THE TIME DIMENSION AND VALUE OF FLEXIBILITY IN RESOURCE ALLOCATION: THE CASE OF THE MARITIME INDUSTRY

KOSTAS AXARLOGLOU
Democritus University of Thrace
Dept. of International Economic Relations and Development
University Campus, 69100, Komotini, Greece
Email: axarlog@otenet.gr

ILIAS VISVIKIS+
ALBA Graduate Business School
at The American College of Greece
6-8 Xenias Str, 115 28 Athens, Greece
Email: ivisviki@alba.edu.gr

STEFANOS ZARKOS
ALBA Graduate Business School
at The American College of Greece
6-8 Xenias Str, 115 28 Athens, Greece
Email: szarkos@alba.edu.gr

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+ **Corresponding Author:** Associate Professor Ilias Visvikis, ALBA Graduate Business School at The American College of Greece, 6-8 Xenias Str, 115 28 Athens, Greece, Tel: +30 210 8964531 (ext. 3291), Fax: +30 210 8964737, Email: ivisviki@alba.edu.gr

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ABSTRACT

The paper analyses empirically the time-varying properties of the spread between voyage and time-charter rates and presents evidence that these properties are directly related to the business cycle (market demand) of the maritime industry, to the expectations for the future market demand and to market volatility. Using a real options methodology, we demonstrate that the time-varying properties of the spread is the outcome of the strategic decision to time-commit company resources in the industry. It is shown that, during a market upturn (downturn) managers choose to commit company resources for a short period (long period), and thus, maintain flexibility (commitment) in better exploiting the upcoming business opportunities (protecting company resources from lack of business opportunities). Overall, the fluctuations of the time-varying spread, between voyage and time-charter rates, offer managerial insights in resource allocation that can better shape up chartering, budgeting and financial management decisions on the time commitment of resources in the maritime industry.

Key Words: Maritime Industry, Resource Allocation, Strategic Flexibility, Commitment, Real Options, Market Conditions.

1. INTRODUCTION

> "*We believe that employing short–term time charters generally increases our flexibility in responding to market developments and assists us in enhancing the amount of charter hire that we are paid, particularly during periods of increasing charter hire rates, while long-term time charters provide us the benefit of relatively stable cash flows"* (Diana Shipping Inc., Annual Report 2005)

The current paper analyzes empirically the time-varying properties of the spread between the voyage and time-charter showing that these properties are directly related to the industry business cycle and other industry characteristics. Moreover, it is shown that the fluctuation of this spread is the outcome of resource allocation decision-making in the maritime industry where managers decide the length of time commitment of company resources (vessels) in a given project (charter contract), and thus, choose between flexibility and commitment in managing key company resources. Methodologically, the paper, using real options, analyzes theoretically how managers in the maritime industry deploy company resources (vessels) by chartering them for various time spans. This decision-making results in variations in the volume of voyage and time-charter fixtures in the market, which consequently influences the spread between voyage and time-charter rates. Finally, using industry data, the paper tests empirically relevant hypotheses about the time-varying properties of the spread that stem from the above decision-making in the industry.

The timing decisions on resource allocation that managers are frequently asked to make are especially relevant in industries that work on a project-basis, such as the construction or the maritime industry, among others. In industries, such as the maritime one, during the execution of a given project, the company has an opportunity cost for committing its resources (vessels) with the project (charter contract) since it gives up more profitable opportunities that come up (*on-going* opportunity cost). Thus, the *on-going* opportunity cost reflects the cost (to the company) from committing resources to the particular project[1]. On the other hand, it is not certain whether the company can still find profitable business opportunities after the completion

[1] Managers in the maritime industry recognize on-going opportunity cost claiming that "*our vessels that are committed to long-term charters may not be available for employment on short-term charters during periods of increasing short-term charter hire rates when these charters may be more profitable than long-term charters*" (Diana Shipping Inc., Annual Report 2010).

of a project, and thus, it may end up having its resources idle (*afterwards* opportunity cost*)*[2]. Thus, the *afterwards* opportunity cost reflects the cost of company's flexibility from not committing its resources in to a given project.

In essence, these two types of opportunity costs reflect the value of the company's flexibility and commitment that stem from the decision to tie up its resources to a project of certain time duration[3]. Naturally, as the *on-going* opportunity cost increases, flexibility (commitment) becomes more (less) valuable for the company and thus, the company has stronger incentives to commit its resources in shorter duration projects. Similarly, as the *afterwards* opportunity cost is increasing, the value of commitment (flexibility) is increasing (decreasing) leading, thus, the company to commit its resources in longer duration projects. The magnitude of these two types of opportunity costs is directly related to the market conditions that the company faces during and after the completion of a project. Specifically, in a market upturn, when increasingly more profitable projects are arising, the *on-going* opportunity cost is quite high (the value of flexibility increases), while the *afterwards* opportunity cost is rather low (the value of commitment diminishes). On the other hand, during a market downturn, increasingly fewer profitable projects come up and thus the *on-going* opportunity cost is low, while the *afterwards* opportunity cost is quite high, making flexibility (commitment) less (more) valuable. Consequently, the managerial decision of committing company resources for some time (i.e. undertaking a project with certain duration) is a strategic one and not a simple choice found in the domain of short-term decision-making.

In the general economics literature there is a long discussion about the trade-offs between flexibility and commitment in managing company resources. Ghemawat and del Sol (1998) claim that there is no any single answer in this debate and managers should find ways to balance the trade-offs between flexibility and commitment in their decision-making. They further argue that the company (or usage) specificity of resources and capabilities play a pivotal role in this trade-off. As such, company (or usage) specific resources reflect increasing company commitment to these resources. Raynor and Leroux (2004) analyse these trade-offs

[2] Managers in the maritime industry seem to evaluate the *afterwards* opportunity cost by claiming that: "*as a result of the volatility in the dry bulk carrier charter market, we may not be able to employ our vessels upon the termination of their existing charters at their current charter hire rates*" (Diana Shipping Inc., Annual Report 2010).

[3] Notice that the decision on resource allocation that is studyied in the current paper follows the "*now or later*" decision, when managers are asked to decide whether they should commit company resources immediately or postpone the decision for some limited amount of time. However, the analysis of the "*now or later*" decision, although very important, is beyond the scope of this paper as has been researched elsewhere (see for instance, Kouvelis *et al*., 2001). On the other hand, the present paper focuses on the time decision on resource allocation, and thus, it takes the "*now or later*" decision as given.

when companies choose R&D projects, while Krishnan and Bhattarcharya (2002) analyze company's commitment in a new technology during a new product development process. Moreover, Del-Almeida, *et al*. (2008) claim that longer resource accumulation lags make flexibility less valuable and thus lead companies to earlier commitment. Finally, Kouvelis *et al*. (2001), Axarloglou and Kouvelis (2007) and Li and Li (2010) analyze the trade-offs of flexibility and commitment when a multinational company penetrates a foreign market. They find that flexibility is more valuable in the presence of an uncertain economic environment and when market demand is stagnant.

In the maritime industry, a capital intensive and highly cyclical and volatile industry, managers (shipowners and charterers) are asked to make decisions on how long to commit their resources (vessels) by choosing the time duration of the charter contracts, considering the current level of (derived) demand for transportation services, along with the growth prospects of the market[4]. Thus, in a market upturn, where freight rates for vessels are increasing, shipowners appreciate flexibility and offer their vessels for short-term fixtures (for instance, voyage/spot contracts[5]), so that to be able to take advantage of the rising freight rates in the near future (high *on-going* opportunity cost). On the other hand, in a market downturn, shipowners evaluate commitment more and prefer to charter their vessels in longer-term contracts (for instance, time-charter contracts[6]), in order to minimize the *afterwards* opportunity cost from having their vessels either idle or chartered in low freight rates[7]. Charterers, who fix vessels to cover their cargo transportation needs, are motivated to act exactly the opposite, since they decide on the time length of vessels fixtures based on a cost minimization principle; that is, in a market upturn they prefer to commit by fixing an agreement for long periods of time in protecting themselves from further rises in freight rates. Similarly, in a market downturn, charterers appreciate flexibility and prefer short-term agreements, in order to take advantage of the upcoming lower freight rates. Consequently, this interaction in the market over time creates variability in voyage and time-charter rates leading to a fluctuation in the spread (relative rates) between the two

[4] It should be noted here that in the maritime industry freight derivatives offer a hedging protection against the adverse price movements of freight rates (see Kavussanos *et al*., 2004). For a survey of the relevant literature see Kavussanos and Visvikis (2006a) and for a detailed analysis Kavussanos and Visvikis (2011).

[5] In voyage charters freight is paid US$/ton to move cargos from port A to port B and all costs paid by the shipowner.

[6] In time-charters freight is paid in US$/day (typically, every 15 days or every month) and the vessel is under the instructions of the charterer who pays the voyage costs (including broking commission, fuel costs, port charges, tugs, canal dues, etc.).

[7] These insights are consistent with maritime practice, where managers "*strategically monitor developments in the dry bulk shipping industry on a regular basis and, subject to market demand, seek to adjust the charter hire periods for our vessels according to prevailing market conditions*" (Diana Shipping Inc., Annual Report 2010) and "*we actively monitor macroeconomic trends … that may affect tanker rates in an attempt to optimize the deployment of our fleet*" (Tsakos Energy Navigation, Annual Report 2010).

types of rates, which is consistent with the arguments of Kavussanos and Alizadeh (2001, 2002) who report that the spread is time-varying[8].

Extending the relevant literature, we develop a theoretical framework, based on real options, to analyse the managerial decisions on the time allocation of resources in the maritime industry. In particular, it is found that it is not only the current stage of the market demand but also the expectations for the future market demand and market volatility that influence the value of flexibility and commitment in managing key company resources. It is also found that the value of flexibility and commitment varies when managers consider allocation of resources that lead to revenue maximization versus cost minimization. Overall, this type of decisions leads to fluctuations first in the volume of fixtures and then in the voyage and Time Charter rates that are incorporated in certain testable hypotheses. Finally, the analyzed decision-making process and the derived empirical results can assist managers (shipowners and charters) in the maritime industry to develop a strategy to manage more effectively the various opportunity costs that stem from committing company resources (vessels) for some period of time in projects (charter agreements). This strategy should enable the company, first, to capitalize on the opportunities that might arise upon the completion of the projects, and second, to protect the company's interests against threats that could potentially jeopardize its future and long-term survival.

The remainder of the paper is organised as follows. Section two provides the theoretical framework, from where a set of testable hypotheses is derived. Section three describes the data and the empirical methodology used in testing the stated hypotheses. Section four presents the empirical results. Section five concludes the paper with a discussion of the main implications of the results.

2. THEORETICAL FRAMEWORK

In the literature, it is known that voyage (spot) rates, and their Time-Charter Equivalents (TCE) rates, command a premium over time-charter (TC) rates[9]. This means that voyage (or TCE) rates should be more "*expensive*" than time-charter rates, as their difference is due to a risk premium ($Spread = TCE - TC = \varphi$). Rejecting the pure expectations theory, Kavussanos and

[8] Axarloglou and Zarkos (2007), examine the ratio between the three-year time-charter rates (long project) and the six-month time-charter rates (short project) for all different vessel types in the dry-bulk sub-segment. As expected, the ratio declines during the upturn of the market and increases during the downturn of the market.

[9] In order to estimate TCE rates, the voyage revenues (net of expenses) are divided by available days for the relevant time period. Expenses primarily consist of port, canal and bunker fuel costs.

Alizadeh (2002) have shown that there is indeed a positive risk premium, part of which reflects the Unemployment Risk Premium (URP) that influences the value of commitment and flexibility in the industry. However, apart from unemployment risk, the difference between voyage and time-charter rates is also caused by some extra costs associated with voyage market operations, which are not present while the vessel is on time-charter. Such costs include higher administrative and relocation costs necessary for gaining a new voyage contract and a higher financing cost of the debt for the shipowner, as voyage contracts offer a less secured stream of cash-flows, among others. Most of the additional costs described above are not subject to uncertainty, as they are known in advance and occur consistently in voyage charters[10]. Thus, all these types of costs – the Trip Specific Additional Costs (TSAC) – diminish the value of flexibility and produce a price premium for the voyage rates over the time-charter rates, which, as it is shown later, can be either positive, zero or negative. Thus, the spread, φ, between TCE and TC rates can be expressed as:

$$\varphi = TCE - TC = URP + TSAC \tag{1}$$

Assuming that TSAC remain constant over time, then the spread is a function only of the URP; that is, $\varphi = f(URP)$. Since φ has been found to be time-varying (see Kavussanos and Alizadeh, 2002), then URP must be time-varying too. Moreover, URP incorporates both the *on-going* and the *afterwards* opportunity costs that tend to move in opposite directions during the industry cycle. In particular, in a market downturn, URP is quite high increasing the value of commitment for shipowners who prefer long-term charters for their vessels. On the other hand, in a market upturn the URP is declining (actually, it can be either zero or negative) since the *on-going* opportunity cost is high and the *afterwards* opportunity cost is quite low. In that case, shipowners prefer to commit their vessels for a short period of time in order to take advantage of the improving market conditions in the near future. Consequently, as URP falls, the spread decreases, though it might remain overall positive, due to the additional costs (i.e. TSAC).

Suppose that a shipowner (charterer) has to choose between, say, a series of six one-month voyage charters that pay TCE with a six-month time-charter contract that pays TC. This is analogous to the selection of two mutually exclusive contracts (projects) of different duration. In the financial literature, the replacement chain or the equivalent annuity approach assumes

[10] It should be noted that TCE rates do not include the bunker fuel price risk, which is included in voyage rates, and as such, are more comparable with time-charter rates.

that the short project (voyage contract) can be repeated in the future over a specific time horizon (for more, see Dixit and Pindyck, 1994; Garrison and Noreen, 2003; Horngren, *et al*., 2000; Needles and Crosson, 2002; and Needles, *et al*., 1999, amongst others). However, the assumption that the cash-flows of the project can be repeated in the future with certainty seems to be particularly unrealistic in projects under conditions of high uncertainty, like in the maritime industry (see Axarloglou and Zarkos, 2010). The market uncertainty leads to highly cyclical, seasonal and volatile freight rates, which further translate into highly uncertain income and costs for the cargo carriers and shippers, respectively.

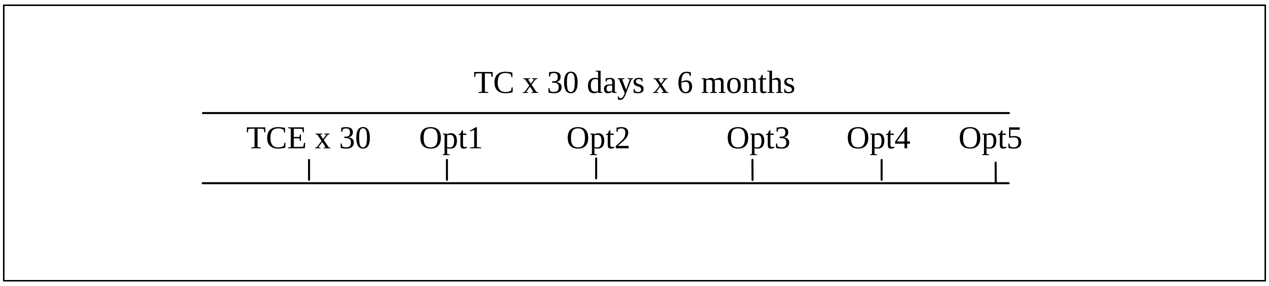
Figure 1, illustrates that when a six-month time-charter contract is compared with a stream of six one-month voyage contracts, a number of separate real options appear that cover a common time horizon with the time-charter contract. In a direct analogy with a call option[11], the shipowner has the right but not the obligation to renew the voyage charter contract when the initial voyage contract (TCE x 30) expires. Given the time horizon in this example, five possible renewal real options (Opt) are created, after the initial one-month voyage charter. Thus, by choosing the short duration projects (voyage contracts) over the longer-term (time-charter) project (that pays TC x 30 days x 6 months) the company buys a series of call options, whereas the opposite choice would mean that the company forgo those real options.

The voyage freight rate (TCE) is equivalent to the value of the underlying asset of these real option contracts, while the voyage costs (VC) are equivalent to the exercise (strike) price of the options. Thus, the intrinsic value of these options will be the difference between the revenue of the voyage charter and the corresponding voyage costs. The shipowner will decide to enter into a new voyage charter only if the intrinsic value is positive (i.e. the revenues exceed the voyage costs). This way, the shipowner manages to get a positive contribution to his fixed costs. Otherwise, the shipowner will most probably not enter into a new contract, realizing a net loss equal to the fixed costs that have to be paid during the period the vessel is kept out of the market[12].

[11] A call option contract gives to its holder the right but not the obligation to acquire an asset in a future point of time, but at a specific price determined on the issuance date of the contract.

[12] The case, where a shipowner decides to operate the vessel below break-even rates, in order to avoid having the vessel idle, is not addressed here as it is a rear case and can be executed for only under very short periods of time.

Figure 1: A Comparison of a six-month time-charter with a series of six one-month voyage charters



Notes: TC are US$/day, TCE are US$/day = [(US$/ton * tons) – VC] / 30, VC are voyage costs and Opt is a real option = max [(voyage rate at expiry in periods n) – VC, 0].

Following the above, a number of key factors that affect the value of these options for the shipowner (and analogous for the charterer) can be determined. First, in Figure 1 it can be seen that the voyage charter contract (that earns TCE) is followed by a number of options, each of which refer to the voyage rate that will be realized in different points in time; that is, the current voyage rate will fluctuate for one month to give Opt1, it will fluctuate for two months to give Opt2, and so on. Thus, the longer the time to maturity (i.e. the longer the time commitment), other things being equal, the higher the option value (i.e. the value of flexibility), since the voyage rate has more time to fluctuate and thus obtain extreme values. Although the voyage rate might get extremely low, the option will not be exercised if the revenues from the contract are smaller than the voyage costs. On the other hand, high values of the voyage rates bring high profits to the shipowner as the intrinsic value increases. It can then be argued that due to this asymmetry in payoffs $Opt(n) < Opt(n+1)$ and the longer the length of the time-charter the higher the total option value that arises from the renewals of the short voyage contracts.

Second, the current level of the voyage freight rate is equivalent to the current value of the underlying asset. The options theory states that as this value increases the value of the call option also increases, as the intrinsic value becomes larger. Thus, high current voyage rates make it more likely that the options from the renewals of the voyage charter contracts will be executed profitably, and thus, flexibility is more valuable. On the contrary, if the current voyage rates are low, the value of the options fall, as it becomes less likely for the shipowner to find profitable voyage charter contracts during the comparison period with a time-charter of the same duration, and thus commitment becomes more valuable.

Third, the higher the level of uncertainty, the more extreme values the voyage freight rate might get and thus commitment on longer contracts becomes more valuable. The uncertainty increases the potential for higher earnings for the shipowner, while the maximum potential loss is restricted to a certain level. More specifically, whenever the option ends out-of-the-money, the option is not exercised. In that case, the loss cannot exceed the amount of the fixed costs the shipowner pays for that period.

Fourth, the skeweness of the distribution of the voyage rates affects the value of the call option. For example, a right-skewed distribution assigns lower probability to the upside moves of the rates, lowering thus the values of the call option and the flexibility. On the other hand, a left-skewed distribution makes an upper move of the rates more probable, leading to a higher call option value and flexibility. Thus, the realization of the current freight rate is considered as a determinant of the option value only in conjunction with the type of skeweness that reflects the expectations of the future trend of this rate. In other words, the value of flexibility (and commitment) is not only due to the level of the freight rates and current transportation demand (i.e. the stage of the market, as it is widely considered in the relevant literature), but also by the growth prospects of the market. For instance, a low freight rate would produce a low option value, but if its uncertainty follows a distribution heavily skewed to the left, then the option value will increase (leading, thus, to higher value of flexibility). Apparently, the type of skeweness of the distribution of the voyage rates reflects the expectations for the rates that will follow in the future, which finally are proxied by the forward (derivatives) rates that are available in the market. In other words, positive market expectations will make the distribution to skew to the left, forward rates to rise and the option value to increase and vice versa.

Fifth, as seen earlier, voyage costs (i.e. the exercise price of an option) are incremental to the decision of the shipowner to enter into a voyage freight contract. Thus, the lower the value of the voyage costs, the higher the value of the option. However, as the voyage costs consist mainly of the uncertain bunker fuel expenses that follow the general economic trends of the crude oil market they are subject to uncertainty too. The above observation brings some complications in calculating the option value described in the literature, as both the voyage rate (underlying asset) and the voyage costs (exercise price) fall in a state of uncertainty.

Following the above factors that affect the value of the stream of options that result from a voyage charter, when compared with a single time-charter contract of the same duration, the Total Earnings from a Time-charter (*TET*) can be represented as:

$$TET = TC * d * n \tag{2}$$

where, TC is defined as before, *d* is the number of days that correspond to the size of the typical voyage rate contract (i.e. 30 days), and *n* is the number of periods (in months) of the time-charter. Then, the Total Earnings (from the replacement chain) of the voyage contract (*TES*) are:

$$TES = TCE * d + \sum O_i - TSAC * d * n \tag{3}$$

where, O_i is the option value at the end of each period corresponding to the earnings the company will make if it accepts to enter in a new voyage contract in that period. In the absence of uncertainty we get:

$$\sum O_i = \sum TCE_i * d = (n-1) TCE * d \tag{4}$$

In order to avoid any arbitrage opportunities, the total earnings in each of the two cases should be the equal:

$$\begin{aligned} &TET = TES \\ &TC * n * d = TCE * d + (n-1) TCE * d - TSAC * d * n \\ &TCE - TC = TSAC \end{aligned} \tag{5}$$

The economic intuition here is that, in equilibrium, the shipowner, who gets into a voyage (spot) charter contract, rather than a time-charter, bears an opportunity cost (TSAC) and for this reason asks for an extra compensation (risk premium). This extra compensation is equal to the amount of TSAC and this causes a positive spread between TCE and TC. If the compensation is higher or lower than that, the market would restore the equilibrium by the self-correcting mechanism of supply and demand. Therefore, in absence of uncertainty, the TCE rate will be higher than the time-charter rate and the spread is affected by TSAC only, meaning that the

URP is zero (i.e. $\varphi = TSAC + 0$). However, when uncertainty is introduced the following is produced:

$$TC * n * d = TCE * d + \sum O_i - TSAC * d * n \tag{6}$$

$$TCE - TC = (n-1)TC - \left(\frac{\sum O_i}{d} \right) + TSAC * n \tag{7}$$

In essence:
$$URP = (n-1)TC - \left(\frac{\sum O_i}{d} \right) \tag{8}$$

The URP is now a result of a comparison between the time-charter contract (for a specific period) with the equivalent voyage rate contracts given by the sum of their corresponding options. When the option value determinants change in a way that the value of the options increases, then $(n-1)TC < \left(\frac{\sum O_i}{d} \right)$ and a negative value for URP is derived. As a result, the spread φ between TCE and TC falls and becomes lower than TSAC. This difference can be described as the motive of the shipowner to choose short duration voyage charter contracts, instead of a time-charter that expands over the same time period, at comparatively lower freight rates.

Similarly, when the option determinants lead to a fall in value of the options, then $(n-1)TC > \left(\frac{\sum O_i}{d} \right)$ and a positive value for URP is derived, and the spread φ will be higher than TSAC. This means that in unfavourable market conditions, the short voyage charter contracts become even less attractive, because on top of the TSAC there is another cost which arises from the *afterwards* opportunity cost; that is, the likelihood that the shipowner is unable to find sufficiently profitable contracts after the initial voyage charter contracts ends. As a result the spread φ will be wider, as the shipowner asks for an extra compensation to bear the risk that stem from the *afterwards* opportunity cost.

The managerial insights that have been presented above point out towards certain managerial decisions by shipowners and charterers that are ultimately reflected in the determination of freight rates. More specifically, in a market upturn, shipowners appreciate flexibility, and thus, prefer voyage fixtures for their vessels while charterers prefer to commit on long-term contracts and thus seek time-charter fixtures. Since, a market upturn is considered to be a "*seller's market*", where the behaviour of shipowners dominates the one of charterers, overall it is expected that the number of voyage fixtures to increase while the number of time-charter hires to decline. Consequently, the spread (φ) becomes smaller (larger), reflecting a higher value of flexibility in resource management. Obviously, the above reasoning holds true in case of a market downturn but of course in the opposite direction. This insight is incorporated in the next hypothesis:

Hypothesis 1: Realization of favourable (unfavourable) market conditions are associated with higher (lower) value of flexibility for shipowners (and lower value of flexibility for charterers) and, thus, a larger (smaller) number of voyage fixtures, a smaller (larger) number of time-charter fixtures and finally lower (higher) spreads of the freight rates.

However, expectations about the growth prospects of the maritime industry are not independent of the current stage of the industry. Economic agents in the industry are expected to react differently if the industry is booming as opposed to be stagnating. It is initially assumed that the future freight rates follow a normal distribution and thus, expectations about the industry are neutral. However, if future freight rates follow a left (right) skewed distribution then it is more probable for the freight rates to increase (decrease) in the future. This makes flexibility more (less) valuable for shipowners – and less valuable for charterers – leading to larger (smaller) number of voyage fixtures, smaller (larger) number of time-charter hires and, thus, to a reduced spread[13]. Similar reasoning holds true in case that the maritime industry is stagnant, but freight rates follow a left skewed distribution. This intuition is incorporated in the next hypothesis:

Hypothesis 2: If future freight rates follow a left (right) skewed distribution, then the value of flexibility for shipowners increases (decreases) leading to a larger (smaller) volume of voyage fixtures, a smaller (larger) volume of time-charter hires and, thus, a smaller (larger) spread of the freight rates. The opposite is held true for charterers.

[13] Notice that, if the skeweness of the distribution of freight rates is particularly large, the spread (TCE – TC) might become even negative.

The bunker fuel cost is the main determinant of voyage costs, and in case of a voyage fixture, it is covered by shipowners, while in case of a time-charter hire it is covered by charterers. Thus, when bunker fuel cost increases, the volume of voyage fixtures is expected to decline. Moreover, as already discussed, the bunker fuel cost is equivalent to the exercise price of the call option. Therefore, when fuel prices increase, the exercise price of the call option also increases, reducing the value of the option. Consequently, shipowners perceive flexibility (commitment) as less (more) valuable, while charterers perceive flexibility as more valuable. As a result, the spread between voyage and time-charter rates will increase:

Hypothesis 3: Higher (lower) bunker fuel prices depress the volume of voyage fixtures in the market, lead to less (more) valuable flexibility for shipowners, while are associated with higher (lower) freight rate spreads.

Finally, due to the asymmetry of the payoffs embodied in real options, an increase in the market volatility increases the value of flexibility, leading shipowners to prefer more short-term contracts for their vessels, depressing thus the spreads of the freight rates:

Hypothesis 4: Higher (lower) market volatility in the maritime industry increases (decreases) the value of flexibility and is associated with smaller (higher) spreads of freight rates.

3. DATA AND METHODOLOGY

The theoretical framework presented so far outlines key factors that influence the value of commitment and flexibility in resource allocation in the maritime industry. The paper does not aim in testing the stated decision-making process in resource allocation, which after all is frequently observed among managers in the maritime industry, but rather study the implication of this process on the volume of various types of (voyage and time-charter) fixtures in the market and the factors that influence the properties and the over-time fluctuations of the spread between voyage and time-charter freight rates. Following the general literature, the stated managerial decision-making process is analysed using a real options framework and its implications are empirically tested with the use of regression analysis on industry aggregate data (see Kouvelis *et al*., 2001 and Li and Li, 2010, among others). In investigating empirically the stated testable hypotheses, monthly data are collected from Clarkson's Research Network (SIN) and Datastream International for Capesize (150,000 dwt) and Panamax (65,000 dwt) dry-bulk vessels on voyage and time-charter freight rates for 6-months $\left(TC_t^6\right)$, 12-months $\left(TC_t^{12}\right)$ and 36-months $\left(TC_t^{36}\right)$ contracts, from January 1992 to September 2011, and also on the volume of voyage and time-charter fixtures, from September 2008 to September 2011.[14] Since voyage rates are expressed in US$/ton, while time-charter rates are expressed in US$/day, in the ensuing analysis TCE rates (in US$/day) are used $\left(S_t\right)$ instead of voyage rates[15].

The variation of the volume of voyage $\left(SP_t\right)$ and time-charter fixtures $\left(TC_t\right)$ over time is first examined, since changes in these trade volumes reflect the actual decision-making in resource allocation of shipowners and charterers. The factors that cause the spread, between TCE and TC rates, to fluctuate are then examined, since the decision-making of managers on flexibility and commitment is reflected in this spread. For that, the ratios between TCE and TC rates are calculated for each of the different duration contracts and for each type of vessels in the used sample. Notice that Kavussanos and Alizadeh (2001) argue that dry-bulk freight rates show significant seasonal variations, with stronger seasonality for voyage rates, larger vessels and when the market follows an upturn. Therefore, before continuing with the empirical estimation, freight rates are seasonally adjusted, by regressing each freight rate series on monthly (seasonal) dummies. The residuals (innovations) from these regressions are then used as the dependent variables in the ensuing empirical estimations. Specifically, $\left(\hat{S}_t^6\right)$ is the spread (ratio) between the TCE and the six-months TC rates, $\left(\hat{S}_t^{12}\right)$ is the spread between the TCE and the 12-months TC rates and $\left(\hat{S}_t^{36}\right)$ is the spread between TCE and the 36-months TC rates. Similarly, $\left(T\hat{C}_t^{6,12}\right)$ is the spread between the six-months and the 12-months TC rates, $\left(T\hat{C}_t^{6,36}\right)$ is the spread between the six-months and the 36-months TC rates, and finally, $\left(T\hat{C}_t^{12,36}\right)$ is the analogous one between the 12-months and the 36-months TC rates. Tables 1 and 2 present the summary statistics and correlation coefficients, respectively, of the Panamax and Capesize freight spreads and the volume of voyage and time-charter fixtures.

[14] Panamax vessels carry mainly grain, coal and bauxite and larger minor bulk parcels from North America and Australia to Japan and West Europe, while Capesize vessels carry iron ore from South America and Australia to Japan, West Europe and North America, and coal from North America and Australia to Japan and Western Europe.
[15] The data set consists of different vessels types in order to be able to derive more universal results. Technological changes in each vessels class takes place gradually and in a homogeneous way, and as such, it is not expected to have a detrimental impact on freight rate levels, but rather have a smooth impact over time.

Expectations about the cyclicality of the maritime industry play an important role in the strategic decisions of managers in chartering vessels. Therefore, in the estimations, the current stage of the maritime industry (i.e. boom or recession) is captured by the dummy variables $(BOOM_{it})$ and (RES_{it}) that take the value of one when the Baltic Dry Index (BDI) shows a positive growth for three consecutive months (a market upturn) or a negative growth for three consecutive months (a market downturn), respectively[16,17].

Moreover, the expectations shipowners and charterers have on the cyclical movements in the industry also influences their strategic decisions in chartering vessels. Notice though, that the demand to charter a vessel is a derived demand from the transportation needs for major dry-bulk commodities, such as corn, soy and wheat. In the literature it has been argued that commodity prices spill over new information to freight rates, and as such can be used as a good predictor of the freight market (see for instance Haigh and Bryant, 2001 and Yu *et al*., 2007). To proxy this type of expectations, the prompt-month commodity futures contracts, traded at the Chicago Mercantile Exchange, are used[18]. An un-weighted average of the three commodity futures prices is derived and used as a proxy for agents' expectations about the future path of the maritime industry (EXP_t). An increase (decrease) in (EXP_t) reflects an expected upturn (downturn) of the industry. Of course, as it is illustrated in Hypotheses 2 and 3, the spreads in the freight rates depend on the expectations about the shipping industry conditional on the current stage of the industry. To capture this effect, an interaction variable is constructed between (EXP_t) and the current stage of the shipping industry, as it is proxy by either $(BOOM_{it})$ or (RES_{it}).

As Hypothesis 4 indicates, market volatility plays an important role in affecting the freight rate spreads in the shipping industry. To proxy this market volatility (VOL_{it}) the Bollerslev's (1986) Generalised Autoregressive Conditional Heteroskedastic (GARCH) model is employed, and the conditional volatility of the maritime business cycle is estimated as:

[16] The BDI index, published daily by The Baltic Exchange in London, provides an assessment of the price (cost) of transporting major dry-bulk raw commodities (including coal, iron ore and grain) by ocean-going (Capesize, Panamax, Supramax and Handysize) vessels.
[17] The definition of industry upturns and downturns is consistent with the general economics literature (see Devinney, 1990 and Miron, 1996, among others).
[18] It should be noted, that a better proxy to capture the future expectations of the physical freight market would be the forward-looking freight derivatives prices; say Forward Freight Agreement (FFA) prices. However, FFA prices are not available for the entire sample used.

$$\Delta BDI_t = \phi_0 + \sum_{i=1}^{p-1} \phi_i \Delta BDI_{t-1} + \varepsilon_t \qquad ; \varepsilon_t \sim \text{iid}(0,h_t) \tag{9a}$$

$$h_t = a_0 + a_1 h_{t-1} + \beta_1 \varepsilon_{t-1}^2 \tag{9b}$$

where, BDI_t is the natural logarithm of the monthly BDI price changes, Δ is the first-difference operator, and ε_t are the residuals that follow a normal distribution with a zero mean and time-varying variance, h_t. After ensuring that the model is well specified, with error-terms free of any linear and non-linear dependencies, the estimated conditional variance (h_t) is used in the ensuing analysis as the volatility variable (VOL_{it}). Finally, fuel costs also appear to have an impact on the value of flexibility in the industry, and thus on freight rate spreads as it is expressed in Hypothesis 4. To proxy fuel cost in the estimations the Intermediate Fuel Oil (IFO) 380cst (centistoke) bunker fuel prices in Rotterdam $(FUEL_t)$ are used[19].

5. EMPIRICAL RESULTS

5.1. Voyage and Time-Charter Fixtures

The theoretical insights developed in the paper suggest that managers in the shipping industry evaluate flexibility and commitment based on the fluctuations of the rates of their industry. As Hypothesis 1 states, in a market upturn, shipowners appreciate flexibility and tend to offer their vessels for short-term fixtures (voyage charters). Furthermore, during the upturn of the industry cycle, the volume of voyage fixtures is expected to increase, while the volume of time-charter hires to decrease. To test this insight along with the ones stated in Hypotheses 2 and 3 the following set of equations is estimated using Ordinary Least Squares (OLS):

$$\begin{aligned} SP_t &= f(BOOM_t, SHIP2, VOL_t, FUEL_t, EXP_t) \\ TC_t &= f(BOOM_t, SHIP2, VOL_t, FUEL_t, EXP_t) \end{aligned} \tag{10}$$

Notice that in the set of Equations (10), the dependent variables are, respectively, the volume of voyage fixtures (SP_t) and time-charter hires (TC_t), while the independent variables are as described previously. Moreover, as Table 1 indicates that on average there is some noticeable difference in the volume level of the fixtures between Panamax and Capesize vessels, with

[19] Around 60% of the world trade in bunkers is in IFO380cst (see Kavussanos and Visvikis, 2006b for a detailed analysis). The main European bunkering market is the ARA (Amsterdam – Rotterdam – Antwerp) region.

Capesize voyage (time-charter) fixtures to be greater (less) than Panamax voyage (time-charter) fixtures, a dummy variable is included to capture those effects between vessel classes $(SHIP2)$.

The respective positive growth $(BOOM_{it})$ coefficients in Table 3 indicate that in a market upturn, and for the entire sample, the volume of voyage fixtures is not statistically different than in other periods of time. In contrast, the volume of time-charter fixtures declines (-0.203) in market upturns (due to the negative sign), which is consistent with Hypothesis *1*; that is, shipowners maintain flexibility and do not tight up their vessels in time-charter contracts. Moreover, the volume of voyage contracts declines in the presence of high market uncertainty (VOL_{it}) and when the bunker fuel prices $(FUEL_t)$ increase, which are consistent with Hypotheses 2 and 4, respectively. Finally, the expectation of a future market upturn (EXP_t) leads to an increase in the volume of both short-term and long-term fixtures, which is also consistent with Hypothesis 3.

To check the robustness of the above results, the set of Equations (10) is restructured by normalizing (dividing), firstly, the volume of voyage and time-charter fixtures by the total volume of fixtures – equations $(R1_{it})$ and $(R2_{it})$ respectively – and secondly, the short-term (voyage) fixtures by long-term (time-charter) fixtures – equation $(R3_{it})$. The following set of equations is then estimated:

$$\begin{aligned} R1_{it} &= f\left(BOOM_t, BOOMS2_{it}, VOL\ , FUEL_t, EXP_t\right) \\ R2_{it} &= f\left(BOOM_t, BOOMS2_{it}, VOL\ , FUEL_t, EXP_t\right) \\ R3_{it} &= f\left(BOOM_t, BOOMS2_{it}, VOL\ , FUEL_t, EXP_t\right) \end{aligned} \tag{11}$$

An interaction dummy variable named $(BOOMS2_t)$ between $(BOOM_t)$ and $(SHIP2)$ is also included to capture the finding that Panamax vessels tend to be employed more under time-charter agreements than Capesize vessels. The results in Table 3 indicate that during a market upturn, the volume of voyage fixtures increase (0.065) while the one for time-charter fixtures decreases (-0.065). Moreover, the ratio between voyage and time-charter fixtures also increases (0.882) in a market upturn. Overall, these findings further support Hypothesis 1, reflecting the increased value of flexibility for shipowners when the shipping industry is in an upturn state. These findings are also consistent with managerial practice where for instance Tsakos Energy

Navigation adjusted the share of its vessels in time-charter fixtures from 29% to 19%, and in voyage fixtures from 8% to 17% between 2008 and 2010 (a period during which charter rates were increasing, especially in 2009-2010; Tsakos Energy Navigation, Annual Report 2010). Overall, these insights reflect the fact that in a market upturn, when demand for fixtures increases overall, shipowners impose their conditions and preference towards voyage fixtures and move away from time-charter ones, maintaining their flexibility in managing their vessels to take advantage of future profitable opportunities.

5.2. Over-time Fluctuations in the Freight Rate Spread

The managerial decisions towards a fixture of certain duration that have been studied in the previous section, lead to certain fluctuations in the freight rates for fixtures of various durations. This section empirically examines the formulated hypotheses using the data on voyage and time-charter rates for both Capesize and Panamax vessels. Since the data are in panel form, the Fixed Effects model is used in the ensuing estimations[20]. The model estimates a separate intercept for each type of vessel in the sample, assuming that unknown vessel-specific differences might be shifting the estimated regression lines[21]. In testing Hypotheses 3 and 4, the reduced form Equations (12) and (13) are estimated:

$$\hat{S}_t^n = f\left(BOOM_t, RES_t, FUEL_t, VOL_t\right) \tag{12}$$

$$\widehat{TC}_t^{n,m} = f\left(BOOM_t, RES_t, FUEL_t, VOL_t\right) \tag{13}$$

The dependent variable in Equation (12) is the ratio between the TCE and each of the three types of time-charter rates in the data set (Model 1), while the dependent variable in Equation (13) is, respectively, the ratio between the rates of *n*-months long time-charter rate and an *m*-months long time-charter rate (Model 2 and 3).

The empirical results from estimating Equation (12) are presented in Table 4. In all six estimations, the respective spreads between short-term and longer-term freight rates are slightly lower in recessions, but are not statistically significant (except in one case) from the level of the spreads in non-recession times. Similarly, the respective spreads are slightly higher during boom

[20] Panel data allow the testing of hypotheses both over time (time dimension of the data) and across various objects of the population (cross sectional dimension). Thus, it improves the relevance of the empirical results.

[21] The OLS and the Random Effects Model are also initially used, but the Lagrange Multiplier test (that helps in choosing between the OLS model and the Fixed and Random Effects models) and the Hausman test (that helps in choosing between the Fixed and the Random Effects models) ranked the Fixed Effects Model as the most appropriate one.

times, but again there is no statistically significant effect. On the other hand, the estimated coefficient of volatility (VOL_t) is negative and (in most cases) statistically significant, indicating that as the freights market becomes more volatile and riskier, flexibility becomes more valuable, leading shipowners to prefer shorter duration contracts. Consequently, the spread between short and long freight contracts shrinks, which is consistent with Hypothesis 4. Notice also that volatility tends to depress more the spread between short-term and longer-term contracts, which is again consistent with Hypothesis 4, since in volatile markets longer terms contracts are the least desirable by shipowners. Moreover, the estimated coefficient of bunker fuel $(FUEL_t)$ is positive and statistically significant (in all but one case), indicating that an increase in the bunker fuel cost boosts the spread between short-term and long-term freight rates. Moreover, this effect appears to be stronger for spreads that involve longer term contracts. As it has been discussed already, higher fuel prices increase the value of flexibility and shipowners value longer terms freight contracts. Thus, the above spread increases, finding that is consistent with Hypothesis 3.

The analysis also emphasises the fact that shipowners, in their decision on the length of the contract for their vessels, consider on one hand the income security from chartering their vessel for a long time (reducing thus the *afterwards* opportunity cost) but also the possibility for giving up profitable charters if they do so (*on-going* opportunity cost). In Hypothesis 1, it is argued that as shipowners expect an upturn (downturn) in the industry, the spread between short-term and long-term freight contract rates should shrink (expand). Thus, in the estimations the future expectations regarding the market (EXP_t) are incorporated, and the following reduced form equations are estimated:

$$\hat{S}_t^n = f(BOOM_t, RES_t, FUEL_t, VOL_t, EXP_t) \tag{14}$$

$$\widehat{TC}_t^{n,m} = f(BOOM_t, RES_t, FUEL_t, VOL_t, EXP_t) \tag{15}$$

As can be seen in Table 5, the estimated coefficient for (EXP_t) is negative in all estimations (but two) and is also statistically significant for $\hat{S}_t^6$ and $\hat{S}_t^{12}$. This indicates that as agents in the industry expect an upturn (downturn) in the industry cycle, they make decisions that lead to smaller (larger) spreads between the spot freight rate and the six-month and 12-month time-charter rates, respectively. Notice here that, as expected, these effects die out the longer the duration of the freight contracts. Overall, these findings are consistent with Hypothesis 1.

Finally, in Hypothesis 2, it is argued that given the current cyclical stage of the maritime industry, an expectation of an industry upturn (downturn) will lead to smaller (larger) spreads. Thus, the following reduced form Equations (16) and (17) are estimated:

$$\hat{S}_t^n = f\left(BOOM_t, RES_t, FUEL_t, VOL_t, EXP_t * BOOM_t\right) \tag{16}$$

$$\widehat{TC}_t^{n,m} = f\left(BOOM_t, RES_t, FUEL_t, VOL_t, EXP_t * BOOM_t\right) \tag{17}$$

As can be seen in Table 6, the estimated coefficient for $\left(EXP_t * BOOM_t\right)$ is negative in all (but two) regressions and again statistically significant in the $\hat{S}_t^6$ and $\hat{S}_t^{12}$ regressions, further supporting Hypothesis 2.[22]

6. CONCLUSION

This paper emphasizes the strategic aspects of the managerial decision to commit resources for a certain period of time, considering it as a strategic decision and not as a simple choice found in the domain of short-term decision-making. In this type of decisions, managers should develop a strategy to manage effectively the various opportunity costs that stem from committing company resources for some period of time in the pursued projects. This particular strategy should enable the company first to capitalize on the opportunities that might arise upon the completion of the projects and second to protect the company's interests against threats that could potentially jeopardize its future and long-term survival.[23] The asymmetry between potential company profits and losses under conditions of uncertainty is formulated in the real options framework presented in this paper. The framework demonstrates how managers evaluate and structure resource investments under uncertainty by balancing out flexibility and commitment so that to reduce the company's downside risk and enhance its upside potential. The theoretical framework and the empirical findings of the paper suggest that managers in the

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[22] Notice that similar results are derived for the case of expectations about an upcoming recession, but are not reported for brevity purposes. These results are available from authors upon request.

[23] This strategic decision-making appears very appealing among management practitioners in the maritime industry. Managers, in an effort to weather the volatile industry cycle state that: "*we have employed a high percentage of our fleet on a long and medium-term employment with fixed rates … We believe this approach has resulted in high utilization rates for our vessels. At the same time, we maintain flexibility in our chartering policy to allow us to take advantage of favourable rate trends through spot market employment …*" (Tsakos Energy Navigation, Annual Report 2010).

maritime industry, in evaluating flexibility and commitment in resource allocation, should consider various factors that influence the opportunity costs that stem from this allocation. Specifically, managers, in their decision-making, should take into consideration the stage of the industry business cycle, the growth prospects of the industry, as well as the market volatility. These factors influence the value of flexibility and commitment in allocating resources, and thus, shape up decisions on the time related elements of this allocation. Since these decisions are materialised in organized markets for these resources, they also influence the overtime fluctuations in the price of these resources.

The empirical results present evidence in favour of the notion that shipowners, during a market upturn, prefer chartering their vessels under (short) voyage contracts as opposed to time-charter contracts (and thus maintain flexibility), while at the same time, charterers switch in chartering vessels under (lengthy) time-charter contracts as opposed to voyage contacts (and thus prefer to commit). The outcome of their behaviour leads to a drop in the spread between short-term and long-term charters for vessels. The managerial heuristic then for shipowners is to maintain flexibility in market upturns and commit in longer charters in market downturns, while in the case of charterers is to commit to longer charters in market upturns and shorter charters in market downturns. Finally, the decision of managers to postpone the commitment of their resources for later on, and thus pursue some extra flexibility, and the allowance of managers to reverse their commitment of resources before the expiration time of the projects are left for future research.

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Table 1: Summary Statistics for Panamax and Capesize Vessels

Panel A: Panamax Vessels				
Variable	**Mean**	**Stand. Deviation**	**Maximum**	**Minimum**
S_t^{6}	0.994	0.016	1.038	0.929
S_t^{12}	1.000	0.024	1.059	0.869
S_t^{36}	1.017	0.044	1.124	0.868
$TC_t^{6,12}$	1.006	0.013	1.035	0.930
$TC_t^{6,36}$	1.017	0.044	1.124	0.868
$TC_t^{12,36}$	1.016	0.026	1.082	0.971
SP_t	4.543	0.294	4.859	3.401
TC_t	3.571	0.545	4.564	2.303
Panel B: Capesize Vessels				
Variable	**Mean**	**Stand. Deviation**	**Maximum**	**Minimum**
S_t^{6}	0.998	0.015	1.049	0.900
S_t^{12}	0.999	0.021	1.052	0.883
S_t^{36}	1.004	0.037	1.098	0.888
$TC_t^{6,12}$	1.001	0.014	1.035	0.895
$TC_t^{6,36}$	1.004	0.037	1.096	0.877
$TC_t^{12,36}$	1.006	0.022	1.056	0.959
SP_t	5.354	0.285	5.617	3.828
TC_t	2.134	0.696	3.401	0.693

Table 2: Correlation Coefficients for Panamax and Capesize Vessels

Panel A: Panamax Vessels

	S_t^{6}	S_t^{12}	S_t^{36}	$TC_t^{6,12}$	$TC_t^{6,36}$	$TC_t^{12,36}$	BFI_t	$FUEL_t$	EXP_t	VOL_t
S_t^{6}	1									
S_t^{12}	0.846	1								
S_t^{36}	0.670	0.861	1							
$TC_t^{6,12}$	0.273	0.744	0.713	1						
$TC_t^{6,36}$	0.671	0.862	1.000	0.713	1					
$TC_t^{12,36}$	0.345	0.528	0.886	0.516	0.886	1				
BFI_t	0.370	0.536	0.751	0.500	0.751	0.767	1			
$FUEL_t$	-0.071	0.136	0.460	0.336	0.460	0.651	0.542	1		
EXP_t	-0.208	-0.91	0.218	0.097	0.218	0.452	0.435	0.804	1	
VOL_t	0.078	0.049	0.222	-0.009	0.220	0.323	0.128	0.463	0.498	

Panel B: Capesize Vessels

	S_t^{6}	S_t^{12}	S_t^{36}	$TC_t^{6,12}$	$TC_t^{6,36}$	$TC_t^{12,36}$	BFI_t	$FUEL_t$	EXP_t	VOL_t
S_t^{6}	1									
S_t^{12}	0.756	1								
S_t^{36}	0.567	0.861	1							
$TC_t^{6,12}$	0.101	0.728	0.718	1						
$TC_t^{6,36}$	0.567	0.861	1.000	0.718	1					
$TC_t^{12,36}$	0.217	0.469	0.854	0.494	0.854	1				
BFI_t	0.114	0.433	0.711	0.545	0.711	0.789	1			
$FUEL_t$	-0.170	0.061	0.301	0.275	0.301	0.461	0.542	1		
EXP_t	-0.252	-0.086	0.099	0.138	0.099	0.261	0.435	0.804	1	
VOL_t	-0.208	-0.122	0.097	0.037	0.097	0.293	0.128	0.463	0.498	1

Table 3: Spot and Time-Charter Fixtures

Dept. Variable	SP_{it}	TC_{it}	$R1_{it}$	$R2_{it}$	$R3_{it}$
Constant	8.793*	2.118	0.706*	0.293	4.577
	(5.714)	(0.647)	(2.047)	(0.085)	(0.716)
$BOOM_{it}$	-0.003	-0.203*	0.065*	-0.065*	0.882*
	(-0.061)	(-2.156)	(5.953)	(-5.953)	(4.343)
$SHIP2$	-0.810*	1.479*			
	(-12.001)	(10.298)			
$BOOMS2_{it}$			-0.088*	0.087*	-1.035*
			(-9.967)	(9.966)	(-6.345)
VOL_t	-3.840**	0.958	-0.195	0.195	-3.648
	(-1.901)	(0.222)	(-0.429)	(0.429)	(-0.434)
$FUEL_t$	-0.522*	0.036	-0.013	0.013	-0.445
	(-2.241)	(0.073)	(-0.257)	(0.257)	(-0.459)
EXP_t	4.447*	8.193**	-0.416	0.416	-1.442
	(2.159)	(1.870)	(-0.900)	(0.901)	(-0.168)
$\overline{R}^2$	0.690	0.614	0.589	0.589	0.361
Observations	74	74	74	74	74

Notes: (*) and (**) indicate 0.025 and 0.05 significance levels, respectively; *t*-statistics are reported in the parentheses (.).

Table 4: Voyage vs. Time-Charter Rates: Market Conditions and Fuel Costs

	Model 1 $\hat{S}_t^{6}$	**Model 1** $\hat{S}_t^{12}$	**Model 1** $\hat{S}_t^{36}$	**Model 2** $\hat{TC}_t^{6,12}$	**Model 2** $\hat{TC}_t^{6,36}$	**Model 3** $\hat{TC}_t^{12,36}$
Constant	0.009	-0.031*	-0.161*	-0.040*	-0.161*	-0.130*
	(0.716)	(-1.737)	(-5.693)	(-3.975)	(-5.693)	(-8.928)
$BOOM_{it}$	-0.001	0.001	0.004	0.001	0.004	0.003
	(-0.154)	(0.0622)	(0.436)	(0.310)	(0.436)	(0.741)
RES_{it}	-0.003	-0.006**	-0.005	-0.003	-0.005	0.001
	(-0.833)	(-1.165)	(-0.625)	(-0.977)	(-0.625)	(0.178)
VOL_t	-0.023	-0.114*	-0.142*	-0.091*	-0.142*	-0.029
	(-0.775)	(-2.742)	(-2.136)	(-3.826)	(-2.136)	(-0.867)
$FUEL_t$	-0.001	0.008*	0.0328*	0.009*	0.0328*	0.025*
	(-0.524)	(4.395)	(12.368)	(9.352)	(12.368)	(18.039)
$\overline{R}^2$	0.032	0.118	0.318	0.252	0.318	0.498
Observations	466	466	466	466	466	466

Notes: (*) and (**) indicate 0.025 and 0.05 significance levels, respectively; *t*-statistics are reported in the parentheses (.).

Table 5: Voyage vs. Time-Charter Rates: Market Conditions and Static Expectations

	Model 1 $\hat{S}_t^{6}$	**Model 1** $\hat{S}_t^{12}$	**Model 1** $\hat{S}_t^{36}$	**Model 2** $T\hat{C}_t^{6,12}$	**Model 2** $T\hat{C}_t^{6,36}$	**Model 3** $T\hat{C}_t^{12,36}$
Constant	0.009	-0.031**	-0.162*	-0.040*	-0.162*	-0.130*
	(0.701)	(-1.755)	(-5.689)	(-3.967)	(-5.689)	(-8.936)
$BOOM_{it}$	-0.001	-0.0001	0.004	0.001	0.004	0.004
	(-0.268)	(-0.004)	(0.426)	(0.332)	(0.426)	(0.804)
RES_{it}	-0.004	-0.007	-0.005	-0.003	-0.006	0.001
	(-0.997)	(-1.258)	(-0.637)	(-0.944)	(-0.637)	(0.263)
VOL_t	-0.034	-0.123*	-0.144*	-0.089*	-0.144*	-0.023
	(-1.134)	(-2.944)	(-2.150)	(-3.729)	(-2.151)	(0.669)
$FUEL_t$	-0.0002	0.008*	0.0328*	0.009*	0.033*	0.024*
	(-0.177)	(5.126)	(12.312)	(9.221)	(12.312)	(17.784)
EXP_t	-0.202*	-0.165**	-0.037	0.032	-0.037	0.126**
	(-3.239)	(-1.906)	(-0.267)	(0.649)	(-0.267)	(1.766)
$\overline{R}^2$	0.051	0.123	0.317	0.251	0.317	0.499
Observations	466	466	466	466	466	466

Notes: (*) and (**) indicate 0.025 and 0.05 significance levels, respectively; *t*-statistics are reported in the parentheses (.).

Table 6: Voyage vs. Time-Charter Rates: Market Conditions and Dynamic Expectations

	Model 1 $\hat{S}_t^{6}$	**Model 1** $\hat{S}_t^{12}$	**Model 1** $\hat{S}_t^{36}$	**Model 2** $T\hat{C}_t^{6,12}$	**Model 2** $T\hat{C}_t^{6,36}$	**Model 3** $T\hat{C}_t^{12,36}$
Constant	0.008	-0.032**	-0.162*	-0.040*	-0.162*	-0.129*
	(0.650)	(-1.804)	(-5.687)	(-3.998)	(-5.687)	(-8.882)
$BOOM_{it}$	-0.001	0.001	0.004	0.001	0.004	0.003
	(0.131)	(0.085)	(0.437)	(0.319)	(0.437)	(0.718)
RES_{it}	-0.003	-0.006	-0.005	-0.003	-0.005	0.001
	(-0.818)	(-1.150)	(-0.624)	(-0.969)	(-0.623)	(0.159)
VOL_t	-0.026	-0.118*	-0.142*	-0.091*	-0.144*	-0.026
	(-0.871)	(-2.837)	(-2.135)	(-3.859)	(-2.135)	(-0.766)
$FUEL_t$	-0.001	0.008*	0.033*	0.009*	0.033*	0.024*
	(0.394)	(5.061)	(12.332)	(9.381)	(12.332)	(17.924)
$EXP_t * BOOM_{it}$	-0.073**	-0.096**	-0.006	-0.024	-0.006	0.089*
	(-1.940)	(-1.841)	(-0.076)	(-0.796)	(-0.076)	(2.086)
$\overline{R}^2$	0.038	0.122	0.317	0.251	0.316	0.501
Observations	466	466	466	466	466	466

Notes: (*) and (**) indicate 0.025 and 0.05 significance levels, respectively; *t*-statistics are reported in the parentheses (.).