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Risks and Returns of Ship Operators

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Abstract

This thesis aims to shed some light on the risks and returns of asset-light ship operators, who are in the business of executing voyages mainly through chartered vessels, by applying principles from basic maritime economics and modern financial theory. By adapting the Fama-French multi-factor model to identify the main risk factors of freight, fuel price, vessel speed, default and voyage complexity for ship operators, I present a framework for explaining why ship operators should be able to earn a net positive return on their business model.

In addition to economic theory, the ideas in this thesis were also formed with knowledge of the practical world which were obtained through interviews with and data provided by industry practitioners. It is hoped that by giving attention to this segment of the shipping industry, further academic research will be encouraged. Likewise, industry practitioners stand to benefit greatly from the academic research already done on freight markets and would ideally be inspired to apply some of the ideas in this thesis and other modern economic tools to improve their business operations.

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1. Introduction

Maritime economics is a relatively under-studied subset of economics and finance and within this subset, most studies concern themselves with the analysis of the four major shipping markets of freights (both spot and time-charter), new-buildings, second-hand ships and demolition. There has so far been no study to my knowledge of dedicated ship operators and their roles in the value chain of the shipping industry. Conventional shipping businesses usually involve ship owners "owning steel" and companies focusing on a pure chartering strategy without owning any ships remain out of the limelight. Yet because of their business model where they are usually fixing single voyages or short-term time charters, they are one of the most sensitive market players to spot freight rates and well-placed to make use of the research that academia has produced on freight markets. In their tests for market efficiency, (Ådland & Koekebakke, 2004) and (Ådland & Strandenes, 2006) showed that with high liquidity and low transactions costs, there is potential for freight traders, ship operators and shipping pools to construct profitable trading opportunities. This paper aims to follow up on this theme by giving a theoretical exposition on why these market agents, and specifically ship operators, should be able to earn consistent profits and shedding some light on their economic risks and rewards.

The term ship operator in the context of this paper is a simplified one referring to companies whose work typically begins with finding a vessel that is available for charter, employing the vessel by finding cargo to transport, and subsequently executing the voyage. The charter of the vessel may be on various terms e.g. bareboat, trip charter, time charter or voyage charter, and the process can begin with either of the vessel and cargo being secured first. They are thus in part a ship broker and in part the operations department of a conventional ship-owning shipping company. As we shall explain later, they are also in part freight traders due to their net exposure to the freight market at any point in time. Some examples of ship operators or companies where such an operation is a significant contributor to its overall business include Western Bulk ASA, DS Norden, Ultrabulk, SwissMarine Services, XO Shipping, Copenship, MUR Shipping, and Oldendorff.

A reason why ship operators are seldom in the lime-light could be due to the fact that the volume of shipments which they are involved in are generally small compared to the global market for shipments. Most shipments today involve large, regular volumes due to the long lead time for producing cargoes, be they raw materials like iron ore, semi-finished goods like steel bars or finished goods like automobiles and electronic goods. Shipment contracts are often written for large volumes to give the security needed by suppliers to invest in capital. When buyers are bringing in large, regular volumes of cargo, it is more cost-efficient to have in-house departments managing the operations of such shipments rather than outsourcing them to ship operators. Many large corporate buyers of cargo go as far as owning ships themselves, essentially housing a shipping company within their corporation. Thus, the voyages that pure ship operators manage are typically for small shipments by small and medium enterprises, or for irregular shipments which were not previously budgeted for by the in-house department of the aforementioned large corporations. The latter could be due to an unexpected increase in volume needed, or a late change in the source location of cargo that necessitates the engagement of a third party. Nevertheless, though their role in the context of global shipping might be relatively small, they provide an important bridging service to many companies on the supply side (ship owners) and demand side (cargo owners) of a shipping transaction.

Pure ship operators are typically involved in conventional bulk shipping (also termed tramp or commodity shipping). This differs from container (or liner) shipping in that the container service usually requires a certain frequency of voyages and transports cargo of higher value for which shipment lead times and interest costs become important. As such, companies involved in liner shipping often maintain excess shipping capacity as a buffer for spikes in volumes and there is not much of a spot market for liner shipping. Routes are also well-established and fixed between key ports that can handle the large volumes of cargo. In short, there is less of a need for pure ship operators in liner shipping and our discussion in this paper will focus on ship operators in the bulk shipping segment, and specifically dry bulk shipping. Here, the type of goods shipped is highly diversified and may include all main grains, ores, minerals, and semi-finished goods like steel and cement. Due to the flexibility of modern dry bulk ships in carrying various types of dry cargo, it is common for ship operators to be involved in more than one type of product market even if they specialize in only one type of vessel. Diversification amongst different cargo categories might in fact be a necessity due to the irregular nature of the shipments they are managing.

One of the most important business performance indicators for ship operators is the net time charter margin. In the next section, we will elaborate on the net time charter margin and its significance to academics and practitioners alike. This will be followed by section 3, where we build a theoretical argument for the basis of a positive net time charter margin for ship operators by borrowing from multi-factor models used in modern finance. In section 4, we will summarize our hypothesis and supplement our theoretical argument by analysing the case of a Norwegian dry bulk shipping company, Western Bulk ASA. The paper will then conclude with some general observations and suggestions for future extensions.

2. Net time charter margin

When a cargo owner hires a vessel for shipping its goods, it typically pays a voyage rate per ton of cargo for what is called a voyage charter. Multiplying the voyage rate by the total volume of cargo to be shipped gives the voyage revenue accruable to the vessel owner. In a voyage charter, the cargo owner only has to pay the voyage rate and load the goods. The main responsibility of the shipment and all associated costs are borne by the vessel owner. Alternatively, cargo owners can also charter a vessel for a period of time and execute the shipment of cargo themselves. In this case, they would typically pay a time charter rate for each day of vessel hire. In addition, they would have to bear the voyage costs such as costs of fuel, port usage and the use of certain seaways such as canals. All other vessel operating costs such as crew salaries, maintenance expenses and insurance are borne by the vessel owner. In other words, they pay for the voyage costs but not the costs of operating the vessels. From a theoretical point of view, time charter rates are derived from voyage rates on an equivalent basis and the cost to a cargo owner of shipping its cargo should be the same regardless of whether it employs a vessel on a time charter basis or on a voyage basis (see Equation 1 below). Regardless of the charter term, a time charter equivalent can always be calculated.

In the case of a typical ship operator who receives voyage revenue from cargo owners and hire vessels from a ship owner on a time charter basis, the net time charter margin refers to the residual from subtracting voyage revenue by voyage costs and the time charter cost of the vessel (see Equation 2 below). As explained, net time charter margins should theoretically be be zero due to the equivalence between hiring a ship on a voyage charter and on a period charter.

$$VR = C_f + C_p + C_s + TCE \quad \text{(Eq. 1)}$$

$$VR - C_f - C_p - C_s - TCE = TCM_{net} \quad \text{(Eq. 2)}$$

where

$VR =$ voyage revenue

$C_f =$ cost of fuel

$C_p =$ costs associated with port usage

$C_s =$ cost of using certain seaways (canals etc.)

$TCE =$ time charter equivalent rate

$TCM_{net} =$ net time charter margin

However, this equivalence between paying a voyage rate and a time charter equivalent rate plus voyage costs applies only to shippers who can take on the management of a time chartered vessel at zero marginal management costs. This is usually relevant only to companies with an existing operations department with spare capacity to take on the additional voyage at little to no extra cost. For shippers without such spare capacity there is a real marginal cost of managing the additional voyage, mainly in the form of labour. Moreover, the existence of ship operators suggests that net time charter margins are not truly zero all the time and that in addition to the marginal cost of managing a voyage, there must be other reasons why ship operators are able to more than just cover marginal costs and indeed earn a decent enough return on capital in order to attract market entrants.

Revenues for ship operators are mainly in the form of voyage revenue collected from cargo owners, and the overwhelming majority of its costs can be attributed to the aforementioned voyage and charter costs. These two costs are often very high, resulting in very tight gross profit margins for ship operators of less than 5%. In contrast to traditional vessel-owning shipping companies, ship operators conduct their business with high operational leverage and would have to be very strict about the freight rates which they receive and charge in the market. However, the benefit that they have over the traditional model is that the asset-light business model requires less capital to start and they can often operate comfortably without significant amounts of financial leverage. Not only is it unnecessary for them to finance the upfront purchase of expensive vessels, they are also able to tap on their clients for working capital since voyage revenues are typically collected upfront whereas vessel charter costs are paid on a monthly basis over its charter period.

In our introduction, we mentioned that for fixtures where the ship operator deals directly with the ship owners and the cargo owner, they are in fact acting in part like a ship broker helping to match the two parties in a fixture. Given that ship brokers often charge in the region of 1% of the total freight bill as commission, it makes sense that ship operators should be able earn a net time charter margin of at least 1% in cases where they deal directly with ship and cargo owners. In the next section, we will elaborate on some factors which we believe contribute to the net time charter margin and explain why it can be positive.

3. Risk premia and skill in a ship operator's business model

We start by borrowing the concept of multi-factor models from (Fama & French, 1992) where they posited that stock returns can be attributed as compensation for the exposure to certain risks. That returns are a compensation for taking on risks is now a cornerstone of modern financial theory and it is also the starting point for building our argument for positive net time charter margins. In our case, several risk factors that ship operators are likely to be exposed to in their daily course of business have been identified and these in part explain the positive returns in which they are able to generate.

3.1. Operational risk

Firstly, the net time charter margin should encompass some compensation for taking on the operational risk associated with a voyage. This refers to the risk of the voyage being delayed due to factors which the charterer of a vessel can be responsible for and includes, but is not limited to, accidents, adverse sea conditions, port congestions, slower-than-expected stevedoring etc. However, costs of delays that are due to the fault of the ship's crew are usually not included. In reality, there is considerable effort involved in coordinating a shipment among the different agents in a voyage and to consistently execute smooth voyages over a sustained period of time requires skill and experience. Even then, delays and accidents occur once in a while and charterers should price the associated costs into their asking rates for voyages accordingly by factoring in a premium to the asking prices.

Intuitively, the premium associated with operational risk might vary with average vessel speeds, freight rates, fuel prices and the complexity of shipment. The impact of vessel speed can be explained by common sense. When voyages are priced with the assumption of high vessel speeds, this leaves little room for error in the execution of the shipment. Delays are more likely to be costly since it will be difficult to compensate for any lost time at sea or in ports by increasing vessel speed after an unplanned delay. As explained by (Koopmans, 1939), high vessel speeds tend to coincide with high freight levels. At high and rising levels of freight rates, there is a very strong incentive for ship owners and charters to reduce voyage time by increasing vessel speed in order to carry more cargoes. By sailing at speeds faster than that which is laid out in the charterparty, ship owners or operators can finish a voyage earlier than expected and book in a new voyage. This more often than not leads to vessels being operated at close to their maximum speeds. Thus, we can see also that freight rate levels play a part in affecting the operational risk of a voyage through their influence on average vessel speeds.

The influence of fuel prices on operational risk is also intuitive. In the environment of high oil price and low charter rates of late 2009 to early 2014, it was common for the cost of bunker in a voyage to constitute 60% of the total voyage costs (Lloyd's List, 2012). As such, accidents, re-routing of shipments and other delays which result in an increase use of fuel will have a measurable impact that is closely related to fuel prices. Ship operators often factor the cost of bunker into contracts they sign with cargo and ship owners in a voyage and can reasonably lock in a fixed margin for a voyage they execute through pre-purchases of bunker and forward contracts. However, delays in a voyage may result in a mismatch between the expected delivery of bunker as stipulated in a contract and the time at which it is actually collected by a vessel, and the ship operator may be liable for the associated costs. Even if a voyage goes smoothly as planned, there is fuel price risk to be borne due to the need, in most cases, to return a chartered vessel with the same amount of fuel it came with. The cost of this fuel to be returned to the vessel owner can be difficult to hedge because the vessel’s shipping route may not be charted out at the time of charter, or the owner wishes for the vessel to be returned to a location where bunkering is not easily available, or a combination of both. In a market environment of high oil price volatility, this fuel price risk would be heightened accordingly.

As for the final influence on operational risk in this short discussion, more complex shipments involving specialized cargo, specialized equipment, multiple cargoes and/or multiple loading and discharge locations should theoretically require more specialized skills and involve higher operational risk. Multiple loading and discharge locations for example, compound the chance of delays happening at ports and a mistake in the arrangement of different cargoes may have the knock-on effect of disrupting the order of ports of call. A typical "complex voyage" may involve picking up various steel products such as rolled steel, steel bars and other semi-finished steel products from various locations in continental Europe and shipping them to a number of locations in North America – all in one voyage. Such goods need to be loaded in a specific sequence and this adds to the complexity of fixing such a voyage. This explanatory factor for the operational risk premium should unlike the aforementioned ones, be independent of the freight rate environment and scale proportionately with the complexity of the voyage instead. Highly skilled ship operators may be able to mitigate some of this risk and thus get an edge over their competitors.

3.2. Freight risk

At this point, we should be reminded that freight markets are considerably illiquid when compared with markets for more conventional commodities. In markets for various minerals and grains for example, large volumes are often traded on a daily basis in standardized terms and exchanges such as the London Metal Exchange can handle spot trades instantaneously. On the other hand, the level of liquidity in freight markets is not even high enough for a standardized exchange to be formed where buyers and sellers can trade freely and efficiently. To this day, the Baltic Exchange, the leading independent source of maritime market information, relies on quotes and assessments by shipbrokers to form its price indices instead of relying on the aggregation of data from actual trades like how it is done in more efficient markets like the stock market. This reflects primarily the lack of volume of fungible trades that makes aggregation and comparisons of different voyages straightforward and secondarily, the lack of regulation that forces all voyages and trades to be reported to a central body where the market data can be collated and disseminated in an impartial and objective manner. That brings us to the next factor that influences net time charter margins – freight rate risk.

Due to the low liquidity and volumes in freight markets, a ship operator can rarely execute a perfect spot trade. That is, it is not often possible to find a ready cargo and a matching vessel which can make the shipment at the same instance. The convention instead, is for operators to fix a cargo (or vessel) first, before going back to the other market to look for a corresponding vessel (or cargo). In practice, the time between getting a shipment of cargo and fixing a vessel to transport it can be as short a few days and as long as a month or more. In the case where the mandate to deliver a cargo is obtained first, time is needed to negotiate on the specific terms of the contract and to do background checks on the creditworthiness of the counterparty. Furthermore, cargo owners often plan shipments in advance and thus ship operators will still have to wait for a period of time before executing a shipment of cargo if the contract for cargo was obtained first. The process for chartering in a vessel can similarly be a lengthy one. Background checks here are often more stringent as vessels needed to be assessed if they meet the minimum requirements for the types of voyage which the operator wishes to execute. In both cases, the use of brokers and dealing with unfamiliar counterparties will further lengthen the contracting process. The freight market is often described as possessing the characteristics of perfect competition (Norman, 1979) and indeed, the turnover of shipping companies is considerably high and closing deals with new and small companies are commonplace.

The effect of the lag between obtaining a cargo mandate and fixing a vessel means that for the period where the voyage is not fixed, the charterer is exposed to short-term freight risk through either a long or short freight position. The existence of a positive freight risk premium implies that forward freight rates will exceed expected future spot freight rates and conversely, a negative risk premium implies that forward freight rates are lower than expected future spot freight rates. Depending on the order in which ship operators secure their contracts for cargo and vessels, they can be positioned accordingly to benefit from either a positive freight risk premium or a negative freight risk premium.

By way of an example, let's assume that time is denoted by T, current price of freight is denoted by P, the forward price of freight is F and that time periods are denoted in subscript $_{0,\ 1,\ 2}$ and so on. If a ship operator secures a cargo (or vessel) at T_0 for shipping at P_0, to be executed at a future time period T_1 and without a matching vessel (or cargo), then it is in fact having a short (or long) position on the freight rate from T_0 to T_1. If the operator subsequently fixes a vessel at P_1 and $P_1 < P_0$ then the ship operator would have made money on the position. The same logic applies if the cargo (or vessel) was secured in advance at time T_0 for shipment in T_2 at forward rate $F_{0,2}$. It is short the forward freight rate $F_{0,2}$ and would hope that future rates such as $F_{1,2}$, P_1 and P_2 are lower than $F_{0,2}$.

By combining the different individual positions that they have across various shipments and deals, it is possible for ship operators to calculate a net position on their portfolio[1]. For a risk adverse ship operator, this would usually mean a net short position on freight rates. This is because it would be logical for the operator to always secure a cargo and the attending revenue before chartering a vessel. Even if a matching vessel for the voyage was subsequently chartered at a higher rate than the rate obtained on the cargo, the loss will be small compared to the loss it would incur should it charter in a vessel for which it is unable to employ due to the inability to either find cargo or to re-let in the market. However, it is debatable whether or not such a risk profile accurately describes the average ship operator in the industry.

As (Ådland & Cullinane, 2005) argued, the sign of the net freight risk premium varies with the duration of exposure as well as overall market conditions and even for a short-term exposure, it is possible for the term structure to have either a positive or negative net freight risk premium. In strong freight markets, the high called risk of transport shortage brought about by excess demand for freight services causes the net risk premium of freight to be positive. Vessels that are chartered in the future are expected to obtain higher rates than they do today and thus ship operators would prefer to secure vessels before they secure cargo. In doing so, they maintain a short-term long freight position and would benefit if freight rates indeed rise as expected between the time they charter in the vessel and the time in which they subsequently secure the cargo for transportation. In weak freight markets, the converse is true. Here, the utilisation risk of not having your vessel employed due to a surplus supply of transport capacity outweighs the other risk factors and causes the net risk premium to be negative. In this situation, cargo is king and it pays to secure a cargo before the vessel since vessel availability is high. Ship operators can thus be momentarily short freight by first securing their cargo before looking for a vessel to transport that cargo. If this theoretical approach is right, successful harvesting of the freight risk would require an accurate reading of the market condition at least for the short-term. This also introduces an element of

[1] This coincides with the explanation in (Ådland & Cullinane, 2005) that freight markets are likely to present negative freight risk premiums most of the time (i.e. other than for the short-term in strong freight markets).

speculation or investment skill in the business whereby savvy forecasters of the freight market would be able to adjust their freight book accordingly to profit from their skill. This can explain why even the most risk adverse ship operators may hold a net long freight position in their portfolio of voyages if they have a strong belief in their investment skill.

3.3. Default risk

A third major risk factor that may have an influence on the net time charter margin is the default risk factor. In the context of ship operators, default risk can come from two main sources. In transactions where they deal directly with cargo and vessel owners, default risk would come mainly from the cargo owners. In the case where ships have been chartered but for which due to various reasons the operator is unable or unwilling to operate, they may re-let it into the market and thus take on charter default risk. To see why this is so, we should examine the nature of default risk in the context of shipping.

Charter parties are bilateral contracts with fairly standard forms and much industry-specific language. As with almost all legal contracts, there can be at times breaches in the contract terms which result in legal disputes and costs. From a practical point of view, even renegotiation of contract terms which result in the lowering of freight rates stipulated may be considered a default. The difference that sets default risk in charterparties apart from default risk in most other financial markets is that it is mostly one-sided with the charterer holding the upper hand (Ådland & Jia, 2008). This is due to the practicalities of maritime law where it is easier to force ship arrests from owners who do not deliver the promised vessel than to force payments from charterers who default on their payment. The international nature of the maritime industry where ship owner and charterer often operate in different jurisdictions exacerbate this asymmetry by making it difficult and sometime impractical to enforce financial claims, especially when charters are of short durations and charter payments owed are small relatively to legal costs.

Logically, charterers who default do so only when the net present value of the contract is negative, either because they are unable to find employment for the vessel or because the present value of revenues that can be obtained is lower than the costs stipulated in the contract at the time of fixture. Thus, a default from a charterparty will always result in a monetary loss for the ship owner because the revenue that they can get from alternative employment will also be lower than that which was stipulated in the charterparty. It follows then that the default risk premium should be positive to compensate the ship owner for the probability of such a loss. (Ådland & Cullinane, 2005) and (Ådland & Jia, 2008) argued convincingly that this default risk premium will depend at least in part on the duration of the time charter, freight market conditions and the financial condition of the charterer. Specifically, the default risk premium increases with the spot freight rate level and the charter duration. Since ship operators are in the middle of a transaction between ship owners and cargo owners, they are charged a default risk premium by ship owners in the freight rates at which they lease vessels, and are able to charge a default risk premium to the cargo owners. If there are ways in which to influence the default risk premium in which they pay and that which they are charged, ship operators can then theoretically create a net non-zero default risk spread (the difference between the default risk premium they pay and are charged).

For example, from a theoretical point of view, if ship operators are able to service a long duration shipment contract with a series of short-term time charters, this should contribute to a net positive default spread. Having said that, doing so may heighten other risk elements such as the risk of transport shortage or operational risk involved in handling different vessels for one shipment contract. Next, by having higher financial stability and creditworthiness than their clients, they should be able to incur less of a default premium than that which they charge their clients. This can be compared to the way the banking industry earns their net interest income, by paying a lower interest rate on depositors than the interest rate in which they charge their borrowers. This applies to the ship operator regardless of whether their client is a cargo owner hiring a vessel or a fellow ship operator or owner to which they are re-letting a vessel. In the case where most of a ship operator's customers are small and medium enterprises, they can improve their relative financial stability by increasing firm size, capital buffer and maintaining diversity in their portfolio of voyages with respect to geographical areas of operation and type of cargoes carried.

3.4. Operator skill and "alpha"

As much as the freight market is used as an example of perfect competition, in reality it is not. The chief aspect of freight markets that violates perfect competition criteria is that information among the market participants is far from perfect. As mentioned earlier, there is considerable illiquidity in freight market transactions and a lack of a standardized, transparent exchange for market information. Counterparties in a deal and brokers hold much of the transactional information private and may use this to entrench their position along the value chain for shipping services. A majority of freight transactions in both the spot and term charter markets are undisclosed even to established database providers like Clarksons and Platts and therein lies the rationale for another contributor to a positive net time charter margin – savvy ship operators should theoretically be able to exploit informational asymmetries in markets to earn an almost riskless profit. With reference to (Fama & French, 1992) this is akin to the alpha generated by stock market investors who are able to achieve returns in excess of their exposure to the risk factors that can be identified and measured. This can be more clearly explained by way of examples. The following sub-sections provide a list of areas where I believe that alpha returns can be captured with some knowledge of basic economic principles and operator skill. This not an exhaustive list, but should be treated as an illustration of alpha generation and a launching pad for further ideas.

3.4.1. Geographical allocation of fleet

The first area which we will look at is the opportunity for skilled operators to earn profits through exploiting the differences in freight rates across different geographical regions. Empirical observation has shown that there exist material differences in freight rates across the major geographical markets for freight, most notably between the rates in the Atlantic basin and those in the Pacific basin. (Laulajainen, 2007) and (Ådland, Bjerknes, & Herje, 2013) present some evidence of this. In a perfectly competitive market with no friction costs, this should not happen as idle vessels should be able to relocate freely and immediately to areas with higher freight rates and depress these rates, while raising the market rates in the regions they leave such that all prices converge towards a global equilibrium. As (Ådland, Bjerknes, & Herje, 2013) articulated, there are several reasons why this does not happen in practice. To summarize the main arguments, firstly, ships move slowly around the world and short-run price differentials will persist as long as the demand-supply imbalances that cause them cannot be address by the swift re-allocation of fleet supply. When the time horizon extends past the time needed for ships to be re-deployed, then there should be less cause for price differentials to persist. Secondly, although individual ship owners are price-takers in the market, market spot prices are set following the aggregate actions of all ship owners. Due to imperfect knowledge in the market for freight, not all spot fixtures are readily observable and their terms made public. This introduces an element of speculation on the part of individual ship owners when it comes to their deployment of vessels to various basins and setting of prices, and may lead to an over-supply in certain regions and under-supply in others and consequently, to the supply-demand imbalances from which price differences may arise. Thirdly, practical issues may prevent perfect competition on a global scale. A Japanese ship owner may have experience working only in the Pacific and lack the sufficient know-how and network to operate as effectively in the Atlantic Basin. This limits the extent to which individual ship owners may re-deployment their vessels for work in another geographical region.

In their paper, (Ådland, Bjerknes, & Herje, 2013) found that in certain periods where the difference in regional freight rates were sufficiently large, there were profits to be made by switching the operation of a vessel from a low-paying region to a high-paying region. They analysed the differences between Capesize dry bulk freight rates for the Trans-Pacific and the Trans-Atlantic routes and found a high value for switching especially in the 2003 to 2009 period where the spread was abnormally high. Operators with a global presence and a diversified portfolio of vessels and cargo will presumably be in a better position to exploit this market inefficiency. While they will have to factor in the time taken to move a vessel to and from the two regions, there could also be opportunities for more profits if they were able to find employment for the vessel during the switching period. Having said that, the value of this switching strategy would diminish in oversupplied global freight markets where the presence of excess tonnage ensures that differences between regional freight rates are smaller in magnitude and revert more quickly to equilibrium.

3.4.2. Minimizing ballast

The second area where operator skill may make a difference in generating positive net time charter margins is through the minimization of ballast. The demand for freight services is very much derived from the demand for the cargo it carries and freight rates are often quoted in dollars per ton of cargo. In the calculation of this cost of freight to cargo owners, the maritime convention is to assume a direct route of laden voyage from the port of loading to the port of discharge followed by a direct route of ballast voyage back to the point of origin. That is, equation (2) can in fact be re-written as equation (3) below.

$$VR - C_{f,1} - C_{f,2} - C_p - C_s - TCE_1 - TCE_2 = TCM_{net} \qquad \text{(Eq. 3)}$$

where

$VR =$ voyage revenue

$C_{f,1} =$ cost of fuel for departure leg

$C_{f,2} =$ cost of fuel for return leg

$TCE_1 =$ time charter equivalent cost of freight for departure leg

$TCE_2 =$ time charter equivalent cost of freight for return leg

$C_p =$ costs associated with port usage

$C_s =$ cost of using certain seaways (canals etc.)

$TCM_{net} =$ net time charter margin

Following pricing conventions, the departure leg is normally assumed to be laden and the return leg is assumed to be ballast. A skilled operator can take advantage of this to earn more profits out of its time charter. In the simplest of ways, if an operator can find a cargo to ship for the return leg of the voyage, the voyage revenue he would have received for that leg would represent pure profits to his operations due to the fact that its costs would have already been factored into the price he charged. For the last five decades, the cost of fuel and charter costs have been the two largest components of the voyage. Thus, if these were able to be minimized significantly or have additional revenue earned on them, then a ship operator would be able to significantly increase its profitability.

In reality, finding perfect matches where the departure leg and the return leg are both laden is uncommon. A more plausible way to minimize ballast might be to alter the return route and make an extra shipment or two before returning to the point of origin, effectively making the round-trip journey a three-legged one or more. To extend this even further, by analysing all its available cargo and vessels under contract as one portfolio, a ship operator may be able to optimize its routes and profitability through a simple linear optimization either from a cost minimization perspective if there are more options for vessels or from a profit maximization perspective if there are more options for cargo.

3.4.3. Exploiting the imperfect pricing of fuel efficiency

Since the second half of 2007 up until the summer of 2014, apart from a short blip during the crisis period of late 2008 to early 2009, crude oil prices have generally traded at spot prices above US$80 per barrel. In this high oil price environment, fuel costs were often as high as 60% of total freight costs (Lloyd's List, 2012) and fuel efficiency and fuel costs management became the buzzwords of the shipping industry. During this period, there was increased interest in newer and more fuel-efficient vessels. Some of these vessels, were sought after both from a cost-savings perspective as well as from a marketing perspective by ship owners who wanted to be seen as more progressive and environmentally-friendly.

Some studies have shown that some freight markets have shown characteristics of a bifurcated market where more fuel efficient vessels trade at a significant premium than older and less fuel efficient vessels. Part of this is due to the cost savings that come with the newer vessels and the result of charterers trading high freight rates for fuel savings. However, it remains debatable as to whether or not the improved fuel efficiency is fully reflected in adequately higher freight rates for such more fuel efficient vessels. (Agnolucci, Smith, & Rehmatulla, 2014) estimates through an empirical study of the Panamax market that on average only 40% of the fuel savings delivered by energy efficiency accrued to ship owners for the years from 2008 to 2012. This was attributed to the lack of perfect informational transparency in shipping deals as well as the varying degrees of bargaining power that ship owners and charterers hold over a transaction under different market conditions.

Firstly, as fuel consumption clauses included in time charter contracts are hard to verify, charterers may find it difficult to enforce fuel consumption guarantees and rebates. Thus charterers may be unwillingly to pay a significant premium for fuel efficiency which they cannot measure or benefit from fully. Secondly, under perfect market conditions, one can expect the benefits of fuel efficiency to be shared between both the ship owners and charterers. The exact proportion under which this is split would depend on the bargaining power that each has and this varies accordingly with the tightness of the freight market. Rolling estimates from the afore-mentioned study confirms that the percentage of fuel accruing to the ship owner decreases as observations from the peak of the market in 2008 are dropped from the sample. This supports the theory that in weak market conditions where there is a surplus of freight and not enough cargo, charterers hold a stronger bargaining power and obtain a discount on the premium for more fuel-efficient vessels.

What this means for ship operators is that they are able to lower their total operating costs simply by utilizing more fuel-efficient vessels. Assuming that cargo owners are ambivalent towards operators who use such vessels and pay a voyage rate that is at least equivalent to that operated by a less fuel-efficient vessel (which is highly plausible given their preference for more fuel-efficient, environmentally-friendly vessles), ship operators can then easily earn a positive net time charter margin.

The magnitude of the contribution to the net time charter margin from such a manoeuvre would logically be time-varying and larger under strong freight market conditions where more fuel efficient vessels trade at larger premiums over less fuel-efficient vessels, and when bunker costs are high and a large portion of total voyage costs. To fully exploit the financial benefits of operating more fuel-efficient vessels, ship operators can also negotiate for voyages to be completed under a shorter duration and thus higher vessel speeds. This is to take advantage of the fact that the reduction in fuel consumption from more fuel efficient vessels is larger at higher sailing speeds. Furthermore, the choice of such vessels can also amplify the contribution to positive net time charter margins from geographical switching of the fleet if the operator is able to charter the vessel from a weaker market and employ it in a tighter market. It also pays to increase one's informational advantage when it comes to the actual measurable benefits from more fuel efficient vessels and this can be done by improving one's familiarity with such vessels and constantly employing them in markets where both cargo and ship owners are less well-informed.

3.4.4. Speed optimization

Last but not least, another way in which ship operators can strive for "alpha" is by simply optimizing the speed at which they sail their vessels. As outlined in (Strandenes, 1981) and (Ronen, 1982) and applied in (Assman, 2012), there exists a theoretical optimal speed at which vessels should sail. This depends on among other things, spot freight rates, cargo size, price of bunker, voyage distance and ship-specific constants, the last of which is dependent on the make and engine characteristics of each individual vessel. One can find the theoretical optimum speed by expressing daily earnings on a vessel in terms of these inputs and then maximizing the earnings equation by finding the first derivative with respect to speed.

Given the theory, optimal speed should be a simple non-linear function of the ratio between spot freight rate and bunker price. Ceteris paribus, this means that optimal speeds should increase with increasing spot freight rates and decrease with increasing bunker prices and vice versa. To a certain extent, these were borne out in the shipping crises in the 1970s and early 1980s as well as the 2009 to 2014 era where a confluence of economic events culminated in high oil prices and low spot freight rates and an ensuing trough in the cyclical shipping market. The practice of slow-steaming then grew in popularity as ship owners and operator strove to maintain profitability.

Nevertheless, by now we should be convinced that in maritime economics, reality can often differ from theory. In his empirical survey of 17,974 voyages performed by 1,800 Capesize ships in 2011 and 2012 and using the observed ratios between spot freight rates and bunker prices, (Ådland, 2013) estimated theoretical optimal speeds ranging from 10 to 15 knots, with an average speed of 11 knots, standard deviation of 1.1 knots and typical confidence intervals in the order of 4 knots. Actual observed speeds in practice however were nearly constant throughout this period and varied within a smaller range of 10 to 11 knots. This near-constant average speeds over time were observed both for the sample as a whole and across loading conditions and routes, and stood out in stark contrast to the wide range of theoretical optimal speeds at which they should be sailing.

As noted by the author, this apparent rift between theory and practice could be due to several reasons. Firstly, it could be an organizational obstacle where the knowledge gap between the chartering department and their technical department prevents charterers from implementing findings on real-time performance data to tweak vessel sailing performance. Secondly, this could be due to the existence of a significant amount of long-term time charters or contracts of affreightment. Even though spot trades are the alternative cost of charter and therefore implying that spot freight rates should be used when determining optimal speed, the party paying for fuel may not bother with optimizing speed for a small percentage gain as long as there is certainty of long-term cash flows. Finally, the practicalities of shipping operations might prevent the implementation of theoretically optimum sailing speeds. Cost of delays, laycan, and minimum laden speeds, as well as the lack of a formalized and effective way of sharing the gains of speed optimization between both the ship owner and the charterer present disincentives for speed optimization. The marginal benefit of diligent speed optimization for most ship owners and charterers is too small to take their attention away from their modus operandi of getting in new trades and negotiating the profit margins of these new trades. Ship operators who rely more on trade credit and a covered long-short model and are more dependent on leveraging small margins on individual freight trades, should be able to benefit more.

4. Summary of risk premia and skill

To summarize, we can model the returns of a ship operator in a general way as follows:

$$R_{SO} = \alpha + \beta_S F_S + \beta_B F_B + \beta_C F_C + \beta_F F_F + \beta_D F_D \qquad \text{(Eq. 4)}$$

where

$R_{SO} =$ returns of ship operators

$\alpha =$ alpha generated through operator skill

$F_S =$ average vessel speed factor

$F_B =$ bunker (or fuel) price factor

$F_C =$ voyage complexity factor

$F_F =$ freight rate factor

$F_D =$ default risk factor

$\beta_S, \beta_B \ldots =$ factor betas

In other words the net time charter margins of ship operators, which form the gross margins of their business model, results from the combination of ship operators taking on operational, freight rate and default risk and exercising their skills in structuring "arbitrage" deals to extract profits from a trade. As explained, operational risk can be further separated into the average vessel speed, fuel price, and complexity factors.

Several hurdles arise when one attempts a statistical analysis to test for the influence of each factor on ship operators' returns. Firstly, the freight risk premium as discussed has a time-varying property and does not fit into most forms of linear regressions. Secondly, freight levels and the trend in which rates are going will affect some of the other risk factors and most notably the average vessel speed and default risk factors. To a certain extent, the degree to which ship operators can exploit arbitrage opportunities through skill (such as through geographical switching and exploiting fuel efficiency) as illustrated in the previous section might also be affected by the general freight market condition. Therefore, one needs to consider the problem of multicollinearity in any statistical study which separates the different factors.

Nonetheless, it should be intuitively clear and logical that the level and trend of freight rates would have a significant impact on the ability of ship operators to generate a positive net time charter margin. For the reasons articulated and the fact that freight revenue represents the top line of a ship operator's profit and loss account, one can even expect overall freight market conditions to be the most influential of the listed factors on the fortunes of ship operators.

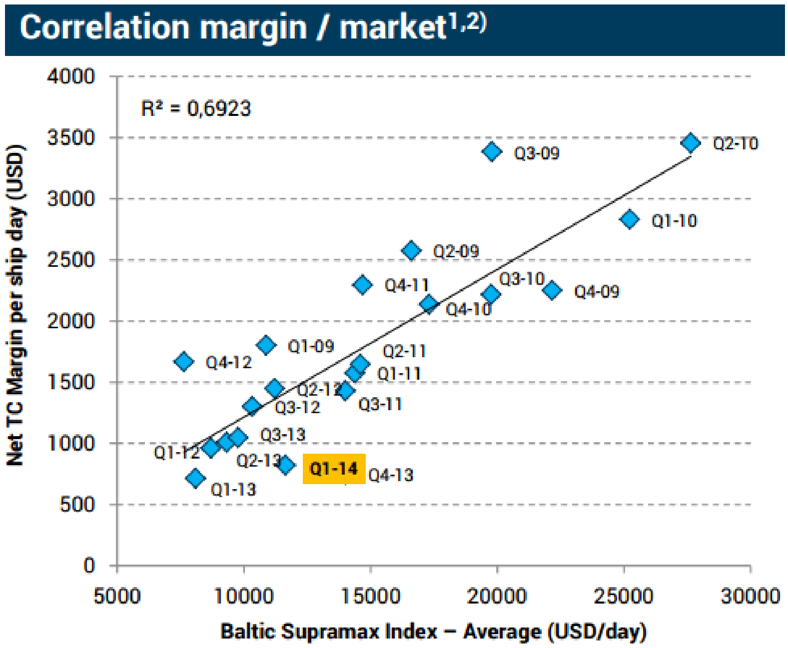
4.1. Case study of Western Bulk ASA

Western Bulk ASA ("Western Bulk") is a global operator of dry bulk vessels and the world's third largest operator of Supramax vessels (Western Bulk ASA, 2015). Based in Oslo, Norway and listed on the Oslo Stock Exchange since October 2013, it is one of the major Supramax vessel operators and has operations predominantly in the Atlantic, Pacific, Indian Ocean and Mediterranean regions. Western Bulk presents an interesting case study because they fit the mold of ship operators in our discussion well. They do not own any vessels but instead operate a fleet of vessels on both short- and long-term charters which as of the first quarter of 2014, numbered an average of 180 (Western Bulk ASA, 2014). Furthermore, the study of risks and returns of ship operators apply best to operators of medium-sized vessels like Western Bulk since such vessels and relatively more flexible in terms of the cargo they carry and the ports at which they can call at with their mounted-crane design (Strandenes, 2012), and well-positioned to exploit new and different trading and arbitrage strategies.

In the period from January 2009 to March 2014, the company operated voyages totalling an average of 3,407 ship days per month[2]. A simple linear regression of the company's net time charter margin result per ship day and the market freight rate gives an R^2 of 0.6923 for a positive correlation as shown in the figure below.

[2] The volume of voyages operated as measured by the number of ship days in this period has more or less been in a steady upward trend and the lowest, median and highest figure recorded in that period are 1,155, 3,222 and 5,762.

Figure 1: Linear regression of Western Bulk's quarterly net time charter margin per ship day and average market freight rates (Western Bulk ASA, 2014).



I have repeated the test using monthly data from January 2007 to March 2014, and further tests were also conducted with the net time charter margin per ship day being the dependent variable and the Baltic Supramax Index and bunker prices as the independent variables. In total three ordinary least squares regressions were conducted, all with the monthly average net time charter margin per ship day as the proxy for the company's profitability and thus the dependent variable. This was calculated by dividing the monthly, accumulated net time charter margin by the total number of ship days for the month. When using the Baltic Supramax Index as a proxy for freight rates, data used were compiled by (Clarksons Plc, 2014) and observations were lagged by three months. The Supramax index was used since Western Bulk's operations are mainly in this class of vessel. The main reason for lagging the observations is that the business's voyages are typically fixed in advance. Although this could mean an advance of anywhere from a week to a few months, we derive confidence in using a three month period by the company's usage of quarterly figures in their own studies. As for bunker prices, monthly average prices of 380cst bunker fuel valued in Rotterdam and compiled by (Clarksons Plc, 2014) were used. Although none of the geographical segments in which the company operates form a majority of its operations, the Atlantic region has historically generated the largest amount of net time charter margins of all the geographical regions. Observations for bunker prices are lagged in the same way as that described for the

Baltic Supramax Index observations. The results of these tests are as shown in Figure 2 below.

Figure 2: Regression statistics

				Statistics for independent variables				
Test	**No. of observ-ations**	**Dependent variable**	***Intercept/* Independent variable**	**Coefficients**	**t Stat**	**P-value**	**R^2**	**Significance F (ANOVA)**
1	87	Net time charter margin	*Intercept*	*1095*	*3.512*	*0.001*	0.297	4.844E-08
			Baltic Supramax Index (lagged, 3M)	0.677	5.992	4.844E-08		
2	87	Net time charter margin	*Intercept*	*5461*	*7.590*	*3.765E-11*	0.166	8.918E-05
			Bunker prices (Rotterdam, lagged, 3M)	-5.833	-4.115	8.918E-05		
3	87	Net time charter margin	*Intercept*	*3310*	*4.430*	*2.818E-05*	0.375	2.750E-09
			Baltic Supramax Index (lagged, 3M)	0.586	5.291	9.518E-07		
			Bunker prices (Rotterdam, lagged, 3M)	-4.121	-3.229	0.002		

As can be seen, the results of these tests echo those of the company's, with a positive intercept and relationship between net time charter margins and the Baltic Supramax Index. Even if these tests are simplistic, the logic implied by the results of these tests are as it should be – as freight levels increase, the net time charter margins in absolute terms will increase. This can occur even if net time charter margins as a percentage of voyage revenue remains the same. Higher freight levels should increase net time charter margins directly through increasing the freight risk and indirectly by raising the cost of default, the incentive to operate at higher speeds with lower margins for error. The positive intercept observed in test 1 is in line with the expectation of arbitrage opportunities being unrelated to freight rate levels. Furthermore, in an environment of high and volatile freight rates, there exists a greater potential for ship operators to take bets on the direction of the freight markets by having net long or short freight positions as described in section 3.2. Whether or not they succeed in doing so in a profitable manner, and to what extent are the results down to skill or pure luck, is another matter for discussion.

The results of the regression against bunker prices is a little more surprising, with the negative correlation seemingly implying that the company has not been able to price fuel risk into their voyages. Note however that the net time charter margins here do not include the effects of fuel price hedging which the company engages in, through the use of forward contracts for example, and thus might not give an accurate picture of their ability to mitigate fuel price risks.

There are admittedly flaws with the simple tests conducted, not least of which are the possibility of multicollinearity between freight rates and fuel prices and more importantly, the fact that freight rates are only likely to be stationary in the very long-term and when analyzed in a non-linear fashion (Koekebakker, Ådland, & Sødal, 2006; Tvedt, 2003). Spot freight rates in particular are known to be locally non-stationary (Berg-Andreassen, 1996) and thus for a period as short as seven years as observed in these tests, tests assuming freight rates linear relationships can easily lead to spurious results. A suggestion for further research would be to conduct a test of these variables, and the other risk factors identified in the model, using more sophisticated statistical techniques such as the generalized additive models (Hastie & Tibshirani, 1990) used in (Köhn, 2008).

5. Concluding Remarks

This thesis has put forth a model for explaining the returns of a standard ship operator. This model measures the returns of ship operators using the net time charter margin and posits that a positive net time charter margin is at least in part, a compensation for the different risk factors that the ship operator is exposed to in its daily operations. Through basic maritime economics and interviews with industry practitioners and academics alike, a number of influential risk factors have been identified. Of foremost importance is the freight rate risk since it directly impacts the revenue and cost of charter (often the largest expense) in the ship operator’s profit and loss account, encourages ship operators to take net freight positions in their portfolios of voyages and influences average vessel speeds and default risk premiums. In addition, fuel price risk, default risk, voyage complexity and average vessel speeds will also have a significant impact on the profitability of ship operators by altering the size of the net time charter margin which they earn. Finally, the model allows for the possibility of excess returns by skilled ship operators, depending on their ability to identify and exploit arbitrage opportunities.

It is hoped that this model will be beneficial to both academics and industry practitioners by encouraging further in-depth study into the ship operator's business model. Much of the academic knowledge about freight rates is directly useful to the ship operators' mode of operations and this lends a real purpose to further academic research. New tools like generalized additive models show promise in improving the analysis of non-linear stationary freight rates and their use should be further explored. Practitioners can also benefit from a more theoretical and grounded approach to business, especially since they operate in an industry that has historically been known for a significant amount of speculative behaviour. In particular, further research into suitable quantitative measures of the different risk factors as well as the magnitude of each factor's influence on net time charter margins would be very useful in tailoring an appropriate business strategy for a ship operator according to its risk appetite.

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7. References

Agnolucci, P., Smith, T., & Rehmatulla, N. (2014). Energy efficiency and time charter rates: Energy efficiency savings recovered by ship owners in the Panamax market. *Transportation Research Part A*(66), 173-184.

Assman, L. M. (2012). Vessel speeds in response to freight rate and bunker price movements - An analysis of the VLCC tanker market. Norwegian School of Economics, Master thesis.

Berg-Andreassen, J. A. (1996). Some properties of international maritime statistics. *Maritime Policy & Management, 23,* 381-395.

Clarksons Plc. (2014). Shipping Intelligence Network.

Fama, E., & French, K. (1992). The cross-section of expected stock returns. *The Journal of Finance, XLVII*(2).

Hastie, T., & Tibshirani, R. (1990). *Generalized Additive Models.* Florida: Chapman and Hall / CRC Press.

Koekebakker, S., Ådland, R., & Sødal, S. (2006). Are Spot Freight Rates Stationary? *Journal of Transport Economics and Policy, 40*(3), 449-472.

Koopmans, T. C. (1939). *Tanker freight rates and tankship building.* Haarlem, Netherlands: De Erven F. Bohn.

Köhn, S. (2008). *Generalized additive models in the context of shipping economics*. PhD Thesis, University of Leicester, Department of Economics.

Laulajainen, R. (2007). Dry bulk shipping market inefficiency, the wide perspective. *Journal of Transport Geography*, 217-224.

Lloyd's List. (2012). *Jumbo Dilemma.* 26 November 2012.

Norman, V. (1979). Economics of bulk shipping. Norwegian School of Economics and Business Administration, Bergen: Institute for Shipping Research.

Ronen, D. (1982). The effect of oil price on the optimal speed of ships. *Journal of the Operational Research Society*(33), 1035 - 1040.

Strandenes, S. P. (1981). Demand substitution between tankers of different sizes. *Norwegian Maritime Research*(11), 27 - 36.

Strandenes, S. P. (2012). Maritime Freight Markets. I W. K. Talley (Red.), *The Blackwell Companion to Maritime Economics* (s. Ch. 6). Wiley-Blackwell.

Tvedt, J. (2003). A new perspective on price dynamics of the dry bulk market. *Maritime Policy & Management, 30*(3), 221-230.

Western Bulk ASA. (2014). *First Quarter 2014 Presentation.* Oslo: Western Bulk ASA.

Western Bulk ASA. (2015). *This is Western Bulk*. Hentet June 2015 fra Western Bulk ASA: http://www.westernbulk.com/this-is-western-bulk

Ådland, R. (2013). Speed choice in the Capesize sector: An empirical survey across routes and loading conditions. Marseille, France: IAME.

Ådland, R., & Cullinane, K. (2005). A time-varying risk premium in the term structure of bulk shipping freight rates. *Journal of Transport Economics and Policy, 39*(2), 191-208.

Ådland, R., & Jia, H. (2008). Charter market default risk: A conceptual approach. *Transportation Research, 44*, 152-163.

Ådland, R., & Koekebakke, S. (2004). Market efficiency in the second-hand market for bulk ships. *Maritime Economics & Logistics, 6*, 1-15.

Ådland, R., & Strandenes, S. (2006). Market efficiency in the bulk freight market revisited. *Maritime Policy & Management, 33*(2), 107-117.

Ådland, R., Bjerknes, F., & Herje, C. (2013). The value of route choice in the drybulk market: a real option approach. Hong Kong: International Forum on Shipping, Ports and Airports.