Cyprus University of Technology
Faculty of Management and Economics

Doctoral Dissertation

Three Essays on

Behavioural Finance in Shipping Markets

Konstantinos Melas

Limassol, July 2019

CYPRUS UNIVERSITY OF TECHNOLOGY

FACULTY OF MANAGEMENT AND ECONOMICS

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Approval Form

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Three Essays on Behavioural Finance in Shipping Markets

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What complexity of life! The invoices are made by people
Who have loves, hates, passions, politics, crimes at times—
And are so well written, so much to the point, so independent of all this!
There are some who look at an invoice and do not feel this.
But it is certain that you, Cesário Verde, felt it.
I, for my part, feel it most humanly, almost to the p[o]int of tears!
Some would tell me there is no poetry in commerce or offices.
On the contrary, it enters by all our pores... I breathe, like the air from the sea,
Because all of it is concerned with ships, modern navigation,
Because the bills and commercial letters are the beginning of history
And the ships which take the merchandise over the eternal sea are the end.

Fernardo Pessoa, Naval Ode

Naval Ode Translations: reading the poet's dispositions, Filipa de Freitas, Universidade Nova de Lisboa

ABSTRACT

Shipping finance is a strand of literature that was mainly initiated by Costas Grammenos and its main driver was the need of shipowners and ship operators to manage the financial aspect of the sector given the volatility that it is always apparent. The research that has been conducted up to now focuses on examining aspects relevant to the assets (ships) and the freight rates (cash flow). Despite the work that has already been conducted all these years, the financial crisis of 2008 re-enforced the need to develop a better understanding of the complexities of the external and the internal drivers of the shipping industry. In the current thesis, three topics that are of prime importance to the industry have been researched in order to address certain unanswered questions. More precisely, the volatility spillovers of the freight rates, corporate governance of the shipping companies and sales and purchases of second-hand dry bulk carriers have been examined.

Chapter 1 explores the determinants of investment diversification in the shipping industry, as measured by the net volatility spillover index introduced by Diebold & Yilmaz (2012) and in the shipping context by Tsouknidis (2016). Specific indicators of shipping economic activity as introduced in Papapostolou et al. (2016) are used as potential determinants of the net volatility spillover indices across the dry bulk and tanker shipping segments and sub-segments. Results reveal that certain measures of investment prospects and activity in the second-hand vessels market are positively associated with increased volatility spillovers across shipping segments.

Chapter 2, reviews the role of corporate governance in maritime enterprises. While various research has been conducted on the executive teams of shipping companies and their relationship with the companies' performance, results, however, remain inconclusive on the specific characteristics that are having a positive influence on the companies' performance. In the current research, we have employed the largest sample that has been used up to now and we are examining the relation between the demographic characteristics of the board of directors with the financial performance of the shipping companies. Nevertheless, given the volatility that exists in the shipping market, we further examine the demographic characteristics that are

particularly important when the market participants are either overly optimistic or overly pessimistic for the outlook of the market.

In this chapter, a literature review of the relevant bibliography reveals the unique characteristics of the shipping industry as far as corporate practices and their outcomes are concerned. Moreover, the chapter discusses how corporate governance affects enterprises at large and why both academics and professionals have been active in the field, trying both to grasp the conundrum of corporate boards, and additionally to create ameliorating policies.

Finally, exploratory research is conducted to reveal the demographic profile of the corporate boards. The revealed trends of the last 15 years provide the reader with insight of the practices that maritime enterprises have been using in order to provide better mechanisms of governance.

Chapter 3, re-examines the methods for vessel valuation and the predominant factors that affect them. Given the diffusion of information that derives from recent technological advances, we further test previous models with an updated and more thorough dataset. Accordingly, evidence on the significance of the different level of information when compared to annual averages is provided. Additionally, we further enhance the existing literature by adding an extrapolating variable that accounts for the profitability of vessels. Thus, we employ a statistical technique, based on the precise age of a vessel, to capture the total profit that she will provide until she is demolished. The estimation provides results that reduce the variance between the actual transaction prices and the predicted ones when compared to benchmark models by 20%.

Keywords: shipping, maritime, finance, management

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1.1 Economic activity and volatility spillovers across shipping freight markets

1.1.1 Introduction

Operating within the ocean-going shipping business exposes participants to severe operational and financial risks (Kavussanos & Visvikis, 2006). At the same time, demand for shipping services is inelastic, and supply can adjust to demand only sluggishly due to the time-lag of ship construction (Kalouptsidi, 2014). As a result of the aforementioned unique and distinct features, freight rates exhibit substantial volatility across segments (dry bulk, tankers, containers) and sub-segments according to vessel size (e.g. Capesize, Panamax and Handysize). Prior studies on freight rate volatility have documented the existence of excess and time-varying volatility across shipping markets (see, for instance, Kavussanos, 1996a;b and Drobetz et al., 2012).

Even though scholars in the field agree on the existence of high and time-varying volatility, far less evidence has been documented on measuring interactions of shipping freight rates across segments and sub-segments by identifying time-varying volatility spillovers across them. This is partly because the relevant methodology to measure directional volatility spillovers has been introduced only relatively recently by Diebold & Yilmaz, 2009; 2012 (DY hereafter), with an application in the financial markets. The DY methodology enables the identification and measurement of time-varying and directional volatility spillovers which, when applied in the shipping markets, reveals how economic information is transmitted across shipping segments and sub-segments. Tsouknidis (2016) was the first to apply DY methodology in shipping markets and revealed that volatility spillovers increased during the global financial crisis period (2007-2010) and they were larger within tanker sub-segments rather than dry bulk sub-segments over the period 1998-2015.

Even if previous literature on the issue has identified and revealed the existence and direction of volatility spillovers within and between shipping freight rate segments and sub-segments, it misses an analytical investigation of their determinants over time. In other words, the investigation of the factors affecting the magnitude and direction of volatility spillovers across shipping freight markets over time comprises a significant gap in the research literature. This chapter fills this gap in the literature and proposes, as prominent candidate variables, to explain volatility spillovers across shipping segments a set of components (proxies) used to construct a shipping sentiment indicator. Using sentiment to explain volatility spillovers in the shipping markets is motivated by the fact that several studies propose sentiment as an important economic driver for consumption and investment in the capital markets (Baker & Wurgler, 2006, 2007). In a seminal paper, Yang & Zhou (2017) investigate

the determinants of volatility spillovers across countries and asset classes during the period of quantitative easing followed by the Federal Reserve Bank. In similar fashion to Yang and Zhou (2017), we have used specific components (proxies) of sentiment for the shipping market, as introduced by Papapostolou et al. (2014), to explain freight rate volatility spillovers computed with the DY methodology.

The economic rationale implying the existence of volatility spillovers across and within shipping segments and sub-segments is based on the close relation - and often competition - across vessels in similar segments. For example, different types of vessels can transport the same cargo and, in this way, create competition among different shipping sectors. Furthermore, shipping investors may reallocate their capital from one shipping sector to another by buying and/or selling part of their fleet. Most shipping companies operate in several shipping sub-sectors and investors may change their investment within shipping sub-sectors if they identify an attractive investment opportunity. Thus, imbalances of demand and supply forces, which translate into the volatility of freight rates in one segment, may soon be transmitted to other segments.

Moreover, a positive sentiment according to literature is an important factor when it comes to the decision of companies when it comes to acquisition of property, plant and equipment (Arif & Lee, 2014), which in our setting would be vessels. Nevertheless according to the theoretical paper of Scarsi (2007), the good sentiment in the shipping markets is creating a herding behaviour of the players. Thus, based on the latter, we expect that the good sentiment that may exist in the specific sub-segments will enact the herding behaviour and will force information (Kavussanos, Visvikis, & Dimitrakopoulos, 2014), in the form of volatility spillovers, to be exchanged within the different sub-segments.

In this chapter, we investigate whether indicators of the mood for shipping investments (sentiment) may account for the observed volatility spillovers across shipping sub-segments in a contemporaneous and lagged fashion. Instead of utilising the aggregate shipping sentiment indicators as proposed by Papapostolou et al., (2014, 2016), we rely on specific components used in the calculation of the aggregate shipping sentiment. In this way, we can reveal which specific components of shipping sentiment may explain investors' repositioning between and within the dry bulk and tankers segments and sub-segments.

The latter components that are derived by Papapostolou et al. (2014), contain variables (proxies) that encapsulate three different aspects of the shipping market which project the intentions of investors (either to buy or sell in a specific sub-segment of the market) in monthly observations. Three broad categories are used in accordance with the literature that project the latter, namely: 1) market's expectations, captured by the net (money) contracting in a specific segment; 2) valuation, captured by the ratios of the price per earnings and the difference between the second-hand vessels and the newbuildings; 3) the market's liquidity, captured by the year's average sales of vessels over the total fleet size. Thus, by establishing if a relation exists between the proxies and the volatility spillovers, we can draw conclusions on how the

specific preferences of investors for specific sub-segments can further affect the volatility of freight rates in other sub-segments.

The current chapter is organized as follows: Section 1.1.2 provides a critical review of the literature on the issue; Section 1.1.3 explains in detail the methodology followed; Section 1.1.4 describes the dataset; Section 1.1.5 discusses the empirical results obtained, and Section 1.1.6 concludes on the findings.

1.1.2 Literature Review

Market volatility is an intrinsic aspect of the capital markets and participants can measure or predict the risk and the return of different asset classes (Torben et al., 1999). In the maritime context, extreme volatility is historically encountered in the freight rates of the vessels (both in the spot market and in charter contracts with a wider time span like time charters and bareboats) and subsequently in the prices of vessels per se, irrespective of their age (Goulielmos & Psifia, 2006). The effect of volatility on the market's stakeholders is, however, a significant factor which drives the high ambiguity that exists in the shipping sector and is persistent for both the dry bulk (Jing, Marlow, & Hui, 2008) and the tanker markets (Li et al., 2014).

The major component that is affected by volatility is the cash stream of shipping entities (Kavussanos et al., 2014), since it will affect the freight rates. Cash streams can either highly increase due to an increase in the freight rates or decrease accordingly, either bringing high profits to the shipping companies or minimising their profitability.

Several studies have been devoted to the identification and measurement of volatility in shipping markets and to the interdependence that exists between the different sub-segments. Prominent among these, are the studies of Kavussanos (1996;1997), (2003) and Drobetz et al. (2012); such studies use the well-known GARCH family of models to capture the volatility dynamics of freight rates. Kavussanos (1996) has shown that volatility of the prices for smaller tanker vessels and dry bulk vessels is lower when compared to the larger ones and thus showing a clear segregation that exists between the different sub-segments in the same market. Accordingly, freight rates perform in the same manner as the prices of vessels; the freight rates of smaller vessels exhibit less volatility when compared to the larger ones, especially for the time charter rates. Moreover, Kavussanos has provided evidence that volatility is lower for the time charter freight rates when compared to the freight rates of the spot market. Thus, shipowners are better protected by the volatility's fluctuations by investing in smaller vessels and by chartering them under time charter parties.

Nevertheless, given that the shipping sector is a secondary service sector, meaning that the initial need is for the transportation of goods, so, the absolute market segmentation within shipping is not possible given the relation that will exist when

the need for more transportation arises. Kavussanos has provided evidence on the pronounced segmentation effect that exists for different sizes of bulk and tanker vessels and the second-hand vessels. Despite the volatility of the specific sub-segments of the shipping markets, Alizadeh-Masoodian (2001) has provided evidence by using a BEKK GARCH model, that unidirectional volatility spillover affects all types of vessel, from large to small. Nevertheless, previous studies have been focusing on average results on volatility. However, initially, Chen, et al. (2010) have examined daily data from shipping freight rates between 1998-2008, specifically for the Capesizes and Panamaxes, and have shown that the volatility between the two sub-segments is inter-changing over time. Finally, Chung & Weon (2013) and Tsouknidis (2016) provide evidence on the dynamic spillover effect in the shipping freight markets, while Li et al. (2018) show that the dry bulk and the clean tanker segments are the main contributors of volatility in the shipping sector, since they are more important for global trade when compared to the dirty tanker and the containerships.

Recent researches have focused on the factors that are affecting volatility within the shipping sector both on a micro and on a macro level. Dai et al. (2015) have investigated the volatility that exists in the newbuilding vessel prices and provide evidence that the most predominant factor that affects the latter is the volatility of the freight rates. As far as the determinants of the shipping freights rates are concerned, Alizadeh and Talley (2011) have provided a thorough microeconomics research on the dry bulk market. Their research has revealed that freight rates are correlated with the size of the vessel and with the laycan period during which vessels remain in the ports.

1.1.3 Conceptual Model and Hypotheses

1.1.3.1 Hypotheses

In the current research we are focusing on the dry bulk and the tanker markets given that they are exhibiting more volatility in the industry according to Li et al. (2018) when compared to the containership market. Kavussanos has given evidence that risk averse shipping investors are better off on average, when they invest in smaller vessels and they employ them under time charters. However, Tsouknidis (2016) suggests that volatility spillovers are apparent from smaller vessels to larger vessels in the tanker and the dry bulk segments. Thus, we can conclude that when certain criteria are met, shipping investors are willing to endure more risk by engaging in activities that would require larger vessels.

While there could be various reasons for the latter change of risk appetite, given the inter-relation between the shipping industry and the global economy, in the current research we are focusing on the economic activity within the industry. In order to do so, we employ variables that provide information on the market expectations,

valuation and the liquidity of the market for each sub-segment. Positive developments in specific sub-segments will lead the ratios that have been previously described to either increase or decrease accordingly, since not all of them are indicators of optimistic news. We expect these developments, to act as mitigators of news to the large pool of the shipping investors. When positive developments are appearing in a specific sub-segment, we expect that investors will tend to flux in the latter so as to capture the positive developments that are taking place. Thus, the latter sub-segment will act as a net receiver of volatility spillovers. On the contrary, when there are negative developments in a specific sub-segment, shipping investors will tend to withdraw, making the sub-segment a net transmitter of volatility to the other sub-segments.

Initially, when it comes to the turnover of vessels that are sold, the current ratio is providing a good indication for the market since it is providing a 12-month average of the sales of the sub-segment. Thus an increase on Turnover is providing feedback on an optimistic activity of the market. Accordingly, we expect that more investors will flux in so as to benefit from the positive financial signs that the sub-segment is providing and consequently making it a net receiver of information.

H 1: Ceteris paribus. we expect that an increase in the turnover ratio will lead to a decrease in the net spillover of the subsegment

Accordingly, net contracting, as a variable is measuring in absolute numbers of vessels that have been either added or removed in a specific month from the relevant sub-segment. A positive number of our variable means that the number of vessels has been increased and accordingly a negative number means the opposite. Thus, we expect that the positive sentiment notion for the sub-segment will make a net receiver of volatility driving its dependent variable to more negative values.

H2:Ceteris paribus, we expect that an increase in the net contracting ratio will lead to a decrease in the net spillover of the subsegment

In the same manner as the net contracting, the money contracted variable is measuring a positive sentiment of the subsegments. More precisely, it is measuring in absolute numbers the money that has been spent by shipping investors in ordering new vessels. Once again, we expect that an increase in the current variable will lead investors to flux in this specific part of the market, thus making the subsegment a net receiver of volatility, ceteris paribus.

H3:Ceteris paribus, we expect that an increase in the money contracted ratio will lead to a decrease in the net spillover of the subsegment

On the contrary to the previous variables, the price per earnings variable is acting in an antithetical manner. An increase of the ratio is providing a negative signal for the market, since it is providing information on how fast the investment on a specific vessel will return the amount invested. Thus, we expect that an increase of the

ratio will lead investors to search for other opportunities in the market, making the sub-segment a net transmitter.

H4:Ceteris, paribus, we expect that an increase in the price per earnings ratio will lead to an increase in the net spillover of the subsegment

Finally, we are measuring the ratio of the second-hand prices over the newbuilding ones as an indicator of the state of the market. A high ratio means that the prices for second-hand vessels are high when compared to the newly delivered ones and consequently the market is in need for transportation services. The latter effect is providing a positive outlook for the sub-segment and we expect that this will lead it to become a net receiver of volatility.

H5:We expect that an increase in the secondhand-newbuilding prices ratio will lead to a decrease in the net spillover of the subsegment

1.1.3.2 Estimating realised volatility

In order to estimate the volatility of the shipping freight rates, we are using the realised volatility (RV) estimator. Realised volatility is used by Andersen et al. (2003) who propose that realised volatility is free of tight parametric functional form assumptions and, at the same time, it provides a consistent estimate of ex-post return volatility. Thus, volatility is estimated as the squared logarithmic difference of the monthly freight rates of each segment, for each different sub-segment of the two markets.

1.1.3.3 Estimating return spillovers

The net volatility spillover effect is calculated in accordance with Diebold & Yilmaz (2012) and Tsouknidis et al. (2016), by proceeding to a VAR estimation framework. The generalised decomposition version of the spillover index analysis is derived from the VAR modelling and the resulting estimation of variance decompositions. Variance decompositions give us information on what fraction of the H-step ahead forecast error variance in variables y_{it}, for i - 1, 2, . . . , N is due to shocks to the remaining y_{jt} variables, for j = 1, 2, . . . , N, when i ≠ j. In other words, this approach provides information about the contributions of shocks to the forecast error variances of all the shipping freight markets examined. The model can be written as:

$$Y_t = \sum_{k=1}^{K} \Phi_{It} Y_{t-1} + \varepsilon_t$$

where Y_t $(Y_{1t}, Y_{2t}, \dots, Y_{Nt})$ is the vector of the N endogenous variables; Φ_{it} is a NxN parameter matrix and ε_t is the vector of disturbances which are independently and

identically distributed over time. The moving average representation of the previous model is equal to:

$$Y_t = \sum_{k=0}^{\infty} A_{It}\varepsilon_{t-1} + \varepsilon_t$$

where the *N x N* coefficient matrices A_k follow $A_k = \Phi_1 A_{k\ 1} + \Phi_2 A_{2\ 1} + \cdots + \Phi_K A_{k\ k}$, with $A_0$the N x N identity matrix and $A_i - 0$, for *i*<0. In this way, the variance decomposition transformation of the moving average coefficients captures the dynamics of the system. However, since VAR innovations are typically contemporaneously correlated, we are using Cholesky factorization as an identification scheme to achieve orthogonality, which makes the results dependent on the order of the variables. In order to overcome this issue, Diebold and Yilmaz (2012) use the generalized VAR decomposition approach based on Koop, Pesaran, & Potter (1996) and Pesaran & Shin (1998). Following this approach, variance decompositions are invariant to the order of the variables. Specifically, the *ij* entry of the H-step-ahead variance decomposition is equal to:

$$z_{ij}(H) = \frac{\sigma_{jj}^{-1} \sum_{h\ 0}^{H\ 1}(e_t A_h \sum e_j)^{\ 2}}{\sum_{h\ 0}^{H\ 1}(e_t A_h \sum A_h e_t)}$$

where Σ is the variance matrix of the error vector e; σ_{jj} is the standard deviation of the error term *e* for the *j*th equation and ei is a vector with ones in *j*th elements and zeros otherwise. However, when applying the generalised VAR modelling, each row in the variance decomposition table is not equal to one, i.e. the summation of the own and cross-variable variance contributions shares are not equal to one. In order to overcome this issue, each entry of the variance decomposition matrix is normalised as:

$$\widetilde{z_{ij}}\,(H) = \frac{z_{it}\,(H)}{\sum_{j\ 1}^{N} z_{ij}(H)}$$

where $\sum_{j\ 1}^{N} \widetilde{z_{ij}}\,(H) - 1$ and $\sum_{ij\ 1}^{N} \widetilde{z_{ij}}\,(H) - N$.

Given the results above the total spillover index (SI) is computed as:

$$SI = \frac{\sum_{i\ j\ 1, i\neq j}^{N} \widetilde{z_{ij}}\,(H)}{\sum_{ij\ 1}^{N} z_{ij}(H)}\ x\ 100$$

SI represents the average input of spillovers from shocks across all variables to the total forecast error variance. Then, the directional spillovers across variables are calculated on the latter model. More precisely, the directional spillovers received by variable *i* from all the other variables are defined as:

$$DSI_{i\leftarrow j}(H) - \frac{\sum_{j-1, i\neq j}^{N} \widetilde{z_{ij}}\,(H)}{\sum_{i,j-1}^{N} z_{ij}(H)} x100$$

Accordingly, the directional spillover transmitted by variable i to all other variables are defined as:

$$DSI_{i\to j}\,(H) - \frac{\sum_{j-1,j\neq i}^{N} \widetilde{z_{ji}}\,(H)}{\sum_{j-1}^{N} z_{ji}\,(H)}\; x\; 100$$

The net spillovers, i.e. whether one of the examined variables is a receiver or a transmitter of shocks to all other variables, can be computed as the difference of the previous two equations:

$$NSI - \; DSI_{i\to j}(H)\;\; DSI_{i\leftarrow j}(H)$$

Finally, the net pairwise spillovers, i.e. whether one of the examined variables is a receiver or a transmitter of shocks to one of the other variables, can be computed for each pair of variables *ij* as:

$$NPSI - \left(\frac{\widetilde{z_{ji}}\,(H) - \widetilde{z_{ij}}(H)}{N}\right) x100$$

Our results on the latter estimations have a range of values from -100 to +100. Positive values of the net volatility spillovers index reveal that the sub-segment is acting as a net transmitter to the other sub-segments, while negative values reveal that the sub-segment is acting as a net receiver of information.

1.1.3.4 Estimating economic activity variables

Measuring sentiment, whether it is for the sector markets or specific sectors like shipping, is not an easily conducted task given that there is no universal consensus on the proxies that one should be using (Schmeling, 2009). Nevertheless, specifically for the shipping market, Papapostolou et al. (2014) and Papapostolou, Pouliasis, Nomikos, & Kyriakou (2016) have provided five proxies that are an indication of the pessimistic or optimistic sentiment that shipping investors have for the market each month (either the tanker, the dry bulk or the containership).

The five proxy variables fall under three categories: 1) market expectations; 2) valuation and 3) liquidity. Market expectations are measured by the net contracting, and the money committed proxies. Valuation is computed by the price-to-earnings and the second-hand-to-newbuilding price proxies, and finally, liquidity is measured by the Turnover proxy. The proxy variables are calculated as follows:

$$NetContracting_{i,t} = \left(order_{i,t} - order_{i,t-1} + del_{i,t}\right) - scrap_{i,t}$$

where $order_{i,t}$ is the order book, that is, the number of vessels awaiting construction or being constructed, for sector i and month t, $del_{i,t}$ the number of vessel deliveries, and $scrap_{i,t}$ the number of vessels being scrapped.

$$MoneyContracted_{i,t} = \; order_{i,t}\; x\; newPx_{i,t}$$

where $newPx_{i,t}$, *t* is the price of newbuilding vessels for sector *i* and month *t*.

$$PricePerEarnings_{i,t} = \frac{schPx_{i,t}}{earn_{i,t}}$$

where $schPx_{i,t}$, *t* is the price of five-year-old second-hand vessels, and $earn_{i,t}$ the annualised earnings (1-year time charter rates2) in sector *i* for month *t*.

$$SecondhandNewBuilding_{i,t} = \frac{schPx_{i,t}}{newPx_{i,t}}$$

$$Turnover_{i,t} = M^{-1} \sum_{s=t-M+1}^{t} {Sale_{i,s}}/{Fleet_{i,s}}$$

where $Fleet_{i,s}$ is the total number of available vessels in sector *i* and month *s*, and $Sale_{i,s}$ the number of vessels sold.

1.1.3.5 Model specification

The model derives its conceptual origin from the seminal work of Diebold & Yilmaz (2009; 2012) and Papapostolou et al., (2014). Thus, our dependent variable is the net volatilty spillover for each sub-segment of the tanker and the bulk market, and the independent varibales are the economic activity proxies that have been previously described.

The model we therefore employ in the current research is:

$$NetSpillover_t^i = MoneyContracted_t^i + NetContracting_t^i + PricePerEarnings_t^i + SecondhandoverNewBuilding_t^i + Turnover_t^i$$

where $NetSpillover$ is the volatility spillover that the sub-segment *i* receives or gives in month *t*; $MoneyContracted$ is the net amount of dollars that have been spent in month *t* for the acquisition of vessels of the sub-segment *i*; $NetContracting$ is the net number of vessels that have been added or excluded from the total number of vessels in month *t* for the sub-segment *i*; $PricePerEarnings$ is the ratio between the price of the average five-year-old vessel over the estimated one year income that it can generate in the sub-segment *i* in month *t*; $SecondhandoverNewBuilding$ is the ratio of the price of a five-year-old vessel, over the price of a newly built vessel for the sub-segment *i* in month *t* and $Turnover$ is the 12 month average ratio of sales over the total fleet for the sub-segment *i* in month *t*.

Table 1 - Chapter 1 - Variables Description

Variable	Description	Source	Variable Names	Units of Measurement
Net Volatility Spillover	*A VAR estimation of the net volatility that is either transmitted or received between the subsegments each month*	*Clarksons Shipping Intelligence Network*	*HANDYSPILL* *SUPRASPILL* *PANASPILL* *CAPESPILL* *AFRASPILL* *SUEZSPILL* *VLCCSPILL*	*Scale starting from -75 to +75. Negative numbers are given to net transmitting segments while positive ones to net receiving segments.*
Net Contracting	*The number of the vessels that have been added in the fleet of a sub-segment in a specific month*	*Clarksons Shipping Intelligence Network*	*NetContracting [Handysize]* *NetContracting [Supramax]* *NetContracting [Panamax]* *NetContracting [Capesize]* *NetContracting [Aframax]* *NetContracting [Suezmax]* *NetContracting [VLCC]*	*The absolute number as calculated by the new orders of the month minus any demolitions and losses of vessels.*
Money Contracted	*The amount of money that has been invested in a month for all the newbuilding projects that have started*	*Clarksons Shipping Intelligence Network*	*MoneyContracted [Handysize]* *MoneyContracted [Supramax]* *MoneyContracted [Panamax]* *MoneyContracted [Capesize]* *MoneyContracted [Aframax]* *MoneyContracted [Suezmax]*	*Expressed in dollar terms*

			MoneyContracted [VLCC]	
Price per Earnings	*The price of a second-hand vessel over the annual earnings that she is expected to return*	*Clarksons Shipping Intelligence Network*	*PricePerEarnings [Handysize] PricePerEarnings [Supramax] PricePerEarnings [Panamax] PricePerEarnings [Capesize] PricePerEarnings [Aframax] PricePerEarnings [Suezmax]PricePerEarnings [VLCC]*	*Ratio which takes values higher than 1*
SecondhandNewbuilding	*Ratio that provides values between the prices of a secondhand and a newbuilding vessels of the same sub-segment*	*Clarksons Shipping Intelligence Network*	*SecondhandoverNewBuilding [Handysize] SecondhandoverNewBuilding [Supramax] SecondhandoverNewBuilding [Panamax] SecondhandoverNewBuilding [Capesize] SecondhandoverNewBuilding [Aframax] SecondhandoverNewBuilding [Suezmax] SecondhandoverNewBuilding [VLCC]*	*Ratio that takes values normally between 0.1 to 2.*
Turnover	*The 12-month rolling average of the ratio of the new fleet additions divided by the whole number of the fleet*	*Clarksons Shipping Intelligence Network*	*Turnover [Handysize] Turnover [Supramax] Turnover [Panamax] Turnover [Capesize] Turnover*	*A ratio that takes values between 0 to 1.*

[Aframax]

Turnover

[Suezmax]

Turnover

[VLCC]

1.1.3.6 Econometric analysis

The first part of our analysis started by computing the volatility spillovers for the sub-segments of the dry bulk and the tanker market and accordingly the respective economic activity variables, as they have been previously described. Accordingly, we winsorized at the level of 1% to exclude any outliers that may be apparent.

As a first step, we explored the relation between the dependent variable and the economic activities variables on a parsimonious level. Thus, we tested for the stationarity of the variables, and where variables are non-stationary, we used the logarithmic difference of the variable.

In order to proceed with our model building, we performed the Heteroskedasticity White Test. For serial correlation we used the Breusch-Godfrey Test and checked for multicollinearity issues that may be predominant. When heteroskedasticity and serial correlation were apparent we used the Newey-West method. When multicollinearity was apparent, we excluded one variable from our model. When we completed the regression analysis both for contemporaneous and for lag variables, we explored a second aspect of the volatility spillovers that could be apparent, the concept of asymmetry. We provided an econometric analysis of the difference that exists in the relation between the economic activity variables and the volatility spillovers when volatility spillovers were either positive or negative.

1.1.4 Data

Data has been collected from Clarkson's Shipping Intelligence Network database. For our dependent variable we have used two different freight rates, so as to enhance the current research. Initially, we have used the long run historical 1-year time charter rates and have then progressed our analysis by using the long run historical earnings as the dependent variables. Long run historical earnings have been calculated by Clarkson's and have been based on voyage charter rates and their volatility is higher when compared to 1-year time charter rates. The high volatility has enabled us to be more coherent in our results.

Additionally, as independent variables, we have used: the number of monthly orders of vessels; the number of monthly deliveries of vessels; the number of monthly demolitions of vessels; the monthly newbuilding prices; the monthly prices of five-

year-old second-hand vessels; the number of vessels sold each month and finally the total number of fleets. The latter variables have been collected for each sub-segment both for the dry bulk market and for the tanker market. Finally, we have 182 monthly observations in our sample for the period starting from October 2003 and ending in November 2018.

1.1.5 Results

1.1.5.1 Long run historical 1-year time charters

1.1.5.1.1 Descriptive Statistics and Correlation Tables

As a starting point, we have explored for any outlying observations in our sample. Since all our data seems to be consistent, we have tested for stationarity in our time-series variables. Thus, we have performed the augmented Dickey-Fuller test to see if our variables are stationary or not. As can be observed from Tables 1 and 2, it is common to have non-stationary time-series variables since they do not pass the 5% threshold.

When stationarity is apparent in the initial time-series, according to the bibliography, we have proceed to the next stage of using the logarithmic difference to establish a stationary series. It should be noted that just for the case of the NetContracting variable in the Handymax segment, we had to use the second logarithmic difference in order to establish a stationary time-series.

Table 2 - Chapter 1 - Descriptive statistics for bulk carriers - Sample Period: 2002-2018 – Long run historical 1-year Time Charters

	Mean	Minimum	Median	Maximum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Sum	Sum Sq. Dev.	Observations	ADF [p-value]	ADF [p-value] 1st Difference	ADF [p-value] 2nd Difference
HANDYSPILL	-19,52	-73	-9	2	26,87946	-1,04041	2,288151	36.87831 [0.000]	-3572,15	131496	183	-1.69304 [0.4331]	-11.8345 [0.000]	
SUPRASPILL	-14,832	-64,4	-9,75	13,4	19,03969	-0,67347	2,130953	19.59223 [0.000]	-2714,25	65976,78	183	-2.60936 [0.0929]	-12.1979 [0.000]	
PANASPILL	30,69153	-5,5	19,5	106	37,97698	0,885339	2,120096	29.81018 [0.000]	5616,55	262489,6	183	-1.84211 [0.3592]	-13.20681 [0.000]	
CAPESPILL	3,734615	-20	0	43,75	10,32055	1,530734	6,317795	154.551 [0.000]	679,7	19278,97	182	-3.81062 [0.0034]		
MoneyContracted [Handysize]	14965,81	1519	10472	48000	11705,37	1,038428	3,112973	32.98646 [0.000]	2738744	2,49E+10	183	-1.4737 [0.5449]	-3.73511 [0.004]	
MoneyContracted [Supramax]	20377,04	2679	17052,75	55131	13513,54	0,704922	2,607335	16.33159 [0.000]	3728998	3,32E+10	183	-1.80282 [0.3784]	-4.30878 [0.000]	
MoneyContracted [Panamax]	15724,52	2064	12488,75	39852	10243,17	0,756007	2,360064	20.55477 [0.000]	2877586	1,91E+10	183	-2.40702 [0.1412]	-5.68553 [0.000]	
MoneyContracted [Capesize]	23843,63	2340	13712,25	84864	21325,25	1,315255	3,690773	56.092 [0.000]	4339541	8,23E+10	182	-1.7972 [0.3811]	-2.8711 [0.0507]	
NetContracting [Handysize]	534	85	435	1202	339,9397	0,629415	2,079885	18.53839 [0.001]	97722	21031736	183	-2.28167 [0.1791]	-2.05995 [0.261]	-9.6162 [0.000]
NetContracting [Supramax]	13,56831	-39	10	95	22,85272	0,787502	4,319871	32.19807 [0.000]	2483	95048,9	183	-2.78933 [0.0617]	-13.6200 [0.000]	
NetContracting [Panamax]	8	-32	6	67	17,22348	0,811	4,450429	36.10154 [0.000]	1464	53990	183	-3.57136 [0.0072]		
NetContracting [Capesize]	6,39011	-33	5	53	15,60091	0,704326	4,141021	24.92055 [0.000]	1163	44053,3	182	-3.14223 [0.0252]		
PricePerEarnings [Handysize]	4,898346	2,806549	4,956288	8,081206	1,027299	0,106552	3,050571	0.365775 [0.8329]	896,3973	192,0726	183	-3.31811 [0.0154]		
PricePerEarnings [Supramax]	4,617476	2,026164	4,751413	7,019429	1,139128	-0,24877	2,303099	5.590839 [0.061]	844,9981	236,1654	183	-2.11298 [0.2399]	-11.6430 [0.000]	
PricePerEarnings [Panamax]	4,76798	2,15585	4,86618	7,013699	1,164941	-0,12846	2,162621	5.84996 [0.0537]	872,5404	246,99	183	-2.303 [0.1721]	-10.7886 [0.000]	
PricePerEarnings [Capesize]	5,317967	1,801116	4,957886	12,11628	2,250997	0,650951	2,865586	12.99039 [0.002]	967,8699	917,1246	182	-2.99674 [0.037]		
SecondhandoverNewBuilding [Handysize]	0,843747	0,461538	0,847059	1,367089	0,185283	0,291259	3,359682	3.573816 [0.1675]	154,4058	6,248055	183	-1.94436 [0.3115]	-12.3552 [0.000]	
SecondhandoverNewBuilding [Supramax]	0,904435	0,5	0,901639	1,5625	0,230575	0,923985	4,075897	34.86567 [0.000]	165,5116	9,676015	183	-2.72667 [0.0714]	-9.00492 [0.000]	
SecondhandoverNewBuilding [Panamax]	0,935224	0,509804	0,907563	1,618182	0,260393	0,788258	3,4044	20.19819 [0.000]	171,146	12,3404	183	-2.73093 [0.0707]	-10.0587 [0.000]	
SecondhandoverNewBuilding [Capesize]	0,891821	0,511364	0,832251	1,597938	0,244142	1,038948	3,984091	40.08618 [0.000]	162,3115	10,78853	182	-2.97948 [0.0387]		
Turnover [Handysize]	0,004836	0,002718	0,004694	0,008446	0,001515	0,640811	2,460382	14.74478 [0.006]	0,884946	0,000418	183	-3.22518 [0.0201]		
Turnover [Supramax]	0,038891	-3,97834	0,052872	1,447985	0,777779	-2,27702	11,93995	767.5475 [0.000]	7,117106	110,099	183	-5.26419 [0.000]		
Turnover [Panamax]	0,005927	0,002657	0,005687	0,010846	0,002145	0,54249	2,391054	11.80346 [0.0027]	1,084576	0,000837	183	-2.04124 [0.2691]	-8.903027 [0.000]	
Turnover [Capesize]	0,004707	0,002224	0,004455	0,00955	0,00166	0,762074	3,111512	17.71059 [0.000]	0,85671	0,000499	182	-2.7094 [0.0743]	-12.783 [0.000]	

Notes: The examined period for the sub-segments of the dry bulk segment is from 1 November 2002 to 31 January 2018, since data availability for the dry freight rates starts on 1 November 2002. Returns are the daily continuously compounded returns. Mean refers to the arithmetic

Table 3 - Chapter 1 - Descriptive statistics for tankers – Sample Period: 2002-2018 – Long run historical 1 year Time Charters

	Mean	Minimum	Median	Maximum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Sum	Sum Sq. Dev.	Observations	ADF [p-value]	ADF [p-value] 1st Difference
AFRASPILL	-1,24868	-78,2	-0,8	16	14,07017	-3,9973	22,27769	3448.05 [0.000]	-237,25	37416,26	190	-4.7216 [0.0001]	
SUEZSPILL	-1,24868	-78,2	-0,8	16	14,07017	-3,9973	22,27769	3448.05 [0.0001]	-237,25	37416,26	190	-4.721587 [0.0001]	
VLCCSPILL	-0,42605	-26,6	0,25	16,4	6,488467	-1,09466	6,24574	121.3464 [0.000]	-80,95	7956,939	190	-3.8886 [0.0026]	
MoneyContracted [Aframax]	9227,697	2491	7317,25	23595	5562,775	1,251791	3,466168	51.34141 [0.0000]	1753263	5,85E+09	190	-1.894968 [0.3342]	-5.83534 [0.0000]
NetContracting [Aframax]	3,021053	-8	2	26	6,438112	0,893535	4,092121	34.72522 [0.0000]	574	7833,916	190	-4.656682 [0.0002]	
PricePerEarnings [Aframax]	5,450756	3,802069	5,424828	7,127743	0,85401	0,09901	1,982093	8.513156 [0.0141]	1035,644	137,8438	190	-2.540858 [0.1075]	-13.8334 [0.0000]
SecondhandoverNewBuilding [Aframax]	0,817383	0,561224	0,809584	1,065574	0,139599	0,028581	1,919796	9.263361 [0.0097]	155,3027	3,683213	190	-1.552906 [0.5047]	-13.7363 [0.0000]
Turnover [Aframax]	0,005054	0,002286	0,004264	0,010113	0,002056	0,635165	2,121668	18.8829 [0.0001]	0,960312	0,000799	190	-1.588609 [0.4864]	-13.5384 [0.0000]
MoneyContracted [Suezmax]	6486,722	2340	5344,25	16975	3451,403	0,99739	3,216167	31.8715 [0.0001]	1232477	2,25E+09	190	-1.847806 [0.3565]	-6.07790 [0.0000]
NetContracting [Suezmax]	1,873684	-12	1	17	4,543132	0,374557	4,136419	14.66658 [0.0001]	356	3900,968	190	-7.043659 [0.0000]	
PricePerEarnings [Suezmax]	5,608268	3,551497	5,497555	8,10134	1,058336	0,335966	2,228092	8.291413 [0.0158]	1065,571	211,6942	190	-2.145949 [0.2271]	
SecondhandoverNewBuilding [Suezmax]	0,89055	0,689655	0,895043	1,109827	0,111475	-0,07921	1,886157	10.02047 [0.007]	169,2046	2,348655	190	-10.89728 [0.0000]	
Turnover [Suezmax]	0,00648	0,001368	0,005165	0,016443	0,004005	0,791516	2,571185	21.29483 [0.000]	1,231132	0,003031	190	-1.168588 [0.6877]	-12.7800 [0.0000]
MoneyContracted [VLCC]	13765	3930	10652	41120	8632,22	1,121275	3,583782	42.51118 [0.000]	2615351	1,41E+10	190	-1.654723 [0.4526]	-6.54311 [0.0000]
NetContracting [VLCC]	2,542105	-9	2	28	6,080223	1,09336	5,960002	107.2183 [0.000]	483	6987,163	190	-12.03509 [0.000]	
PricePerEarnings [VLCC]	6,141155	3,88786	5,970807	9,411036	1,305459	0,467774	2,419907	9.593082 [0.008]	1166,82	322,0983	190	-2.499428 [0.1172]	-12.7058 [0.0000]
SecondhandoverNewBuilding [VLCC]	0,819664	0,585859	0,838429	1,03125	0,112424	-0,33177	2,094004	9.983734 [0.006]	155,7362	2,388806	190	-1.982183 [0.2946]	-12.5756 [0.0000]
Turnover [VLCC]	0,006011	0,002112	0,005471	0,014556	0,002756	1,099333	4,224432	50.13912 [0.000]	1,142145	0,001435	190	-2.648768 [0.0852]	-11.7194 [0.0000]

Following on, we have performed a correlation analysis so as to observe for any correlations that may exist between the variables that will be used. As can be observed from Tables 3, and 4,and according to the literature (Asteriou & Hall, 2007) it is quite common to have variables which correlate that are higher than the 60% cut-off point.

Table 4 - Chapter 1 - Correlation table for bulk carriers – Long run historical 1-year Time Charters

Handysize						
	ΔHANDYSPILL	ΔMoneyContracted	Δ2NetContracting	PricePerEarnings	ΔSecondhandNewBuilding	Turnover
ΔHANDYSPILL	1					
ΔMoneyContracted	-0.023	1				
Δ2NetContracting	-0.039	0.283	1			
PricePerEarnings	-0.000	-0.516	0.028	1		
ΔSecondhandNewBuilding	0.496	0.058	-0.039	-0.099	1	
Turnover	-0.034	0.460	-0.006	-0.751	0.178	1
Supramax						
	ΔSUPRASPILL	ΔMoneyContracted	ΔNetContracting	ΔPricePerEarnings	ΔSecondhandNewBuilding	Turnover
ΔSUPRASPILL	1					
ΔMoneyContracted	-0.058	1				
ΔNetContracting	-0.042	0.307	1			
PricePerEarnings	-0.208	-0.017	0.134	1		
ΔSecondhandNewBuilding	0.498	0.059	0.051	-0.270	1	
Turnover	0.027	0.229	0.150	-0.028	0.098	1
Panamax						
	Δ2PANASPILL	ΔMoneyContracted	NetContracting	ΔPricePerEarnings	ΔSecondhandNewBuilding	Turnover
Δ2_PANASPILL	1					
ΔMoneyContracted	-0.041	1				
NetContracting	0.024	0.718	1			
ΔPricePerEarnings	0.098	-0.008	0.095	1		
ΔSecondhandNewBuilding	-0.193	0.068	0.039	-0.130	1	
ΔTurnover	0.008	0.011	-0.076	-0.314	0.281	1
Capesize						
	CAPESPILL	ΔMoneyContracted	NetContracting	PricePerEarnings	SecondhandNewbuilding	Turnover
CAPESPILL	1					
ΔMoneyContracted	-0.122	1				
NetContracting	-0.120	0.744	1			
PricePerEarnings	-0.041	-0.530	-0.469	1		
SecondhandNewbuilding	-0.073	0.458	0.641	-0.591	1	
ΔTurnover	-0.119	-0.025	-0.093	-0.012	-0.149	1

Notes: The correlation table presents the relation that exists between the variables that have already been theorised in the text. The numbers in bold are the ones that exceed the 60% threshold that is widely used in the literature. In Table 2 relations between variables are exceeding the current threshold and thus a variable of the pair is excluded.

Table 5 - Chapter 1 - Correlation table for tankers – Long run historical 1-year Time Charters

Aframax						
	AFRASPILL	ΔMoneyContracted	NetContracting	ΔPricePerEarnings	ΔSecondhandNewBuilding	ΔTurnover
AFRASPILL	1					
ΔMoneyContracted	-0.102	1				
NetContracting	0.028	0.752	1			
ΔPricePerEarnings	0.026	0.003	0.006	1		
ΔSecondhandNewBuilding	-0.050	0.011	0.050	0.499	1	
ΔTurnover	-0.119	0.063	-0.050	-0.022	0.169	1
Suezmax						
	SUEZSPILL	ΔMoneyContracted	NetContracting	PricePerEarnings	SecondhandNewBuilding	ΔTurnover
SUEZSPILL	1					
ΔMoneyContracted	-0.032	1				
NetContracting	0.073	0.801	1			
PricePerEarnings	-0.186	-0.304	-0.233	1		
SecondhandNewBuilding	0.231	0.330	0.312	-0.491	1	
ΔTurnover	-0.089	-0.021	-0.093	-0.006	-0.006	1
VLCC						
	VLCCSPILL	ΔMoneyContracted	NetContracting	Δ PricePerEarnings	ΔSecondhandNewBuilding	ΔTurnover
VLCCSPILL	1					
ΔMoneyContracted	0.148	1				
NetContracting	0.041	0.819	1			
ΔPricePerEarnings	-0.061	0.167	0.128	1		
ΔSecondhandNewBuilding	-0.023	0.121	0.090	0.124	1	
ΔTurnover	0.047	0.149	0.131	0.073	0.222	1

More precisely, for the Handysize segment, PricePerEarnings and Turnover variables are negatively correlated at a 75% rate; for the Capesize segment, NetContracting and Secondhand/Newbuilding are positively correlated at a 64% level; for the Aframax segment ΔMoneyContracted and NetContracting are positively correlated at a 75% level; for the Suezmax segment ΔMoneyContracted and NetContracting are positively correlated at a level of 80% and finally for the VLCC segment ΔMoneyContracted and NetContracting are positively correlated at a level of 81%. Thus, so as to avoid any multicollinearity issues, we have excluded from our analysis the PricePerEarnings variable from the Handysize segment, the NetContracting variable from the Capesize segment and ΔMoneyContracted variable from all our analyses in the tanker market.

1.1.5.1.2 OLS & LAG Regressions Results

We have analysed the sub-segments of the tanker industry (namely Aframaxes, Suezmaxes and VLCCs) and also the bulk vessel sub-segments (namely Handysizes, Supramaxes/Handymaxes, Panamaxes and Capesizes). In the current analysis, economic indicators seem to be more important for the volatility spillovers of the bulk vessel sub-segments. We have found that four different indicators have a significance on the spillover, while only two have a significance in the tanker sub-segments. On the contrary, money that has been contracted as an absolute figure is of no importance to the volatility spillovers for any sub-segments of our two categories. This can be an indication that the shipping sector market is paying little or no attention to the actual news announcements when it comes to the acquisitions or sales of vessels by others.

In the bulk carriers' sub-segments, we have observed that the far more important economic indicator is the ratio between the second-hand prices and the newbuildings prices. This ratio has a significant relation with all the sub-segments. The analysis reveals that the higher the ratio - meaning that the prices of the second-hand vessels is rather high compared to the price of the newbuildings - for Handysize, Supramax and Panamax vessels, the volatility spillovers will increase. More precisely, the high price of the ratio means that when the sub-segment's market is on an incline, this will lead to higher volatility in the other markets as well. The reason for this appears to be that a positive outlook in one sub-segment has a positive diffusion to other sub-segments as well.

Nevertheless, we have different results for the Capesize sub-segment. In the latter, a positive outlook of the market is decreasing the volatility spillovers for the Capesizes. Our results, which are in accordance with previous studies (Tsouknidis;2016) indicate that Capesizes may act as the status sub-segment for investors who ultimately give priority to larger vessels.

Moreover, our PricePerEarnings ratio acts according to the previous ratio, as they are both parts of the valuation category that has been initially described. Thus, we have found a negative correlation between PricePerEarnings and the Panamax sub-segments volatility spillovers.

Moving on to the tanker market, the relation between economic activity and the spillover effect is not equally consistent. A positive outlook of the second-hand market of Suezmaxes is driving the spillover to move positively to the other sub-segments, while the higher sales of Aframaxes are having a negative effect on its spillover.

Accordingly, when we have explored the relation between the spillover effects and the lag economic activities indicator, as per the previous results, we have observed the negative relation that exists between the valuation variables in the smaller segments and the positive relation in the larger segments. Still, the results in

the dry bulk market when compared to the tanker market are consistent as far as the significance of the variables is concerned.

Table 6 - Chapter 1 - OLS Contemporaneous results for bulk carriers – Long run historical 1-year Time Charters

	ΔHANDYSPILL	ΔSUPRASPILL	ΔPANASPILL	CAPESPILL
C	0.003002 [0.001899]	0.0000461 [0.09471]	0.0000274 [0.000771]	14.88159 [9.893571]
ΔMoneyContracted [Handysize]	0.0017 [0.010622]			
Δ2NetContracting [Handysize]	-0.002499 [-0.613909]			
ΔSecondhandNewBuilding [Handysize]	0.058298** [0.00407]			
Turnover [Handysize]	-0.612306* [0.346608]			
ΔMoneyContracted [Supramax]		-0.010079 [0.000486]		
ΔNetContracting [Supramax]		-0.010536 [0.009125]		
ΔPricePerEarnings [Supramax]		-0.007265 [0.021696]		
ΔSecondhandNewBuilding [Supramax]		0.052138*** [0.007292]		
Turnover [Supramax]		-0.00000289 [0.000646]		
ΔMoneyContracted [Panamax]			-0.005003 [0.013284]	
ΔPricePerEarnings [Panamax]			0.005701 [0.0074]	
ΔSecondhandNewBuilding [Panamax]			-0.048975 [0.030288]	
ΔTurnover [Panamax]			0.004086 [0.009873]	
ΔMoneyContracted [Capesize]				-29.07109 [18.04382]
PricePerEarnings [Capesize]				-1.023056 [0.847722]
SecondhandNewBuilding [Capesize]				-6.182573 [6.383227]
ΔTurnover [Capesize]				-18.25908* [10.99219]
Observations	182	182	182	182
R-squared	0.262185	0.262507	0.08582	0.059007
Adjusted R-squared	0.245511	0.241555	0.065946	0.037742
F-statistic	1.572.439	1.252.925	4.318.302	277.481
Prob(F-statistic)	0	0	0.002313	0.028597

Notes: This table presents the results of the estimated panel data regressions between the net spillovers of each dry bulk segment and different variables of the shipping economic activity as described in the main text. The coefficients of spillovers and time dummies are suppressed where t-stat are used, tests the joint significance of the estimated coefficients. The Hausman test statistic (1978) is utilized in all models to select between the fixed and random-effects specifications. Letter Δ stands for the log first differences. t-statistics are reported in parentheses below the estimated coefficients. Statistical significance of the estimated coefficients is denoted with *, ** and *** for 10%, 5% and 1% significance levels, respectively. All model specifications are estimated with two-way clustered adjusted standard errors (Petersen, 2009).

Table 7 - Chapter 1 - OLS Contemporaneous results for tankers – Long run historical 1-year Time Charters

	AFRASPILL	SUEZSPILL	VLCCSPILL
C	-1.254646 [1.950436]	-16.44228 [13.68617]	-0.48287 [0.962192]
ΔMoneyContracted [Aframax]	-23.38372 [-1.602548]		
ΔPricePerEarnings [Aframax]	12.93292 [18.78212]		
ΔSecondhandNewBuilding [Aframax]	-18.82657 [15.79601]		
ΔTurnover [Aframax]	-14.3658 [10.66229]		
ΔMoneyContracted [Suezmax]		-32.69328 [25.46032]	
PricePerEarnings [Suezmax]		-1.638988 [1.698247]	
SecondhandNewBuilding [Suezmax]		27.43215* [15.17273]	
ΔTurnover [Suezmax]		-8.642942 [6.904726]	
ΔMoneyContracted [VLCC]			16.9445 [11.23918]
ΔPricePerEarnings [VLCC]			-6.919948 [5.245222]
ΔSecondhandNewBuilding [VLCC]			-6.362497 [11.63541]
ΔTurnover [VLCC]			1.953137 [5.926295]
Observations	189	189	189
R-squared	0.025969	0.08582	0.031922
Adjusted R-squared	0.004794	0.065946	0.010877
F-statistic	1.226422	4.318302	1.516822
Prob(F-statistic)	0.301153	0.002313	0.199024

Notes: The table presents the results for the tanker segments. See Table No. 5 for specifications of the variables and the econometric approach used.

Table 8 - Chapter 1 - OLS Lag results for bulk carriers and tankers– Long run historical 1-year Time Charters

	ΔHANDYSPILL	ΔSUPRASPILL	ΔPANASPILL	CAPESPILL	AFRASPILL
C	0.00000765 [0.000556]	0.00007 [0.000539]	0.0000328 [0.000725]	-7.887307 [5.999751]	-1.250141 [2.04711]
ΔSecondhandNewBuilding(-3) [Handysize]	-0.00559*** [0.00204]				
ΔMoneyContracted(-2) [Supramax]		-0.019569 [0.012432]			
ΔSecondhandNewBuilding(-2) [Supramax]		-0.00221 [0.004445]			
ΔPricePerEarnings(-1) [Panamax]			0.015827 [0.013032]		
ΔTurnover(-2) [Panamax]			-0.01885* [0.011384]		
NetContracting(-1) [Capesize]				-0.1627** [0.069364]	
SecondhandNewBuilding(-6) [Capesize]				14.17287* [7.294857]	
ΔTurnover(-5) [Capesize]				-14.263* [7.762941]	
ΔTurnover(-6) [Capesize]				-9.926568 [7.21473]	
ΔTurnover(-6) [Aframax]					-14.0317* [8.441599]
Observations	182	182	182	182	183
R-squared	0.002459	0.022872	0.047839	0.156339	0.009744
Adjusted R-squared	-0.003083	0.011955	0.037201	0.13738	0.004273
F-statistic	0.443751	2.094975	4.496755	8.246298	1.781056
Prob(F-statistic)	0.506171	0.126081	0.012433	0.000004	0.183696

Notes: The table presents the results of the OLS regressions both for the dry and the tanker markets and their subsequent segments. The results presented show the lag variables that bare some statistical significance in the net spillover of the month in t=0. The brackets (.) next to the variables represent the respective prior months i=-1,-2,-3,-4,-5,-6. Up to 6 months before t=0 have been used.

1.1.5.2 Long run historical earnings

We have proceeded to the equivalent analysis of the earnings time-series, as they are provided by Clarkson's Shipping Intelligence Network. Although, 1-year time charters are provided on a consistent basis by the database, neither earnings nor their equivalent spot rates are consistent. We have been able to collect data for the Capesize and the Panamax dry bulk sub-segments and the Aframax, the Supramax and the VLCC tanker sub-segments. After calculating the volatility spillovers for earnings, we have matched the dependent variable with the economic activity variables and we winsorized for the 1%, by the same procedure followed for the time charter rates. Accordingly, given the time-series nature of our data, we have proceed to the Augmented Dickey-Fuller test of stationarity with a cut-off point of 5%. Through the time-series, we have calculated and tested the first logarithmic difference of the equivalent variable for non-stationarity. However, for the MoneyContracted variable for the Capesize segment, we have used the second logarithmic difference as a variable since both the initial variable and the first logarithmic differences are non-stationary.

We have then proceeded to the correlation analysis of our variables in order to check for any multicollinearity issues. We have again used the 60% cut-off point. The variables ***NetContracting*** and ***MoneyContracted*** are highly correlated in the tanker market, and thus we have excluded the Net Contracting variable from our analysis. In the dry bulk sub-segments, we have excluded from our analysis the ***MoneyContracted*** variable for the Panamaxes and the ***SecondhandtoNewbuildings*** variable for the Capesize sub-segment.

Despite the results that we have obtained from the 1-year time charter rates for the bulk carriers, the equivalent results for the vessels earnings are not significant, at least on a contemporaneous basis. As can be observed from Table 11, none of our examined variables are statistically significant and thus cannot explain the volatility spillovers of the dry bulk carriers. The reason for the latter can be that we only have historical data for two sub-segments of the dry bulk market. Thus, the full extent of the volatility spillovers may not have been captured by our VAR estimation framework.

However, the results for the tanker market are providing information concerning the economic activity and its relation to its volatility spillovers. Turnover, the variable that is the proxy ratio for the liquidity that exists in the sub-segment, has a positive relation with the spillovers. In contrast with our results for the time charter rates, where no results were obtained, VLCCs, which represent the larger vessels of the market, appear to be net-givers of volatility when the liquidity in the sub-segment is high for the one or more years.

Checking for a connection between volatility spillovers and our lagged variables, we find equivalent results as in our contemporaneous analysis, as can be

observed from Table No.13. VLCCs are still net-givers, with one-month time lag, while the smaller vessels appear to be net-receivers. More precisely, Suezmaxes are net- receivers of volatility when the liquidity in the market is high, with a five month time lag, while Aframaxes show a low significance positive correlation between the *SecondhandNewBuilding* prices and volatility spillovers, with a one-month time lag.

Table 9 - Chapter 1 - Descriptive statistics for bulk carriers and tankers - Sample Period: 2000-2018 - Long run historical earnings

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probabilit v	Sum	Sum Sq. Dev.	Observation s	ADF [p-value]	ADF [p-value]	ADF [p-value]
VLCCSPILL	2,841	1	30	-5	7,395	1,989	6,802	270,023	0	608	11.648,60	214	-3.30313 [0,016]		
SUEZSPILL	3,467	3	12	-3	2,914	0,317	3,273	4,258	0,119	742	1.809,27	214	-5.20592 [0.000]		
AFRASPILL	7,626	3,5	29	-15	12,004	0,09	1,713	15,06	0,001	1.632,00	30.690,09	214	-1.479025 [0.5425]	-14.1276 [0.0000]	
CAPESPILL	-3,416	0.0000	3	-14	5,514	-0,68	1,725	31,004	0	-731	6.475,99	214	-1.351359 [0.6055]	-19.7763 [0.0000]	
PANASPILL	3,416	0	14	-3	5,514	0,68	1,725	31,004	0	731	6.475,99	214	-1.351359 [0.6055]	-19.8019 [0.0000]	
Money Contracted [VLCC]	12855,58	9488,5	37848	3969	8405,01	1,209	3,654	55,931	0	2751095	1.50E+10	214	-1.668761 [0.4457]	-6.695400 [0.0000]	
Money Contracted [Suezmax]	6.056,9	5.015,0	16.019	1.665,	3.436,5	1,055	3,25	40,278	0	12961	2.52E+09	214	-1.996448 [0.2883]	-6.742683 [0.0000]	
Money Contracted [Aframax]	8.518,6	6.624,5	23.314	1.156,	5.609,6	1,282	3,707	63,112	0	1822991	6.70E+09	214	-2.081251 [0.2526]	-4.707821 [0.0001]	
Money Contracted [Capesize]	20578,55	11900	83435	1445,25	21099,3	1,442	4,131	85,553	0	4403809	9.48E+10	214	-2.097406 [0.2460]	2 [0.1049]	-14.254 [0.0000]
Money Contracted [Panamax]	13815,98	10024,25	39600	1260	10547,2	0,849	2,568	27,394	0	2956619	2.37E+10	214	-2.292300 [0.1754]	-3.291032 [0.0165]	
NetContracting [VLCC]	2,294	2	24	-9	5,823	0,859	4,866	57,37	0	491	7.222,45	214	-7.821750 [0.0000]		
NetContracting [Suezmax]	1,729	1	13	-9	4,278	0,343	3,3	4,99	0,082	370	3.898,28	214	-7.612811 [0.0000]		
NetContracting [Aframax]	3,042	3	22	-8	6,14	0,705	3,528	20,188	0	651	8.030,62	214	-5.206442 [0.0000]		
NetContracting [Capesize]	5,65	4	50	-26	14,334	0,936	4,587	53,682	0	1.209,00	43.764,71	214	-3.276431 [0.0172]		
NetContracting [Panamax]	7,126	5	61	-26	16,002	0,915	4,548	51,215	0	1.525,00	54.539,59	214	-3.849333 [0.0029]		
PricePerEarnings [VLCC]	5,962	5,758	9,251	3,67	1,337	0,499	2,488	11,209	0,004	1.275,79	380,676	214	-2.579518 [0.0988]	-13 [0.0000]	
PricePerEarnings [Suezmax]	5,434	5,25	8,048	3,177	1,133	0,235	2,364	5,579	0,061	1.162,91	273	214	-2.105687 [0.2427]	-1301866 [0.0000]	
PricePerEarnings [Aframax]	5,303	5,257	7,104	3,716	0,905	0,196	1,96	11,016	0,004	1.134,77	174,465	214	-2.359145 [0.1547]	-14.96612 [0.0000]	
PricePerEarnings [Capesize]	5,323	5,102	10,594	1,999	2,052	0,56	2,79	11,578	0,003	1.139,18	896,849	214	-3.126099 [0.0261]		
PricePerEarnings [Panamax]	4,783	4,869	6,988	2,255	1,084	-0,155	2,42	3,862	0,145	1.023,51	250,37	214	-2.483066 [0.1210]	-11.59117 [0.0000]	
SecondhandoverNewbuilding [VLCC]	0,828	0,842	1,006	0,606	0,108	-0,499	2,226	14,217	0,001	177,143	2,487	214	-2.124062 [0.2355]	-14.09760 [0.0000]	
SecondhandoverNewbuilding [Suezmax]	0,892	0,895	1,073	0,696	0,105	-0,151	2,036	9,104	0,011	190,963	2,337	214	-2.186772 [0.2118]	-14.85562 [0.0000]	
SecondhandoverNewbuilding [Aframax]	0,828	0,836	1,06	0,569	0,135	-0,13	1,982	9,836	0,007	177,126	3,899	214	-1.828011 [0.3662]	-14.84090 [0.0000]	
SecondhandoverNewbuilding [Capesize]	0,873	0,815	1,594	0,522	0,23	1,268	4,683	82,608	0	186,904	11,237	214	-3.128338 [0.0260]		
SecondhandoverNewbuilding [Panamax]	0,905	0,84	1,609	0,515	0,252	1,013	3,775	41,929	0	193,625	13,51	214	-2.834964 [0.0551]		
Turnover [VLCC]	0,006	0,005	0,014	0,002	0,003	1,124	4,508	65,366	0	1,279	0,001	214	-2.789218 [0.0616]		
Turnover [Suezmax]	0,007	0,006	0,016	0,001	0,004	0,723	2,687	19,542	0	1,412	0,003	214	-1.109398 [0.7122]	-13.66642 [0.0000]	
Turnover [Aframax]	0,005	0,004	0,01	0,002	0,002	0,575	2,101	18,998	0	1,089	0,001	214	-1.705969 [0.4268]	-5.604826 [0.0000]	
Turnover [Capesize]	0,005	0,004	0,009	0,002	0,002	0,781	3,15	21,971	0	0,989	0,001	214	-1.507723 [0.5279]	-6.974287 [0.0000]	
Turnover [Panamax]	0,006	0,005	0,011	0,003	0,002	0,711	2,8	18,399	0	1,245	0,001	214	-2.202144 [0.2062]	-9.915391 [0.0000]	

Notes: The examined period for the sub-segments of the dry bulk segment is from 1 November 2002 to 31 January 2018, since data availability for the dry freight rates starts 1st November 2002. Returns are the daily continuously compounded returns. For the rest of the specifications concerning the variables and the descriptive econometric analysis see Tables No.1 and No.2.

Table 10 - Chapter 1 – Correlation table for dry bulk carriers - Sample Period: 2002-2018- Long run historical earnings

			Panamax			
	ΔPANASPILL	ΔMoneyContracted	NetContracting	ΔPricePerEarnings	SecondhandoverNewbuilding	ΔTurnover
ΔPANASPILL	1					
ΔMoneyContracted	0,066	1				
NetContracting	0,063	0,689	1			
ΔPricePerEarnings	-0,056	-0,024	0,081	1		
SecondhandoverNewbuilding	0,053	0,425	0,613	0,068	1	
ΔTurnover	-0,117	0,038	-0,061	-0,285	-0,113	1
			Capesize			
	ΔCAPESPILL	Δ2_ MoneyContracted	NetContracting	PricePerEarnings	SecondhandoverNewbuilding	ΔTurnover
ΔCAPESPILL	1					
Δ2_ MoneyContracted	-0,012	1				
NetContracting	0,122	0,231	1			
PricePerEarnings	-0,017	0,015	-0,481	1		
SecondhandoverNewbuilding	-0,039	0,001	0,651	-0,602	1	
ΔTurnover	0,074	0,019	-0,061	-0,042	-0,111	1

Notes: See Table No. 3

Table 11 - Chapter 1 - OLS results for bulk carriers - Long run historical earnings

	Δ_CAPESPILL	Δ_PANASPILL
Constant	-0.000349 (0.000336)	-7.24E-5 (0.000166)
Δ2MoneyContracted [Capesize]	-0.001157 (0.001091)	
NetContracting [Capesize]	1.59E-05 (1.46E-05)	
PricePerEarnings [Capesize]	4.56E-05 (4.32E-05)	
ΔTurnover [Capesize]	0.001164 (0.001037)	
ΔMoneyContracted [Panamax]		0.001243 (0.001258)
ΔPricePerEarnings [Panamax]		-0.001454 (0.001156)
SecondhandNewBuilding [Panamax]		8.84E-05 (0.000195)
ΔTurnover [Panamax]		-0.002649 (0.001912)
Observations	214	216
R-squared	0,027347	0.027304
Adjusted R-squared	0,008731	0.001281
F-statistic	1,469032	1,480738
Prob(F-statistic)	0,212791	0,209155
Notes: See Table No.6		

Table 12 - Chapter 1 - OLS results for tankers - Long run historical earnings

	ΔAFRASPILL	SUEZSPILL	VLCCSPILL
Constant	0.000116 (0.000163)	3,484821 (0,369063)	-4,80708** (2,251044)
ΔMoneyContracted [Aframax]	-0.001505 (0.002311)		
ΔPricePerEarnings [Aframax]	-0.002364 (0.006877)		
ΔSecondhandNewBuilding [Aframax]	0.003822 (0.005736)		
ΔTurnover [Aframax]	0.001553 (0.001267)		
ΔMoneyContracted [Suezmax]		-5,62165 (3,586426)	
ΔPricePerEarnings [Suezmax]		-0,841176 (2,457814)	
ΔSecondhandNewBuilding [Suezmax]		4,22224 (3,991834)	
ΔTurnover [Suezmax]		-1,280484 (1,40726)	
ΔMoneyContracted [VLCC]			14,42336 (9,490763)
ΔPricePerEarnings [VLCC]			-6,192678 (7,327705)
ΔSecondhandNewBuilding [VLCC]			13,34115 (9,092381)
Turnover [VLCC]			1273,236*** (386,7842)
Observations	216	216	214
R-squared	0,011459	0,019346	0,259658
Adjusted R-squared	-0,007282	0.000755	0,245488
F-statistic	0,611443	1,040617	18,32546
Prob(F-statistic)	0,654836	0,387207	0
Notes: See Table No.5			

Table 13 - Chapter 1 - OLS Lag results for bulk carriers and tankers - Long run historical earnings

	ΔAFRASPILL	SUEZSPILL	VLCCSPILL	ΔCAPESPILL
Constant	0,000108 (0.000153)	3,556612*** (0,390611)	-3,97625* (2,208059)	-1.56E-5 (6.61E-05)
ΔSecondhandNewBuilding(-1) [Aframax]	0,005463** (0.002590)			
NetContracting(-1) [Suezmax]		-0,067777 (0,043519)		
ΔPricePerEarnings(-4) [Suezmax]		4,311341 (2,643681)		
ΔSecondhandNewBuilding(-6) [Suezmax]		-7,522605 (4,642464)		
ΔTurnover(-5) [Suezmax]		- 3,681352** (1,639194)		
ΔMoneyContracted(-1) [VLCC]			15,12175 (9,191449)	
ΔTurnover(-1) [VLCC]			1136,49*** (381,7183)	
Δ2MoneyContracted(-4) [Capesize]				-0.001225 (0.000881)
ΔTurnover(-5) [Capesize]				0.000622* (0.000387)
Observations	215	210	215	211
R-squared	0,010022	0,068849	0.209831	0.005462
Adjusted R-squared	0,005374	0,05068	0.202377	-0,004101
F-statistic	2,156271	3,789381	28,1486	0,571176
Prob(F-statistic)	0,143464	0,00538	0.000000	0,565744
Notes: See Table No.7				

1.1.6 Conclusion

In the current research, we have tried to shed light on the economic determinants that drive volatility spillovers among the sub-segments of the tanker and the dry bulk shipping segments. While literature up to now is quite extensive on the volatility that exists in the industry, both for freight rates and vessel prices, a gap exists in its drivers. Tsouknidis (2016) has provided evidence that the volatility of freight rates is not sub-segment oriented, but dynamic spillovers exist to other sub-segments as well. Thus, we have extended the latter findings by addressing the issue of which are the determinants of volatility spillovers and, subsequently, we have filled a gap that

exists in the literature which concerns shipping volatility's relation with micro and macro variables. In order to do so, we have used three sets of variables that come under the categories of market expectations, valuation and market liquidity, as proposed by Papapostolou et al. (2014). Our results provide evidence that the ratios that denote the valuation of vessels and the liquidity of the sub-segments market are important factors when it comes to the volatility spillovers effect. More precisely, valuation plays a significant role for the dry bulk market, since a high valuation of Handysize and Supramaxes drives the volatility of the freight rates to be distributed to other segments as well. On the contrary for the Capesize segment, the results are antithetical by receiving volatility from the other markets when the valuation proxies are higher. In the tanker market, liquidity is the main driver of volatility spillovers. VLCCs are net-givers of volatility when the liquidity in this sub-segment is high for one year or more, while Suezmaxes are net-receivers of volatility.

Two different conclusions can be derived from our results. On the one hand, dry bulk investors are mitigating their preferences as soon as the value of smaller vessels rises. Thus, more volatility is apparent in the larger vessels. On the other hand in the tanker market, investors will target the medium and the smaller vessels market as soon as the VLCC's market begins to be saturated by a larger number of available vessels.

Our results can be further explained by the nature of the cargo that dry bulk carriers and tankers are carrying (Branch, 2007). While there is a large variety of cargo that dry bulk carriers can transport, tankers have limits both on the cargo and the volume that will be available for transfer due to the limited market of oil producers. Thus, dry bulk investors can start by investing in smaller dry bulk carriers and, when the market is booming, they can expand to larger ones, since there is cargo available. On the contrary, investors in the tanker market seem to be predominantly interested in larger vessels, since larger vessels are associated with contracts that have a larger time span. Nevertheless, when the market of VLCCs is saturated, this will provide investment opportunities in the smaller vessels sub-segments for transportation between ports and hubs.

Despite our findings, further research is needed on this issue. Specifically, since our time-series data is limited given the short period examined, literature would be enhanced by the extension of our findings for a longer period. Moreover, in the current chapter, we have examined the shipping related economic activity and its relation to the volatility spillovers, but the general economic conditions and their implications on volatility spillovers have not been examined as yet. While we know that macroeconomic factors affect shipping stocks (Grammenos & Arkoulis, 2002), research has not been conducted on their implication on volatility related matters.

2 ESSAY TWO

2.1 Corporate governance, market sentiment and shipping company performance

2.1.1 Introduction

Contemporary shipping companies are increasingly adopting a corporatist approach as evidenced by the gradual changes in internal structures and management (Notteboom, 2004); strategic alliance formation (Panayides & Widmer, 2011); mergers and acquisitions (Alexandrou et al., 2014) and the new approaches to raising finance (Merikas, Gounopoulos, & Nounis, 2009). Such changes have inevitably led to greater attention to corporate governance in the shipping industry.

Corporate governance consists of a set of rules and regulations which aim to act as a safeguard mechanism protecting the interests of shareholders. The safeguarding mechanisms are intended to ameliorate conflicts that can arise either between principals and agents (Agency Problem I) or between principals and principals (Agency Problem II). There are two streams of prevention measures that have been used in order to prevent malpractices by principals. The first is the use of legal clauses that are included in the agreements of the enterprises' managing teams to prevent potential corporate misbehaviour from their part. The second entails the synthesis of the board of directors (BoD) that serves as a controlling mechanism for the benefit of the shareholders. Corporate governance research has identified positive effects that the BoD can have on the performance and the sustainability of companies (McIntyre, Murphy, & Mitchell, 2007).

Nevertheless, while corporate governance acts as a protection mechanism against the exploitation of shareholders and principals, it should also act as a mechanism for the decision-making process of companies. Even though, the cognitive procedures that take place in a group, like the board of directors have been described by Forbes & Milliken (1999) on a theoretical basis, little attention has been given to the interplay between the external factors and the individual demographic characteristics. In the current chapter, we have built on the theory of Dow (2011) that the sentiment of the market is an important factor of the external environment and ultimately can affect the decision process in the board of directors. Arif & Lee (2014) provide empirical evidence that good sentiment affect the corporate risk taking. During high investor sentiment, companies tend to raise more equity and overinvest in PPE and R&D (Jensen, 2005). Similarly, under-priced firms forego investment projects with positive NPV, that is market overvaluation (undervaluation) will coincide with higher (lower) levels of aggregate investment, even though the subsequent returns to these investments may be lower (higher) than expected (Arif and Lee, 2014). Moreover, literature provides empirical findings on the positive relation between market sentiment and the expectations of future cash flows by the managers of companies (Habib & Hasan, 2017).

A major part of current academic research has focused on the demographic characteristics of the board of directors and their respective significance on the performance of enterprises (Goergen, 2012). However, results are not conclusive on which characteristics are important when performance is considered on a generalised level. On the contrary, different characteristics are important for different sectors (Erkens, Hung, & Matos, 2012) and in different countries (Doidge et al., 2007).

The ensuing chapter is organised as follows. Initially, we review the relevant literature focusing on corporate governance and corporate governance in the maritime sector. Following this, we consider the moderating role of market sentiment and develop a conceptual model and explain our research hypotheses. This is followed by an analysis of the relevant data which includes multivariate analysis of the relation of the BoD's characteristics and the financial performance of companies under different states of the market sentiment. The results are then presented and discussed before concluding with practical and theoretical implications.

2.1.2 Literature Review

2.1.2.1 Theoretical aspects of corporate governance

Corporate Governance has been defined on various occasions both on an academic and a constitutional policy basis (US Congress, 2002). Nevertheless, the definition of Goergen and Renneboog (2008, p.4) gives a thorough treatment of the topic:

> *"Corporate governance system is the combination of mechanisms which ensure that the management (the agent) runs the firm for the benefit of one or several stakeholders (principals). Such stakeholders may cover shareholders, creditors, suppliers, clients, employees, and other parties with whom the firm conducts its business."*

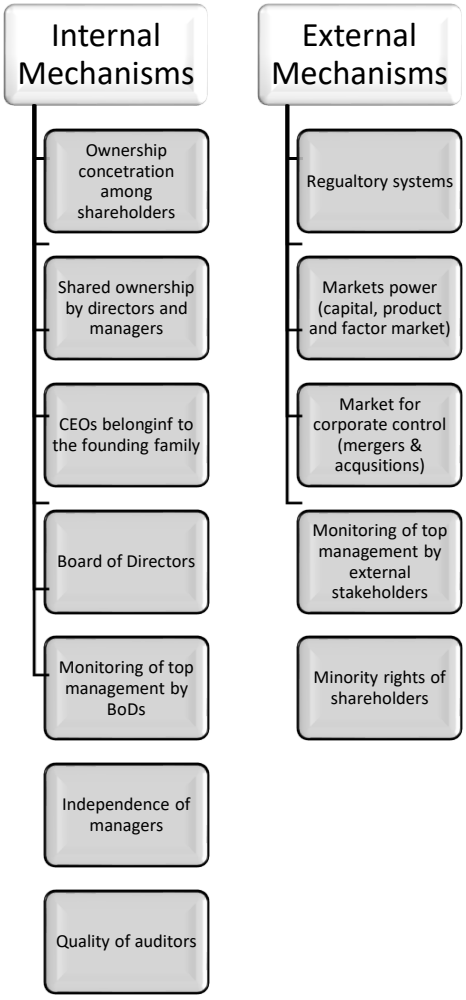
While corporate governance is a concept that applies to all enterprises, often it is the board of directors of the publicly listed firms that come under scrutiny. This is because, in their majority, privately held companies are managed by their shareholders. This is not to say of course that the latter combined role is of little importance, but given the significance that board of directors' decisions may have on the value of the shareholders' investments in monetary terms, it is reasonable that the socio-economic environment (policy-makers, professionals and academics) is mainly concerned about the listed companies where the separation of ownership and management is more predominant.

The spectrum of the shareholders, the top management team and the stakeholders of the companies create a dynamic environment where different individuals collaborate to create value for an enterprise in a multinational setting. Corporate governance can be examined in the context of the relation between the management and shareholders and other stakeholders or by focusing on management

activities alone. The literature provides two different schools of thought regarding the relation of the management of the companies and the investors of the company. On the one hand, stewardship theory considers the managers as stewards that act in the best interests and on behalf of the shareholders, thus creating value for the entity (Davis et al., 1997). On the other hand, agency theory suggests that the agents (i.e. managers) will primarily act in an individualistic manner, as they will try to benefit themselves. On this basis, the relation that exists between them and their principals (i.e. shareholders) is endogenously frictional (Jensen and Meckling, 1976). Two different types of problems can be present as far as agency theory is concerned. 'Agency Problem I' is the state when agents act for their own benefit rather than for the benefit of their managers (i.e. shareholders). Subsequently, 'Problem II' arises when shareholders that hold large blocks of shares try to expropriate benefits from minor shareholders (Villalonga and Amit, 2006). Despite the significant body of research that has been conducted over the years, it is still not clear why some agents tend to have self-seeking behaviours while others do not. Nevertheless, the novel work of Wiseman and Gomez-Mejia (1998) on the behavioural aspects of the managerial process, does give some insights on the latter ambiguity.

With regards to the mechanisms through which the principals try to control the agents of the firm to avoid any malicious acts from their part, both internal and external functions should be in place. As can be seen in ***Figure 1,*** actions can be taken both internally from the principals of the company so that they can be protected, but also externally. External mechanisms that are in place are policies that can be attributed either to governmental or institutional initiatives. On the contrary, the internal mechanisms are set in place mostly by the shareholders of the company.

Figure 1 - Chapter 2 - Internal and External Mechanisms of Corporate Governance



(Giannakopoulou, Thalassinos, & Stamatopoulos, 2016)

A system that is universally accepted as a positive enhancement to the companies' control (corporate governance) on the principal-agent frictional relationship, is the existence of a board of directors that serves as a supervisory body in the operation of a given company. The board of directors, more often than not, consists of internal and external directors that periodically oversee the operations of the company, to maximise the company's value. The board of director's function is not to account for all the daily operations of the company but on the contrary to make decisions on strategic issues. A critical issue that is thoroughly examined in the literature is the composition of the board of directors per se and its optimal structure that can lead the corporation to achieve a positive and sustainable performance. Different corporations need different management approaches, not only in the daily operations but also for their overall strategy. Financial performance (Core et al., 1999), investment decisions (Billett et al., 2011), and earnings quality (Larcker et al., 2007) are all crucial factors that strongly affect the value of the company (whether positive or negative) and are discussed and decided in the board of directors'

meetings. Various aspects of the boards' composition have been researched, and the results provide insights into the most suitable composition. More precisely, the board of directors that have a more pluralistic composition either demographically, or in terms of human or social capital, appear to drive their companies towards a more sustainable business model (Johnson et al., 2013).

Currently there is research on the effects of demographic characteristics on businesses' entrepreneurial outcomes. For instance, Erhardt et al. (2003) examined the effects of demographic diversification and found it to have a significant effect on company performance. Boards that are composed of members that come from different geographic positions can tackle problems of the enterprise from different contextual backgrounds and thus enhance corporate value. Likewise, differentiation in the cognitive skills of the BoDs' members also enhance the dynamics of the team (Forbes & Milliken, 1999).

The size of the board is considered an important factor (Cheng, 2008) since there is a clear cost and benefit relation according to the number of people that sit on the board. While more individuals means more expertise, the velocity by which decisions are taken by a larger group is minimised. Thus, the literature is suggesting that high-growth enterprises are better off when they keep the board of directors small in order for decisions to be taken promptly. On the contrary, enterprises that are not part of sectors that are experiencing high-growth opportunities are better off when they are composed of a bigger board of directors (Coles et al., 2008).

Additionally, the percentage of external directors (Booth and Deli 1996) has been researched thoroughly in corporate governance literature. External directors are considered to possess relevant experience and expertise and serving on the board gives them a broader perspective on corporate issues. However, a critical concern that may arise is the degree of independence that the latter members have. A recent stream of the literature suggests that even though from a legislative perspective directors are considered independent; they tend to be overly sympathetic with the company's management (Cohen et al., 2012). It should also be mentioned that under certain national contexts, it can be the case that not all the criteria are met when independence is considered and thus listed companies may perform their obligations in the fringe of the law (Santella et al., 2006)

The role of the chairman of the board of directors is also important , as he acts as the person in charge of the meetings. Various academics have reported on outcomes when one single person is not only the chairman of the board but is also the CEO of the company. The results are mainly inconclusive since a stream of research states that the combination of the two roles has negative effects on the company's performance (Charitou and Louca, 2013) while other scholars state the opposite (Rechner and Dalton, 1991). Nevertheless, it is still not clear whether the latter inconclusiveness is because of endogeneity issues or issues related to agency problems vs stewardship (Krause et al., 2014).

Lately, attention has also been given to the mixture of genders in BoDs. It is not just the issues of equality that renders this focus appropriate, but also the issue of optimum performance of companies that invite more women on to their boards. Research has provided evidence that women, under the corporate governance context, show fewer overconfidence characteristics, and thus their approach towards investments (M&As) is less aggressive or expansive (Terjesen et al., 2009).

2.1.2.2 Corporate governance implications under various market conditions

While the literature has extensively researched various corporate governance issues, little attention has been given to the impact that the BoD has under different market conditions. The issue arose initially when the financial crisis of 1999 had hit the Asian markets. In the work of Johnson et al. (2000), evidence is provided that countries which have weak regulations on minority shareholders, tend to lose investors' interest under turmoil periods and consequently have their stock markets devaluated. On the same theoretical basis, Erkens et al. (2012) have examined the performance of financial firms during the financial crisis of 2007-2008. They have provided evidence that both a high number of institutional investors and a high number of independent directors acted harmfully for the entities during the global financial crisis. More precisely, firms that had a high number of institutional investors before the crisis had taken more risks prior to this period, and this had driven lower stock returns during the crisis. Additionally, firms with more independent directors had raised more equity during the crisis, and the latter transferred the wealth from the shareholders to the debt-holders.

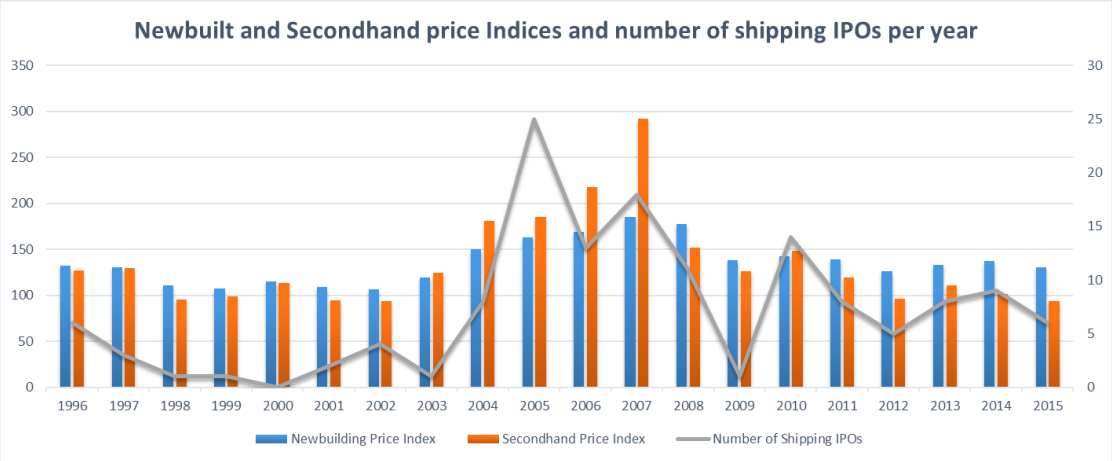
Apart from the literature that deals with financial crises and corporate governance, another stream of literature has focused on business and economic cycles, and how BoDs act under different market conditions. Philippon (2006) provides evidence that badly governed firms are more prone to over-investments and excessive hiring during the boom periods; two facts that will lead to lower profit margins overall and more volatility in their earnings during the contraction period. Accordingly, Kedia & Philippon (2009) have shown that fraudulent accounting is more likely to be apparent during the boom period of the market, where managers of non-performing firms tend to over-invest and over-hire, in order to keep up with the performing firms of their industry.

It has become apparent that the inter-relationship between corporate governance and its effects under different market conditions requires further research, especially in the context of volatility and uncertainty swings, where steady decision-making by BoDs becomes even more important in comparison to stable market conditions.

2.1.2.3 Corporate governance in the maritime sector

Since the year 2000, maritime enterprises have started to float in the global stock markets, mainly as a means for raising equity finance and as a means for financing their asset acquisitions and operations (Kavussanos & Visvikis, 2016). The freight rate prices have risen to very high values, and thus the acquisition of both new and second-hand vessels has become capital intensive, as can be observed in ***Figure 2***. The latter booming environment and the infusion of money in the industry have given rise to agency problems that are harmful to the whole spectrum of the stakeholders. Thus, corporate governance mechanisms have been established to ameliorate potential threats.

Figure 2 - Chapter 2 - Newbuild and Second-hand price indices



The Clarkson Newbuilding Price Index is calculated by averaging the $ per dwt values of the various ship types. The base of 100 is taken as the average index value as of January 1988.

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The literature on corporate governance of listed maritime companies is still limited given the fruitful setting that the industry is providing. Both the inherent volatile environment of the industry and the nature of the sector's core assets create a multifaceted managerial environment that corporate governance should protect. Most of the studies have been focusing on the board of directors and how its demographic characteristics are correlated with the entities' performance measures. The only attempt so far to review the literature on corporate governance has been conducted by Giannakopoulou et al. (2016). Research by Andreou et al. (2014), Syriopoulos & Tsatsaronis (2012), Randøy et al. (2003) and Koufopoulos et al. (2010) represent the bulk of academic publications that focus on corporate governance in shipping, both on active measures and on demographic characteristics of the BoD (Table No.14).

Table 14 - Chapter 2 - Board of directors literature review findings

Corporate Governance of Shipping Firms				
BoD Measures and Demographics	**Investment**	**Performance**	**Profitability**	**Earnings Management**
Founding Family CEOs		+ (Randøy et al. 2003)		
		+ (Syriopoulos & Tsatsaronis 2011)		
Board Independence		# (Syriopoulos & Tsatsaronis 2011)	+ (Randøy et al. 2003)	
Level of ownership by the board (plus officers & directors)		+ (Andreou et al. 2014)	# (Randøy et al. 2003)	+ (Andreou et al. 2014)
		# (Syriopoulos & Tsatsaronis 2011)		
Corporate Governance Committee		+ (Andreou et al. 2014)		
CEO Duality		+ (Andreou et al. 2014)		
		- (Syriopoulos & Tsatsaronis 2012)		
Busy Directors		- (Andreou et al. 2014)		
Number of Directors	- (Andreou et al. 2014)			
+: Positive Correlation, - : Negative Correlation, # : No Correlation				
Notes: This figure presents the empirical evidence that in the literature on the correlation between key board of directors' measures and the following information characteristics of shipping firms: *Investment*, *Financial Performance*, *Profitability* and *Earnings Management*.				

Nevertheless, the latter research is still inconclusive on certain key corporate governance issues. For example, previous studies do not provide conclusive evidence on whether CEOs should play a predominant role in the enterprise by also serving as the chairman of the board of directors. Also, scant attention is given to whether larger boards of directors are better for improving the performance of a company or not. The most recent and thorough research on the matter is that of Andreou et al.

(2014) which focuses on a broader sample compared to previous research. More precisely, the latter study uses data from the US stock markets for the period between 1999-2010, and the sample consists of 46 firms and 273 firm-year observations. Andreou et al. (2014) have found that the number of board members matters. Their findings suggest that the larger the number of board members in the shipping company, the lower the sub-optimal investments will be. Also, in their research they shed light on the duality of the CEO/Chairperson. They show that the latter duality can have a positive outcome on the financial performance of the shipping companies while the percentage of ownership of the board also has a positive impact on financial performance. This means that maritime enterprises, more often than not, are managed by their founding members (or their extended family) and tend to perform better when compared to their counterparts.

On the contrary, Syriopoulos & Tsatsaronis (2011) have found evidence that contradicts the previous research. Nevertheless, it should be mentioned that their sample consists of 11 Nasdaq Greek listed maritime companies for the period between 2004-2008. While Andreou et al. (2014) show evidence that the higher the numerical composition of board members of the shipping company, the lower the sub-optimal investments will be, Syriopoulos & Tsatsaronis (2011) found that small boards can better serve the economic targets of a shipping company.

Interestingly though, both researches have found that CEO duality is a favourable board characteristic since it increases the company's performance. Randøy's et al. (2003) research has shown that founding CEOs and greater board independence can increase the profitability of a maritime company. However, contrary to Andreou et al. (2014) who found that insider ownership improves performance, Randøy et al. (2003) didn't find any significant relation. It is critical though to mention that the work of Randøy et al. (2003) focused on the Scandinavian market by examining 50 listed maritime enterprises with headquarters either in Norway or Sweden for the years between 1996-1998. The latter is a significant differentiation given the different legislation that was in place in the Nordic countries at the time. A more comprehensive analysis has been conducted by Koufopoulos et al. (2010). In their research, data was acquired through questionnaires that were answered by maritime executives who served in Greek listed companies. The research was conducted between 2006-2007, and 179 managing directors of maritime companies were asked to participate in the research. The final response rate was 20.3%. Despite the targeted research group that Koufopoulos et al. (2010) used, their results are highly valuable for the maritime context given the gap that exists in survey results. In their research, the prominent role of the family members of the founder was revealed.

Furthermore, the CEO/Chairman duality is prominent in more than half of the examined companies. Also, for most companies, external directors are a relatively small fraction in the composition of the board of directors. A critical point that has

been raised for the first time in the maritime context is the frequency with which the board of directors convenes. Results show that in their majority (30,8% of the sample) board of directors have weekly meetings. Secondly, the trend is towards meetings that are held every three months (23.1%) and thirdly every month (11.5%). Given the latter fact, assumptions can be made on the influence that directors have both on the company's performance, its plans and the market in general. Furthermore, it should be mentioned that a very large number of meetings will eventually prohibit external directors from joining the team given the considerable effort that should be given in this engagement, while the actual economic benefit that one could have on serving on a shipping corporate governance board is still not researched.

In addition, the work of Lambertides and Louca (2008) focuses on the ownership structure of the maritime enterprises and how the latter affects their performance. Ownership concentration is an additional factor affecting the enterprises. High share concentration with accompanying voting rights means that the majority of shareholders can act harmfully towards the rest of the shareholders as suggested by agency theory and the problems arising. Louca and Lambertides (2008) investigated a sample of 312 firm-year observations of European listed enterprises for the period covering 2002-2004. Interestingly, they found that the operating performance of the maritime entities investigated was positively associated with foreign shareholders and with investment firms. This suggests that block holders who have both the means and the knowledge to control the board of directors, as to the operating part of the entities, can improve the companies' operational performance.

Finally, recent research has attempted to shed light on the different aspects of the corporate governance conundrum and not to solely focus on financial indicators. Lee and Han (2016) examined containership enterprises for 2015 and showed that while corporate governance does not affect the financial performance of entities directly, it does affect their business scope. Additionally, Lee and Han (2016) have provided survey results on the ways that corporate governance in shipping companies can tackle problems which have arisen due to globalisation.

2.1.3 Conceptual Model and Hypotheses

This research has aimed to investigate the relation between corporate governance demographics and the performance of shipping firms under periods of over-pessimistic and over-optimistic sentiment in the market. While extensive research has already been conducted on the significance of the BoDs in different countries and different sectors, as well as on the personality characteristics of the managers, no research is available about the market conditions and the response of business executives to them. One would expect that BoDs' steady decision making assumes greater importance when the sentiment of the market is either very high or very low,

since their collective decisions should ameliorate overreactions on behalf of the top management team. The shipping industry provides a perfect setting to explore the specific research questions given that the extreme volatility that is historically encountered in the industry is frequently shifting market sentiment between the two extremes. Thus, the current research is not only contributing to shipping finance literature but is also enhancing relevant finance literature, despite the fact that it is a sectorial research.

In the current research, we have examined five different corporate governance variables that the literature purports to be very significant for company performance. The variables include the average age of the board members, the number of people on the board, the percentage of the independent board members, CEO duality and the percentage of females that serve on the board. The latter is described in the literature as notions of decisions.

2.1.3.1 Age

Initially, we have considered the average age of the BoD members as an important factor for the decision-making process of the company. Previous researchers have found that the older the age of directors, the less likely they are to initiate changes and accordingly; older directors tend to be more risk averse (Kang, Cheng, & Gray, 2007). Since risk-aversion is the desired aspect of the BoD when over-pessimistic and over-optimistic market conditions are apparent, we have expected that a higher average age of the BoDs' members will be positively correlated with a better financial performance of the shipping firms in the high/low sentiment periods.

H1a: A higher average age of the BoD members will be positively correlated with better financial performance of the shipping firms in the high sentiment periods.

H1b: A higher average age of the BoD members will be positively correlated with better financial performance of the shipping firms in the low sentiment periods.

2.1.3.2 Number of board members

Concerning the number of directors that serve on the board, we have explored if the number of board members is positively or negatively influencing the financial performance of shipping firms. Evidence has shown that there is a threshold on the number of directors that should sit on the board (Coles et al., 2008). A high number of directors is likely to create frictions in the decision-making process, given the extended time needed for a decision to be made. Evidence show that non-diversified firms where the knowledge of the specific industry is of importance, are better served by a small number of members of the BoD. Since shipping companies are not primarily diversified in different sectors, and knowledge of the industry is crucial,

we expect that small BoDs will have a positive effect on the financial performance both in overly optimistic and overly pessimistic periods.

H2a: A smaller number of board members will have a positive effect on the company's financial performance in high sentiment periods.

H2b: A smaller number of board members will have a positive effect on the company's financial performance in low sentiment periods.

2.1.3.3 Number of independent directors

We have tested for the relation between the independence of board members and performance. Despite discussions over the years regarding the importance of independent directors on the board, there has been mixed evidence culminating into a conundrum as to what the exact role of independent directors is (Johnson et al., 2013). At the one end, under an agency theory perspective, independent directors can act as an alleviating mechanism of any agency costs (Masulis, Wang, & Xie, 2007); on the other end however, independent directors should additionally act as consulting individuals for the executive members of the board regarding the company's performance. Nevertheless, Erkens et al. (2012) found that during the financial crisis the higher the number of independent directors was, the more prone they were to act harmfully at the expense of the shareholders. Thus, we have hypothesised that under high optimistic and high pessimistic periods, the higher the number of independent directors is, the lower the company's financial performance will be.

H3a: A higher number of independent directors will have a positive effect on financial performance in high sentiment periods.

H3b: A higher number of independent directors will have a positive effect on financial performance in low sentiment periods.

2.1.3.4 Duality

Literature on duality issues spans over three decades and is controversial as researchers derive their conceptualisation processes either from agency theory or use stewardship theory. Boyd (1995) concluded that under highly volatile periods duality could act positively for the financial performance of the companies, while in contrast Dalton et al. (1998) found a weak, negative correlation between CEO duality and financial performance in their meta-analysis. In this study, we have hypothesised that the concentration of power will have a negative effect on financial performance in extreme market sentiment conditions. CEO duality means that the CEO will have more power in the decision-making process of the business, but intrinsically this means that the CEO is more likely to be affected by market sentiment, since decisions will be made less inclusively. Evidence from the behavioural economics stream of literature has shown that group decisions tend, under uncertainty, to be

more accurate when compared to decisions of individuals (Bainbridge, 2002). On the contrary, a separation of the roles may lead to a more inclusive decision making of the different executives and managers, and thus sentiment can be ameliorated from or, at least, not affect the decision-making process vastly.

H4a: CEO duality will have a negative effect on financial performance on the extremely high market sentiment period.

H4b: CEO duality will have a negative effect on financial performance on the extremely low sentiment period.

2.1.3.5 Females on the board of directors

A major advancement in the composition of boards of directors is the steady increase in the number of female members. Female board members consistently seem to add positive value to the boards that they are serving on, irrespective of the sector or the geographic area researched (Campbell and Minguez-Vera 2008). Likewise, female board members have increased their representation in the boards of shipping companies. While in 2000 the females serving on the boards were around 4 %, in 2015 the number was approximately 11% (Melas, 2019).

Research suggests positive implications regarding gender diversity on BoDs. For instance, it was found that women tend to be less over-confident compared to their male counterparts. Thus, mergers and acquisitions that have taken place under boards with a number of female directors were more successful in the long-run (Kang et al., 2007). However, it is still not clear whether women have a positive influence on companies' performance. A strand of the literature has theorised on an endogenic relation that may exist (Hagendorff & Keasey, 2012). More precisely, it is stated that women on average are choosing to serve on boards with better financial performance when compared to men. In the current research, given the lower levels of over-confidence that women exhibit, we have expected that they would be less influenced by the sentiment of the market and remain prudent both on highly optimistic and highly pessimistic periods and influencing positive financial performance.

H5a: Female presence on the board will have a positive effect on performance in extremely high market sentiment periods.

H5b: Female presence on the board will have a positive effect on performance in extremely low market sentiment periods.

2.1.4 Data

2.1.4.1 Estimating sentiment

2.1.4.1.1 Estimating sentiments' ratios

Initially, five proxies are calculated as described by Papapostolou et al. (2014). More specifically:

$$NC_{i,t} = \left(order_{i,t} - order_{i,t-1} + del_{i,t}\right) - scrap_{i,t}$$

where $order_{i,t}$ is the order book, that is, the number of vessels awaiting construction or being constructed, for sector i and month t, $del_{i,t}$ the number of vessel deliveries, and $scrap_{i,t}$ the number of vessels being scrapped.

$$MC_{i,t} = order_{i,t}\ x\ newPx_{i,t}$$

where $newPx_{i,t}$, *t* is the price of newbuilding vessels for sector *i* and month *t.*

$$PE_{i,t} = \frac{schPx_{i,t}}{earn_{i,t}}$$

where $schPx_{i,t}$, *t* is the price of 5-year-old second-hand vessels, and $earn_{i,t}$ the annualized earnings (1-year time charter rates) in sector *i* for month *t.*

$$SNB_{i,t} = \frac{schPx_{i,t}}{newPx_{i,t}}$$

$$TURN_{i,t} = M^{-1} \sum_{s=t-M+1}^{t} Sale_{i,s} \Big/ Fleet_{i,s}$$

where $Fleet_{i,s}$ is the total number of available vessels in sector *i* and month *s*, and $Sale_{i,s}$ the number of vessels sold.

After calculating the proxies, we orthogonalise the latter one by one to exclude any macroeconomic fundamentals from the non-sentiment part (i.e. the world economy part). To do so, we regress each proxy with three variables:

- G7 monthly industrial production growth
- A dummy variable for the recession periods of G7 (monthly)
- A dummy variable for the recession periods of the five major Asian countries (monthly)

To get results that are qualitatively similar, we are using year fixed effects in the orthogonalising process. After the latter regressions, the residuals of the regressions are used. The final stage includes the de-trending of the variables with the Hodrick-Prescott filter on a monthly basis. In accordance with Papapostolou et al. (2014; 2016), we proceed to the principal component analysis. We are using 15 variables initially. In order to do so, we include the one-month lag and the two months lag proxies that are included in the matrix. With the latter variables, we calculate the first principal component of the estimation. In order to estimate which variables will be included in the equation, we further estimate the correlation between the first principal component and the 15 proxy variables. For each proxy, we use the one that has a higher correlation with the principal component. Finally,

the model includes the five proxies that have been previously described, and as coefficients, we are using the first principal component of the selected proxies. The estimation comes to the following model

$$Sentiment_{Handymax} = 0.3089 * NC_1 + 0.1695 * MC_0 - 0.2711 * PE_1 + 0.2965 * SNB_1 + 0.2716 * TURN_2$$

which is qualitatively similar to the estimation of Papapostolou et al. (2016):

$$Sentiment_{Handymax} = 0.373 * NC_2 + 0.393 * MC_0 - 0.421 * PE_1 + 0.591 * SNB_2 + 0.425 * TURN_2$$

Apart from the qualitative similarities, after checking for the correlation between the predicted numbers of Papaostolou et al. (2016) and our model, we find a 93% correlation, further justifying the validity of the model.

2.1.4.2 Data collection

Data of all ship-owning enterprises listed on the financial markets has been included in the sample. The sample includes companies that have as a sole operation the transportation of goods by sea. In order to identify the shipping firms that are listed globally, a thorough research has been conducted in Bloomberg and Datastream about the enterprises that have been generating 50% and more of their income from sea transportation activities. Boardex Global has been used to retrieve all the available information that exists for the board of directors of the shipping companies.

The estimation of market sentiment was carried out in accordance with the approach of Papapostolou et al. (2016), and data was collected from the Clarkson Shipping Intelligence database. After calculating sentiment for the three different predominant segments of the industry, namely the bulk market, the containership market and the tanker market, for the period 2000-2015, we have matched the latter data with the vessel profile of each company that it is included in the sample.

To find the vessel profile of each company, we have conducted an online search of the current vessel mix that each entity has. Since, most often than not, the vessel mix of the shipping companies does not change historically, and since each company is operating mainly in one segment, we do not expect the latter to create noise in our analysis. During the process of finding the vessel profile, we excluded the entities that are active in the LNG and LPG sectors and the ones with only supporting operations for the transportation sector such as by providing offshore and port related services. This is because these companies would not be homogeneous regarding calculating their equivalent sentiment index. Finally, it should be mentioned that three companies in our sample could not be included given that they did not have a specific vessel profile and had an equal mix of vessels in different

sectors. After completing these steps, we developed a sample of 64 companies that are incorporated in 19 countries and are listed in 16 stock markets.

We collected data from Compustat concerning the companies' financial performance Return on Assets (***ROA***) under the respective control variables. In order to be consistent with the literature, we included the control variables that have also been used by Andreou et al. (2014) and McNichols (2002) to distinguish the variation that derives from the corporate governance demographics and the intrinsic financial characteristics of each company. Namely, in our analysis, we use the ***Debt to Equity*** ratio, the ***Age*** of the company, the ***Size*** of the company, the ***Cash*** that each company holds and the ***Tobin Q*** ratio that provides information on the firm's growth opportunities. Finally, the total number of firm-year observations are 474.

Table 15 - Companies included in the sample and their vessels' profile

Company's Name	Vessel Profile	Company's Name	Vessel Profile
Aegean Marine Petroleum	Tankers	Mercator Lines (Singapore) Ltd	Bulk Carriers
Algoma Central Corp	Bulk Carriers	MISC Bhd	Tankers
Capital Product Partners LP	Tankers	Navios Maritime Acquisition	Tankers
Compagnie Maritime Belge SA	Bulk Carriers	Navios Maritime Holdings Inc	Bulk Carriers
Concordia Maritime AB	Tankers	Navios Maritime Partners LP	Bulk Carriers
COSCO Corporation (Singapore)	Bulk Carriers	NewLead Holdings Ltd	Bulk Carriers
Costamare Inc	Containerships	Nippon Yusen KK	Containerships
Courage Marine Group Ltd	Bulk Carriers	Noble Group Ltd	Bulk Carriers
d'Amico International Shipping	Tankers	Nordic American Tanker Ltd	Tankers
Danaos Corp	Containerships	Nordic Shipholding A/S	Tankers
DFDS A/S	Containerships	Odfjell SE	Tankers
DHT Holdings Inc	Tankers	Omega Navigation Enterprises Inc	Tankers
Diana Containerships Inc	Containerships	Orient Overseas International Ltd	Containerships
Diana Shipping Inc	Bulk Carriers	Overseas Shipholding Group Inc	Tankers
DryShips Inc	Bulk Carriers	Pacific Basin Shipping Ltd	Bulk Carriers
Eagle Bulk Shipping Inc	Bulk Carriers	Pan Ocean Co Ltd	Bulk Carriers
Euronav NV	Tankers	Paragon Shipping Inc	Bulk Carriers
Euroseas Ltd	Containerships	Rickmers Maritime	Containerships
Evergreen Marine Corp Taiwan	Containerships	Safe Bulkers Inc	Bulk Carriers
Excel Maritime Carriers LLC	Bulk Carriers	Scorpio Tankers Inc	Tankers
FreeSeas Inc	Bulk Carriers	SEACOR Holdings Inc	Tankers
Frontline Ltd	Tankers	Seanergy Maritime Holdings Corp	Bulk Carriers
Genco Shipping & Trading Ltd	Bulk Carriers	Seaspan Corp	Containerships
Global Ship Lease Inc	Containerships	Sinotrans Ltd	Containerships
Globus Maritime Ltd	Bulk Carriers	Tsakos Energy Navigation Ltd	Tankers
Golden Ocean Group Ltd	Bulk Carriers	Star Bulk Carriers Corp	Bulk Carriers
Great Eastern Shipping Company	Tankers	Teekay Corp	Tankers
Grindrod Ltd	Bulk Carriers	Teekay Offshore Partners LP	Tankers
International Shipholding Corp	Bulk Carriers	Teekay Tankers Ltd	Tankers
James Fisher and Sons plc	Tankers	Top Ships Inc	Tankers
Kirby Corp	Tankers	Winland Ocean Shipping Corp	Bulk Carriers
Matson Inc	Containerships		

2.1.5 Results

We performed a multivariate analysis to establish which of the variables, that have been described in section 2.1.4.1, had the expected relationship with the financial performance of shipping companies in the overly pessimistic and the overly optimistic periods of the market. The main driver of the current research was whether corporate governance is a significant factor in the performance of companies, especially when the behavioural outlook of the players in the market is in its trough or its peak.

In the current setting, shipping sentiment was not used per se as an explanatory variable for the performance of the entities, but it served as a threshold that let us examine the relation between the rest of the variables when certain points are reached.

Table 16 - Chapter 2 - Variables used in the multivariate analysis

Variable	Description	Source
Dependent Variables		
ROA	Return on Assets is calculated as the ration of the Earnings before Interest and Taxation over the Total Assets of the company. Takes values between 0 to 1.	Compustat
Corporate Governance Variables		
Number of Directors	The absolute number of directors that serve on board.	Boardex Global
Duality	A binary variable that gets the value 1 if the CEO is also the president of the board of directors and the value 0 otherwise.	Boardex Global
Independent Directors	The percentage of independent directors that serve on the board over the total number of directors.	Boardex Global
Females	The percentage of the female directors that serve on the board over the total number of directors.	Boardex Global
Average Age	The average age of the directors that serve on board.	Boardex Global
Control Variables		
Debt to Equity	The ratio of the total debt of the company over the total equity	Compustat
Age	The age of the company as an absolute number	Online search
Size	The natural logarithm of the company's total assets	Compustat
Cash	The ratio of Cash and Cash Equivalents over the Total Assets of the company	Compustat
Tobin Q	The ratio of the market value of equity over the book value of equity	Compustat

Our analysis relies on two different settings. On the one hand, the corporate governance demographics that matter when sentiment is positive and when it is not. The latter was quantified by calculating the mean for each segment and by calculating our results for the first scenario and then for the second scenario.

We further investigated the corporate governance relation with our performance indicators by estimating our results for the first and fourth quartile according to the year's sentiment.

Initially, we combined the datasets concerning shipping firms' performance, the board of directors and the annual sentiment of the market. Then the latter was sorted for any missing data and respectively winsorized at a level of 1% for outliers. Finally, we had 474 firm-year observations that were examined. From the descriptive statistics table and the correlation matrix, we have observed a rather high correlation between the number of directors that served on the board and the age of the company. This may suggest that the older firms tend to have more directors that serve on the BoD compared to younger firms.

Table 17 - Chapter 2 - Descriptive statistics – Period: 2000-2015

DESCRIPTIVE STATISTICS

stats	ROA	NUMDIR	DUALITY	INDEPERC	FEMALES	AVERAGE	DEBTEQUITY	AGE	SIZE	CASH	TOBINQ
mean	3,225	7,785	0,545	0,541	0,085	57,56	0,562	38,389	21,089	0,102	0,565
min	-53,92	3	0	0	0	44,571	0	1	17,939	0,002	0,023
p50	4,04	7	1	0,556	0	57,2	0,537	20	21,203	0,073	0,371
max	30,42	15	1	1	0,5	73	2,21	164	23,716	0,442	4,813
sd	11,379	2,366	0,499	0,208	0,131	5,502	0,296	42,95	1,165	0,082	0,699
skewness	-2,02	0,543	-0,179	-0,221	1,626	0,161	2,338	1,36	-0,186	1,419	3,758
kurtosis	11,736	32,365	1,032	3,428	4,937	2,897	13,522	3,84	2,791	5,347	20,534

Notes: See Table No.16 for the specification of variables. Min and max are the minimum and maximum values of the sample data, respectively. Mean refers to the arithmetic average. Standard deviation is the monthly standard deviation of the respective variable. Skewness and kurtosis are the estimated centralised third and fourth moments of the data.

Accordingly, we regressed our variables on a basis level to see which demographics of the board have an effect irrespective of the sentiment. We have used both time fixed effects and market fixed effects to account time specific variation and for variation that is predominant due to different regulations by the different markets. Finally, we have clustered our sample on a company basis.

Results show that a high number of board members has a negative effect on the company's performance and the results are significant at the 1% level. Our results support previous literature which states that larger boards decrease the variability of performance of the entities (Cheng, 2008). Larger boards are slower in decision-making processes since more time is needed in order for a decision to be made. Especially, when the market is over-optimistic or over-pessimistic, the plurality of the opinions expressed in the board is counterproductive for the companies. The current result is in accordance with the results of Andreou et al. (2014).

Table 18 - Chapter 2 - Correlation Table

	ROA	NUMDIR	DUALITY	INDEPERC	FEMALES	AVERAGE	DEBTEQUITY	AGE	SIZE	CASH	TOBINQ
ROA	1										
NUMDIR	0,1084	1									
DUALITY	-0,0163	-0,1007	1								
INDEPERC	-0,0682	0,0093	-0,0726	1							
FEMALES	0,0334	-0,291	0,1184	-0,0313	1						
AVERAGEAGE	0,0004	0,2838	-0,0181	0,1294	-0,3621	1					
DEBTEQUITY	-0,1897	-0,1751	-0,0406	0,0825	0,1374	-0,1385	1				
AGE	0,1627	0,3584	-0,0986	-0,1462	-0,0115	0,1692	-0,0995	1			
SIZE	0,1977	0,4099	-0,0125	0,0726	0,0885	0,2912	0,099	0,0169	1		
CASH	0,1398	0,2037	0,0139	-0,2075	0,0349	0,0269	-0,1419	0,0576	0,1742	1	
TOBINQ	0,3809	-0,213	0,1717	-0,1596	0,2013	-0,2012	-0,1388	-0,0057	-0,1282	0,0966	1

Notes: The current figure presents the correlation that exists between our variables. In the strand of literature any correlation that exceeds the 0.6 threshold is considered high enough and is a rule of thumb for multicollinearity issue that may be present (Asteriou & Hall, 2007). In our sample, all variables are uncorrelated with one another thus we are proceeding with including them in our models.

We have re-calculated the respective coefficients for the latter model under two scenarios. In the first scenario, we have used the firm-year observations that their respective sentiment is above 50% and it is named as a below average sentiment. To do so, we matched the vessel profile of the company with the respective sentiment either for the tanker, the dry bulk or the containership markets. Accordingly, following the same procedure, we estimated the high and the low sentiment periods. We used the percentage scale, and by using the highest sentiment index number as the dominator, we divided each month's sentiment index number, and then we multiplied with one hundred. In the first part of our analysis, the sentiment is divided into two categories the ones that fall below the 50% threshold and the ones above that.

Results show that a higher number of directors has a negative effect on the performance of shipping companies, irrespective of the market's sentiment and evidence shows that this is a robust result. Additionally, duality is having a negative effect on the financial performance when sentiment is above the 50% threshold. This result supports previous literature that has found mixed results concerning duality (Andreou et al., 2014; Syriopoulos and Tsatsaronis, 2012). Thus, CEO duality under a positive sentiment acts negatively for shipping companies, most probably due to the concentrated power on one person when the sentiment is positive. As for our control variables, the age of companies as well as ***Tobin Q***, which represents growth options, both act positively on performance, irrespective of the market's sentiment.

Table 19 - OLS Regression for the whole sample, the above average and the below average sentiment periods

VARIABLES	1 General	2 High Sentiment	3 Low Sentiment
NUMDIR	-1.216***	-1.148***	-1.383***
	(0.277)	(0.385)	(0.506)
DUALITY	-2.394	-5.203**	0.0476
	-1.778	-1.980	-2.457
INDEPENDENTPERC	-4.205	-5.086	-2.095
	-4.321	-4.060	-6.151
FEMALES	6.352	8.267	0.569
	-7.505	-7.263	-8.991
AVERAGEAGE	0.0985	0.100	0.124
	(0.202)	(0.185)	(0.272)
DEBTEQUITY	-5.933*	-11.23***	0.903
	-3.349	-3.785	-4.210
AGE	0.0503**	0.0255	0.0729***
	(0.0204)	(0.0231)	(0.0252)
SIZE	4.949***	3.812***	6.184***
	(0.684)	(0.756)	-1.531
CASH	9.096	11.00	3.398
	-5.741	-8.288	-6.736
TOBINQ	4.941***	4.658***	4.322***
	-1.165	-1.247	-1.591
Constant	-85.56***	-59.56***	-123.0***
	(22.68)	(18.76)	(42.87)
Observations	474	239	226
R-squared	0.460	0.531	0.482
Year Fixed Effects	Yes	Yes	Yes
Market Fixed Effects	Yes	Yes	Yes

Notes: This table presents the results of the estimated panel data regressions between the yearly financial performance of the shipping companies presented in Table No.2, the BoD demographic characteristics variables and the control as described in the main text and Table No.3. The coefficients of the variables and time dummies are suppressed where they are used t-stat, tests the joint significance of the estimated coefficients. The Hausman (1978) test statistic is utilised in all models to select between the fixed and random-effects specifications. In all models, fixed effects are chosen. Standard deviations are reported in parentheses below the estimated coefficients. Statistical significance of the estimated coefficients is denoted with *, ** and *** for 10%, 5% and 1% significance levels, respectively. All models' specifications are estimated with two-way clustered adjusted standard errors (Petersen, 2009). In the first model, we explore the significance that our variables have in the yearly financial performance of the shipping companies, while in the second and the third one, we explore their significance when there is the high or low sentiment in the market.

To further analyse the effect that sentiment has as a moderating factor in the relation between corporate governance demographics and financial performance, we segregated the states of sentiment into two segments, namely 0-25% and 75%-100%. We did so, to investigate whether it is the extreme sentiment scenarios that are giving us the previous results or if the latter significant variables are representing the normal state.

Table 20 - OLS Regressions of the 1st and the 4th quadrille of the total sentiment index

VARIABLES	1 0%-25%	2 75%-100%
NUMDIR	-1.578*	-0.772**
	(0.836)	(0.342)
DUALITY	-0.686	-4.935*
	-3.489	-2.570
INDEPENDENTPERC	-4.394	-1.053
	(10.17)	-6.910
FEMALES	5.741	16.47*
	(13.24)	-8.675
AVERAGEAGE	0.312	0.258
	(0.299)	(0.254)
DEBTEQUITY	0.452	-7.563
	-5.096	-5.094
AGE	0.108**	0.0117
	(0.0486)	(0.0341)
SIZE	8.086***	1.040
	-1.478	(0.825)
CASH	-2.896	9.510
	(13.98)	(14.42)
TOBINQ	7.337**	3.769**
	-3.099	-1.863
Constant	-171.3***	-8.016
	(41.48)	(18.46)
Observations	115	125
R-squared	0.541	0.458
Year Fixed Effects	Yes	Yes
Market Fixed Effects	Yes	Yes

Notes: The figure presents the results of OLS regressions for different states of sentiment. More precisely, we have examined 4 states, namely 0-25%, 25-50%, 50-75%, 75-100%. The breakpoint of the sentiment is 50%, thus values that are higher than 50% state a positive sentiment for the market, while values lower than 50% express negative expectations for the market. For the rest of the figures, specifications see the notes in Table No3.

The number of directors is still a robust result and is negatively correlated with financial performance. Duality has a negative effect on performance both in the low and the high sentiment. The current results provide us with evidence on the harmful effects that a concentration of responsibilities has in the shipping business context. Whether our results are driven by overconfidence of the CEOs in the high sentiment period, or the opposite in the low sentiment period is something to be investigated, provided that these results suggest the existence of poor decisions on behalf of the shipping enterprises. The results on the representation of women on the BoDs provide further evidence on the significance of women's representation. The percentage of female presence on the board significantly affects the financial performance of a company in the 75-100% band at a level of 10%. The current results contribute to the literature on the value that women bring as board members. The prudent managerial approach associated with female directors is enhancing companies' performance when sentiment is extremely high. Thus, women's prudence is a constraining factor for the adoption by companies of a risky strategy given the sentiment of the market.

2.1.5.1 Lagged Results

Recent literature has given extensive importance to the role that endogeneity may play in the results that financial literature is presenting. More precisely, Wintoki, Linck, & Netter (2012) have provided evidence that past financial performance may be an indicator of the current state of the board of directors and thus given such a dynamic relationship, little is the contribution of the board of directors' demographics, on the companies' performance. In order to tackle the latter concerns, we repeated the main regression analysis after including lagged values of each dependent variable in each model, in accordance with Andreou et al. (2014) and Harford, Mansi, & Maxwell (2008).

As can be observed, the most important variable that is still negatively affecting the financial performance of companies is the number of directors that serve on the board, meaning that the higher the number of people who are serving on the board, the lower the company's ROA will be. This is to say that given the dynamic nature of the sector, decisions should be made at a fast pace.

Table 21 - Endogeneity Test of the whole sample, the above average and the below average sentiment periods

VARIABLES	1 General	2 High Sentiment	3 Low Sentiment
NUMDIR	-1.069***	-1.576	-0.975
	(0.383)	-1.006	(0.712)
DUALITY	-6.477	-5.041	-8.488
	-6.530	-4.795	-12.568
INDEPENDENTPERC	3.011	4.644	3.368
	-7.110	-11.247	-7.667
FEMALES	-5.082	-0.843	-19.738
	-9.915	-12.385	-15.774
AVERAGEAGE	-0.022	-0.279	0.229
	(0.195)	(0.411)	(0.277)
DEBTEQUITY	-4.869	-7.552	-0.862
	-3.979	-4.933	-4.257
AGE	-4.045	-6.228	-2.738
	-2.386	-4.727	-3.173
SIZE	14.686***	13.690***	13.855***
	-2.911	-2.829	-4.648
CASH	-0.158	-5.525	7.579
	-7.552	-10.317	-11.568
TOBINQ	4.947***	5.994***	3.650***
	-1.533	-2.359	-1.727
Constant	-71.425	-55.605	-96.886
	-21.421	-19.189	-48.550
Lag_NUMDIR	0.148	0.533	0.207
	(0.399)	(0.862)	(0.830)
Lag_DUALITY	3.960	1.347	6.256
	-6.136	-5.054	-11.732
Lag_INDEPENDENTPERC	-8.936	-7.661	-11.104
	-8.430	-11.613	-8.352
Lag_FEMALES	10.857	4.887	24.996
	-10.106	-12.710	-18.430
Lag_AVERAGEAGE	0.128	0.442	-0.194
	(0.243)	(0.445)	(0.244)
Lag_DEBTEQUITY	0.771	-2.172	1.808
	-4.340	-6.068	-5.593
Lag_AGE	4.118***	6.257	2.845
	-2.389	-4.736	-3.179
Lag_SIZE	-10.411***	-9.921***	-8.805***
	-3.123	-2.814	-4.754
Lag_CASH	0.629	11.722	-17.266
	-9.395	-9.456	-15.116
Lag_TOBINQ	-1.218	-2.169	0.049
	-1.147	-1.559	-1.675
Observations	408	200	200
R-squared	0.538	0.6044	0.5419
Year Fixed Effects	Yes	Yes	Yes
Market Fixed Effects	Yes	Yes	Yes

Notes: The table represents the OLS regression performed in order to exclude any endogeneity issues that may be apparent in our previous results in accordance with Ashbaugh-Skaife, Collins, & LaFond, (2006). Thus, we have calculated again our models as described in Figure No.14, but additionally, we have included all the lag values of the dependent variables to establish that our results have not been driven by endogeneity. The variables that bare the term LAG in front of them are the ones described previously. For more information on the variables see Table no. 3.

Table 22 - Endogeneity Test of the 1st and the 4th quadrille of the total sentiment index

VARIABLES	1 0%-25%	4 75%-100%
NUMDIR	0.307	-2.154*
	-2.001	-1.154
DUALITY	-27.933	-5.775
	-21.138	-4.286
INDEPENDENTPERC	-7.303	20.634
	-23.557	-19.186
FEMALES	-53.730	12.615
	-36.834	-15.089
AVERAGEAGE	0.462	-0.745
	(0.537)	(0.539)
DEBTEQUITY	2.268	0.786
	-3.931	-6.201
AGE	-0.699	-1.867
	-5.695	-5.142
SIZE	31.826***	5.122
	-10.298	-4.252
CASH	-17.871	-3.650
	-24.374	-18.392
TOBINQ	0.458	6.034
	-6.456	-3.723
Constant	-108.308**	-12.067
	-50.821	-21.639
Lag_NUMDIR	-0.868	1.705
	-2.093	-1.212
Lag_DUALITY	24.399	-0.320
	-20.493	-5.468
Lag_INDEPENDENTPERC	-6.175	-23.710
	-24.875	-20.136
Lag_FEMALES	64.820	2.343
	(37.978)*	-15.073
Lag_AVERAGEAGE	-0.099	1.019*
	(0.601)	(0.599)
Lag_DEBTEQUITY	-3.349	-12.283**
	-6.460	-5.752
Lag_AGE	0.801	1.854
	-5.694	-5.160
Lag_SIZE	-26.733**	-3.960
	-11.029	-4.623
Lag_CASH	10.458	4.951
	-26.378	-16.005
Lag_TOBINQ	2.195	-2.882
	-5.145	-3.694
Observations	100	100
R-squared	0.6292	0.63
Year Fixed Effects	Yes	Yes
Market Fixed Effects	Yes	Yes
Notes: See notes in Table No.21		

2.1.6 Conclusion

In the current chapter, we examined corporate governance in the shipping companies given the high volatility of sentiment that exists in the specific market. The changes between over-pessimism and over-optimism of the market are common, leading the BoDs to face a challenging role in the decision-making process of the shipping firms. We have examined five demographic characteristics that have been widely researched in literature and associated with the performance measures of companies (Daily, Dalton, & Cannella, 2003). Our evidence shows that a large board has negative effects on the financial performance of the shipping firms irrespective of the sentiment market, leading us to the conclusion that the time consumed for consensus to be achieved acts adversely on the companies. Our results enhance the argument of Coles et al. (2008) that industries where the inside managers have sound firm-specific knowledge perform better financial wise.

On the contrary, our results provide inconclusive findings concerning the CEO duality conundrum. While Andreou et al. (2014) have shown evidence of a positive relation between CEO duality and financial performance, and Syriopoulos & Tsatsaronis (2012) have provided evidence of a negative relation, our results show that while a negative relation is predominant in the over-optimistic periods, the latter result is driven by endogeneity as in the results provided by Wintoki et al. (2012) for various sectors. Accordingly, while females seem to have a positive influence on the financial performance of companies in the very high over-optimistic periods, the results are not robust when endogeneity is tested.

Our chapter provides further insights in the shipping management literature given the recent floating of shipping companies in the markets and the tighter regulations (US Congress, 2002) that have been introduced due to economic scandals which have erupted over the last years (Premeaux, 2009), (Elson et al., 2015). We provide evidence that a large board of directors is the main factor that relates to negative financial performance in periods where the sentiment is primarily over-optimistic. Thus, we conclude that the implication of a large number of directors in the decision-making process of shipping companies seems to act destructively by either being over-optimistic for the market or being too prudent.

While the current chapter has shed light on the growing literature concerning corporate governance implications on performance, certain limitations still exist. More research is needed on the implications that a large number of directors is having on companies' performance. Our results, while robust, do not provide information on the nature of the negative relation between the number of directors, the sentiment and its drivers. Furthermore, while our sample is one of the biggest on the topic of corporate governance in shipping, still data could not be found for a large number of the worldwide listed shipping firms. More research on the matter could further enhance our knowledge on the dynamics that exist in a board and how they relate to companies' performance. While up to now, literature has been mainly driven by the individual characteristics of the members of the BoD, the interplay that exists is also a topic that should be researched.

Last but not least, despite the influx of the shipping companies in the stock markets, there is a significant proportion of the companies of the industry that prefer to remain private (Harlaftis & Theotokas, 2004). Despite their private character, insights on their corporate governance could enhance our knowledge and fill gaps in the literature relating to the embedded governance mechanisms of the industry.

3 ESSAY THREE

3.1 Modelling sales and purchases transactions in the second-hand bulk market: an applied equilibrium approach

3.1.1 Introduction

The secretive nature of the shipping business environment coupled with the over-the-counter conduct of business (Harlaftis & Theotokas, 2004) has contributed to the relatively limited attention given to vessels' valuation by the research community over the years. Nevertheless, the impact of shipping on the world economy is considerable given the level of trading activity that takes place. Currently, every month at least one billion dollars' worth of cargo and transportation services are contracted between shipowners and charterers. The latter figure was in the region of seven billion dollars per month before the economic crisis of 2008.

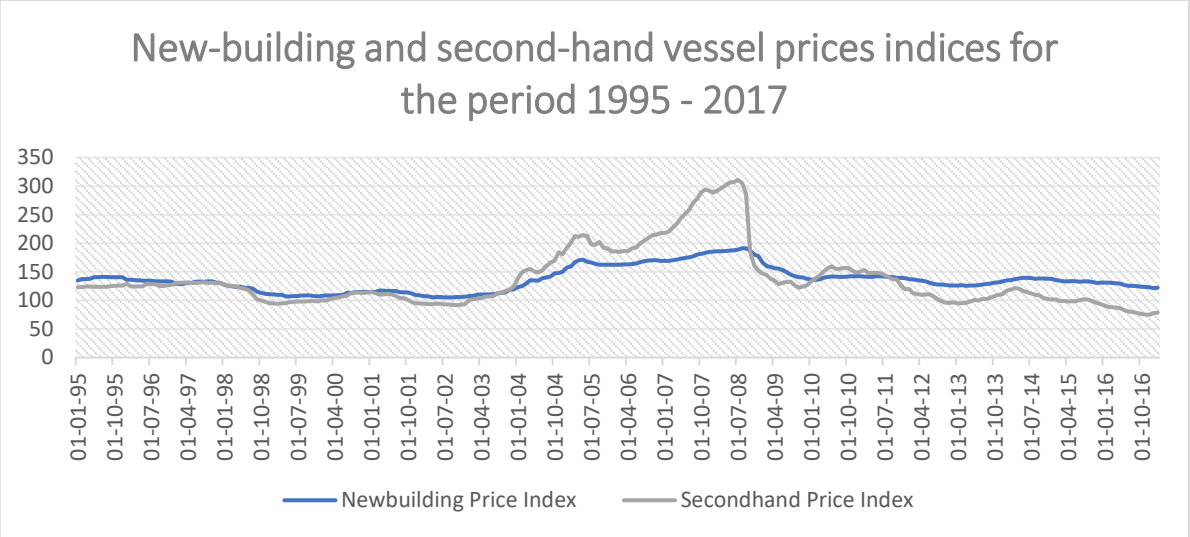
Nevertheless, the inherent problem of the maritime industry is its high volatility. As can be observed from ***Figure 3***, the prices of both newbuilding and second-hand vessels have fluctuated greatly for the past 30 years, leading business owners to bear the risk of acquiring assets with somewhat unpredictable long-term cash flows. The facts provided by VesselValue are rather striking, that in February 2017one-third of the container vessels had market values below their equivalent scrap values[1]. Given the fact that an average vessel can cost from 20 million to 200 million dollars, it is of prime importance for the shipowners to be sure of the value of their vessel, not only in the short-term but also during the significant part of her operational life. Thus, in the current research, an enhanced valuation approach has been implemented based on the framework provided by previous researchers, with further enhanced variables that capture the dimensions of time and vessel profitability which up tp now have not been used in a demand and supply approach.

The concept that the price of a vessel is derived through the market equilibrium has been expressed initially by Haralambides, Tsolakis, & Cridland (2004a) (HTC hereafter). Nevertheless, the limitations that they faced in their research regarding the data collection, and the data frequency, raised questions as to the fitness of their modelling and forecasting approach, not only in the modelling aspect but also in terms of the forecasting. In an attempt to explain the misfit between the model considered and the forecasted results, we have examined the relation between the average prices of the vessel transactions, as described by Clarkson's Shipping Intelligence Network, and the actual prices of each transaction. We see that for all of the three dry bulk sub-segments

[1] More on the value of containership prices can be found in the Lloyds List article titled "*One third of boxship fleet worth no more than scrap value*" - https://www.lloydslist.com/ll/sector/containers/article550130.ece

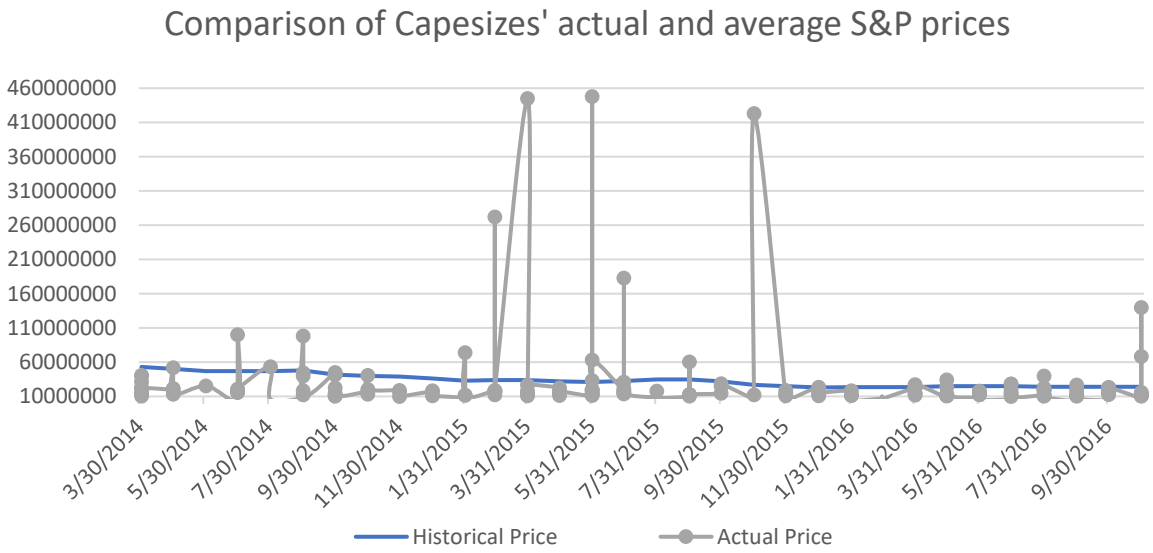
that have been examined there tends to be an upward trend in the estimation of the average prices.

Figure 3 - Chapter 3 - Volatility among indices of vessel prices



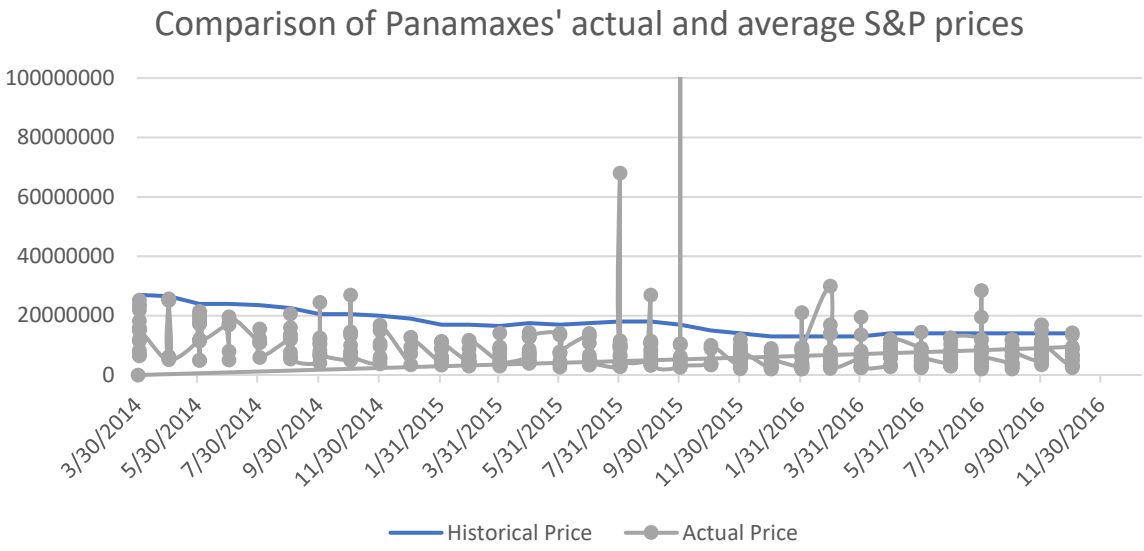
There are specific reasons, why the average calculated price that the shipping database is providing could differ from the sales and purchase prices of the dry bulk sub-segments. Initially, the average second-hand prices that are used are the ones for the five-year-old vessels, while trades occur among vessels of all the ages. Additionally, the prices of the S&P trades are affected both by the technical aspects of the vessels and the dry-docking inspections. As with vessels of different ages, the technical aspects of the vessels and the dry-docking inspections are aspects that are hard to express in monetary terms.

Figure 4 - Chapter 3 - Comparison figure between the average transaction prices of the dry bulk sub-segments and the actual S&P prices



The contribution of the current chapter is the creation of a well-grounded model that not only performs better in the sample period but additionally gives more accurate ex-ante results as far as the values of vessels are concerned. The motivation for a more precise valuation model is derived from the 2008 financial crisis which led many shipowners at the time to financial distress. The latter was a consequence of two different problems that are predominant in the valuation techniques used in the industry. From an asset management perspective the use of comparable prices as a valuation technique, while it does provide a simple approach to valuation, also bears the underlying assumption that the primary asset that has been used as the basis asset has been valued fairly (Summers, 1985). The inherent problem with the latter is that a false value of the asset that serves as the base asset, not only leads to wrong valuations but furthermore acts as a catalyst to the trends of any industry as far as asset values are concerned. In addition, the shipping industry provides secondary services to the world economy, meaning that transportation services are needed, given that there are flows of cargo that should be transported (Stopford, 2009). On this basis, future cash flows tend to be highly volatile when disaggregation is not performed according to the age of the assets.

Figure 5 - Chapter 3 - Comparison figure between the average transaction prices of the dry bulk sub-segments and the actual S&P prices



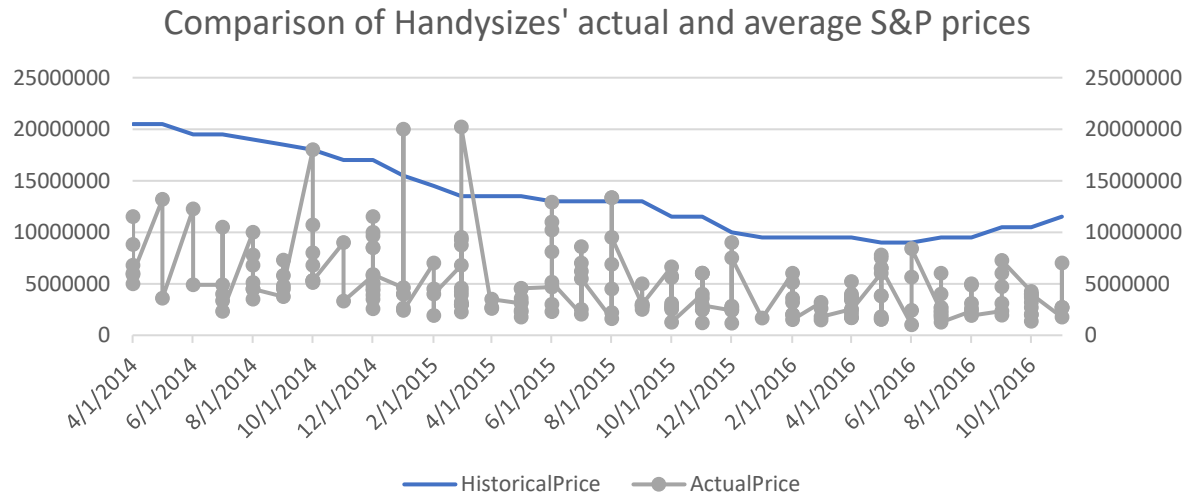
This research proposes a model that drives its contextual approach from HTC (2004) by further disaggregating vessels according to their age and consequently adding omitted variables to the existing model. The latter approach is derived from the valuation techniques suggested by Damodaran (2010), and the fact that it is not only essential to incorporate into the valuation models the short-term expected cash flows that an asset is expected to have, but also to try and capture its long-term revenues.

Our research uses the HTC model as a benchmark which we have enhanced by switching from year data to monthly data to disaggregate shipping information and how it is introduced in our model. We believe that the latter is an important addition given the vast diffusion and consequent availability of information that exists in the 21st Century. Moreover, we have further developed the model by introducing a new approach to calculate the profitability that each vessel will have according to her remaining operational life. Both the disaggregation of information, and the age disaggregation provide better out-of-sample estimations than the previous model, and reduce the variance between the expected price and the actual price by 20% on average. Thus, not only does the current chapter enhance the maritime research field from an asset management perspective, but additionally, the applied nature of our model can easily be adopted by stakeholders (shipowners, S&P shipbrokers, shipping financial analysts) of the industry that hold an interest in shipping investments.

The ensuing chapter is organised as follows: Section 3.1.2 provides a review of the models currently used by practitioners on vessel valuation; Section 3.1.3 explains the conceptual model in detail; Section 3.1.4 describes the dataset; Section 3.1.5

explains the methodology that has been followed; Section 3.1.6. illustrates the empirical results obtained and Section 3.1.7 concludes on the findings.

Figure 6 - Chapter 3 - Comparison figure between the average transaction prices of the dry bulk sub-segments and the actual S&P prices



3.1.2 Current Models

Presently, there are two different approaches when it comes to the valuation of vessels; the mark-to-market (Haralambides, Tsolakis, and Cridland 2004) and the mark-to-model approach (Kavussanos & Alizadeh, 2002).

3.1.2.1 Mark-to-market

A mark-to-market valuation is an approach that uses comparable assets to compute the value of a vessel. Given that vessel prices can easily be retrieved through databases or even newspapers, mark-to-market valuation states that the value of the vessel can be calculated when one compares two vessels with similarities in their age, their tonnage capacity, their hull, and their machinery. Moreover, given the volatility of the prices in the industry, exact dates of the transactions do matter. The mark-to-market approach has four distinctive advantages. It is less time consuming, it is more easily explained, it is simpler to defend and finally, it is more likely to reflect the current sentiment of the market (Damodaran 2010). A more efficient approach to the aforementioned valuation version is to incorporate econometric modelling in the valuation of the vessels, by creating a regression with the most recent sales and acquisitions that took place and it can be compared with with the vessel valuated. As Esty and Sheen (2010) have illustrated in their case study, using an ordinary least squares estimation can give a comparative approach to the value of the vessel. More precisely, by using four variables that explain the market price of the vessel and two addtional variables for time effects,

these will capture the value of a vessel. While in the case study, the above described linear model fits well and has a 5% variation from the price of the vessel that investors should value, a prominent problem is evident since the financial crisis that erupted in 2008. A similar vessel that was sold six months after the one examined in the Esty and Sheen (2010) case study had a 75% upward variation from the actual price.

3.1.2.2 Mark-to-model

In contrast, the mark-to-model valuation approach is a technique derived from the discounted cash flow valuation approach. Discounted cash flows measure the intrinsic value of an asset (Damodaran, 2010) as they estimate the present value of the future income that an asset will generate, given the lifespan of the asset, its growth and the risk associated with the asset. Discounted cash flows have also been used in the maritime context for companies and investors to compute the value of vessels. Initially, the method was introduced by Kavussanos and Alizadeh (2002) and subsequently it was established in the industry with the name LTAV (Long-term Asset Value) approach by the Hamburg Shipowning Association (Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V., VHSS) and Pricewaterhouse Coopers (Schinas, Grau, & Johns, 2015). Their project was initiated in 2009 when the maritime market was facing difficult times - the majority of loans that had been given were under the loan-to-value clause. Thus, as the vessel prices diminished, banking organisations were under the obligation to terminate these loans.

Nevertheless, VHSS has created a consortium of shipping related entities that are taking action so that stakeholders (bank associations, accounting associations, the German Finance Ministry) re-evaluate the valuation techniques of vessels. More precisely, the LTAV approach is calculating the freight rates received minus the operating expenses of each vessel yearly, and then discounting by the appropriate weighted average cost of capital. Finally, vessels at the end of their operational life are sold as scrap metal to shipyards that carry out their demolition. However, one of the major problems with the LTAV formula is the assumption that the vessel will be operating for all her life under time charters; an applied approach to the market-to-model valuation is given by Mayr (2015). Esty and Sheen (2011) created a case study regarding the VHSS case and how they act according to the LTAV approach. In the case study, an approximation they tried to calculate is the value of a vessel by using the LTAV approach. The current freight rate used is the spot price. The latter increases to the historical average until year four and the freight rate remains the same for the last five years of the vessel's life. Then the price decreases by the old ship reduction rate (-30%). The operating expenses of the vessel remain constant for the whole period. The current approach still does not deliver results that can entirely alleviate the distinction between the value and the price of an asset. As VHSS reports ("Long Term Asset Value - Summary," 2009) the fluctuation of the LTAV approach by the actual market price is ±15% for tankers and container ships and more significant for bulk carriers.

Furthermore, on a more conceptual framework, discounted cash flow models have the inherent problem of base year fixation and outsourcing key inputs.

3.1.3 Conceptual Model

3.1.3.1 Conceptual development

Equilibrium approaches state that the price of any given asset will be a balance between the asset's demand and its equivalent supply. In an econometric form, the latter relation is expressed as:

$$Q_D = Q_S$$

The important factor however, is to distinguish the variables that affect the demand and supply of each side of the latter equilibrium. On the basis of prior analyses, we expect several key variables to be necessary for the latter model.

Initially, we expect the demand for vessels to be influenced by the revenues that they are expected to have, the average prices of newbuilding and second-hand vessels and the access to liquidity that shipowners might have. Thus, the formula of demand would be:

$$Q^{D}_{SecondHand} = f(Revnues, Secondhand\ Prices, Newbuilding\ Prices, Liquidity)$$

On the contrary, the supply of the second-hand vessels will be driven by the lack of disposition of available berths in the shipyards, the prices of second-hand vessels and the number of vessels that have been demolished or have been lost.

$$Q^{S}_{SecondHand} = f(Shipyard\ Capacity, Secondhand\ Prices, Demolitions\ \&\ Losses)$$

Equivalently, we expect that the prices will be the equilibrium of the latter variables described.

$$= f\Big(\underset{Revnues}{+}, \underset{Sec/nd\ Prices}{+}, \underset{New/ng\ Prices}{+}, \underset{Liquidity}{+}, \underset{Shipyard\ Capacity}{\overset{Secondhand\ Prices}{-}}, \underset{Shipbuilding\ Cost}{+}, \underset{Demolitions\&Losses}{+}\Big)$$

3.1.3.2 Model specifications

3.1.3.2.1 Revenues

The current analysis starts with the consideration that the revenue which the vessel will generate is the most important determinant factor of the vessel's price. Previous researchers have shown the high correlation that exists between different vessel types and the freight rates that can be earned (Kavussanos & Alizadeh, 2002; Adland & Koekebakker, 2004; 2007) However, the existing literature is using the 1-year time charter rate as a proxy for the revenues that a vessel will generate. This approach, however, does not fully capture the sum of the expected cash flows that the vessel is expected to generate. Additionally, with the latter approach, the cost of running a vessel is not considered. To tackle the aforementioned problem, a hybrid method of linear interpolation and constant values is used.

3.1.3.2.2 Second-hand prices

The prices of second-hand vessels come as an important variable both for the newbuilding and for the second-hand vessels. Newbuilding and second-hand vessels have been described by HTC, as a substitute product. As soon as shipowners decide on the type of vessel they want to acquire, they have to make the choice of whether they will be investing in building a new vessel or if they will acquire a second-hand one. While newbuildings have the advantage that they are built to the exact specifications that the shipowners agree with the shipyards, they take approximately three years to build. The building period is a risk factor for the shipowners given that they assume the future state of the market when they decide on the construction. Second-hand vessels, though, are delivered very promptly given that the S&P is successful, and the shipowner is able to provide transportation services in a short time. However, the specifications and technical aspects of the vessel may not be as the purchaser would want them initially. Thus, a trade-off is apparent between the two vessel categories.

3.1.3.2.3 Newbuilding prices

The prices of newbuilding vessels are introduced as variables to both the demand side of the newbuilding equilibrium and also the demand price of second-hand vessels. We expect, as previously, past prices of new-built vessels to have a positive relation for both equilibria.

3.1.3.2.4 Demolitions and losses

Demolitions and losses affect the total tonnage of vessels that are available in the shipping markets. As demolitions are rising, the world capacity is minimised, and consequently, it is more competitive for charterers to find vessels to move their cargo. The latter shortage of ton-miles is expected to create a rise in the demand for vessels that are in the market. Thus, a positive relation is expected both for newbuildings and second-hand vessels.

3.1.3.2.5 Shipyard capacity

Shipyard capacity gives a notion of the shipping industry as a whole. When we discuss shipyard capacity, two different aspects should be considered. On the one hand, it is the actual number of shipyards that exist; in the early 2000s, there was a boom in the creation of shipyards especially in China, due to governmental decision policy. On the other hand, however, since the 2008 crisis, a large number of shipyards are facing foreclosure[2].

[2] More information concerning the state of the market as far as shipyards are concerned can be found in the article titled “Chinese shipyards facing collapse ” - http://fairplay.ihs.com/commerce/article/4267716/chinese-shipyards-facing-collapse

Table 23 - Chapter 3 - Number of vessels that are included in each sub-segment

	Description of Bulk Carriers included in the sample
Handy	212
Panamax	294
Capesize	249
Total Second-hand Bulk Carriers	***755***

Additionally, it is not only the number of existing shipyards but also the number of vessels which can be built simultaneously. The amount of vessels that can be produced depends on the number of berths that each shipyard has. Thus, we expect to find a negative relationship between shipyard capacity and the price of vessels.

3.1.3.2.6 Financial liquidity

Apart from the rise of the vessel prices that has already been discussed, financial liquidity has always been a major topic in the shipping industry, and thus access to liquidity providers is a constant objective of the shipowners (Galani, 2015). The influx of cash in the shipping entities does not only provide the means for the well-being of the business but also acts as a risk-averse strategy as far as the assets of the shipowners are concerned. Accordingly, the cost of borrowing is considered of high importance, since it can affect the viability of an investment in vessels but also the viability of the entity as a whole.

3.1.4 Data

The data for the current study was collected from the Shipping Intelligence Network database of Clarkson's. Data on the transactions that took place is available on a rolling three year window. Thus, we have collected data starting from April 2014 until December 2016. Our data consists of 755 bulk carriers' transactions. More precisely, we have used as observations 212 transactions of Handy bulk carriers, 294 transactions of Panamax bulk carriers and 249 observations of Capesize bulk carriers.

3.1.5 Methodology

For the present research, an alternative approach has been used to shed light on vessel valuation techniques, by comparing our model with our benchmark model that has been previously described, to establish which one of the two provides more accurate results both on an ex-post and an ex-ante basis.

At first, we collected the data from Clarkson's Shipping Intelligence Network. The current collection procedure gave an advantage compared to previous studies which

most often than not had been using hand-collection techniques due to the absence of reliable databases that could provide long historical information. Additionally, since Haralambides et al. (2004) used yearly data in their research, and we have used monthly data, we have further investigated for unit roots[3]. We have applied the Augmented Dickey and Fuller test to observe whether stationarity is predominant, since previous studies concluded on the existence of non-stationarity for various shipping variables (Geman & Smith, 2012). Furthermore, we have investigated the lagged differences that should be utilised. The latter is of prime importance given the alteration of the data. On various occasions, researchers have used one lag variable in their models (Kagkarakis, Merikas, & Merika, 2016). The latter means that vessel prices are related to the value of the variable one year before. However, since we have used monthly data, this may not be the case. For this reason, we have tested for each variable if up to five lag values are significant and affect vessel prices. The latter has been done for each of the different markets that were tested.

Following this, we have performed the augmented Dickey-Fuller test for our model that has been previously explained. It could be the case that specific variables which we have used are not reflected in vessel prices instantly but do have a lag relation.

The current analysis has revealed that the information bares in the difference of the variables between time *t* and *t-1* rather than the absolute or average vessels' price. To be certain that our variables were well specified, we included the monthly differences expressed in percentages.

Finally, we have performed OLS regressions to examine the overall goodness-of-fit of the models. Nevertheless, what is more important is not only to discuss how our models have performed throughout the whole period but to observe if they can predict the future values of vessels. Thus, we have proceeded with an out-of-sample analysis for the previously described models. Specifically, we have tested our models for the remaining six months of our sample starting in April 2016 until December 2016. In order to do so, we calculated the coefficients for the period between April 2014 and March 2016 and tested whether the prices of the model are reasonable estimators of the actual prices of the transactions.

[3] Results of the unit root tests are not included in the current research, since they do not fall per se in the scope of the econometric analysis performed. However, they can be provided by the authors upon request.

Table 24 - Chapter 3 - Description of the variables used in the analysis and information on the data sources from where information has been retrieved

Variable Name	Description	Database
Dependent Variable		
S&P_Price	The natural logarithm of the price that a vessel has been acquired expressed in dollars	Clarkson's Shipping Intelligence Research
Vessel Specific Variables		
Revenues	The natural logarithm of the total income that the vessel is expected to generate in her economic life.[1] Freight rates are computed based on three different classes of bulk carriers Handy, Panamax and Capesize. For the latter asset classes, we are using the one, three and five-year time charter rates. Finally, we subtract the operating expenses from the OpCost database. We have data for 2014 and 2015 and we are using their average for 2016. Finally, we are interpolating the revenues for the remaining years.	Clarkson's Shipping Intelligence Research (Items Codes: 34030, 78067, 10616, 10655, 56077, 56090, 70974, 70983, 71001) & Moore Stephens OpCost
Sec_Price	The monthly difference of the natural logarithm of the second-hand prices of four different vessel classes on a monthly basis: Panamax Bulk carrier 10-Year-Old, Capesize 10-Year-Old, Handy size 10-Year-Old. Matching has been performed according to the specific transaction that took place.	Clarkson's Shipping Intelligence Research (Items Codes: 61511, 4324, 72747)
New_Price	The monthly difference of the natural logarithm of the newbuilding prices of four different vessel classes on a monthly basis: Panamax Bulk carrier, Handysize Bulk carrier, Capesize Bulk carrier. Matching has been performed according to the specific transaction that took place.	Clarkson's Shipping Intelligence Research (Items' Codes: 11118, 18794, 70741)
Demolitions	The natural logarithm of the demolitions of bulk carriers +10k dwt in Million DWT on a monthly basis.	Clarkson's Shipping Intelligence Research (Items' Codes: 30234)
Losses	The natural logarithm of the losses of bulk carriers' tankers +10k dwt in Million DWT on a monthly basis.	Clarkson's Shipping Intelligence Research (Items' Codes: 30224)

3.1.5.1 Dependent variable

The dependent variable in the current research is the natural logarithm of the price of the transaction that took place between the seller and the acquirer of the vessel. Data has been retrieved from Clarkson Research – Shipping Intelligence Network.

3.1.5.2 Explanatory variables

Revenues are calculated based on the time-series provided by Clarkson's Shipping Intelligence Network. Clarkson's provides data for the one, three and five-year time charter rates. Then, operating expenses are deducted from the latter number to have an approximation of the actual vessels' revenue that is closer to the real figure. Additionally, we are using linear interpolation to calculate the time charter rates for years two and four. Finally, we further extend the profitability of a vessel for her 25-year lifespan by assuming that her daily profitability will remain constant from year five onwards. Then, we match the remaining years of the vessel with the time charter rate previously calculated. Second-hand and newbuilding vessel prices are time-series provided by Clarkson's database. The latter time-series are the average prices of the transactions that have been conducted throughout the equivalent month. Demolitions and losses are measured by the actual deadweight tonnage that has been scrapped or lost during the month. As far as the construction side of vessels is concerned, we measure shipyard capacity as the total deadweight tonnage currently built by all the shipyards worldwide. For the previous variables, we are using monthly data according to the size of vessels. Finally, we include as a liquidity indicator the three-month LIBOR, extracted from Thompson Eikon.

3.1.6 Empirical Analysis

3.1.6.1 Descriptive statistics

In our sample, a basic limitation derives from the fact that for certain classes of vessels the data was not adequate to proceed to an analysis. This means that for specific vessel sizes there has not been an adequate trading activity for the three years that we are examining in our sample. More precisely, the current research has been conducted by analysing the newbuilding and the second-hand vessels in the bulk market. However, the various levels of disaggregation have created databases that could not be analysed due to the small number of observations available.

Following this, we test the stationarity of the variables. We test for the existence of stationarity in our sample to use the first level difference that will eventually convey the extra information in our models. Issues that usually arise from the stationarity of the time-series variables that exist in the shipping industry are also predominant in the recent literature (Kagkarakis et al., 2016).

Table 25 - Chapter 3 - Descriptive statistics for the three sub-segments

	-1	-2	-3	-4	-5
VARIABLES	N	mean	sd	min	max
		Handy Vessels			
S&P_Price	212	15.20	0.597	13.82	16.82
Revenues	212	16.19	1.063	12.07	17.88
Fr_Rate	212	-0.00626	0.0516	-0.182	0.119
Sec_Price	212	-0.0261	0.0494	-0.223	0.0541
New_Price	212	-0.00485	0.00939	-0.0445	0.0106
Demolitions	212	14.42	0.574	13.57	15.54
Losses	212	2.738	4.763	0	11.99
Libor	212	-0.0407	0.124	-0.500	0
OrderBook	212	-0.0202	0.0213	-0.0657	0.0248
		Panamax Vessels			
S&P_Price	299	15.52	0.523	14.53	17.22
Revenues	299	16.73	1.211	12.34	19.06
Fr_Rate	299	-0.0108	0.0474	-0.121	0.0820
Sec_Price	299	-0.0262	0.0445	-0.154	0.0445
New_Price	299	-0.00842	0.00983	-0.0308	0.00844
Demolitions	299	14.60	0.654	13.57	15.54
Losses	299	2.636	4.742	0	11.99
Libor	299	-0.0155	0.0801	-0.500	0
OrderBook	299	-0.0254	0.0213	-0.0657	0.0248
		Capesize Vessels			
S&P_Price	249	16.45	0.801	14.80	19.92
Revenues	249	17.68	0.727	15.23	19.24
Fr_Rate	249	0.00814	0.140	-0.311	0.305
Sec_Price	249	-0.0122	0.0774	-0.288	0.154
New_Price	249	-0.00883	0.0131	-0.0465	0.0175
Demolitions	249	14.47	0.600	13.57	15.54
Losses	249	1.972	4.219	0	11.99
Libor	249	-0.0146	0.0808	-0.500	0
OrderBook	249	-0.0227	0.0212	-0.0657	0.0248

Notes: See Table No.24 for the specification of variables. In the current research, we have used information from Clarkson SIN and the time span that data was available was equivalent to 2.5 years. More precisely, the observations (N) that we have used are 212 S&P of Handy second-hand vessels, 299 S&P of Panamax second-hand vessels and 249 S&P of Capesize second-hand vessels. The observations start from April 2014 until December 2016. Min and max are the minimum and maximum values of the sample data, respectively. Mean refers to the arithmetic average. Standard deviation is the monthly standard deviation of the respective variable.

After the latter tests, we are using the first differences in the time-series variables in our models to gain the best results regarding the valuations of the vessels. It should be mentioned that since the variable that conveys the information for the revenues which the vessels are expected to gain (*Revenues*) is not a time-series variable, it is not checked for potential stationarity problems.

As can be observed in the Spearman correlation table, while some variables for specific vessel classes have a high correlation, it is not more than 60% that would lead us to believe that multicollinearity issues can be present. Moreover, the short period that is available for the current research is, in fact, a factor that is expected to raise the correlation between the monthly independent variables. Finally, since the transactions of vessels are a panel data dataset and their observations vary through time, we are using an OLS regression to analyse the fitness of our model.

Table 26 - Chapter 3 - Spearman correlation test for the three different sub-segments

Variables	S&P_Price	Revenues	Fr_Rate	NewPrice	Sec_Price	Dem/ons	Losses	OrderBook	Libor
Handy Vessels									
S&P_Price	1								
Revenues	0.4258*	1							
Fr_Rate	-0.1428*	-0.0267	1						
New_Price	-0.0183	0.0138	-0.2078*	1					
Sec_Price	-0.0698	-0.0503	0.2651*	-0.2513*	1				
Demolitions	-0.1294	0.0201	0.0553	-0.2363*	-0.2524*	1			
Losses	-0.0263	-0.0205	-0.2461*	0.1103	-0.3445*	0.1063	1		
OrderBook	0.1534*	0.1142	-0.2241*	0.2200*	-0.4584*	0.0275	-0.2568*	1	
Libor	-0.1576*	-0.1008	0.1343	-0.1976*	0.041	0.2797*	-0.0302	-0.0531	1
Panamax Vessels									
S&P_Price	1								
Revenues	0.6721*	1							
Fr_Rate	-0.02	0.0723	1						
New_Price	-0.0769	-0.1015	0.022	1					
Sec_Price	-0.1095	0.0049	0.5202*	0.0088	1				
Demolitions	-0.0401	0.2493*	-0.2971*	-0.4629*	-0.064	1			
Losses	-0.041	0.0021	-0.0482	0.1019	0.1406*	-0.0436	1		
OrderBook	0.0684	-0.0541	-0.3182*	0.3045*	-0.3050*	-0.2180*	-0.3755*	1	
Libor	-0.1397*	-0.0552	0.1970*	-0.1220*	0.1268*	0.1814*	-0.0549	-0.1269*	1
Capesize Vessels									
S&P_Price	1								
Revenues	0.6626*	1							
Fr_Rate	-0.1199	0.0177	1						
New_Price	0.0808	0.0078	-0.2694*	1					
Sec_Price	0.1203	0.0724	-0.0216	0.4076*	1				
Demolitions	-0.1303*	0.2951*	-0.0022	-0.3009*	-0.1788*	1			
Losses	-0.0263	-0.035	-0.1798*	-0.0115	-0.1911*	-0.0151	1		
OrderBook	0.1940*	0.0566	-0.2886*	-0.0097	0.0562	-0.0619	-0.2410*	1	
Libor	0.0196	0.0237	0.1043	-0.0503	0.2198*	0.0466	-0.2125*	-0.1145	1

Notes: The current table presents the Spearman correlation matrix that exists between our variables. In the strand of literature any correlation that exceeds the 0.6 threshold is considered high enough and is a rule of thumb for multicollinearity issues that may be present (Asteriou & Hall, 2007). In our sample, all variables are uncorrelated with one another thus we are proceeding with including them in our models. The asterisk (*) next to each variable represents relations between the variables that are significant.

3.1.6.2 Regression analysis

The results provided show the better performance that our model has on the valuation of vessels when compared to the benchmark model. The variable of expected earnings

outperforms the equivalent variable of the 1-year time charter. The current is predominant for all the bulk markets at the significance level of 1% .

Table 27 - Chapter 3 - Second-hand bulk vessels – Disaggregated model

VARIABLES	-1 Handy	-2 Panamax	-3 Capesize
Revenues	0.363***	0.786***	0.694***
	(0.0415)	(0.0359)	(0.0596)
Sec_Price	1577	1.233***	0.469
	(1.044)	(0.441)	(0.583)
New_Price	-1934	-0.559	-1.625
	(4.186)	(2.168)	(3.383)
Demolitions	-0.0589	-0.0306	0.0309
	(0.0713)	(0.0310)	(0.0712)
Losses	0.00770	-0.00270	0.00457
	(0.00898)	(0.00433)	(0.0102)
OrderBook	3.812*	-1.635	-2.406
	(2.021)	(1.016)	(2.156)
Libor	-0.300	0.208	0.541
	(0.324)	(0.241)	(0.528)
Constant	10.43***	3.300***	4.197***
	(1.269)	(0.729)	-1608
Observations	212	299	249
R-squared	0.316	0.636	0.387
Time Fixed Effects	Yes	Yes	Yes

Notes: This table presents the results of the estimated panel data regressions between the S&P prices and the variables That are described in Table No.2. Statistical significance of the estimated coefficients is denoted with *, ** and *** for 10%, 5% and 1% significance levels, respectively.

While the rest of the variables that are included in the model act as significant factors in different settings, it cannot be predetermined whether they will affect the disaggregated model significantly or not. Nevertheless, as far as the signs of the coefficients are concerned, the results provide a good indicator of the state of the industry. The orderbook that exists in the shipyards, while it has a positive impact on the prices of Handy vessels that are bought and sold, it does have a negative but not significant impact on the Panamax and Capesize bulks. The reason could be that since Handymax vessels are built faster compared to their bigger counterparts, they have a closer correlation on a price context with the second-hand market.

Table 28 -- Chapter 3 - Second-hand bulk vessels – Aggregated Model

VARIABLES	-1 Handy	-2 Panamax	-3 Capesize
STEEL(-1)		0.003933	
		(0.003268)	
LNNB(-1)		0.570689	
		(2.006377)	
LIBOR(-1)	-0.154356		-0.288570
	(0.165193)		(0.256360)
LNSH(-1)	0.795317*	-0.823729	0.924906
	(0.309595)	(1.442725)	(0.497709)
DUMMY	2.198159**	-0.978879	2.309213**
	(0.507750)	(2.193137)	(0.602358)
D(LNOB)	-0.301743	1.768146	0.033723
	(0.195160)	(1.545252)	(0.177488)
D(LIBOR)	0.572458**	0.028490	0.216945
	(0.170681)	(0.378245)	(0.181902)
D(LNNB)	-0.134280	2.820427	3.228776**
	(0.854295)	(1.938329)	(0.767709)
D(LNFREIGHT)	0.560207	0.308107	-0.400717
	(0.277426)	(0.868732)	(0.213314)
Constant	3.438129	18.95725	1.309171
	(5.149349)	(24.42332)	(8.699281)
Sample Period	2006-2015	2006-2015	2006-2015
R-squared	0.973576	0.961671	0.981926

Notes: In the current chapter, we represent our results by using the models as they have been estimated from Haralambides et al. (2004). For specification of the variables see Table No.2. The data used is monthly and is taken from Clarkson's' Network. Number in the brackets (-1, -2,-3…,-N) describe the lagged values that have been used in the initial research. The letter D in front of the variables describes the difference between the current and the previous month. LN stands for the natural logarithm of the variable.

Moreover, the prices of Panamax vessels have a significant positive relationship with the average second-hand market prices of the previous month. On the contrary, while the rest of the segments still have a positive impact it is not significant. Thus, we acquire the notion that in the Panamax segment, there is a trend that we would expect to find to be prevalent in the market by investors who would acquire vessels and pricing on a comparable approach. From the current analysis, we can conclude on a theoretical basis that while all our variables are in close relation with the prices of vessels, a strong significant correlation cannot be concluded. Both in the current and our benchmark research the majority of variables, while they bear information that enhances our model, are not highly correlated with the price. Nevertheless, it seems that the main variable, when prices are considered, is the stream of revenue that a vessel will create irrespective

of the external macro-environment. Thus, our results provide evidence on the commoditisation of bulk vessels in the current era, a shift from the classical perspective which states that vessels act solely as a means of transport. Vessels are mainly valued based on the flow of income that they can provide and not on the other aspects of the micro-variables. This therefore leads us to the conclusion that vessels are mainly acquired as investment vehicles rather than long-term assets that will be used in a multi-dimensional strategic plan of a business.

3.1.6.3 Out- of-sample estimations

The last part of the current research consists of the test whether the latter model that has been developed can predict the future prices of vessels. In order to test this model, we are using an out-of-sample estimation approach. As previously noted, our data spans the period from April 2014 to December 2016. Thus, we initially estimate the coefficients of our model for the various shipping markets with data starting from April 2014 until March 2016. Then, we use the previously described models, both with the proposed one that disaggregates vessels according to her age and the one that uses the 1-year time charter rate, to test whether the transactions of the following six months can be predicted consistently.

As previously noted, since the current research is based on the concept of the research framework of Haralambides et al. (2004), we are using their respective models to estimate the prices of their transaction and conclude on our prediction accuracy. In order to measure the ability of the two models to predict, we follow Nelson (1991) and check for the variance between the transaction price and the estimated one.

Figure 7 - Chapter 3 – Out-of-sample estimation – Second-hand Handy size bulk carriers

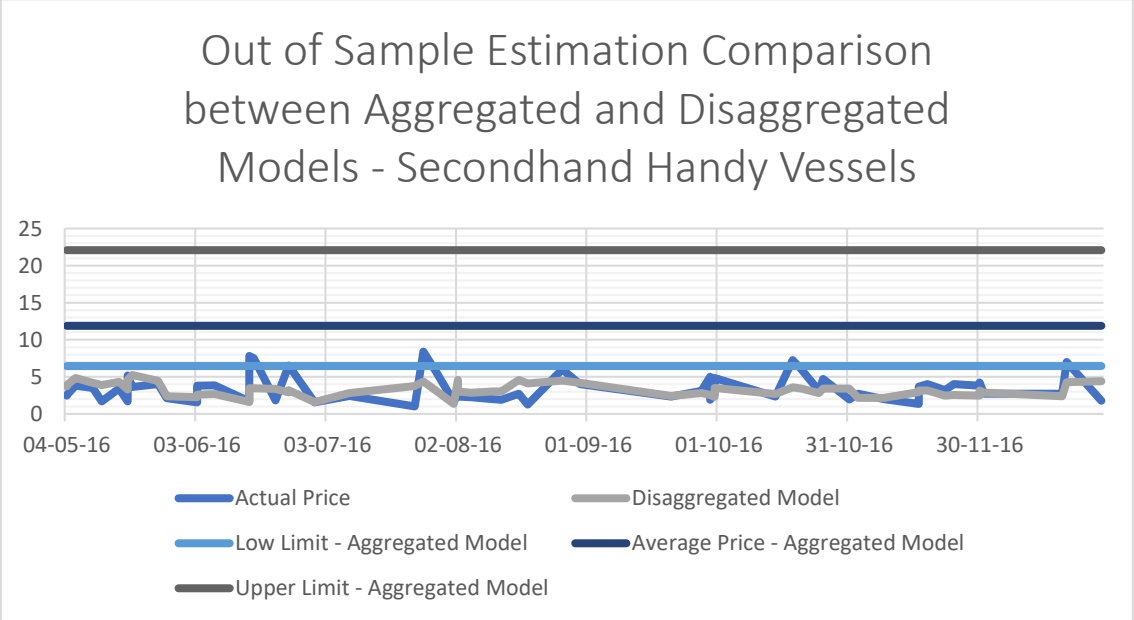
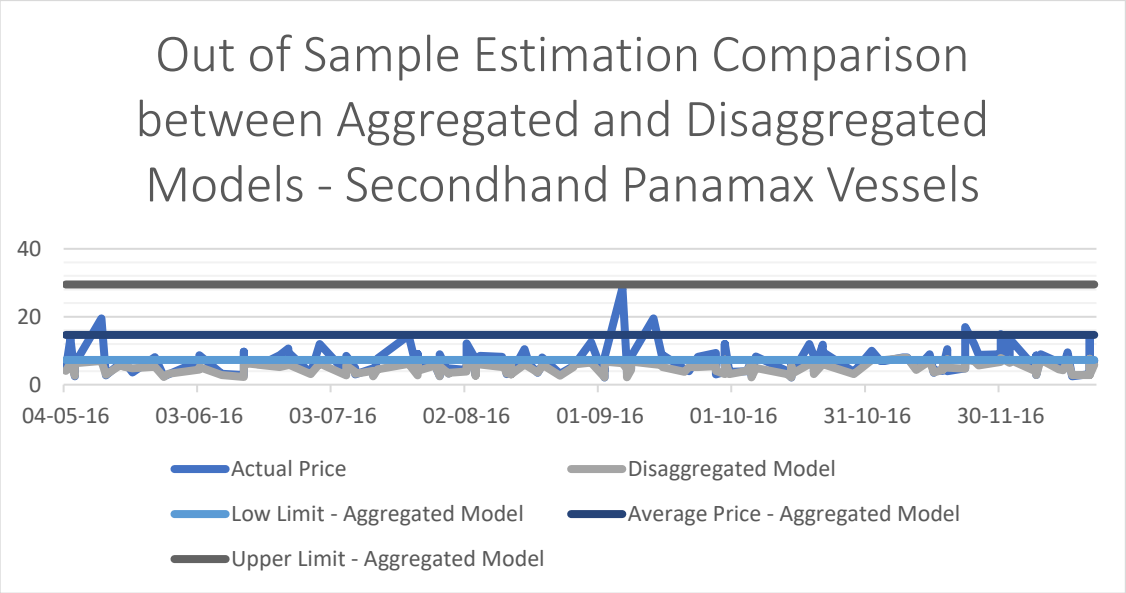
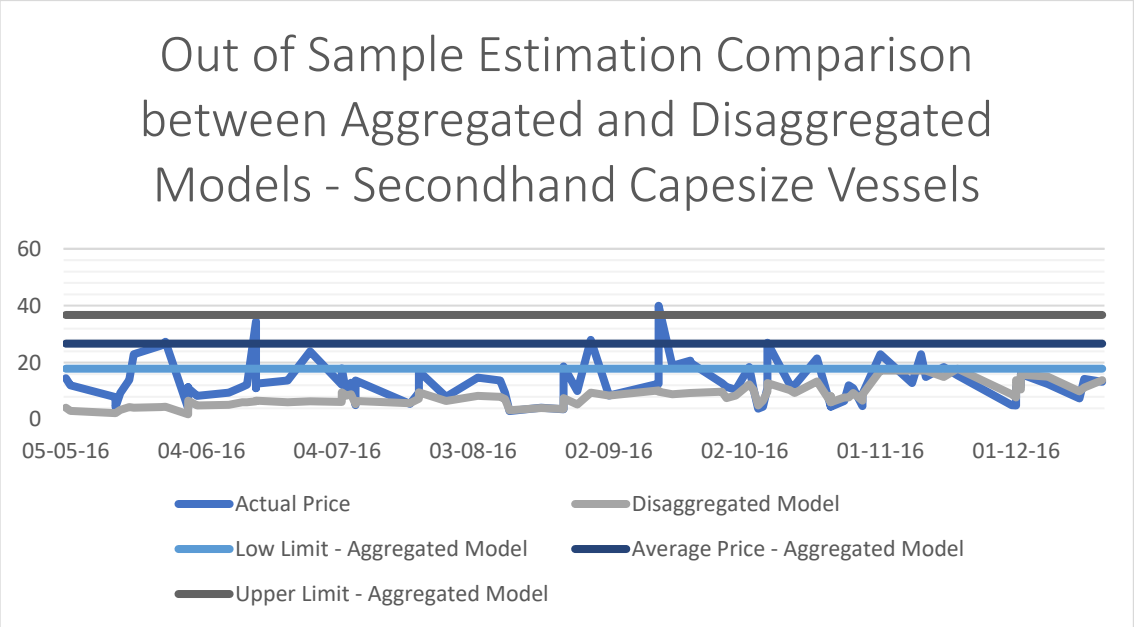


Figure 8 - Chapter 3 – Out-of-sample estimation – Second-hand Panamax bulk carriers



Starting with the Handy market, our model is providing 72% lower variance when compared to our benchmark model. More precisely, the disaggregated model exhibits a variance equal to 0.1672 while our benchmark model exhibits a variance equal to 0.6072. Equivalent are the results for the Panamax segment and the Capesize segment, where, for the Panamaxes we have a decreased variance of 35% and for the Capesize segment 4.68%. Thus, we can conclude from the latter that our model exhibits a better performance when compared to the benchmark model. What it is predominant though, in all three segments, is the fact that our models provide slightly lower prices than the ones of the transactions. It could be the case that this fact is not an endogenic fault of the models but on the contrary that a premium exists given the over-the-counter nature of the market.

Figure 9 - Chapter 3 – Out-of-sample estimation – Second-hand Capesize bulk carriers



3.1.6.4 Robustness test

In order to establish that our hypothesis regarding the new approach for vessels' valuation stands and it is not only affected by the variables used, we re-evaluate the expected income that a vessel is to have during her service. As a robustness test, we interpolate the revenues that a vessel will have for her whole economic life based on the one, three and five-year time charter rates in the previous month's transactions. While this approach is creating a trend in the results, we believe that it enhances our findings on the basis of a common fallacy that is often predominant in the investment world, namely the "hot hand fallacy" (Ayton & Fischer, 2004), which states that prior performance is a good indicator for the future of an investment.

Our results are consistent with our previous findings and further strengthen the importance that profitability and lifespan have in the valuation of vessels. In all of the three categories, the results are statistically significant for the level of 1%. Additionally, orderbooks and demolitions are affecting our model significantly and according to the expected positive sign.

VARIABLES	1 Capesize	2 Panamax	3 Handy
Revenues-Robust	0.776***	0.298***	0.244***
	(0.0534)	(0.0193)	(0.0345)
Sec_Price	-0.370	-0.780	0.657
	(0.530)	(0.524)	-1.090
New_Price	-4.335	-8.109***	-5.779
	-3.101	-2.607	-4.388
Demolitions	-0.444***	-0.202***	-0.146*
	(0.0662)	(0.0390)	(0.0744)
Losses	0.00883	-0.00237	0.0103
	(0.00935)	(0.00523)	(0.00944)
OrderBook	5.168***	2.098*	4.434**
	-1.853	-1.217	-2.119
Libor	0.516	-0.559*	-0.485
	(0.482)	(0.285)	(0.338)
Constant	9.214***	13.46***	13.37***
	-1.128	(0.563)	-1.187
Observations	249	299	212
R-squared	0.489	0.468	0.245
Time Fixed Effects	Yes	Yes	Yes
Notes: See notes in Table 27.			

3.1.7 Conclusion

The present research has provided evidence on valuation effectiveness of a newly introduced model that enhances previous research of HTC, with the concept of the vessels' age as the main parameter in their valuation by applying the disaggregation method. Although previous researchers have used the concept of disaggregation of the sizes of the vessels, still there is no clear evidence on the actual predictive ability of the latter when specific transactions were to be considered rather than average vessel prices that would act as time-series. Thus, in the proposed model, we have tried to encapsulate real market transactions phenomena, and its accuracy has been tested on an out-of-sample period. As the results have shown, monthly data, the difference level, and the age relevance have produced better estimations for the prices of vessels and have minimised the variance between actual prices and the predicted ones. The results for the latter have provided consistent results that are a fair approximation of the transaction price.

Nevertheless, a premium has to be applied to the actual price of the transaction given the non-existence of organised markets for vessels as hard assets. The current research has faced some limitations regarding the period examined which is not extended due to data limitation. Also, the Handymax trades that occurred during the

period examined were limited, and thus a well-rounded econometric result could not be reached. In conclusion, the latter model introduced is as an addition to the important concept of vessels' valuation practices. While we have tried to encapsulate the majority of the variables that act as catalysts for the pricing of vessels, still more research is needed on the matter. The model proposed does not include neither variables regarding macroeconomic conditions nor variables for sudden economic shocks. Moreover, a limitation of the current research is the limited time span of the available data. The current research could be further enhanced by a more expanded dataset. Additionally, research should be conducted on the applicability of the current model to the rest of the shipping segments apart from the second-hand dry bulk vessels.

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