "HRZ". The company is comprised of two operating subsidiaries:

- Horizon Lines LLC, operates a fleet of twenty-one containership and five port terminals which link United States with Alaska, Hawaii, Guam, Micronesia and Puerto Rico
- Horizon Logistics, LLC, offers a variety of logistic solutions to its customers which include Aero Logistics, information technology developed by Horizon Services Group and intermodal trucking and warehousing services provided by Sea-Logix. Horizon Lines, Inc.

The main goal for the company is to develop pioneering logistics solutions for its customers that expand supply procession efficiency and create competitive advantage.

Seaspan Corporation (www.seaspancorp.com)

Seaspan Corp. is trading on the New York Stock Exchange (NYSE) under the symbol "SSW". Seaspan's fleet consists of 68 containerships, 39 of which are already in operation and 29 will be delivered in the next three years. The competitive strength of the company is that its operating fleet has an average remaining charter period of approximately seven years with the world's largest liner companies, including China Shipping Container Lines (Asia) Co. Ltd., Hapag Lloyd AG, Cosco Container Lines Co., Ltd., Mitsui O.S.K. Lines Ltd. and A.P. Møller-Mærsk A/S.

Chapter 6 - Methodology and Data Description

In our study we will attempt to identify the determinants of the shipping stock returns, by developing a multi-factor model similar to those described above. For the selection of the explanatory variables we try to incorporate elements from the considerations of Martin Stopford with regard to the factors that determine the supply and demand model in shipping market. Moreover based on the regression results of the abovementioned studies, we select to include variables that were found to be statistical significant in these studies.

The study applies for a number of 29 publicly quoted shipping companies as outlined in Table 3 below, listed in the American stock exchange markets, NASDAQ and NYSE. We selected 21 Greek shipping companies and 8 foreign. As mentioned in the introduction, we focus on the Greek owned fleet, due to its significant market share that possess worldwide.

Additionally, due to the fact that shipping industry is segmented (distinguished in dry bulk, tanker and containership market), we considered appropriate to include in our sample test companies that operate in each of the relevant sub-sectors and test them separately since each sector has its own market characteristics and might interact in a different manner with the respective variables used in the regressions.

In the following tables we present the Companies included in our sample, categorised based on the sub sector in which they corporate. Additional information is included concerning the relevant stock exchange market in which their stocks are traded and their nationality distinguished between Greek and foreign.

- **Tanker Market**

Company	**Stock Exchange Market**	**Ownership**
Top Ships Inc.	NASDAQ	Greek
Stealthgas Inc	NASDAQ	Greek
Aegean Marine Petroleum	NYSE	Greek
Aries Maritime Transport Limited	NASDAQ	Greek

Company	Stock Exchange Market	Ownership
Capital Product Partners	NASDAQ	Greek
Company	**Stock Exchange Market**	**Ownership**
Omega Navigation Enterprises Inc.	NASDAQ	Greek
Tsakos Energy Navigation	NYSE	Greek
Teekay LNG Partners L.P	NYSE	Foreign
OSG America L.P	NYSE	Foreign
TORM	NASDAQ	Foreign
DHT Maritime	NYSE	Foreign
Frontline	NYSE	Foreign

- **Dry Bulk Market**

Company	Stock Exchange Market	Ownership
Euroseas Ltd	NASDAQ	Greek
Oceanfreight	NASDAQ	Greek
Dryships	NASDAQ	Greek
Eagle Bulk Shipping	NASDAQ	Greek
Freeseas	NASDAQ	Greek
Paragon Shipping Inc.	NASDAQ	Greek
Safe Bulkers	NYSE	Greek
Seanergy Maritime	NASDAQ	Greek
Star Bulk Carriers Corp.	NASDAQ	Greek
Navios Maritime Partners L.P	NYSE	Greek
Dianna Shipping	NYSE	Greek
Navios Maritime Holdings Inc	NYSE	Greek
Excel Maritime Carriers Ltd	NYSE	Greek
Genco Shipping & Trading Ltd	NYSE	Foreign

- **Containers Market**

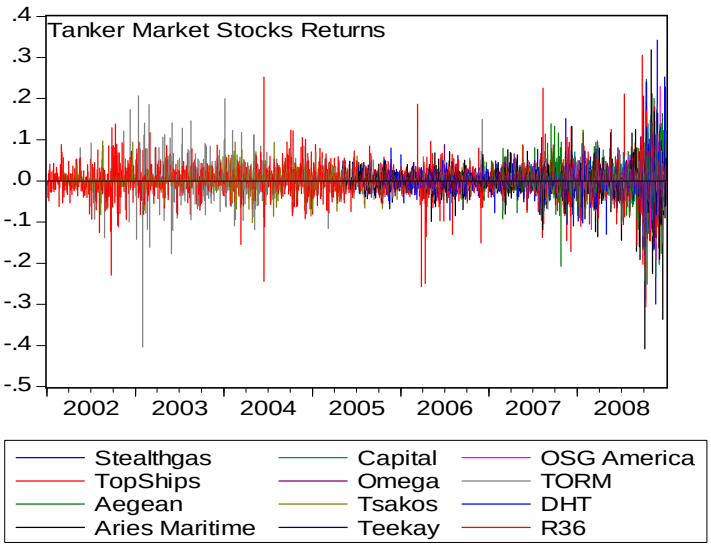
Company	Stock Exchange Market	Ownership
Danaos Corporation	NYSE	Greek
Horizon Lines Inc	NYSE	Foreign
Seaspan Corporation	NYSE	Foreign

The share prices of each Company were collected from the Datastream Service for the period from January 2002 to December 2008. We calculated daily continuously compounded returns using natural logarithms with the formula $\ln(\frac{P_t}{P_{t-1}})$ where P_t is this day's share price and P_{t-1} is the previous day's share price. Taking logarithms stabilizes the variances of the series, and reduces the impact of heteroscedasticity.

The descriptive statistics of the returns of each stock are outlined in the following tables:

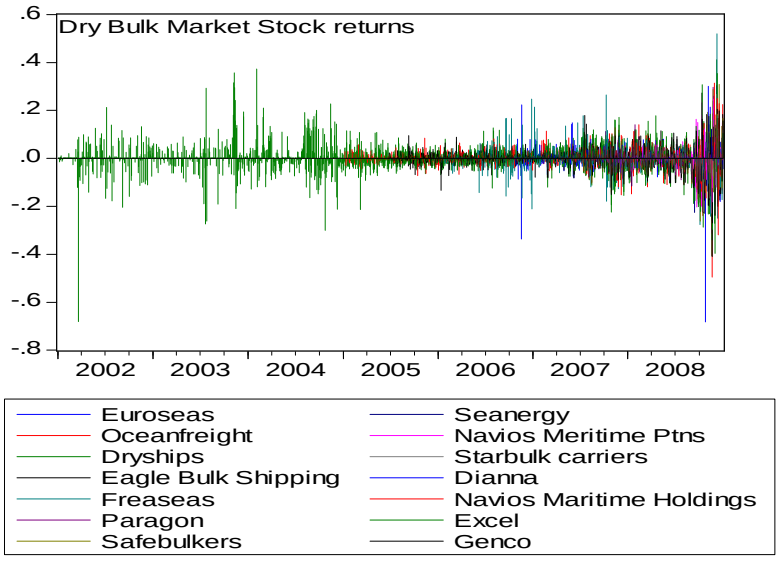
- Descriptive Statistics for Tanker Market Companies returns

Company	Mean	Std Deviation	Skewness	Kurtosis	Observations
Top Ships	-0.002	0.042	-0.336	13.56	1158
Stealthgas Inc	-0.001	0.035	0.166	33.24	844
Aegean Marine Petroleum	0.000	0.051	-0.378	7.72	538
Aries Maritime Transport Limited	-0.004	0.042	-1.406	23.46	933
Capital Product Partners	-0.003	0.038	0.416	9.34	458
Omega Navigation Enterprises Inc.	-0.001	0.029	-0.243	12.76	713
Tsakos Energy Navigation	0.000	0.023	-0.375	7.90	1781
Teekay LNG Partners L.P	0.000	0.024	1.101	22.62	954
OSG America L.P	-0.004	0.037	0.413	12.33	298
TORM	0.001	0.036	-0.729	18.78	1730
DHT Maritime	-0.001	0.030	0.474	12.99	839
Frontline	0.001	0.034	-0.375	9.29	1826



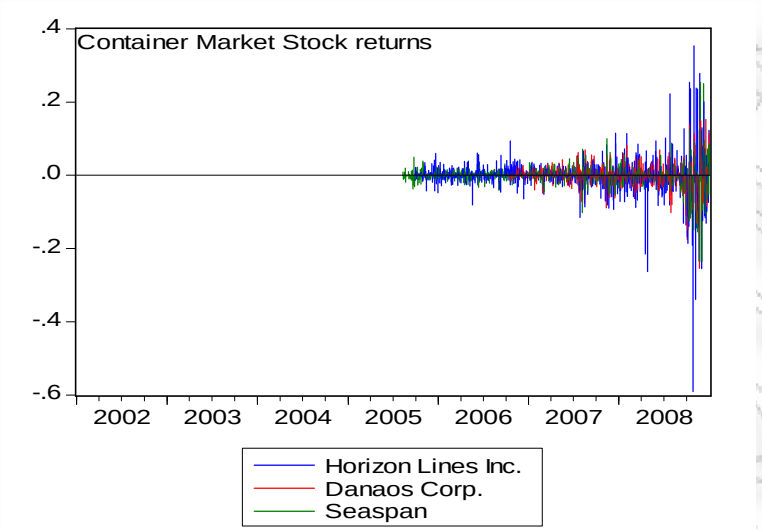
- Descriptive Statistics for Dry Bulk Market Companies returns

Company	Mean	Std Deviation	Skewness	Kurtosis	Observations
Euroseas Ltd	-0.001	0.045	-0.437	11.22	583
Oceanfreight	-0.004	0.062	-1.076	17.12	440
Dryships	-0.001	0.052	-0.354	15.44	1019
Eagle Bulk Shipping	-0.001	0.045	-0.919	18.70	919
Freeseas	-0.002	0.053	0.969	19.36	793
Paragon Shipping Inc.	-0.003	0.056	0.108	9.04	363
Safe Bulkers	-0.007	0.077	0.519	7.25	154
Seanergy Maritime	-0.002	0.027	-2.385	24.47	308
Star Bulk Carriers Corp.	-0.006	0.051	0.046	8.51	282
Navios Maritime Partners L.P	-0.003	0.047	0.372	11.64	296
Dianna Shipping	-0.001	0.045	-11.486	197.98	275
Navios Maritime Holdings Inc	0.000	0.039	-0.417	7.94	1039
Excel Maritime Carriers Ltd	0.000	0.060	-0.505	18.74	1826
Genco Shipping & Trading Ltd	0.000	0.046	-0.808	18.60	898



- Descriptive Statistics for Containers Market Companies returns

Company	Mean	Std Deviation	Skewness	Kurtosis	Observations
Danaos Corporation	-0.002	0.036	-0.709	12.76	583
Horizon Lines Inc	-0.001	0.051	-1.624	33.44	851
Seaspan Corporation	-0.001	0.031	-0.321	23.50	886



The variables used in our multi factor model for the determination of shipping stock returns derive from a combination of the macroeconomic factors that Martin Stopford identifies to have a strong explanatory power over the supply and demand in shipping and consequently over the price performance of shipping stocks, and the variables that were found statistical significant in the previous studies described in the literature overview section.

Having the macroeconomic factors as background we develop our multifactor model that expresses mathematically the relevant relationships:

$$R_i = F(rMSCI, rOIL, rUSEURO, rUSYEN, rUSCAD, rUSSEC, rUSCHF, rUSGBP \\ rBDI, rBDCT, rBDDT, rBCAP, rBHAN, rBPAN, rBSUP, rCOAL, rAGRI, rIRON) \quad \textbf{(1)}$$

Where R_i, is the return of Company i and:

a) **rMSCI** is the daily logarithmic return of the Morgan Stanley Capital International (MSCI) World Equity Index.

MSCI has been selected in order to incorporate the element of World economy and reflect the significance of the 1st macroeconomic factor that Stopford identifies to be the first that determines the shipping demand. However, apart from Stopford, other scientists, like Harvey, have used MSCI as a determinant variable for stock returns movement, and the results were rather disappointing.

b) **rOIL** is the daily logarithmic return of Crude oil , which is measured in us$/bbl (USD per barrel). Oil prices are found to interact with stock returns in various studies. The question is in which direction this variable affects returns. Is there a positive or negative relationship? As literature section reveals previously, findings have been conflicting.

c) **rUSEURO** is the daily logarithmic return of USEURO exchange rate (Euro to US$). As already mentioned due to the international feature of shipping, the foreign exchange factor plays an important role in shipping stocks performance. Since the companies entered in the regression are traded in US exchange markets, we have used the foreign exchange rates of the G-10 industrialized countries (Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, United Kingdom) against US dollar. Since our sample period starts from January 2002, the day when Euro was officially adopted in European Nation, we have additionally calculated daily logarithmic returns for exchange rates for the local currencies of Japan

(**rUSYEN**), Canada (**rUSCAD**), Sweden (**rUSSEK**), Switzerland (**rUSCHF**), United Kingdom (**rUSGBP**).

d) **rBDI** represents the daily logarithmic return of Baltic Dry Index,

rBDCT represents the daily logarithmic return of Baltic Clean Tanker Index,

rBDDT represents the daily logarithmic return of Baltic Dirty Tanker Index,

rBCAP represents the daily logarithmic return of Baltic Capesize Index,

rBHAN represents the daily logarithmic return of Baltic Handysize Index,

rBPAN represents the daily logarithmic return of Baltic Panamax Index and

rBSUP represents the daily logarithmic return of Baltic Supramax Index.

The Baltic Indicess reflect the contribution of the freight rates in the stocks returns movement.

e) **rCOAL, rAGRI** and **rIRON** are the daily logarithmic return on relevant commodities prices. The input of these variables stands for their impact on the demand for seaborne commodity trades. As per our analysis in previous section, these are the most commonly traded commodities in different routes around the globe.

The summary statistics for the returns of the independent variables are outlined in the following table:

- Descriptive statistics for the returns of independent variables

Independent Variable / Factor	Mean Return	Std Deviation	Skewness	Kurtosis	Observations
R_MSCI	0.000	0.011	-0.298	12.87	1826
R_OIL	0.000	0.022	-0.019	4.96	1826
R_USEUR	0.000	0.006	-0.086	4.97	1826
R_USYEN	0.000	0.006	-0.688	7.17	1826
R_USCAD	0.000	0.007	-0.287	8.51	1826
R_USSEK	0.000	0.006	-0.094	10.71	1826
R_USCHF	0.000	0.007	-0.156	7.00	1826
R_USGBP	0.000	0.006	0.216	7.80	1826
R_BDI	0.000	0.016	-1.401	11.51	1826
R_BDCT	0.000	0.013	0.893	8.03	1826
R_BDDT	0.000	0.022	0.033	7.86	1826
R_BCAP	0.000	0.023	-0.980	13.96	1826
R_BHAN	-0.002	0.016	-3.006	19.22	681
R_BPAN	0.000	0.022	-1.601	16.53	1826
R_BSUP	-0.002	0.017	-2.187	15.46	913
R_COAL	0.000	0.019	-2.584	141.86	1826
R_AGRI	0.000	0.015	-0.811	8.85	562
R_IRON	-0.001	0.042	-8.367	140.06	334

- Unit Root testing

Testing for units roots in time series has become a standard tool in modern econometric data analysis. Since conventional statistical analysis assumes that the time series at hand are stationary, and since a unit root implies non-stationarity, it is important to test for unit root. Unit Root test is the most usual method of testing the stationarity of a series.

Consequently, before proceeding with estimating the regression it is considered appropriate to ensure that the time series used, for both dependent and independent variables are *stationary*. A series is said to be stationary if the mean and autocovariances of the series do not depend on time.

Several unit root test methods are available in the literature. We will test stationarity by applying the Augmented Dickey Fuller (ADF) method, since it is widely applied.. Based on the ADF method and considering the equation of a simple AR(1) process $y_t = \rho_{yt-1} + x_t'\delta + \varepsilon_t$, unit root exists when the null hypothesis is accepted, that is ρ=1, implying that is affected by previous period y_{t-1}.

By running unit root tests for all stock prices and independent variables values, we noted that null hypothesis was accepted and that unit root was present (see test results in the following talbles)

- Unit Root test using the Augmented Dickey Fuller method for Tanker Market stock prices

Company	**T-statistic***	**Test result**
Top Ships Inc.	-3.46	No unit root
Stealthgas Inc	-0.39	Unit root
Aegean Marine Petroleum	-1.16	Unit root
Aries Maritime Transport Ltd	-2.96	Unit root
Capital Product Partners	-2.54	Unit root
Omega Navigation Enterprises Inc.	-0.66	Unit root
Tsakos Energy Navigation	-1.14	Unit root
Teekay LNG Partners L.P	-1.27	Unit root
OSG America L.P	-1.60	Unit root
TORM	0.38	Unit root
DHT Maritime	-1.49	Unit root
Frontline	-1.93	Unit root

***t-statistics : critical value at 1% significance level**

- Unit Root test using the Augmented Dickey Fuller method for Dry-Bulk Market stock prices

Company	T-statistic*	Test result
Euroseas Ltd	-1.00	Unit root
Oceanfreight	-1.08	Unit root
Dryships	-0.86	Unit root
Eagle Bulk Shipping	-0.46	Unit root
Company	**T-statistic***	**Test result**
Freeseas	-0.81	Unit root
Paragon Shipping Inc.	-2.12	Unit root
Safe Bulkers	-1.31	Unit root
Seanergy Maritime	-1.42	Unit root
Star Bulk Carriers Corp.	-1.06	Unit root
Navios Maritime Partners L.P	-2.21	Unit root
Dianna Shipping	-2.59	Unit root
Navios Maritime Holdings Inc	-0.78	Unit root
Excel Maritime Carriers Ltd	-2.19	Unit root
Genco Shipping & Trading Ltd	-0.61	Unit root

***t-statistics : critical value at 1% significance level**

- Unit Root test using the Augmented Dickey Fuller method for Containership Market

Company	T-statistic*	Test result
Danaos Corporation	-1.07	Unit root
Horizon Lines Inc	-0.67	Unit root
Seaspan Corporation	0.07	Unit root

***t-statistics : critical value at 1% significance level**

- Unit Root test using the Augmented Dickey Fuller method for the Independent Variables prices

Independent Variable / Factor	T-statistic*	Test result
MSCI	0.08	Unit root
OIL	0.34	Unit root
USEUR	-2.20	Unit root
USYEN	-1.84	Unit root
USCAD	-0.70	Unit root
USSEK	-1.41	Unit root
USCHF	-2.75	Unit root
USGBP	1.55	Unit root
BDI	-0.61	Unit root

Independent Variable / Factor	T-statistic*	Test result
BDCT	-4.46	Unit root
BDDT	-3.75	Unit root
BCAP	-1.38	Unit root
BHAN	-0.74	Unit root
BPAN	-0.66	Unit root
BSUP	-0.45	Unit root
COAL	-3.05	Unit root
AGRI	-0.33	Unit root
IRON	-1.43	Unit root

***t-statistics : critical value at 1% significance level**

The results shown in the previous tables, after applying Unit root tests over the stock prices and the values of the independent variables are the reason, for which, as already discussed, we have selected to regress natural logarithms with the formula $\ln(\frac{P_t}{P_{t-1}})$ where P_t is this day's share price (and the independent variable price) and P_{t-1} is the previous day's share price or variable price.

To prove now that with the use of natural logarithms unit root does no longer exist, we provide the following tables where the results from unit root tests over the returns of each of the stocks and each variable are presented.

- Unit Root test using the Augmented Dickey Fuller method for Tanker Market stock returns ($\ln(\frac{P_t}{P_{t-1}})$ **)**

Company	T-statistic*	Test result
Top Ships Inc.	-34.24	No unit root
Stealthgas Inc	-14.77	No unit root
Aegean Marine Petroleum	-22.64	No unit root
Aries Maritime Transport Ltd	-30.11	No unit root
Capital Product Partners	-19.08	No unit root
Omega Navigation Enterprises Inc.	-24.46	No unit root
Tsakos Energy Navigation	-39.51	No unit root
Teekay LNG Partners L.P	-15.66	No unit root
OSG America L.P	-16.25	No unit root
TORM	-42.21	No unit root
DHT Maritime	-32.39	No unit root
Frontline	-42.03	No unit root

***t-statistics : critical value at 1% significance level**

- Unit Root test using the Augmented Dickey Fuller method for Dry- Bulk Market stock returns ($\ln(\frac{P_t}{P_{t-1}})$)

Company	T-statistic*	Test result
Euroseas Ltd	-24.29	No unit root
Oceanfreight	-20.13	No unit root
Dryships	-10.81	No unit root
Eagle Bulk Shipping	-25.47	No unit root
Freeseas	-29.88	No unit root
Paragon Shipping Inc.	-12.22	No unit root
Safe Bulkers	-9.66	No unit root
Seanergy Maritime	-15.84	No unit root
Star Bulk Carriers Corp.	-13.08	No unit root
Navios Maritime Partners L.P	-13.38	No unit root
Dianna Shipping	-16.49	No unit root
Navios Maritime Holdings Inc	-31.59	No unit root
Excel Maritime Carriers Ltd	-39.11	No unit root
Genco Shipping & Trading Ltd	-27.40	No unit root

***t-statistics : critical value at 1% significance level**

- Unit Root test using the Augmented Dickey Fuller method for Containers Market stock returns ($\ln(\frac{P_t}{P_{t-1}})$)

Company	T-statistic*	Test result
Danaos Corporation	-21.73	No unit root
Horizon Lines Inc	-11.69	No unit root
Seaspan Corporation	-15.44	No unit root

***t-statistics : critical value at 1% significance level**

- Unit Root test using the Augmented Dickey Fuller method in case of the independent variables ($\ln(\frac{P_t}{P_{t-1}})$)

Independent Variable / Factor	T-statistic*	Test result
R_MSCI	-31.34	No unit root
R_OIL	-44.25	No unit root
R_USEUR	-44.26	No unit root
R_USYEN	-44.10	No unit root
R_USCAD	-41.79	No unit root
R_USSEK	-31.88	No unit root
R_USCHF	-44.06	No unit root
R_USGBP	-40.80	No unit root
R_BDI	-14.35	No unit root
R_BDCT	-10.25	No unit root
R_BDDT	-19.46	No unit root
R_BCAP	-17.34	No unit root
R_BHAN	-5.06	No unit root
R_BPAN	-17.30	No unit root
R_BSUP	-6.75	No unit root
R_COAL	-5.21	No unit root
R_AGRI	-22.63	No unit root
R_IRON	-22.01	No unit root

After testing for stationarity in the time series through unit root test and adjusted instationarity observed by using natural logarithms ($\ln(\frac{P_t}{P_{t-1}})$, we proceed with estimating the equations.

A) Estimation Results from regression (1)

$$R_i = c_{1i} + c_{2i}rMSCI + c_{3i}rOIL + c_{4i}rUSEURO + c_{5i}rBDI + c_{6i}rBDCT + c_{7i}BDDT + c_{8i}rBCAP + c_{9i}rBHAN + c_{10i}rBPAN + c_{11i}rBSUP + c_{12i}rCOAL + c_{13i}rAGRI + c_{14i}rUSYEN + c_{15i}rUSCAD + c_{16i}rUSSEK + +c_{17i}rUSCHF + c_{18i}rUSGBP + \varepsilon_i \quad \textbf{(1)}$$

The tables below present the time-series estimated coefficients from the above regression on each of the explanatory variables per shipping sector. As significant have been considered variables with probability levels lower than 0,001 and 0,005 indicating significance at the 1% and 5% level respectively. Furthermore since the size of sample X-values present large variations we are dealing with heteroscedasticity (i.e the disturbance variance is no longer a constant). As a result equations have been corrected for heteroscedasticity using the White heteroscedasticity (White 1980) consistent covariance estimates.

Additionally, the assumption of $Cov(e_i, e_j) = 0$ of the classical multiple regression model seems to remain unchanged, since the guide to whether autocorrelation is present, Durbin - Watson Statistic, is close to 2 for all estimated equations.

Table 1A: Coefficients of estimated equation (1) for Tanker Market, period from 1/1/2002 to 31/12/2008

Company	R_MSCI	R_OIL	R_USEUR	R_BDI	R_BDCT	R_BDDT	R_BCAP	R_BHAN	R_BPAN	R_BSUP	R_COAL	R_AGRI	R_USYEN	R_USCAD	R_USSEK	R_USCHF	R_USGBP
Top Ships Inc.	1.13*	0.05	0.61	-0.58	-0.12	0.01	0.22	-0.17	0.22	0.67**	-0.20**	0.27	0.18	-0.17	0.55	-0.31	-0.57
Stealthgas Inc	1.04*	0.26**	1.30	-1.01	-0.05	-0.03	0.42	0.17	0.06	0.42	0.02	0.21	0.24	0.01	0.91	-1.05	-0.83
Aegean Marine Petroleum	2.10*	-0.05	0.35	-0.58	-0.05	-0.06	0.40	-0.06	0.07	0.38	0.08	0.32**	-0.57	-0.16	0.36	-0.82	-0.28
Aries Maritime Transport Ltd	0.43	0.17	-0.53	-0.21	-0.08	-0.04	0.08	0.22	-0.07	0.17	-0.24	0.03	0.94	-0.21	0.53	0.24	-1.06
Capital Product Partners	1.25*	0.16	0.57	0.79	-0.12	0.05	-0.31	0.02	-0.22	-0.38	-0.10	0.09	-0.06	-0.17	0.69	-0.16	-1.05*
Omega Navigation Enterprises Inc.	1.37*	0.07	0.12	0.98	-0.04	-0.05	-0.37	-0.25	-0.20	0.01	-0.16**	0.15	0.00	-0.26	0.82**	-0.51	0.22
Tsakos Energy Navigation	1.15*	0.06	0.02	-0.20	0.05	-0.02	0.12	-0.17	0.03	0.16	-0.03	0.22*	-0.37**	-0.18	0.34	0.03	-0.39**
Teekay LNG Partners L.P	1.09*	0.11	0.52	0.72	-0.14**	-0.03	-0.31	0.22	-0.19	-0.48	-0.18*	0.22**	-0.17	-0.16	0.60	-0.72	-0.33
OSG America L.P	0.87*	0.26**	1.12*	-0.11	-0.09	-0.05	0.12	0.38	0.00	-0.34	-0.03	0.20	0.07	-0.32	0.45	-0.66	-0.59
TORM	1.72*	-0.08	-1.08*	0.17	0.06	-0.02	0.00	-0.11	-0.09	0.08	-0.03	0.12	0.21	-0.18	0.86*	-0.65	-0.08
DHT Maritime	1.49*	-0.05	-0.41	-0.08	0.08	0.01	0.09	-0.18	-0.03	0.15	0.00	0.22**	-0.24	-0.48**	0.47	0.33	-0.43
Frontline	1.60*	0.15**	-0.24	-0.85	-0.04	0.04	0.37	-0.13	0.19	0.41	0.00	0.21**	-0.27	-0.04	0.53	-0.39	-0.02

Notes:

1. The table displays the coefficients of the independent variables of the equation (1) estimated for the Tanker Market Companies

$$R_i = c_{1i} + c_{2i} rMSCI + c_{3i} rOIL + c_{4i} rUSEURO + c_{5i} rBDI + c_{6i} rBDCT + c_{7i} BDDT + c_{8i} rBCAP + c_{9i} rBHAN + c_{10i} rBPAN + c_{11i} rBSUP + c_{12i} rCOAL + c_{13i} rAGRI + c_{14i} rUSYEN + c_{15i} rUSCAD + c_{16i} rUSSEK + + c_{17i} rUSCHF + c_{18i} rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

Table 1B: Coefficients of estimated equation (1) for Dry Bulk Market, period from 1/1/2002 to 31/12/2008

Company	R_MSCI	R_OIL	R_USEUR	R_BDI	R_BDCT	R_BDDT	R_BCAP	R_BHAN	R_BPAN	R_BSUP	R_COAL	R_AGRI	R_USYEN	R_USCAD	R_USSEK	R_USCHF	R_USGBP
Euroseas Ltd	1.64*	0.03	0.22	0.22	-0.13	-0.02	0.05	0.07	-0.11	0.02	-0.02	0.15	-0.30	-0.08	0.47	-0.19	-0.15
Oceanfreight	2.20*	-0.18	1.12	-2.97	0.03	0.07	1.40	0.12	0.83	0.83	-0.20	0.59*	-0.91	-0.45	0.14	-0.13	-0.09
Dryships	3.02*	0.04	0.75	-0.68	0.22	-0.10	0.76	0.02	0.10	-0.01	-0.04	0.44*	-0.70	0.02	0.37	-0.68	-0.62
Eagle Bulk Shipping	2.57*	-0.05	0.90	-0.67	0.01	-0.05	0.61	-0.08	0.24	0.06	-0.15	0.39*	-0.28	0.10	1.03	-1.21	-0.96**
Freeseas	1.67*	0.00	0.34	-0.87	-0.18	-0.02	0.63	0.12	0.16	0.16	-0.09	0.08	-0.01	0.34	1.29	-0.79	-1.34**
Paragon Shipping Inc.	2.26*	0.03	0.89	-0.87	-0.12	-0.07	0.59	0.07	0.09	0.19	0.04	0.20	0.03	0.00	0.27	-1.02	0.19
Safe Bulkers	1.42*	0.16	-1.21	-3.72	-0.64	-0.15	1.74	0.44	0.99	0.96	-0.29**	-0.06	0.24	-1.04	1.46	-2.59	0.86
Seanergy Maritime	0.40*	0.18	-0.03	1.12	-0.13	-0.05	-0.43	-0.01	-0.27	-0.18	-0.13	-0.11	0.59	0.10	0.81**	-1.08**	0.32
Star Bulk Carriers Corp.	1.49*	-0.02	0.94	-1.81	-0.16	-0.01	1.03	0.16	0.49	0.37	-0.09*	0.28**	-0.64	-0.27	-0.44	0.14	-0.35
Navios Maritime Partners L.P	1.10*	0.10	0.80	-0.41	0.38	0.03	0.32	0.27	0.05	-0.42	0.00	0.43*	-0.52	-0.26	0.38	-0.29	-0.14
Dianna Shipping	-0.20	0.07	-1.25	1.15	-0.34	-0.04	-0.60	-0.44	-0.10	0.16	-0.05	-0.27	1.64	0.56	0.34	-0.04	-0.58
Navios Maritime Holdings Inc	2.03*	-0.04	0.13	-1.76	0.03	0.01	1.06	0.11	0.40	0.46	0.05	0.29**	-0.13	0.06	1.22**	-1.42**	-0.25
Excel Maritime Carriers Ltd	2.90*	-0.02	0.56	-1.21	0.16	-0.09	0.90	0.01	0.44	-0.08	0.08	0.45*	-1.09	0.59	0.25	0.42	-1.45*
Genco Shipping & Trading Ltd	2.81*	-0.06	0.03	0.87	0.07	-0.04	-0.03	-0.60	-0.14	0.09	-0.07	0.32**	-0.54	0.34	1.20**	-0.93	-1.15**

Notes:

1. The table displays the coefficients of the independent variables of the equation (1) estimated for the Dry Bulk Market Companies

$$R_i = c_{1i} + c_{2i} rMSCI + c_{3i} rOIL + c_{4i} rUSEURO + c_{5i} rBDI + c_{6i} rBDCT + c_{7i} BDDT + c_{8i} rBCAP + c_{9i} rBHAN + c_{10i} rBPAN + c_{11i} rBSUP + c_{12i} rCOAL + c_{13i} rAGRI + c_{14i} rUSYEN + c_{15i} rUSCAD + c_{16i} rUSSEK + + c_{17i} rUSCHF + c_{18i} rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

Table 1C: Coefficients of estimated equation (1) for Containership Market, period from 1/1/2002 to 31/12/2008

Company	R_MSCI	R_OIL	R_USEUR	R_BDI	R_BDCT	R_BDDT	R_BCAP	R_BHAN	R_BPAN	R_BSUP	R_COAL	R_AGRI	R_USYEN	R_USCAD	R_USSEK	R_USCHF	R_USGBP
Danaos Corporation	1.25*	0.04	0.95**	0.42	-0.06	0.06	-0.2	0.27	-0.02	-0.39	-0.14**	0.27**	-0.43	-0.06	-0.54	-0.15	-0.28
Horizon Lines Inc	2.86*	-0.3	-0.17	0.28	-0.08	-0.15**	-0.2	0.11	-0.29	0.23	0	-0.03	-1.79**	-0.24	-0.71	0.99	0.33
Seaspan Corporation	1.36*	-0.16	1.53**	-0.56	-0.02	-0.03	0.37	0.26	0.06	0.03	-0.12	0.40*	-0.61	-0.25	-1.03	0.24	-0.64

Notes:

1. The table displays the coefficients of the independent variables of the equation (1) estimated for the Containerships Companies

$$R_i = c_{1i} + c_{2i} rMSCI + c_{3i} rOIL + c_{4i} rUSEURO + c_{5i} rBDI + c_{6i} rBDCT + c_{7i} BDDT + c_{8i} rBCAP + c_{9i} rBHAN + c_{10i} rBPAN + c_{11i} rBSUP + c_{12i} rCOAL + c_{13i} rAGRI + c_{14i} rUSYEN + c_{15i} rUSCAD + c_{16i} rUSSEK + + c_{17i} rUSCHF + c_{18i} rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

With regard to the multi factor variables, assumptions of the classical model of *multiple regression* state that there should exist no linear relationship between the sample values of the explanatory variables. We tested its existence by examining the simple correlation between the sample values. Multicollinearity has been detected with regard to the freight rate indexes variables.

After running the Correlation Matrix for the relevant variables we have the following results:

Correlation Matrix for Baltic Indices	**R_BCAP**	**R_BDCT**	**R_BDDT**	**R_BDI**	**R_BHAN**	**R_BPAN**	**R_BSUP**
R_BCAP	1						
R_BDCT	0.13419	1					
R_BDDT	-0.00415	0.20528	1				
R_BDI	0.89736	0.18316	0.01186	1			
R_BHAN	0.38814	0.24849	0.14202	0.63623	1		
R_BPAN	0.52966	0.13035	-0.02541	0.80297	0.49183	1	
R_BSUP	0.38074	0.21865	0.10619	0.64002	0.81991	0.50262	1

Auto Correlation Matrix for the Baltic Indices reveals autocorrelation between

(BCAP – BDI), (BPAN – BDI) , (BSUP – BDI) and (BHAN – BSUP).

As a result in order to eliminate autocorrelation in sample values, we rerun the regression

by entering the equation (1) only the Baltic Dry Index (BDI), Baltic Clean Tanker Index (BDCT) and Baltic Dirty Tanker Index (BDDT).

B) Estimation Results from regression (2) (modified to correct multicollinearity)

$$R_i = c_{1i} + c_{2i}rMSCI + c_{3i}rOIL + c_{4i}rUSEURO + c_{5i}rBDI + c_{6i}rBDCT + c_{7i}BDDT + c_{8i}rCOAL + c_{9i}rAGRI + c_{10i}rUSYEN + c_{11i}rUSCAD + c_{12i}rUSSEK + c_{13i}rUSCHF + c_{14i}rUSGBP + \varepsilon_i \quad \textbf{(2)}$$

Table 2A: Coefficients of estimated equation (2) for Tanker Market, period from 1/1/2002 to 31/12/2008

Company	R_MSCI	R_OIL	R_USEUR	R_BDI	R_BDCT	R_BDDT	R_COAL	R_AGRI	R_USYEN	R_USCAD	R_USSEK	R_USCHF	R_USGBP
Top Ships Inc.	1.11*	0.06	0.76	0.22	-0.08	0.02	-0.19**	0.32**	0.25	-0.08	0.51	-0.31	-0.54
Stealthgas Inc	1.09*	0.26**	1.38**	-0.10	-0.01	0.00	0.02	0.25	0.26	0.05	0.92	-1.06	-0.85
Aegean Marine Petroleum	2.15*	-0.04	0.42	0.18	-0.04	-0.05	0.08	0.34**	-0.56	-0.11	0.36	-0.85	-0.24
Aries Maritime Transport Limited	0.46	0.18	-0.50	0.01	-0.02	-0.02	-0.23	0.06	0.96	-0.19	0.55	0.25	-1.13**
Capital Product Partners	1.25*	0.16	0.49	-0.04	-0.15	0.04	-0.11	0.06	-0.09	-0.22	0.74	-0.16	-1.09*
Omega Navigation Enterprises Inc.	1.35*	0.08	0.13	0.18**	-0.05	-0.05	-0.16**	0.16	0.01	-0.25	0.87**	-0.51	0.21
Tsakos Energy Navigation	1.16*	0.06	0.05	0.01	0.03	-0.03	-0.04	0.22*	-0.38**	-0.15	0.34	0.01	-0.34
Teekay LNG Partners L.P	1.08*	0.11	0.42	-0.05	-0.14	-0.03	-0.19*	0.19**	-0.20	-0.22	0.63	-0.70	-0.41
OSG America L.P	0.90*	0.24**	1.04**	0.04	-0.10	-0.04	-0.03	0.16	0.03	-0.41	0.44	-0.64	-0.65
TORM	1.74*	-0.07	-1.06	0.07	0.05	-0.02	-0.03	0.13	0.20	-0.17	0.89*	-0.66	-0.07
DHT Maritime	1.50*	-0.05	-0.39	0.00	0.06	0.00	-0.01	0.23**	-0.25	-0.45**	0.49	0.30	-0.39
Frontline	1.62*	0.15**	-0.17	0.00	-0.05	0.04	0.00	0.23**	-0.25	0.01	0.50	-0.41	0.05

Notes:

1. The table displays the coefficients of the independent variables of the equation (2) which represents the adjusted for multicollinearity equation (1) estimated for the Tanker Market Companies

$$R_i = c_{1i} + c_{2i}rMSCI + c_{3i}rOIL + c_{4i}rUSEURO + c_{5i}rBDI + c_{6i}rBDCT + c_{7i}BDDT + c_{8i}rCOAL + c_{9i}rAGRI + c_{10i}rUSYEN + c_{11i}rUSCAD + c_{12i}rUSSEK + c_{13i}rUSCHF + c_{14i}rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

Table 2B: Coefficients of estimated equation (2) for Dry Bulk Market, period from 1/1/2002 to 31/12/2008

Company	R_MSCI	R_OIL	R_USEUR	R_BDI	R_BDCT	R_BDDT	R_COAL	R_AGRI	R_USYEN	R_USCAD	R_USSEK	R_USCHF	R_USGBP
Euroseas Ltd	1.67*	0.04	0.22	0.21**	-0.12	-0.01	-0.03	0.16	-0.31	-0.07	0.50	-0.20	-0.18
Oceanfreight	2.24*	-0.22	1.26	0.24**	0.04	0.09	-0.19	0.61*	-0.88	-0.38	-0.04	-0.15	0.12
Dryships	3.11*	0.01	0.71	0.42*	0.15	-0.11	-0.07	0.41**	-0.78	0.01	0.38	-0.74	-0.49
Eagle Bulk Shipping	2.61*	-0.08	0.89	0.37*	-0.05	-0.06	-0.17**	0.36*	-0.33	0.09	0.99	-1.26	-0.82
Freeseas	1.73*	-0.02	0.35	0.27**	-0.20	-0.02	-0.10	0.07	-0.04	0.35	1.27	-0.83	-1.28**
Paragon Shipping Inc.	2.34*	0.02	0.92	0.13	-0.13	-0.06	0.03	0.21	-0.01	0.01	0.28	-1.07	0.27
Safe Bulkers	1.49*	0.09	-0.96	0.27	-0.45	-0.01	-0.27**	0.04	0.30	-0.92	1.12	-2.53	1.11
Seanergy Maritime	0.39*	0.20	-0.06	0.16**	-0.12	-0.04	-0.13**	-0.11	0.60	0.09	0.88**	-1.08**	0.23
Star Bulk Carriers Corp.	1.55*	-0.05	1.01	0.32*	-0.20	-0.01	-0.10**	0.28	-0.66	-0.26	-0.55	0.11	-0.19
Navios Maritime Partners L.P	1.15*	0.07	0.70	-0.04	0.30	0.01	-0.01	0.35**	-0.61	-0.39	0.38	-0.30	-0.13
Dianna Shipping	-0.28	0.10	-1.21	0.14	-0.29	-0.04	-0.03	-0.24	1.71	0.66	0.35	-0.02	-0.58
Navios Maritime Holdings Inc	2.10*	-0.07	0.19	0.35*	0.01	0.02	0.03	0.29	-0.14	0.10	1.16**	-1.47**	-0.12
Excel Maritime Carriers Ltd	2.94*	-0.07	0.51	0.39**	0.06	-0.12	0.06	0.39**	-1.16**	0.55	0.16	0.36	-1.25**
Genco Shipping Trading Ltd	2.83*	-0.06	0.04	0.45*	-0.01	-0.08	-0.08	0.31**	-0.59	0.37	1.25**	-1.00	-1.02**

Notes:

1. The table displays the coefficients of the independent variables of the equation (2) which represents the adjusted for multicollinearity equation (1) estimated for the Dry Bulk Market Companies

$$R_i = c_{1i} + c_{2i}rMSCI + c_{3i}rOIL + c_{4i}rUSEURO + c_{5i}rBDI + c_{6i}rBDCT + c_{7i}BDDT + c_{8i}rCOAL + c_{9i}rAGRI + c_{10i}rUSYEN + c_{11i}rUSCAD + c_{12i}rUSSEK + c_{13i}rUSCHF + c_{14i}rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

Table 2C: Coefficients of estimated equation (2) for Containership Market, period from 1/1/2002 to 31/12/2008													
Company	**R_MSCI**	**R_OIL**	**R_USEUR**	**R_BDI**	**R_BDCT**	**R_BDDT**	**R_COAL**	**R_AGRI**	**R_USYEN**	**R_USCAD**	**R_USSEK**	**R_USCHF**	**R_USGBP**
Danaos Corporation	1.22*	0.04	0.88	0.05	-0.05	0.06	-0.14	0.25**	-0.43	-0.12	-0.55	-0.12	-0.34
Horizon Lines Inc	2.89*	-0.27	-0.11	-0.13	-0.01	-0.12	0.00	0.02	-1.76**	-0.21	-0.64	1.00	0.21
Seaspan Corporation	1.40*	-0.17	1.52*	0.12	-0.01	-0.02	-0.13	0.40*	-0.62	-0.26	-1.03	0.23	-0.65

Notes:

1. The table displays the coefficients of the independent variables of the equation (2) which represents the adjusted for multicollinearity equation (1) estimated for the Containerships owning Companies

$$R_i = c_{1i} + c_{2i}rMSCI + c_{3i}rOIL + c_{4i}rUSEURO + c_{5i}rBDI + c_{6i}rBDCT + c_{7i}BDDT + c_{8i}rCOAL + c_{9i}rAGRI + c_{10i}rUSYEN + c_{11i}rUSCAD + c_{12i}rUSSEK + c_{13i}rUSCHF + c_{14i}rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

The results from modified equation do not vary significantly from the previous ones.

Small differences occurred with respect to estimated coefficients and probability values which have decreased and increased respectively

Interpretation – Results

- As we are able to observe from the regression results in the tables above, we identify a statistically significant positive relationship between returns of all companies (of three shipping sectors) and **MSCI** which as described previously, reflects the world economy performance. In all companies in each sub-sector apart from Dianna Shipping (Dry bulk market) and Aries Maritime (Tanker Market) , the zero probability value strongly indicates the presence of serial correlation between MSCI and shipping stocks return.

These results are in line with the considerations of Harvey and Stopford described previously in the literature section.

- Statistical important are also found to be the variables regarding the **traded commodities** returns especially for agriculture traded products (i.e wheat) with regard to the majority of companies in dry bulk sector, something that coincides with the considerations of Stopford concerning shipping demand movement. At this face we need to point out that although iron-ore is included in the list of the most famous seaborne commodities trades, we have excluded from the regression due to the limited number of observations obtained.

- Concerning **freight rates**, results reflect a positive statistical relationship with Baltic Dry Index with respect to four out of ten companies in the dry Bulk sector. However, this does not apply for the other sectors (Tanker and Containerships markets), since Baltic Clean Tanker Index (BDCT) and Baltic Dirty Tanker Index (BDDT) have in average proved to be statistical insignificant explanatory factors.

- As already mentioned, **oil** prices have been used in several studies as an important factor that influences stock returns. However, our results regarding the ability of the oil prices to explain shipping stock returns are not in line with the relevant studies results. Oil factor is presented statistical significant only in a limited number of companies of Tanker Market. This was expected, since oil is the main seaborne commodity traded via tanker vessels. However, positive coefficients of the relevant tanker owing companies (StealthGas, OSG America, Frontline) contradict to the consideration that when oil prices rise freight rates fall as a result of reduced demand for oil imports.

- Finally, the coefficient of the **exchange rate** variables is found to be in average insignificant. However, for three companies (Stealthgas , OSG and Seaspan) exchange rate USEURO (US to Euro) found to be statistical significant with a positive coefficient. This is in line with the results of Grammenos and Arkoulis study, through which a positive

relationship between stock returns and changes in USEURO was detected, meaning that an appreciation of USdollar against EURO increases freight rates leading to higher returns.

Additional regressions have been also developed based on the rational of the previous multi factor model by replacing the MSCI index with the Stock Exchange Index of each company based on the Exchange Market in which they trade.

As a result, since the stocks of the companies in our sample are traded in NASDAQ and NYSE, the following two equations have been estimated:

$$R_i = c_{1i} + c_{2i}rNASDAQ + c_{3i}rOIL + c_{4i}rUSEURO + c_{5i}rBDI + c_{6i}rBDCT + c_{7i}BDDT + c_{8i}rCOAL + c_{9i}rAGRI + c_{10i}rUSYEN + c_{11i}rUSCAD + c_{12i}rUSSEK + c_{13i}rUSCHF + c_{14i}rUSGBP + \varepsilon_i \quad \textbf{(3)}$$

$$R_i = c_{1i} + c_{2i}rNYSE\ 100 + c_{3i}rOIL + c_{4i}rUSEURO + c_{5i}rBDI + c_{6i}rBDCT + c_{7i}BDDT + c_{8i}rCOAL + c_{9i}rAGRI + c_{10i}rUSYEN + c_{11i}rUSCAD + c_{12i}rUSSEK + c_{13i}rUSCHF + c_{14i}rUSGBP + \varepsilon_i \quad \textbf{(4)}$$

-Descriptive statistics for the NASDAQ & NYSE returns

Independent Variable / Factor	Mean Return	Std Deviation	Skewness	Kurtosis	Observations
R_NASDAQ	0.000	0.017	-0.150	7.16	1826
R_NYSE100	0.000	0.013	-0.215	15.16	1826

However , before estimating the relevant equations, we need as already performed previously to test for stationarity of the time series of NASDAQ and NYSE. By performing Unit Root testing through ADF method, nonstationarity was identified, implying that natural logarithms

should be used once again. Stationarity was achieved which derives from the results in the following table:

- Unit Root test using the Augmented Dickey Fuller method in case of the returns of NASDAQ & NYSE

Independent Variable / Factor	T-statistic*	Test result
R_NASDAQ	-44.63	No unit root
R_NYSE	-35.72	No unit root

Estimation Results for Companies traded in NASDAQ

We proceed with estimating and test the statistical significance of the coefficients of the factors entering the following equation:

$$R_i = c_{1i} + c_{2i} rNASDAQ + c_{3i} rOIL + c_{4i} rUSEURO + c_{5i} rBDI + c_{6i} rBDCT + c_{7i} BDDT + c_{8i} rCOAL + c_{9i} rAGRI + c_{10i} rUSYEN + c_{11i} rUSCAD + c_{12i} rUSSEK + c_{13i} rUSCHF + c_{14i} rUSGBP + \varepsilon_i \quad \textbf{(3)}$$

The results are summarised in the following table:

Table 3 : Regression results from equation (3) – Companies listed in NASDAQ period from 1/1/2002 to 31/12/2008

Company	r_NASDAQ	r_OIL	r_USEUR	R_BDI	R_BDCT	R_BDDT	R_COAL	R_AGRI	r_USYEN	r_USCAD	r_USSEK	r_USCHF	r_USGBP
Stealthgas	0.40*	0.33*	1.15	-0.12	0.01	0.01	0.01	0.31**	0.63	-0.18	0.57	-0.54	-0.97
Euroseas	0.87*	0.19	0.04	0.18**	-0.08	0.01	-0.03	0.23	0.12	-0.36	0.01	0.38	-0.33
Oceanfreight	1.07*	-0.01	0.94	0.20	0.08	0.11	-0.20	0.71*	-0.24	-0.80	-0.71	0.69	-0.06
TopShips	0.36**	0.12	0.49	0.20	-0.06	0.03	-0.20*	0.38**	0.65	-0.33	0.14	0.27	-0.67
DryShips	1.61*	0.30**	0.37	0.37*	0.22	-0.08	-0.08	0.53*	0.03	-0.53	-0.54	0.34	-0.78
Eagle bulk Shipping	1.28*	0.15	0.55	0.32*	0.01	-0.04	-0.18*	0.47*	0.38	-0.38	0.21	-0.29	-1.07
Freeseas	0.74*	0.11	0.06	0.24	-0.17	0.00	-0.11	0.15	0.49	0.01	0.73	-0.09	-1.46**
Paragon Shipping	1.09*	0.24	0.61	0.09	-0.09	-0.04	0.02	0.32	0.66	-0.44	-0.47	-0.13	0.08
Seanergy	0.10	0.22	-0.17	0.15**	-0.11	-0.04	-0.14**	-0.08	0.75	-0.01	0.74	-0.85	0.20
Star bulk carriers	0.69*	0.07	0.75	0.28**	-0.17	0.01	-0.10**	0.35**	-0.18	-0.65	-1.03	0.77	-0.31
Aries Maritime	0.34*	0.24	-0.48	0.00	-0.01	-0.01	-0.23	0.07	1.03	-0.25	0.43	0.33	-1.16**
Capital product Partners	0.40*	0.23**	0.17	-0.06	-0.13	0.06	-0.12	0.13	0.38	-0.50	0.32	0.48	-1.22*
Omega Nav Ents	0.54*	0.17**	-0.12	0.16	-0.02	-0.04	-0.17	0.23**	0.44	-0.53	0.44	0.10	0.06
Torm	0.72*	0.05	-1.37*	0.04	0.08	-0.01	-0.05	0.22	0.75	-0.52**	0.34	0.10	-0.26

Notes:

1. The table displays the coefficients of the independent variables of the equation (3)

estimated for the Companies whose stocks are traded in NASDAQ Stock Exchange Market

$$R_i = c_{1i} + c_{2i} rNASDAQ + c_{3i} rOIL + c_{4i} rUSEURO + c_{5i} rBDI + c_{6i} rBDCT + c_{7i} BDDT + c_{8i} rCOAL + c_{9i} rAGRI + c_{10i} rUSYEN + c_{11i} rUSCAD + c_{12i} rUSSEK + c_{13i} rUSCHF + c_{14i} rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

Estimation Results for Companies traded in NYSE

We proceed with estimating the following equation :

$$R_i = c_{1i} + c_{2i} rNYSE\ 100 + c_{3i} rOIL + c_{4i} rUSEURO + c_{5i} rBDI + c_{6i} rBDCT + c_{7i} BDDT + c_{8i} rCOAL + c_{9i} rAGRI + c_{10i} rUSYEN + c_{11i} rUSCAD + c_{12i} rUSSEK + c_{13i} rUSCHF + c_{14i} rUSGBP + \varepsilon_i \quad \textbf{(4)}$$

The results are summarised in the following table:

Table 4 : Regression results from equation (4) – Companies listed in NYSE, period from 1/1/2002 to 31/12/2008

Company	r_NYSE100	r_OIL	r_USEUR	R_BDI	R_BDCT	R_BDDT	R_COAL	R_AGRI	r_USYEN	r_USCAD	r_USSEK	r_USCHF	r_USGBP
Danaos	0.65*	0.07	0.87	0.05	-0.08	0.07	-0.14**	0.29**	0.01	-0.32	-0.93	0.23	-0.47
Diana Shipping	-0.20	0.09	-1.25	0.14	-0.28	-0.04	-0.04	-0.24	1.62	0.70	0.43	-0.05	-0.56
Excel	1.74*	0.02	0.64	0.39*	0.00	-0.09	0.06	0.48*	-0.15	0.12	-0.71	1.03	-1.54*
Genco Shipping	1.70*	0.03	0.19	0.45*	-0.07	-0.05	-0.08	0.39*	0.36	-0.04	0.42	-0.38	-1.30*
Navios Holdings	1.23*	-0.01	0.28	0.35*	-0.03	0.03	0.04	0.36**	0.58	-0.22	0.54	-0.98	-0.33
Navios Maritime Partners LP	0.65*	0.10	0.71	-0.04	0.27	0.02	-0.02	0.38*	-0.21	-0.61	0.01	0.00	-0.22
Safe Bulkers	0.62*	0.09	-1.12	0.28	-0.55	0.02	-0.27**	0.12	1.04	-1.36	0.71	-1.86	0.93
Agean Marine Petroleum	1.39*	0.03	0.62	0.19	-0.10	-0.04	0.09	0.40*	0.13	-0.39	-0.25	-0.50	-0.44
Tsakos	0.78*	0.10	0.18	0.01	0.01	-0.02	-0.03	0.25*	-0.01	-0.30	0.01	0.19	-0.45**
Teekay	0.53*	0.13	0.38	-0.05	-0.16**	-0.02	-0.19*	0.24**	0.21	-0.41	0.29	-0.34	-0.53
Horizon Lines	1.91*	-0.17	0.19	-0.12	-0.08	-0.10	0.02	0.09	-0.84	-0.58	-1.46	1.47	-0.06
Seaspan	0.79*	-0.13	1.56*	0.13	-0.04	-0.01	-0.13**	0.44*	-0.13	-0.47	-1.45**	0.58	-0.79**
OSG America	0.52*	0.27**	1.06**	0.04	-0.12	-0.04	-0.03	0.18	0.34	-0.57	0.15	-0.42	-0.72
DHT	1.10*	0.01	-0.14	0.00	0.02	0.01	0.00	0.25*	0.20	-0.62*	0.07	0.45	-0.52
Frontline	1.13*	0.21*	0.05	0.01	-0.09	0.05	0.01	0.26*	0.25	-0.18	0.04	-0.21	-0.09

Notes:

1. The table displays the coefficients of the independent variables of the equation (4)

estimated for the Companies whose stocks are traded in NYSE Stock Exchange Market

$$R_i = c_{1i} + c_{2i} rNYSE\ 100 + c_{3i} rOIL + c_{4i} rUSEURO + c_{5i} rBDI + c_{6i} rBDCT + c_{7i} BDDT + c_{8i} rCOAL + c_{9i} rAGRI + c_{10i} rUSYEN + c_{11i} rUSCAD + c_{12i} rUSSEK + c_{13i} rUSCHF + c_{14i} rUSGBP + \varepsilon_i$$

2. '*', and '**' indicate significance at the 1% and 5% level, respectively

Chapter 7- Summary and Conclusions

Despite the limited number of studies developed over the factors that determine international shipping stock returns, we tried to incorporate their findings into a multi factor model and examine whether these can be used to satisfy our goal ; provide investors with the necessary information regarding which variables should be observed during their effort of maximizing their shipping portfolios returns.

The results presented in previous section support the significant positive impact that world economy has on shipping, reflecting not only the considerations of Martin Stopford and other participants in the shipping economics, but also the historical evidence, where a relatively good correlation between global economic growth and growth in tonnage demand.

A positive relationship with returns has been also identified with regard to the Exchange Market Indices (Nasdaq and Nyse), which reminds us of the previous relationship, only that in this case the world market has been replaced by the Stock Exchange Markets.

The results concerning the remaining factors examined through the multi-regression model, were not so encouraging in total. Although in some cases (in certain companies of our sample) statistical significance was identified, this could not be extrapolated to total population.

A big disappointment was the fact that no significant relationship was detected with regard to freight rates variable. However this can be in full explained. We need to keep in mind that we are dealing with commodity-related Companies since the earnings of maritime companies derive from the levels of freights (the commodity). Based on this consideration a number of studies like the research of Nadeshda Demidova – Menzel and Dr. Thomas Heidorn “Commodities in Asset Management” support, that earnings, or in other words returns, are more related to the state of the economy and the management decisions (sale and purchase decisions), than the commodity price (the freight rate). The same conclusion was reached by the study of Schneeweis and Spurgin (1997) over the investments in energy related companies and their exposure to commodity price changes.

In conclusion, the complex and highly volatile environment of shipping market remains the main barrier for developing precise predictions for the movement and behavior of returns. There should be factors other than those already examined, which may affect shipping stock prices and returns, as for example management decisions, press announcements, the companies' chartering policy, that due to their nature can not be entered into a mathematical equation .

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Useful Web sites

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www.futuremapper.com
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