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«Investment strategies in bulk shipping: The case of the Cape Sector »

Διπλωματική Εργασία για το Μεταπτυχιακό Πρόγραμμα
«Ναυτιλία, Μεταφορές και Διεθνές Εμπόριο – Ν.Λ.Μ.Ε.»

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ΧΙΟΣ
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Abstract

The aim of this work is to create an investment decision-making tool based on second-hand and newbuilding prices for the Cape shipping sector. Maritime investors are often confronted with the dilemma of investing either in the second-hand or the newbuilding market. Using a dataset between January 2004 and June 2017 for the Cape sector, an error correction model has been created to investigate the impact factors such as time-charter rate, shipbuilding costs and market risk have on such a decision. Moreover, the current analysis brings about additional insights and acknowledges the existence of asset play strategies in shipping. Results indicate that the index is directly related to the cyclicality of the shipping industry with iron ore prices, freight rates with cost of newbuilding having the highest impact.

Keywords

Asset Play, Dry bulk shipping, Cape Sector, Investment decision
1. Introduction

Shipowners and shipping investors have been facing difficulties making investment decisions with timing playing a critical role due to the complex and volatile nature of the shipping industry. The shipping market offers significant opportunities for high margins through speculation on ship prices since volatility is a market characteristic. However, at the same time, volatility could also lead to significant losses if investment strategies are implemented at the wrong phase of the market cycle. In competitive and cyclical markets, such as shipping, timing is important. Therefore, the formation of sound investment timing strategies is essential and could prove pivotal in distinguishing successful from unsuccessful investment decisions. The fundamental rule of shipping investment, as in any investment, is to ‘buy low and sell high’ (Adland, 2000). That stands for the ability to invest in the market at the bottom of the business cycle and sell at its peak, when the market has recovered substantially from the previous state, thus leading in high profits.

The fact remains that the shipping industry has been cyclical throughout its entire existence. Although the existence of cycles is undisputed, their character is not regular. Four stages are identified in a cycle: a trough, a recovery, a peak and a collapse. If you can possibly guess and time any of these four extremes it is very likely that you have determined the entry and the exit points of this business (Stopford, 2009).

Investment decisions in shipping are primarily based on the operating cash-flow structures, as well as the time of entry and exit from the market. These two factors are of great importance, especially when the required initial capital outlay rises. The level and the structure of cash flows are influenced by the prevailing conditions of the freight market. In the case of a depressed market with low freight rates, the main factor determining the investment decision is the required capital for entry and the expected return when exiting and not the level of cash flows (Merikas, 2008). This strategy is known as ‘asset play’. Asset play describes a situation whereby the market capitalization of a particular company is less than the assets held by the company. An asset player spots such companies and buys the stocks when market capitalization is leaning towards an increase that surpasses in value the total assets of the company. In other words, asset play is the strategy of ‘buying low and selling high’. According to this strategy, freight condition is fundamental as the ship and freight markets move violently (Adland and Strandenes, 2006).

The valuation of ships is primarily determined by the condition of the freight market. When the market is depressed, the valuation is low and consequently, when the market is booming, the price is higher. The relation between price and trading volume in financial and real asset markets is the main theme in many studies (Alizadeh and Nomikos, 2002). In most studies, although the ship is recognized as a real asset, the relationship is examined from the point of view of demand (as the determinants of price variability in terms of volume, etc.). The decision of investing in shipping is made after the evaluation of the expected level and structure of cash flow. Investing in a booming market can be profitable as the level and the structure of cash flows are satisfactory. The asset play strategy can be applied when investing in a depressed
market despite low levels, leading to an overall investment profit. There is a third case whereby investing in shipping stems from the need of replacing old assets. In addition to the above three cases, a forth case of investing in shipping without a clear time horizon of exit, takes into consideration not only the cash flows but also the expected liquidation value when exiting. In all cases, the key factor for investing is not the demand-supply factor but that of risk-return. In shipping, the second-hand market plays an important role because it offers opportunities in purchasing and selling ships.

The main theme of this study is the relationship between the second-hand and the newbuilding prices in the dry bulk sector and especially in the Capesize bulk carriers. The dependent variable examined is the second-hand with newbuilding price ratio (SP/NP) having a double role, first, as an indicator for the initial investment decision and secondly as a financing forecasting mechanism for the valuation of the assets. The study also investigates the potential of this variable to be used as a tool assisting decision-makers in deciding between second-hand and newbuilding vessels.

The present work aims at clarifying the functional relationship between the second-hand to newbuilding ratio and its main determinants. This attempt is based on economic theory and industry-related data (Engelen, Meersman and Van De Voorde, 2006). As such, volatility and the level of asset value are examined in relation to measurable factors. These are the factors that a decision-maker has to take into consideration.

The way these factors affect asset prices could assist investors in their decision-making process of timing investments. Freight rates, interest rates, shipbuilding costs and market volatility are among the factors under examination. That is another way this work contributes to historical literature. The sales and purchase market is a very exciting but complex one, offering chances for high margins but which can also be affected by many parameters.

The structure of this work is as follows. In the next section an extensive literature review on the issue is presented discussing the contribution of the present work. Section 3 describes the methodology applied and discusses the selected variables, while section 4 presents and discusses the results. Finally, section 5 elaborates on the main contribution of the work and proposes ideas for further research.
2. Literature Review

The timing of investment is the key to success in international shipping. This is because freight rates are sometimes very high for long periods of time, making a ship look more like a money machine than a normal production unit. In other periods, they are close to or even below average long-run costs including normal returns to capital.

One could hardly find a paper on shipping that does not highlight from the very beginning that shipping is a very volatile, unpredictable and risky market. At the same time, shipping is the bloodline of trade, growth and welfare and therefore, its fortunes are inextricably linked to those motivations that drive people and nations to trade more with each other.

2.1 Determinant Factors in S & P of Ships

According to Koopmans (1939), the short-term supply curve in bulk shipping can be characterized by two distinct regimes, depending on whether or not the fleet is fully employed. This is the adjustment mechanism linking supply with demand. The way it operates is quite simple. Shipowners and shippers negotiate to establish a freight rate, which reflects the balance of ships and cargoes available in the market. If there are too many ships, the freight is low, whereas if there are too few ships, it will be high (Stopford, 2009).

![Sea transport supply and demand diagram](source: Stopford, 2009)

Figure 1: The freight rate mechanism, Source: Stopford, 2009

It is important to explain the relationship between the freight rates and the ships’ value. As Stopford points out, when the fleet sails close to the maximum capacity, the aggregate supply function becomes almost perfectly inelastic, resulting in very high freight rates. Conversely, when the available supply exceeds demand, causing a
decrease in freight rates and vessel unemployment, the least cost-efficient vessels withdraw from the market, which results in turn in a series of perfectly elastic steps in the short-term supply function. Boom periods have historically been followed by periods of depressed freight rates, because of a strong supply side response through newbuilding activity. This cyclical nature of the freight rates leads to cyclical and very volatile ship prices. Obviously, a ship has greater value if freight rates and operating income are high, but if changes in ship values are predictable, then there is money to be made from market timing. In shipping this is referred to as asset play. An asset play investor has typically a fairly short investment horizon compared to the typical lifetime of a ship of 25 years or more. Another timing strategy is to switch from freight market segments based on the freight rate differential and relative ship values.

Haralambides, Tsolakis and Cridland (2004) deal with the factors determining the prices of ships. Shipping is one of the few industries having a separate and active market where the main assets themselves (ships) are traded. The price of a ship, like that of every other capital asset, depends on the ship’s expected future profitability or, in other words, on the investor’s expectations regarding future developments in the markets he operates. The timing of the investment is therefore the single most important factor of business success.

Volatility in second-hand ship prices coupled with long delivery times of new ships give rise to considerable speculation (asset play). The yearly volume of second-hand ships changing hands is indeed significant. Transactions in second-hand ships play an important economic role in the shipping industry. They give shipowners and other investors the opportunity to buy and sell ships directly, thus allowing easy entry and exit to the freight market. This is a major condition for market competitiveness. Instances of low freight rates usually coincide with low vessel values but, despite the fact that this is bad news for owners of existing tonnage, it provides opportunities for new investors to buy in at a low cost.

Beenstock and Vergottis (1989) distinguish newbuilding from second-hand markets and adopt an asset pricing modelling approach. At the time of their yard contracting, ships will typically sell at prices that can differ from those of identical existing new ships by a larger or smaller amount. The main reason for this difference in price, they claim, stems from the fact that a new ship is immediately available for trade, while a contracted newbuilding only becomes available after the construction period has lapsed. Because new contracting is for forward delivery, the market for these ships should resemble a forward market.

In their research, Haralambides, Tsolakis and Cridland (2003) discover that newbuilding prices and time-charter rates have the greatest effect of all variables on determining second-hand ship prices, in most cases both in the short and long run. The cost of capital is only significant for bulk carrier owners. The only exception is the Suezmax segment due to its particular characteristics. The Orderbook (as a percentage of the fleet) has a negative effect on the price of second-hand vessels only in the long run and only in large and Panamax tankers.
2.2 Valuation Methods

The maritime literature has borrowed heavily from financial economics over the past decades. Beenstock and Strandenes (1993) introduce the present value model of ships in maritime economics. The price of a ship today is the discounted value of the ship the period that follows plus the freight revenue during that period.

This present value relationship says that the market is efficient if market participants discount future cash flows properly. If market participants are rational (or semi-rational), as suggested by Strandenes, then markets are efficient. Such a framework suggests that ship prices are largely unpredictable.

Asset pricing can be viewed in absolute or relative terms. The present value model for valuing a ship is an absolute valuation relationship, relating freight revenues to the price level of the asset. Absolute asset pricing is a difficult task to accomplish with wide error margins.

Traditionally, the estimated market values of vessels were provided by sale and purchase (S & P) shipbrokers, usually by comparison with historical sales of similar vessels and adjustments in the changes in freight earnings. This was a laborious task that could not guarantee high accuracy, especially for entire company fleets and was necessarily subjective: two different brokers would typically form two different views about the value of a given vessel. However, this decade has seen a shift from traditional broker valuations to data-driven and model-based methodologies, with which valuations can be provided instantly online with supporting data and analytics. These services have been favoured by many of the industry’s leading banks, investors, owners, insurers, and other participants considering their convenience, ease of access, transparency and independence.

Automated valuations employ sophisticated mathematical algorithms to take into account the factors that influence a ship’s value (Stopford, 2009), including:

- sector (dry bulk, oil and refined products, containers, gas, etc.)
- age (traditionally linear but in reality highly non-linear and reactive to market conditions)
- cargo capacity
- freight market dynamics (including spot earnings, long charters and freight derivatives)
- vessel specification, features and equipment

Automation allows more data to be used than say in a traditional broker valuation, and crucially, permits back testing. This means that accuracy can be optimized and reported. Subjectivity and bias are things of the past. In addition to providing valuations, these services are also able to provide a variety of supporting information, such as up-to-date transactional data, which allows users to monitor market activity.
In addition to the basic ship valuation and supporting information described above, more advanced analytics are becoming increasingly available as data collection and processing techniques continue to mature. Advances in financial modelling are making market timing and asset allocation decisions in the shipping industry possible.

Tools and indicators that aid a participant in timing the markets, especially in times of high volatility, are much sought after. One such indicator is price momentum. This allows the participant to look for strong positive trends in prices over a specified period to support entry/exit decisions.

Ships are depreciating assets with a non-linear profile determined by market activity, as shown in Figure 2. The changes in the depreciation profile over market cycles illustrate what the market perceives as the expected working life of the vessel.

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Figure 2: Different markets, different age curves, Source: VesselValue.com

In a weak market there is a strong likelihood of vessels being scrapped early. In a strong market, owners anticipating good returns are more willing to spend resources in extending the life of the vessel, and this is reflected in the shape of the curve.

The market often expresses a preference for vessels of a certain age, size, or other characteristics, mainly because of chartering patterns or international maritime legislation. Following these trends can allow investors to detect under or over-pricing, or even provide early warning of developing bubbles. Certain sectors are far more liquid than others, having the age preference expressed in a time-varying fashion.

2.3 Efficient Market Hypothesis

Kavussanos and Alizadeh (2002) test the efficient market hypothesis\(^1\) within the rational expectation framework in the market for new and second-hand dry bulk ships.

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\(^1\) The efficient market hypothesis (EMH) is an investment theory that reports the inability to "beat the market" because stock market efficiency causes existing share prices to always incorporate
They follow the VAR methodology of Campbell and Schiller (1988), which enables a direct test of the joint hypothesis of rational expectation and market efficiency. The empirical work of their study concludes that the efficient market hypothesis must be rejected for the dry bulk sector. Two more studies support this result (Hale and Vanags (1992) and Glen (1997). They proved that the failure of the EMH may either be attributed to the existence of time-varying risk premia, or reflect arbitrage opportunities in the market. The latter suggests that if prices for vessels are found to deviate consistently from their rational values then, trading strategies can be adapted to exploit excess profit. For example, when ship prices are lower than their fundamental values, then buying and operating these vessels may be profitable since they are underpriced in comparison to their future profitability (i.e. the earnings from freight operations). On the other hand, when prices are higher than their corresponding rational values, then from a shipowner’s point of view it may be more profitable to charter in vessels instead of buying them, because they are overpriced in comparison to their expected future profitability.

Birkeland and Tvedt (1997) discuss asset play in tanker trades assuming mean-reverting freight earnings. In their model, a company owns a minimum of one or a maximum of five ships at all times. The model is only partly based on economic valuation, which means that an asset transaction occurs when an ad hoc markup of expected revenues over costs is observed.

Adland (2000) specifies that technical analysis and asset play can be used to achieve far better returns than the long-term operation of a ship. The paper examines the return of three basic trading rules2 (filter rules, MA averages, support and resistance levels). The best-performing technical trading rule is capable of outperforming the benchmark by an astounding 35% per year. Moreover, none of the trading rules generates negative cumulative wealth, and only one parameterization results in a mean return that is lower than the return from the benchmark buy-and-hold strategy.

The results for the best-performing trading rule show that the mean return following buy signals is positive, and the mean return following sell signals is negative. Hence, both are significantly different from the buy-and-hold mean return according to standard statistical tests. Furthermore, the returns following buy signals are less volatile than those following sell signals. The same applies to the returns of the buy-and-hold strategy. Of course, there is no guarantee that this apparent superior performance will continue in the future, and the concluding test of the best-

2 A trading system is simply a group of specific rules, or parameters that determine entry and exit points for a given equity. These points, known as signals, are often marked on a chart in real time and prompt the immediate execution of a trade.
performing trading rule would be an out-of-sample test after another ten years of data. A further issue at stake is how an investor could have possibly determined the best trading rule prior to committing money to a given rule. Admittedly, there is no indication that it would be possible to find ex ante the trading rule that would perform best in the future, and the probability that an investor would pick a trading rule with an excess mean return that is statistically significant is rather small.

Consequently, it wouldn’t be wise to presume that the results either have or don’t have implications on weak form market efficiency. Overall, two competing explanations for the presence of predictable variations in asset returns have been suggested: (1) markets are inefficient as prices take swings from their fundamental values, and (2) markets are efficient and the predictable variation can be explained by time-varying equilibrium returns. There has been little evidence so far that unambiguously distinguishes these two competing hypotheses. STW (1998) argues that the existence of outperforming trading rules would only seem to have implications for weak form market efficiency or variations in the ex ante risk premium if the rules under consideration are known during the sample period. The application of technical trading rules to maritime financial data series has hardly received any attention from researchers, and it is questionable whether the market players in the industry are sophisticated enough to utilize such investing tools. On the other hand, the types of trading rules considered would have been well-known from other financial applications throughout the time period.

The main problem is most likely the small size of the market in terms of the number of vessels in any given category, and the resulting low liquidity of the sale & purchase market. In other words, there may not be a vessel for sale when the technical trading rule generates a buy signal or a buyer when the trading rule generates a sell signal. Such practical issues may hinder the process of implementation and reduce the effective returns generated by any trading rule. Although trading costs have been discussed in this chapter, the effects of an illiquid market have not been fully considered. The introduction of a time delay in some of the trading rule parameterizations indicates that a delay in the execution of a buy or sell signal has a negative effect on returns.

Despite numerous studies in the literature on ship price formation, on testing the validity of the EMH in shipping markets, and on the behaviour of ship prices and their volatilities, there has been insufficient empirical evidence to suggest whether sale and purchase decisions of merchant ships, based on fundamental and/or technical analysis, can be profitable. For example, Adland and Koekebakker (2004) investigate the performance of technical trading rules and argue that if the market for ships is efficient, then trading strategies based on these rules should not produce wealth in excess of what can be gained through simple buy and hold strategies. Using both in- and out-of-sample tests, they report that, in general, trading rules do not yield excess returns that can compensate for transaction costs.

More specifically, Adland and Koekebakker (2004) examine asset play strategies in the second market for bulk ships. They use an entry-exit model where the buy and sell
signals\(^3\) are generated by technical trading rules. They find that profits from trading rules exceed a simple buy and hold strategy in both the dry bulk and tanker sectors. However, these trading rules are governed by short-term trends in the asset values, resulting in frequent trading. Moreover, when the strategies are adjusted for transaction costs and illiquidity in the second-hand market, the excess profits evaporate, suggesting the conclusion that the sale and purchase markets (S&P) for ships are fairly efficient.

Although their study seems to provide support for the EMH, there may be two points that could be raised given the nature of technical analysis. First, as they point out, their results might be dependent on the variables and set of rules used for constructing the technical trading strategies. Secondly, the use of technical trading rules on their own and not in conjunction with the underlying economic theory may not be as effective in this market. This is because the historical pattern of the underlying series alone is not enough to extract information on the future behaviour of prices, since it is widely documented that ship prices follow random walk processes.

### 2.4 Price and Transactions

Alizadeh and Nomikos (2003) from Cass University examine the price–volume and volume–volatility relationships in the market for second-hand dry bulk vessels. A variety of econometric techniques are employed to investigate both the temporal and lead–lag relationships between price changes and level of trading activity for three different vessel classes as well as a general dry bulk price index. In addition, the volume–volatility relationship is examined using asymmetric conditional heteroscedasticity models.

The results indicate the existence of a significant positive relationship between contemporaneous price change and activity in the sale and purchase market for dry bulk vessels, which is consistent with the literature for financial markets. Causality tests between the two variables demonstrate that price changes Granger cause trading volume in the market for handysize and Panamax vessels as well as in the aggregate dry bulk price index. For those markets such a pattern implies that higher returns, or otherwise higher capital gains encourage more transactions. This may lead in turn to an increase in trading volume. The positive relationship between these two variables may also be due to the fact that the sale and purchase of merchant vessels is a lengthy process. Normally, it takes one to two months, from the time of initial negotiations till the final completion due to vessel inspection and other formalities. This means that the buyer has essentially an option to withdraw his offer should prices in the market fall sharply. Such action taken by buyers may result in a drop in trading volume in the market, which suggests a positive relationship between price changes and trading volume. However, there is no evidence of causality from volume to price changes.

Results from the asymmetric conditional volatility models indicate the asymmetric response of ship price volatility to shocks in the market. Moreover, the results show

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3 An event or condition that alerts investors to dispose of a particular investment.
that there is a negative relationship between trading volume and price volatility. Even though this result seems to be in contrast to what is reported in the literature, it can be explained by the unique characteristics this market possesses, including thin trading and the way information is disseminated in the market.

To conclude, although the level of trading activity does not convey information about future price movements, it contains information about the volatility in the market. More specifically, the higher the volume is, the lower its volatility. Finally, the research findings also suggest that more can be learned about the sale and purchase market for ships by studying the joint dynamics of ship prices and trading volume, and not by focusing solely on the univariate dynamics of ship prices. This is also supported by the fact that our results are consistent across the markets for different size vessels.

2.5 Asset Play between two shipping sectors and the Law of One Price

The well-known economic theory of one price says that two assets that produce the same future payoff should sell at the same price, and this is an example of perfect relative pricing. If it does not hold, arbitrage opportunities exist. Chen and Knez (1995) argue that broadly speaking, assets with similar payoffs across future states should have similar prices regarding integrated markets. In a measure-theoretic framework they develop relative price bounds that allow for examination of near integrated markets.

In the literature on financial markets there are many trading strategies such as the one presented by Gatev et al. (2005) who conducted an empirical study of relative pricing in the stock market using a trading strategy named pairs trading. The strategy can be explained as follows. Pick two common stocks that have moved together in the past. If they deviate in value, buy the cheap one and sell the expensive one. If history repeats itself, prices will converge once more and the speculator will profit. Going back to bulk shipping, there are two main sectors, the drybulk and tanker markets. As ships are typically designed to operate in one of these markets only, high freight rates in one market segment does not automatically produce high freight rates in the other segment. However, Beenstock and Vergottis (1993) argue that freight rates in these two markets cannot drift too far apart due to the shipbuilding and scrapping activity, as well as the existence of a special ship type (the combination carrier) that can operate in both segments. A simple explanation of how it works in the market is the following. An increase in the contracting of tankers reduces the potential future supply of new dry bulk carriers as shipbuilding capacity is scarce. This will ultimately lower tanker freight rates relative to dry bulk freight rates. Furthermore, in times of strong transportation and demand for oil relative to dry bulk commodities, the fleet of

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4 Volatility is a statistical measure of the dispersion of returns for a given security or market index. Volatility can either be measured by using the standard deviation or variance between returns from that same security or market index. Commonly, the higher the volatility, the riskier the security
combination carriers will switch to the tanker market from the dry bulk market and increase supply in the short run until increased newbuilding activity and subsequent deliveries restore the market balance. Such a switch reduces the tanker rates relative to dry cargo rates. Following that reasoning, the two freight markets are more integrated when the fleet of dry or tanker vessels became older (making scrapping a viable option) and the fleet of combination carriers larger.

Sigbjørn Sødal, Steen Koekbakker and Roar Adland (2006) present a real options based model to study the optimal timing of investment when switching between the two main freight market segments in bulk shipping, namely that of tankers (the sea transport of crude oil and oil products) and dry bulk carriers (the sea transport of dry commodities such as iron ore, coal, and grain).

The model is calibrated to real world data on freight rates and second-hand ship values, and it seems to be doing a fairly good job in estimating when a switch from one market segment to the other could be profitable. More specifically, the cost and demand parameters upon which the decisions to switch are made, including the stochastic characteristics of freight rates, are estimated from an empirical analysis that is updated every week throughout a 12-year time period from 1993 to 2005.

The second-hand market for bulk ships seems to have been efficient most of these years in the sense that market switching usually did not pay off. This indicates that no excess profits can be usually made from the switching strategy – the markets are relatively efficient when information is concerned.

At the end of the sample, however, the model indicates market timing abilities. So, it seemed profitable to leave the dry bulk market and enter the tanker market over a significant period of time shortly after the millennium shift and to return to the dry bulk market about three years later. These points in time corresponded to an unprecedented boom period in the tanker and dry bulk freight markets respectively, and the result suggests that agents in the second-hand market were slow in adjusting their expectations. In fact, all the shifts suggested by the model would have paid off. Still it is much too early to judge whether these market segments are informationally inefficient. First, the model identifies only a few excess profit opportunities and it is not evident how to judge the statistical significance of these results. Secondly, testing for market efficiency, in an absolute or relative level, often encounters the “joint-hypothesis”5 problem.

2.6 Modern Economics and Herd Behavior

Modern economics has enriched the analysis of sociological and psychological factors that influenced decision-making by behavioural assumptions. People’s behavior reflects an interaction of cognitive and emotional factors and this can be captured

5 For the stochastic and highly volatile shipping markets one should not pay much attention to the results from a single example.
more effectively by using an approach that focuses on the interplay of different decision-making systems. An interdisciplinary approach is needed incorporating a range of ideas that originate from sociology, economic psychology, and neuroeconomics (Baddeley 2010).

The first one who explained financial instability was Keynes (1936), with reference to stock markets, as a game between sociological and psychological forces in uncertain times. He interprets the waves of optimism and pessimism as psychological forces that affect stock markets and the animal spirits that propel entrepreneurship.

Following this approach, other economists, like Kindleberger & Aliber (2005), have analyzed the socio-psychological impacts of emotional contagion. They identified the speculative euphoria spreading through groups of investors during manic phases as a catalyst in economic and financial booms; in turn, excessive pessimism and extreme risk aversion precipitate bust phases.

Following Keyne’s approach, Akerlof & Shiller (2009) defined five animal spirits: confidence, fairness, corruption, money illusion and storytelling (the latter referring to a method to communicate the elements of a story to an audience through narration). In the context of herding behaviour, confidence and storytelling will be the most crucial of Akerlof and Shiller’s animal spirits. If the state of confidence is strong and people are optimistic, then the macro-economy will be vulnerable to waves of euphoria, optimism and overconfidence, precipitating herding and speculative bubbles. On the contrary, when the state of confidence is weak and people are pessimistic, then the macro-economy will be prone to slumps and financial crises (Baddeley, 2010). These forces will spread via storytelling, word of mouth and false intuitions (i.e. intuitions that prices cannot fall) feeding herding and contagion, all perturbed by anything from dramatic news stories to sporting events.

Okan Duru, (2016) in his work argues that a modern approach to the shipping investments should be established around the sentiments, incentives and behavioural capacity of entrepreneurs. A sound ship investment is probably not achieved with bigger capital or size of fleet but through managing investors, firms and markets’ mental orientation. Short-term rationalities may not be rational in the long run. Time scale plays a significant role in our perception of rationality or logical investment preferences.

The term irrationality of shipping business was first mentioned by Duru (2013) to indicate deviations from optimal investment behaviour in shipping business. The theory of irrational shipping markets illustrates the decision-making process based on the wisdom hierarchy (i.e. data-information-knowledge-wisdom). Recent maritime research and existing documentation describe the common dynamics of shipping markets, and know-how (knowledge) is thought to be present as an input of the decision process.

The irrationality in the shipping business might only be credited to the erroneous nature of human action. Cognitive bias of the investor (i.e. false reasoning and misconception), the errors of crowds (i.e. herding and group thinking bias) and the
adverse motivations stimulated by the industry and organizations play a significant role in priming the irrational actions.

Important drivers behind irrationality rely on the common practices of the shipping business, business ethics and potential for moral inconsistencies in exchange for short-term benefits (self-interest of various stakeholders). The author proved that there are four drivers behind the irrationality in the shipping industry: fixtures and asymmetric information, myopic investment behaviour and hyperbolic discounting, intermediaries (commission incentives), and marine insurance as a motive of moral hazard.

In order to eliminate further disruptive incentives, new-generation consultants and managing directors must withstand the mechanisms that encourage short-term orientation and high-frequency decision-making (severe action bias). Considering that a ship investment has usually around fifteen to twenty years of lifetime (shipping business cycles also last more than a decade), the asset management framework must be justified for slow-down and cautiousness.

2.7 Interesting Approaches on Investment Decision Tools

Fan and Luo (2013) analyzed the decision to expand capacity and ship choice. They studied the possibility of scaling up capacity in accordance with market and corporate properties, and they examined the impact of these factors on advancing the scope of the expansion. Most of the expansion decisions were driven by the market, and larger companies were expanding to maintain market share. When it comes to choosing vessels, the analysis outcomes reinforced the hypothesis that shipping companies make a decision about placing orders for new or second-hand ships prior to considering the ship size. Fans and Lou (2013) also pointed out that second-hand ship purchases are not preferred over new ship orders. For new orders, length reductions in the shipbuilding, the ship size, and the demand growth rate are factors generating increases in ship purchase preferences. For second-hand ships, the optimum size is the handy size.

Gkochari (2015) demonstrated the perfect competitive investment strategy based on optional game choices in dry bulk shipping. Gkochari (2015) investigated the impact of the delayed completion of building new ships and examined how an incomplete delay can reduce the trigger value. He claimed that the analysis could gain additional insight, and he explained the existence of boom-and-bust cycles in shipping.

Eslami, Jung, Lee and Tjolleng (2017) introduced a simple and accurate hybrid prediction model of tanker freight rates, which combines an artificial neural network (ANN) and an adaptive genetic algorithm. An ANN is a computational model based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of the ANN because a neural network changes based on that input and output. Also, the adaptive genetic algorithm (AGA) adaptively searches satisficing network parameters such as input delay size. The ANN iteratively optimizes a prediction network that takes into account parsimonious variables (crude oil price, fleet productivity and bunker price) and time-lag effects as predictors.
Merikas, Merika, & Koutroubousis (2008) indicated that the ratio of proportion to the various ships in the tanker sector can be investigated and utilized as an efficient approach for investment decisions. The ratio of the anticipated motion is determined by owners, brokers, and entrepreneurs, and it is based on expectations and corporate decisions, with the expectation that an organization operates in the appropriate operating sector. They created a correction error model using the size of Suezmax, Handysize, Aframax, and very large crude carrier (VLCC) ships. Investment decisions depend on many factors, which vary depending on the degree of the price ratio and the rate of adjustment of the degree of adjustment relative to the equilibrium level. Overall, Merikas et al. (2008) argued that they determined the ratio of the anticipated motion, namely the expectation and the corporate decision, with the expectation that the organization was operating in its appropriate operating sector.

Alizadeh and Nomikos (2007) tried to fill the gap with a study which was not only based on the past price behaviour for trading strategies, but it also combined technical trading rules with fundamental analysis by using the cointegration relationship between prices and earnings to extract information from the market for investment and trading purposes. They provided a new approach for timing investment and divestment decisions in shipping markets. In particular, they utilized the relationship between variables in shipping markets and devise strategies to identify the timing for sale and purchase of merchant ships. The theoretical relationship between ship prices and TC earnings based on the discounted present value model is discussed in detail and a cointegration relationship is established between ship prices and earnings. Based on this cointegration relationship, we develop a trading strategy that measures the deviation of the price to earnings (P/E) ratio, which is also the cointegrating vector, from its long-run equilibrium and signals sale and purchase opportunities using moving average trading rules. Such strategies are then applied to historical series, which reveal promising results when compared with static buy and hold strategies.

Regarding the tanker market (Alizadeh and Nomikos, 2006), the study revealed that the relationship between price and earnings in shipping markets contains important information about the future behaviour of ship prices, which can be used for investment timing in shipping markets. It is also shown that investors in the tanker market can benefit from combining technical trading rules with fundamental analysis when making sale and purchase decisions. Finally, it seems that these trading strategies work better for the market of larger vessels (VLCC and Aframax) than for the market of smaller ones (Handysize). This can be attributed to the higher volatility present in the market for larger vessels, providing better opportunities for asset players to take advantage of investment timing.

To conclude, the results imply that the relationship between price and earnings in shipping markets contains important information about the future behaviour of ship prices, which can be used for investment timing in shipping markets. Also, they proved

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6 Cointegration is a statistical property of a collection \( (X_1, X_2, ..., X_t) \) of time series variables
that investors in shipping markets can benefit from applying technical trading rules when making sale and purchase decisions.

Moreover, the results also reveal that the combination of technical trading and fundamental analyses could be more effective in the market for larger vessels (Panamax and Capesize) due to higher volatility and price fluctuations in these markets compared to the market for handysize ships. This can be associated with the fact that the markets for smaller ships are more efficient in the sense that there are more participants and these ships are more flexible to operate in terms of the cargo they can carry and the routes in which they operate. It can also be argued that while larger ships could be more suitable for the purpose of asset play in the shipping markets, the timing of investment is of crucial importance as potential gains and losses are higher in these sectors of the shipping industry.

2.8 Greeks: The Masters of asset play

Nowadays, many modern shipping companies differ from the traditional Greek shipping model as capital needs are higher than the need of control, at least to a certain degree. Greek shipowners are actively involved in negotiations and decision-making with all the stakeholders of their companies: crew, bankers, clients, brokers, suppliers, trustees (Grammenos and Choi, 1999). Although the new generation of shipowners listens and learns from the stories (or the collective memories) of the distant past, it also focuses on the future and takes advantage of the newly added financial tools. So, ‘ability’ is the word that describes this new generation of shipowners, being a collateral benefit to the flexibility and adjustability that characterizes the philosophy of many Greek shipping companies (Syriopoulos and Theotokas, 2005).

Furthermore, Harris Karatzanos (2016) has drawn a diagram showing the decision-making process containing the following steps:
A primary element in the creation of any strategy is information. In the modern world, information is taken for granted so it shouldn’t be regarded as an advantage or a point of differentiation. Then comes what summarises the experience in the art of shipping, namely, the reaction to information. This is where the Greek secret lies. After that, the preparation for the possible consequences of the diffusion of information follows. The Greek shipowners are certain when dealing with this issue and the Greek anti-cyclical behaviour. The decision and the action, the finals steps, are the consequences and reasons of the above process.

Greek shipowners have been mostly characterized by anticyclicality in the shipping investments, having gained the admiration of the international maritime community. This admiration has created a desire for a profound study and interpretation of the Greek shipowners’ activities (Theotokas, Lekakou and Karatzanos, 2016).

*Buy low, sell high* is not as easy as it may sound, because in reality it is a strategy based on the profit-maximization of the investor through the *asset value*, which in this case is the ship’s value. The owner here buys the ship in order not only to profit by trading it, but also to utilize the timeframe required to increase the value of his asset, i.e. the ship. This strategy takes time and requires proper management of the ship until the market allows a profitable sale of the vessel. This method is a means of profit today, however, it used to be a means of survival in the late 1950’s that eventually evolved into a speculative way of maximizing the profits of Greek shipping companies.

For the purpose of our analysis, we will refer to the Panamax vessel since it constitutes a representative size / type of ship among the Greek shipping community. As seen on Figure 3, the Panamax value from 2012, Q4 started decreasing gradually until the 1Q of 2014. During the same period, a noticeable volume of second-hand transactions is noticed that denotes the Greek anticyclical practice. Also, at the same time, according to Clarkson’s SIN data, the Greek second-hand activities constituted 15.9% for 2011, 23% for 2012, 24% for 2013 and 41% for 2014, showing a steady growth of the volume of the vessels acquired at a time when prices were fairly lower.

Setting aside the key role of knowledge of the shipping market in the implementation of this policy so as to look for common beliefs among traditional Greek shipowners, we are presented with three basic principles.

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**Figure 3** Panamax BC volume sales in DWT & 10 years old values, Source: Clarkson’s SIN
• “Steal the sea”. This means that a rational owner waits for the right moment and does not directly invest his money.

• “Lathe biōsas”. The phrase being the epitome of Epicurus’ teachings on politics can be summarized as live anonymously, without seeking wealth or glamour.

• “The freight market is never good”. This expression means that no matter what you earn from the sea, the sea-god will take it back from you.
3. Methodology

3.1. Model Variables

3.1.1. Introduction of second-hand to newbuilding price ratio

Second-hand and newbuilding ships are substitutes since an increase in the price of second-hand ships leads to an increase in newbuilding prices too. Moreover, as it is easy for shipowners to switch between second-hand and newbuildings vessels, demand is more elastic, thus marking these options as substitutes (Tsolakis, Cridland and Haralambides, 2003). In other words, a freight rate increase will increase demand for ships with an immediate positive effect on second-hand ship values (Stopford, 2009). This will make shipowners more eager to order new ships and as a result cause the rise of newbuilding prices as well. The above assumptions have drawn the basic hypothesis of this study to use the ratio of second-hand to newbuilding prices (SP/NP) as a tool in the decision-making process for shipowners. This variable has also been used as the dependent variable in the error correction model, which is analyzed in the current study.

3.1.2. The time-charter rate

Based on the model used for the purposes of this study, both newbuilding and second-hand prices are a function of the vessel’s expected revenue. This is expressed as the average time-charter equivalent rate per day. The reason for this is that time-charter rates denote the shipowners’ and charterers’ expectations of things to come (Alizadeh and Nomikos, 2007).

In shipping, operating earnings are represented by time-charter rates, or the time-charter equivalent of spot rates, when a vessel is operated in the spot market. In this study, time-charter rates are used as a proxy for earnings for the econometric decision model for two reasons. First, time-charter rates do not include voyage costs, they represent the net earnings from the chartering activities of the vessel instead. Secondly, since time-charter rates are hire contracts for a number of consecutive periods, they are considered to contain information about future earnings of the vessel during these periods (Kavussanos and Alizadeh, 2002). As a result, it is believed that time-charter rates (earnings) may explain price changes better than current spot rates.

Therefore, it is assumed that the higher the time-charter rate, the higher a ship’s future profitability and, consequently, the higher its value. Additionally, time-charter rate affect the deadweight (dwt) demand sector and the orderbook one. This concept suggests that shipowners will be eager to build more ships of a size that will offer them higher returns.

Additionally, according to a view firstly expressed by Beenstock (1985), new and second-hand ships are also capital assets. This means that they compete with other investments in terms of profitability. The higher the return on investment in shipping, the more money investors will be willing to pour in the market and consequently the higher the demand for new and second-hand ships.
3.1.3. Trade Index - Commodity prices

Demand is more difficult to model than supply because of the numerous variables such as global trade, industrial production and economic growth. Based on Stopford’s parcel size distribution function, there is a close relationship between certain vessel sizes or types and commodities. In the present study, the majority of Capesize vessels is engaged in the transportation of iron ore with no activity in bauxite or phosphate rock trades (Engelen, Meersman and Van De Voorde, 2006).

<table>
<thead>
<tr>
<th>Market segment</th>
<th>Iron ore%</th>
<th>Coal%</th>
<th>Grain%</th>
<th>Bauxite &amp; aluminium%</th>
<th>Phosphate rock%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capesize</td>
<td>70</td>
<td>45</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panamax</td>
<td>22</td>
<td>40</td>
<td>45</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>Handysize/max</td>
<td>8</td>
<td>15</td>
<td>50</td>
<td>55</td>
<td>80</td>
</tr>
</tbody>
</table>

Table 4: Relation between vessel type and transported cargo in dry bulk segment, Source: Alizadeh and Nomikos

For that reason, iron ore prices are used as an indicator of demand in this specific dry market.

3.1.4. Trade Volume

The impact of trading volumes on investment decisions has attracted the attention of both academics and practitioners in their effort to examine the efficient market hypothesis (EMH). Alizadeh and Nomikos (2003) proved that there is a significant relationship between contemporaneous price change and activity volume in the sale and purchase market for dry bulk vessels. Therefore, in this work the relationship between the number of transactions and the SP/NP ratio is examined.

3.1.5. Shipbuilding Costs – Cost per Gross Ton (CGT)

Despite subsidies and industrial policies in a number of shipbuilding countries, (Beenstock and Vergottis, 1989) shipyards do compete with each other and, as a result, shipbuilding prices should bear one way or the other, upon newbuilding prices, at least in the long run.

The benchmarking of building prices for shipping is rather challenging particularly for the econometric modeling. Therefore, the variable used for the purpose of this study is the shipbuilding Cost per Gross tonnage, which is the price of the complete vessel shipbuilding cost divided by the ship compensated gross tonnage7.

3.1.6 Measuring Risk

The investment model adopted for the purpose of this study uses a high parameter since risk is one of the most significant factors behind investment decision in shipping. In the literature, there are different modeling techniques present measuring risk in investment decisions (Campbell and Shiller, 1987). Here, two different methodologies are applied. The first one is an autoregressive regression (AR) model, which uses the

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time-charter series with two-lag chronological departures and estimates the volatility of the market. The second one is an indicator for every month based on the standard deviation method of measuring data dispersion in relation to the mean value of the dataset, and it provides a measurement for the investment’s volatility. As the decision relates to investments, the standard deviation measures the extent to which the return on an investment is deviating from the expected normal or average returns. Lastly, the AR method used here enables more reliable results and is more suitable for the developed econometric model.

3.1.7 Capital Cost Related Variable

The last variable included in the econometric model is the cost of capital. Through the London Inter Bank Offer Rate (LIBOR), a debt financing indicator has been developed for this specific model. It is used as an indicator of the way banking financing affects the decision-making process regarding the newbuilding or second-hand vessels.

3.2 Description of Data

3.2.1 Data set

For the purpose of this study, monthly data for world seaborne trade of iron ore and coal were collected from Clarkson’s Shipping Intelligence Network from January 2004 to June 2017. Specifically, second-hand cape prices for five-year-old ships were collected, as well as newbuilding Capesize prices, time charter rates for one-year contracts of five-year-old vessels, and transaction volume for the same category. Iron ore prices were collected from Index Mundi, endorsed as a trade index for Capesize bulk carriers. Financial data on the one-month London Inter Bank Offered rate (1-month LIBOR) were obtained from the Federal Reserve Economic Data for the same period as a proxy for debt financing. In summary, the following variables were chosen for our model:

- **SH/NP**: five-year-old second-hand price to a new building vessel. This ratio is used as a proxy for the model’s decision making variable.
- **Time charter**: a proxy for the cash flow generation from operating the vessel.
- **Iron ore**: used as a proxy for the main commodity trade.
- **Cgt**: used as a proxy for the shipbuilding prices.
- **LIBOR**: a proxy for the cost of capital.
- **Risk**: the volatility of the freight rate, as a proxy for the risk of the decision.
- **Volume**: a proxy for the trading activity in the sector.
Table 2. ADF-test, variables in levels.

<table>
<thead>
<tr>
<th>Variable</th>
<th>t-statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP/NP</td>
<td>-2.88</td>
<td>0.051</td>
</tr>
<tr>
<td>TC</td>
<td>-2.59</td>
<td>0.096</td>
</tr>
<tr>
<td>CGT</td>
<td>-1.34</td>
<td>0.611</td>
</tr>
<tr>
<td>Iron_Ore</td>
<td>-1.61</td>
<td>0.474</td>
</tr>
<tr>
<td>Risk</td>
<td>-3.97</td>
<td>0.000</td>
</tr>
<tr>
<td>Libor</td>
<td>-0.85</td>
<td>0.801</td>
</tr>
<tr>
<td>Volume</td>
<td>-10.02</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Mac Kinnon’s critical values for rejection of hypothesis of a unit root at 1% is -3.48, at 5% is -2.88, at 10% is -2.58.

Furthermore, E-Views statistical package has been used for the data set formation and model estimation. All data series were checked for stationarity using the Augmented Dickey–Fuller (ADF) unit root test.

The figures in Table 2 show that all variables were found non-stationary with the exception of volume and risk, a fact that implies that the model must be tested for cointegration.

3.2.2 Dummy Variables

During model estimation, some observations could be regarded as outliers. These observations had a large impact on the estimation results. To overcome this problem, dummy variables were included in the model. The dummy, which represents the different phases of the shipping economic cycle, gets value 1 when the cycle is positive and value 0 when the cycle is negative. Value 1 corresponds to all months prior to October 2008 as in this time period the trading activity and freight rates were high. Value 0 represents the months included in the period between October 2008 and 2017 when the economic cycle was on a negative slow down phase. The fact that caused the change in the economic cycle in October 2008 was Lehman Brother’s bankruptcy and the global economic crisis in general.
3.2.3 Data Problems in the pricing of econometric models

As a general rule, the main problem with public information is that it is based on reported observations. These may be subject to an error margin, and depend in part on the source they come from. In addition, they seldom reveal crucial elements such as payment terms. In many business sectors, a discount for cash or prompt payment is considered likely. It may be that typically, payments are staged (contract signing, keel laying, launching, delivery). Some deals have payments that are end-loaded, thus a higher reported price would seem a reasonable expectation. Even for vessels of similar outline specifications, there are valid reasons for price differentials between and within yards (Beenstock and Vergottis, 1989). Some of the factors that affect the price of the vessel are the accuracy of reported prices, the standard design of each vessel order, a single or a massive order, financing terms and others.

3.3 Model Specification

3.3.1 Unit Root Testing

The stationarity (or not) of a series can strongly influence the series' behavior and properties. For example, the persistence of shocks will be infinite for non-stationary series. Also, the use of non-stationary series can lead to spurious regressions. If two variables are trending over time, a regression of one on the other could have a high $R^2$ even if the two are totally unrelated. Moreover, if the variables in a regression model are not stationary, the standard assumptions for asymptotic analysis are not valid. In other words, the usual “t-ratios” will not follow a $t$-distribution and thus the hypothesis testing of regression coefficients cannot be carried out.

The statistical methodologies used to test for stationarity were initiated by Dickey and Fuller (1979) and further improved by Dickey and Fuller (1981). The latter test is applied here.

3.3.2 Testing for cointegration and long run equilibrium

The model used in this study is an error correction model, an idea from modern theory in chronological series which is based on the testing for cointegration. Engle and Granger (1987) introduced the statistical concept of cointegration, and they supported that it is a basic test for causality and validity in various theories.

If two or more series are cointegrated, the common factors that affect them exist along with their permanent or secular trends. As a result, the series will eventually adjust to equilibrium.

This implies that even if, in the short-run, the covariance between the dependent and the explanatory variables shows that they drift apart, in the long-run, the series will eventually adjust to an equilibrium relationship.

The testing for cointegration involves the following steps:

- determining the order of integration in each of the series and conducting a unit root analysis,
• estimating the long-run equilibrium relationship (OLS-ordinary least squares or linear least squares cointegration regression) and testing for integration.

With the purpose of this research in mind, the SH/SP ratio is used as a dependent variable, which is the second-hand price of the vessel divided by the respective shipbuilding price. The set of variables acting as regressors was chosen on the basis of the shipping literature developing a decision-making tool for the shipowner and assisting him in the investment decision between second-hand and newbuilding vessels.

Thus the model takes the following form:

$$(SP/NP)_t = b_0 + b_1 TC + b_2 GGT_t + b_3 Volume_t + b_4 Iron\_Ore_t + b_5 Risk_t + b_6 Libor_t + \epsilon_t$$

SP: Second-hand ship (5-years old) price in millions of US dollars
NP: Shipbuilding price in millions of US dollars
TC: Time-charter rate for one year contract in dollars per day
CGT- Cost per gross tonnage: New building price in millions of US dollars divided by the vessel’s compensated gross tonnage as a proxy for the shipbuilding cost
Volume: Number of transactions in the sale and purchase market
Iron\_Ore: Price of iron ore in US Dollars per Dry Metric Ton
Risk: Volatility of freight rates, obtained by estimating the AR(2) of the freight rate collecting the residuals and constructing their variance
Libor: London Inter Bank Offer Rate

All variables, as mentioned, are found non-stationary except from volume and risk. Both stationary variables, namely volume and risk in the model, are included in the model because they do not affect the final outcome. A linear combination of I(1) series, to wit non stationary series with a unit root, it may occur stationary [I(0)], if the series are cointegrated. If we regress an I(1) series on a number of I(1) and I(0) variables, then the residuals are stationary I(0) given that the series and the variables are cointegrated. A cointegrating relationship is a long-term or equilibrium phenomenon. It is possible that cointegrating variables may deviate from their relationship in the short run, but their association would return in the long run.

The variables are kept in levels, which means that they used transformation without data, to run OLS - ordinary least squares models to test for cointegration. If the
variables are cointegrated, the residuals from the equilibrium regression can be used
to estimate the error correction model. So, the following general dynamic error
correction model is developed based on the Engle–Granger (1987) procedure:

\[
\Delta(\text{SP/NP})_t = b_0 + b_1 \Delta(\text{TC}) + b_2 \Delta(\text{CGT}_t) + b_3 \text{Volume}_t + b_4 \Delta(\text{Iron_Ore}_t) \\
+ b_5 \text{Risk}_t + b_6 \Delta(\text{Libor}_t) + \gamma(\text{ECT}_t) + \varepsilon_t
\]

where ECT is the error correction term. For the above model the following tests were
used for its validation.

An adjusted R2, AIC (Akaike’s Information Criterion) and SBC (Schwarz Bayesian
Criterion) were used for model selection among a finite set of models. A joint
Significance Wald Test and Durbin–Watson statistic were used accordingly for the
added variables and the detection of an autocorrelation presence. Null hypothesis
tested by Augmented Dickey–Fuller test (ADF) and null hypothesis of no
heteroskedasticity tested by The Breusch-Pagan-Godfrey test. Additionally, the Jarque
- Bera test, a goodness-of-fit test, was used to examine whether sample data have the
skewness and kurtosis matching a normal distribution.

The selection of Engle and Granger (1986) procedure was made on the following
grounds: First, it is very straightforward to implement. Secondly, if the decision
variable for the entrepreneur is the SP/NP ratio, then it is a natural choice to assume
that it is the dependent variable in the cointegrating regression. Furthermore, in this
particular application the Engle-Granger criterion of minimum variance is rather more
important than the Johansen (1988) criterion of maximum stationarity. Finally, the
Engle–Granger small sample bias is not necessarily a problem, as the sample size is
quite large and the cointegrating vector is super consistent.
4. Estimated Results

4.1 SP/NP - Ratio

The main goal of the study is to draw conclusions on the right time to invest, according to the constructed ratio of two competitive markets, namely the second-hand and the new building markets. Thus, the covariance of the above markets can be used as a criterion based on which the used and the new building vessels can be considered as different parameters or as a single factor in the decision-making process (Merikas and Koutroubousis, 2006). The magnitude of the ratio, also, plays a very important role. Therefore, the shipowner should take this factor seriously into account in order to achieve a risk-return balance on his investment. Also, overlooking the ratio could lead to a wrong asset valuation.

![Ratio price of Capesize Bulkers (SP/NP)](image)

Figure 4: Data source from Clarksons SIN

A low SP/NP ratio indicated that the rate of market appreciation for the second hand vessel is lower compared to the rate of actual depreciation of the asset. This may suggest that an asset play strategy could be considered since the freight market is weakening. As mentioned in the literature review, freight rates and vessel prices are two cointegrated markets. Hence, lower freight rates lead to lower vessel prices and investment opportunities. Respectively, a high SP/NP ratio indicates that the rate of the market appreciation for the asset is higher compared to the actual depreciation of its value. This may denote that the freight market is strengthening and the operation of the vessel strategy could be considered. A high ratio could also generate a sell signal if a shipowner bought a vessel at a very low price. In this case, the shipping investor can take advantage of the high vessel appreciation in order to make high margins.
Figure 4 illustrates that historically there have been moments in time which are considered ideal for earnings from asset play strategies (i.e. July 2004, May 2006, most of the year 2012 and the first half of 2016). However, here the aim is to further existing work and show that this simple ratio is a very effective tool for decision-makers when it comes to investment. For this purpose, the results compared here are those obtained with the assistance of tools from previous studies that focused on the Cape market.

The first tool is based on the deviation of the price-to-earnings between second-hand prices and time-charter prices, from its long-run mean (Alizadeh and Nomikos, 2007). Figure 5 outlines the moving average (MA) series using the deviation of the log P/E ratio from its long-run (MA36) and short-run (MA6) mean for the Cape market.

The difference between the two constructed MA series is then used as an indicator for investing in the second-hand market. A positive difference between the short and the long MA series signals a new investment decision. This model identifies investment signals during shipping cycles. As seen, the periods when such investment opportunities occurred were those of July 2004, the first quarter of 2011 and the first half of 2012.

The second approach is based on shipowners having rational expectations (Gkochari, 2015). This model is applied to the Cape market and compared to the actual behaviour of shipping investors. Figure 6 implies that the optimal trigger strategy should be exercised the moment the X(t) line rises to the trigger level X* line. Also, it provides the equilibrium pattern of entry into the industry, which is estimated using real time information.
As seen in Figure 6, the model identifies the first trigger, the first investment signal during 2004 when Cape earnings increased sharply compared to historical average time-charter prices and reached $90,000 per day. In addition, during the first half of 2012, another investment opportunity appeared, according to the research model for shipping investors, to buy low and proceed to an asset play strategy in the second-hand market.

The historical peaks of 2007 and 2008 triggered a burst of deadweight supply concentrated development and in spite of the deep recession during 2009, the newbuilding boom continued mostly in times of positive demand shocks (i.e. 2010).

The historical peaks of 2007 and 2008 were followed by the crisis of 2008-2009. For that reason, this period was deliberately omitted by most works since it was considered an outlier (Gkochari, 2015).

Results based on the trading rule model in Figure 5 and the equilibrium exercise strategy pattern in Figure 6 converge overall to suggested buy signals, which generated by SP/NP ratio in this work (Figure 4). These signals were identified during the first half of 2004 and the beginning of 2012. It comes as a great proof that this simple decision-making tool works extremely well and identifies the right timing of investment opportunities for shipowners and shipping investors.
4.2 Model Results

The next issue that the current study analyzes is directly related to the investment decision in shipping markets (second-hand and new building). Therefore, the ratio of second-hand to new building prices is used as a dependent variable in order to identify how it is affected by key factors. For this reason, a specialized type of linear regression is used here and both shipping and financial parameters that appear to be directly correlated according to the economic theory have been introduced as independent variables. In other words, the objective is to quantify the decision between buying a second-hand modern ship or build a new one.

According to the results derived from the model the SP/NP ratio is positively related to the freight rate. A strong freight market is an indicator that it is the right time to operate the vessel. Therefore, from a shipowner's perspective, a sound strategy would be to seek for the opportunity to buy a modern second hand-vessel in order to take advantage of the upcoming strong market trend. The ratio decreases when freight rates show a decreasing trend since both second-hand and newbuilding prices of Cape bulk carriers are positively correlated to freight rate values. As far as the recovery of the market in the future is concerned, the shipowners' expectations lead to newbuilding orders due to the cyclical nature of the market (Tsolakis, Cridland and Haralambides, 2003) and this fact results in turn in a higher price of SP/NP ratio. The independent variable of time-charter (TC) is highly significant if we check t-statistics values.
Table 3. Estimation of the decision-making model with dependent variable the ratio SP/NP* for Capesize bulkers.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.004528</td>
<td>0.38</td>
</tr>
<tr>
<td>TC**</td>
<td>0.0045</td>
<td>2.23</td>
</tr>
<tr>
<td>Risk</td>
<td>-0.7431</td>
<td>0.07</td>
</tr>
<tr>
<td>CGT**</td>
<td>-0.00641</td>
<td>-2.02</td>
</tr>
<tr>
<td>Iron_Ore**</td>
<td>0.000841</td>
<td>1.98</td>
</tr>
<tr>
<td>Volume</td>
<td>0.00423</td>
<td>0.28</td>
</tr>
<tr>
<td>Libor**</td>
<td>0.012</td>
<td>0.56</td>
</tr>
<tr>
<td>ECT</td>
<td>-0.0502</td>
<td>1.96</td>
</tr>
</tbody>
</table>

Adj. R²       | 0.31        |
AIC           | -2.66       |
SBC           | -2.49       |
Wald Test     | 2.52        |
Jarque-Bera   | 39.88       |
Durbin Watson stat | 1.65 |
Breusch-Pagan-Godfrey (Heteroskedasticity) | passed |

*Second-hand price over new building price. **First difference for respective variable.
The volume of transactions in the second-hand market is found positively correlated with the second-hand market prices (Alizadeh and Nomikos, 2002) and as shown in Table 3, it is positively correlated with the dependent variable. This means that a possible increased trading activity in sales and purchases will also increase the SP/NP ratio. Despite the fact that the specific variable is statistically insignificant it assists the stability of the overall model.

Iron prices have a positive effect on the ratio and this stems from the fact that increased iron ore prices indicate strong trading activity of the commodity, implying a strong freight market. This variable, as expected, is statistically significant for the Cape market since iron ore is the main commodity transported in this specific market.

The freight rate volatility variable, expressing risk in this model shows a negative impact in the dependent variable, which is explained by the economic theory from the risk-return relationship (Yang, 2014). However, t-statistics results indicate that the variable is not statistically significant something that can partly be explained by the fact that being an expert, the shipowner is aware that the larger ships are exposed to higher volatility thus are of higher risk.

Based on the model results, the cost of financing has a negative relation with the depended variable. The cost of capital is expressed here by LIBOR. Thus a possible explanation of model results is that when the cost of financing is high, investors are expected to lean towards the second-hand market as they would avoid waiting for the delivery of the new vessel and therefore incur higher financial expenses. The value of the coefficient of this variable is aligned with the expectations raised by the theory, despite the fact that it is statistically insignificant.

As expected, the cost of building a vessel is highly correlated with the price of purchasing a new vessel, therefore a negative correlation with the ratio and a strong statistical significance appears. The negative correlation is explained by the fact that as cost per gross tonnage (CGT) increases, the value of newbuilding prices –being the denominator in the ratio- increases leading to a reduction in the index.

With reference to the error correction, the variable which measures the residuals using the Engle–Granger (1987) procedure for cointegration shows statistical significance with a coefficient value of -0.052. More specifically, the constant term in the error correction term, ECT, represents the equilibrium relationship of the SP/NP ratio in the long run. This implies that the monthly rate of adjustment of the SP/NP ratio to its equilibrium level will be 5 percentage points.

In order to examine the cyclicality of the shipping industry, a dummy variable was created taking the values of 1 for an upward business cycle. Based on the model results, this variable was statistically insignificant and the dummy was dropped.

Finally, the model works well and passes the main diagnostics tests (Table 3). The price of adjusted R² (~0.31) shows a strong linear correlation since it is over the critical value (0.1). Normality and heteroskedastic are tested through the Jarque-Bera test and the Breusch-Pagan-Godfrey test, respectively. Moreover, the relationship between a variable and its lag value, which called autocorrelation is tested for the first order serial
correlation through Durbin Watson test. In order to test the above econometric model results, we check the validity of outputs in comparison to another research which used the same financial instruments.

The study of Merikas and Koutroubousis (2008) introduced the SP/NP index and combined it with a number of maritime factors of the tanker sector during the period 1995-2006. The results of this research are aligned with the results of the present study. The volume of transactions and the cost of financing –LIBOR- were found weakly significant as in the present model. Furthermore, the freight rate and the volatility of the time-charter index have positive and negative influence in the depended variable respectively. The outputs of the current model converge overall with Merika and Koutroubousis’ econometric model. Finally, the parameters of shipbuilding cost, the crude oil prices in Merika’s et al. (2008) work and iron ore prices in this study, were found strongly significant. These are also the most important factors which influence the proposed investment indicator.
5. Summary and Conclusions

This study aims to propose a new approach for timing investment decisions in the Cape sector. For this reason, the key role of the second-hand to newbuilding prices ratio (SP/NP) in the asset play strategy is used. The expression asset play is a generic term used here to indicate the general investment strategy of “buying low and selling high” (Adland, 2000). The data used in the model of the study were collected between 2004 and 2017 since the aim is to examine the behaviour of the model during peaks and troughs of the economic cycle.

This study contributes to the literature in a number of ways. Firstly, a simple and useful decision-making tool for shipping investors is introduced, focusing on the dry bulk sectors. In addition, the functional relationship between the second-hand and newbuilding prices ratio (SP/NP) along with its main determinants are examined with the assistance of regression modeling, which can be used as a prediction mechanism for the valuation of assets. This way, the variability and the level of the asset value can be examined with respect to factors that are measurable and that the decision-maker should seriously take into account before acting.

The results indicate that according to historical average, a low SP/NP could declare a buy signal. Specifically, the right moment to buy a second-hand vessel changes according to the economic cycle. However, a price lower than 0.8 in the examined period of this study devotes a buy signal for a modern second-hand vessel and a good chance for the shipowner to make money from asset play game in the future. Subsequently, the outputs are compared and contrasted with other research results to find out the effectiveness of the SP/NP ratio as a decision-making tool. That being the case, comparing this study’s results with the results of previous studies that examine trading strategies in the cape market, such as the trading rule based on the deviation of the price to earnings (log P/E) ratio from its long-run mean, we came to the conclusion that the examined approach is more effective than those proposed by other authors regarding the time of investment. Although this work focuses on the Cape sector, the same approach could be applied to any bulk shipping market.

As it was outlined, this work developed an econometric regression model in order to identify how the ratio of second-hand to new building prices is affected by key factors. Shipbuilding costs, freight rates and iron ore prices have the greatest effect of all variables in determining the second-hand to newbuilding prices ratio (SP/NP). The cost of capital and the risk parameters are insignificant for Cape bulk carriers because it is something that they learned to handle as a part of the shipping game. The study of Merikas and Koutroubousis (2008) introduced the SP/NP index and combined it with a number of maritime factors of the tanker sector during 1995 and 2006. The results of this research are aligned with the results of the present study.

Finally, this study can be a stimulus to new future investigations as is the use of the introduced investment tool in other shipping sectors like containers and chemicals. It is recommended that further research should be undertaken on the replacement decision, selling in the second-hand market or scraping the vessel. Future work should
also concentrate on an artificial prediction model for second-hand market prices. New technologies used artificial neuron network (ANN) in order to develop computational models based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of the ANN because neural network changes are based on that input and output. Technological evolution thus could offer simple and accurate hybrid prediction models combining artificial neural networks and adaptive genetic algorithms.
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References

19. EViews, 2015, “EViews 9.0 users’ guide”. Irvine California, USA.