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Shipping strategies in dry bulk and tanker markets : specialisation versus diversification

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SHIPPING STRATEGIES IN DRY BULK AND TANKER MARKETS: SPECIALISATION VERSUS DIVERSIFICATION

By

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation: **Shipping Strategies in Dry Bulk and Tanker Markets: Specialisation versus Diversification**

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Recent history has shown that shipping cycles have gotten shorter and more volatile. Unprecedented highs in freight rates have recently been witnessed followed by market free falls, exposing shipowners/managers to ever increasing amounts of risk. Traditionally, an investor in the maritime transportation industry would seek to spread this risk by diversifying the assets in which he invests, which for the purpose of this dissertation are dry bulk and tanker vessels. Ships are therefore considered assets which form a portfolio and the degree to which a portfolio is diversified or specialised depends on the type of vessels included in a fleet. Furthermore, vessels may be fixed on the spot market or the time charter market, which affects the volatility and the earnings that an investor would expect.

A detailed analysis is carried out of the earnings between 1991 and 2009 in four dry bulk sectors and four tanker sectors employed on the spot market, on 1-year time charters and 3-year time charters. Armed with this data, the correlation between all the market sectors, mean earnings and volatility can be calculated in order to apply the Portfolio Theory, thereby determining which combination of assets is most suitable for an investor.

Additionally, another in depth analysis is carried out of companies involved in maritime transportation which are listed on five different stock exchanges in Europe and the United States of America. By analysing each company's share value and volatility between 2005 and 2009, the Capital Asset Pricing Model can then be applied to determine how the company performed. A comparison of each company's

performance with market freight rates allows for a conclusion to be drawn on the impact each strategy had on a company's share price and beta value.

The final chapter draws a conclusion on whether a strategy can be singled out as the most appropriate. Furthermore, qualitative data is introduced to further strengthen the support for either a specialised or a diversified shipping strategy.

KEYWORDS: Portfolio Theory, Capital Asset Pricing Model, Volatility, Beta Value, Risk

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
BCI	Baltic Capesize Index
BDI	Baltic Dry Index
CAPM	Capital Asset Pricing Model
COA	Contracts of Affreightment
CSE	Copenhagen Stock Exchange
DWT	Deadweight
E(Return)	Expected Return
EBIT	Earnings Before Interest and Taxes
EURONEXT	Cross-border European Stock Exchange (Amsterdam, Brussels & Paris)
FPGP	Floating Power Generation Plant
FPSO	Floating Production, Storage and Offloading
FSO	Floating Storage and Off-take
FSRU	Floating Storage Re-gasification Unit
IMO	International Maritime Organisation
LNG	Liquid Natural Gas
LPG	Liquid Petroleum Gas
MPT	Modern Portfolio Theory
NASDAQ	National Association of Securities Dealers Automated Quotations
NYSE	New York Stock Exchange
OBO	Oil/Bulk/Ore Carriers
OPEC	Organisation of the Petroleum Exporting Countries
OSL	Oslo Stock Exchange
PSD	Parcel Size Distribution
StD	Standard Deviation
TCE	Time Charter Equivalent
VLCC	Very Large Crude Carrier

Vessel	Earnings Based on the Following Specifications
Capesize	150,000dwt
Panamax	65,000dwt
Handymax	45,000 dwt
Handysize	30,000dwt
VLCC	285,000 dwt Single Hull (Early 1990s Tanker)
Suezmax	140,000 dwt Single Hull (Early 1990s Tanker)
Aframax	95,000 dwt Single Hull (Early 1990s Tanker)
Products	30,000 dwt

Chapter 1. Introduction

The question of whether a shipping company should specialise or diversify its activities is a recurrent issue in shipping. The objective of this dissertation is to assess the effectiveness of these two strategies for dry bulk and tanker markets using the Portfolio Theory. The application to tramp market was motivated by the fact that it has been described as the closest scenario to perfect competition as prices are largely dependent on the relationship between buyers and sellers. Both groups are numerous, with equal bargaining power; no barriers to entry or exit; freight is a relatively homogenous service and where demand is rather elastic (Branch, 1996). Any shift in balance creates great opportunities or risks (business cycles) for an investor in shipping. This chapter briefly presents the sources of shipping business risks (1.1) and methods of risk management (1.2).

1.1 Sources of Shipping Business Risks

For centuries, a boom in trade, an oil crisis, a war, closure of certain routes and aggressive economic policies by various countries have all produced an imbalance between supply and demand, making freight rates soar. The reverse is also true and over supply of tonnage, reduced international trade or an economic crisis can send freight rates crashing to below breakeven point required by shipowners to meet their operating costs as well as their capital and interest costs. Shipping cycles are made even more unpredictable due to the strong impact of investors' decisions, which are not always rational for want of trying to play the market and reacting to it.

It implies that a business involved in the ownership and/or management of ships exposes itself to a substantial amount of risk. A shipping company, like any other business interest, must be willing to take on operational risk (general business risk), which is caused by the fluctuations in Earnings Before Interest and Taxes (EBIT). This is determined by the income and expenditure of the company, and therefore the amount of risk is determined by the variability of these two factors. In shipping, these include freight rates, voyage costs, operating costs and foreign exchange rates.

A substantial part of the overall cash-flow position of a shipowner emanates from changes in the value of the asset (the ship), which vary greatly according to the stage of the shipping cycle. Therefore, ownership risk is another aspect which an investor must consider (Kavussanos & Visvikis, 2006).

Another serious type of risk that must be taken into consideration by a shipowner/manager is counterparty risk, which arises due to non-performance of counterparties to transactions (Dash, 2004), causing a shipowner to suffer a loss (Smith & Walter, 2003). The provision of seaborne transportation is ultimately a service provided in return for remuneration (freight/hire), which is always substantial The likelihood of the default occurring is known as the probability of default. The risk of accidents and loss is another factor which can affect the operation of a vessel and therefore the cash-flow of the company.

Like any other international company, a shipowner/manager must factor in interest-rate risk and exchange-rate risk. Given the capital intensive industry that shipping is and the high income and expenditure, exposure to these types of risk can be crippling to a company (Kavussanos, 2009).

Cycles are common to many industries and the economy as a whole, so much that the shipping cycles are intrinsically linked to the economic cycles. Within the shipping industry, cycles lie at the very heart of shipping risk and therefore must be understood in order for a shipowner to limit his exposure to this risk.

The long-term trend and the short-term trend must be distinguished. The former is a long-term cycle referred to by Cournot as the 'secular trend' (Cournot, 1927). These cycles are sustained or expected to be sustained over the long-term and are used to distinguish the underlying long-term trends from seasonal variations and the effects of economic cycles (Pietersz, 2009). They are driven by technical, economic or regional change and although they may be hard to detect, they are of great importance to businesses when they are in ascendancy or decline.

The second type of cycle is probably the most important and is referred to as the short-term cycle or the 'business cycle'. They are crucial as they are the form the economic business cycles take, and they are the drivers of shipping market cycles. With regards shipping cycles there are four main stages: a market trough, a recovery, a market peak, and a collapse.

By analysing the 22 cycles that have occurred over the last 266 years, Martin Stopford (2008) reveals that the length of shipping market cycles have decreased over time. The average length of a cycle fell from 12.5 years in 1743 to 7.5 in 2003 most probably due to technology and global communications. The result of shorter cycles is that the length of each individual stage decreases, meaning sharper market recoveries and collapses. It is therefore essential that shipowners have the proper tools for accurate forecasting so a shipowner could reap the benefits of market peaks and be flexible enough to protect his exposure during market troughs.

Finally, the third type of cycle is seasonal, which is extremely evident in shipping. There are particular times of the year when freight rates peak for certain commodities due to a high demand for that particular commodity. Noticeable examples are the surge in grain movements during late September and October as the North American harvest reaches the sea for shipment or the great demand for oil before the winter season.

1.2 Methods of Risk Management

Ships are viewed as investments that generate income through freight and possibly capital gains, if a vessel is sold at the correct time within the shipping cycle. Therefore, for all intents and purposes, ships are assets that form a portfolio and are bought and sold in a manner that will best suit the investor's risk management strategy. The shipping industry consists of a large number of sectors which determine the type of vessel employed in different trades. Vessels used for carrying passengers obviously differ from those used to carry bulk cargo; and ships used to transport bulk cargoes differ from containerised goods; and containerised goods are shipped on different size vessels according to the region or routes on which they are

traded. These different shipping sectors require specialised expertise and yield different freight rates which an investor should be well aware of. Even the period for which a vessel is employed by a charterer would alter the shipowner's income. Therefore, freight data arms an investor with the knowledge to enter different sectors that would limit his risk and the three traditional methods of doing so are the following.

Firstly, Spot Market vs. Time Charter Market. Contracting similar vessels on the same route for varying lengths of time constitute different markets and therefore involve different risks. Spot market contracts are short term and very responsive to the current market conditions as negotiations are carried out at relatively short intervals when compared to a time charter for anything above one year. As a result, shipowners employing their ships on the spot market must accept the prevailing freight rate at the time of negotiations which are extremely volatile. Voyage costs, including bunkers, are paid by the shipowner for each voyage, which adds the extra risk of bunker price volatility to the equation. Furthermore, in the spot market a shipowner risks more frequent periods of unemployment, bears the relocation costs so all these procedures require more ground based personnel coordinating everything. Finally, from a financing aspect, banks require security which is evident in a time charterparty but not in the spot market.

Ideally, a shipowner would have as many vessels employed on the spot market during the peak stage of a cycle and subsequently fix as many vessels on a time charter just before the market collapses. This is easier said than done given that time charters are not flexible and may be fixed right through the cycle peak and end during a market trough, exposing the shipowner to lower freight rates upon renegotiation. However, this manner of employing vessels has been going on for over a century, and has always proved a fruitful exercise for ensuring steady income and reducing a shipowners' exposure to business risk.

Secondly, dry bulk versus tanker markets. Dry and liquid bulk cargoes are subdivided according to the Parcel Size Distribution (PSD) of an individual

consignment of cargo for shipment. There are hundreds of commodities that need to be shipped and each has its own PSD, the shape of which is determined by its economic characteristics. This is determined by the stock levels held by users, the depth of water at the loading and discharging terminals, and the cost savings by using a bigger ship. Iron ore is almost always shipped in vessels over 100,000dwt, with a large amount of shipments on vessels of 150,000dwt. Individual shipments of coal range in size from under 20,000 tons to over 160,000 tons; however, shipments are mainly clustered around 60,000 tons and 150,000 tons. Therefore, it is no surprise that 70% of the iron trade is transported on Capesize vessels followed by 45% of coal and 7% of grain. The grain trade differs slightly with only a few parcels of over 100,000 tons, but many parcels of around 60,000tons, traded primarily on Panamax vessels (Stopford, 2009).

Smaller vessels like Handy vessels are made more flexible in the manner in which they are employed, carrying more types of cargoes such as coal, grain, scrap metal, bauxite, alumina and phosphate rock (Kavussanos & Visvikis, 2006). Furthermore, 86% of Handy size vessels are geared and on average have a draft of 10 metres. These characteristics allow this class of vessels access to a great number of ports, ports which cannot be accessed by larger vessels, either due to their deeper draft requirements or because the vessels are not likely to be geared and the ports do not have the necessary equipment to un/load cargo (Stopford, 2009).

The consequence of these factors is that freight rates for larger vessels are more volatile than those for smaller vessels, as their trade is more restricted. A shipowner may develop his risk management strategy by investing in different ships accordingly.

Thirdly, derivatives, a more modern method of risk management in shipping, provides a more flexible strategy than the two above mentioned methods. They are used to hedge against freight risks as well as other risk exposures, including foreign exchange, bunkers, interest rates, and vessel value risk. These instruments have

contractually created rights and obligations, which allow a shipowner to transfer risk to another person willing to bear it.

This dissertation focuses on the first two ways to hedge against risk (spot versus time charter markets and dry bulk versus tanker vessels). Before assessing the effectiveness of these strategies, by using the Portfolio Theory in Chapter 3 and the Capital Asset Pricing Model in Chapter 4, the next chapter presents the main developments in dry bulk and tanker markets from 1991 to 2009.

Chapter 2. Development of the Dry Bulk and Tanker Markets

Before analysing the freight rate data for the last 20 years of the dry bulk (2.1) and tanker (2.2) markets, it is important to understand certain events that have driven both sectors since 1990 knowing that the rise and fall of freight rates between 2003 and 2009 are unprecedented and due consideration must be given to these events.

As the condition of the global economy deteriorated at the beginning of the 1990s, deliveries had fallen to 4 million dwt per annum, compared with 16 million dwt of tanker deliveries. Therefore, despite the recession, the tonnage was easily absorbed and the dry bulk freight rates maintained healthier levels than those of tankers. However, after five years of relatively strong returns, deliveries built up in 1996 and as the Asian Crisis set in, freight rates plummeted. As the Asian economies recovered, so did dry bulk freight rates, albeit at a less forceful pace than seen in the tanker markets. The dot.com crisis delivered another blow to the dry bulk market, but by 2003, this sector began the recovery stage of a 'super-cycle' (Stopford, 2009).

In the dry bulk sector, the Capesize freight rates are a good indicator of the market's overall performance. As explained in section 1.3, iron ore and coal, which are essential for steel production, are the two major commodities transported on Capesize vessels. This makes the Capesize market extremely sensitive to the global industrial production and the overall performance of the global economy. In fact, the relationship of daily earnings of a 1990s-built Capesize vessel and the year-on-year change in Japanese steel production is extremely close. The turning points in the steel production growth rate have in the past predicted the direction of the Cape market with near perfection, with a few months buffer (Clarksons Research Studies, 2003).

According to the 'Japanese steel production' indicator, as steel production falls, iron ore imports decrease and subsequently capesize freight rates. Such was the case

during the recession of the early 1990s and the 'Asia Crisis' which began in the second half of 1997. Likewise, when steel production begins to increase, so does the Baltic Capesize Index (BCI). However, during the dot.com crisis in 2001 and the 2008 financial crisis, China, one of the big three iron ore importers, continuously increased its imports, thereby overshadowing any indication offered by Japanese steel production.

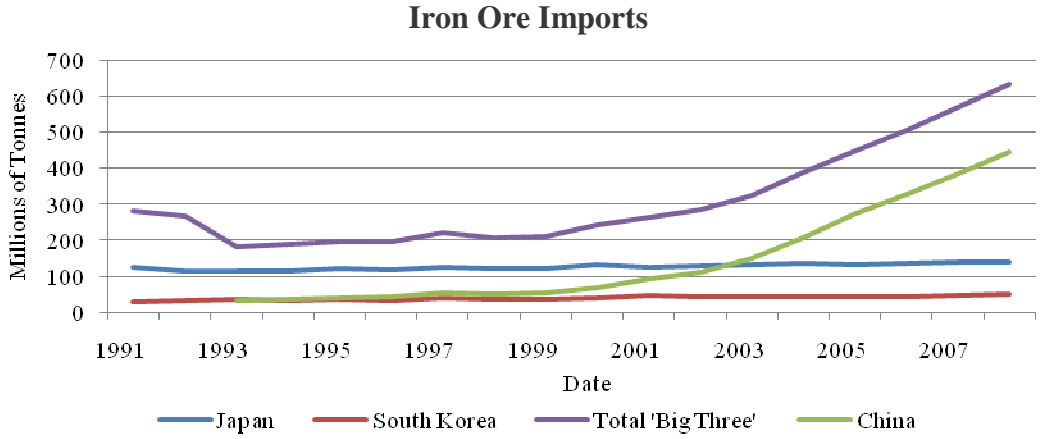

Figure 1.1 Iron Ore Import of the 'Big Three' Importers, 1991-2008 (Yearly Data)
Source: Author and Clarksons Shipping Intelligence Network

The situation was made even more precarious by the sliding coal prices and rising freight rates, which lead buyers of coal to take a wait-and-see attitude. Therefore, the iron ore trade became the primary driver of the Capesize earnings surge from 2000 onwards. This new trend distorted the market as at times the Capesize market was dependent on the vagaries of a single trade, which made an already risky industry, that much more volatile (Clarksons Research Studies, 2003). When demand for coking coal increased, this further strengthened the dry bulk freight rates as exports began to increase (Clarksons Research Studies, 2004). Furthermore, the high oil prices lead to many countries, notably the USA, Germany and Japan to switch to coal fired power plants increasing the demand for thermal coal from the power generation industry, thereby tying up even more tonnage.

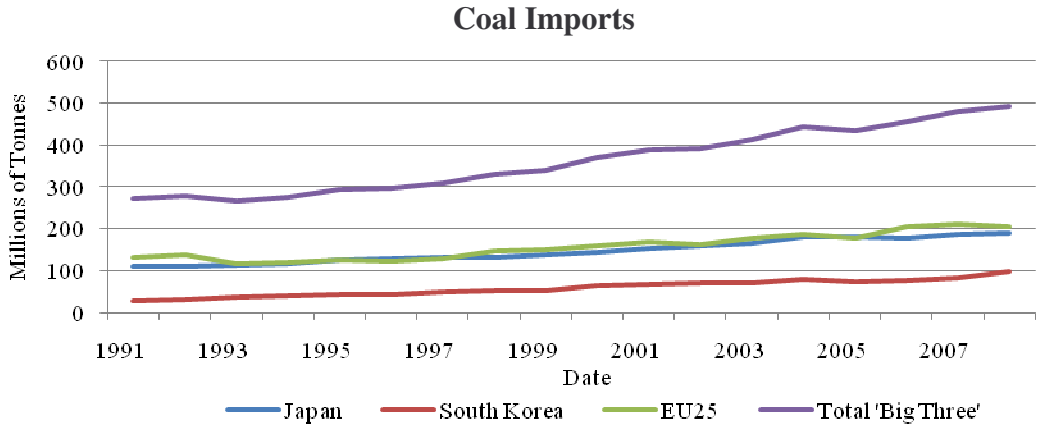

Figure 1.2 Coal Import of the 'Big Three' Importers, 1991-2008 (Yearly Data)
Source: Author and Clarksons Shipping Intelligence Network
Note: EU25: EU15 until 2003; EU25 thereafter

As the 'supercycle' progressed, mining companies were operating at full capacity to meet the ever growing demand. Delays began to arise at ports particularly in China, Brazil and Australia, where three week delays kept upwards of 50 vessels waiting. Delays were mainly due to bad heavy fog, low stockpiles, poor inland connections and equipment breakdown in China, while port facilities were badly damaged in Australia due to cyclones (Clarksons Research Studies, 2004).

As iron ore imports decline both volume and tonne mile trade reduces, thereby increasing the supply of vessels available and reducing freight rates. This situation is witnessed in market recession. A certain amount of demand always remains and this is satisfied by short haul shipments; however, this is never enough to absorb the freed up tonnage from longer shipments, which employ between 2-3 times the number of vessels to ship the equivalent volume (Clarksons Research Studies, 2001).

When freight rates rise, trading patterns are also affected, as importers seek to lower freight rates by reducing tonne miles. For example, traditionally, half of the Japanese iron ore imports come from Australia, followed by Brazil and India. However, as freight rates rose, India became a serious threat to Brazil, often overtaking it as the second-largest importer to Japan (Clarksons Research Studies, 2003).

What was unique about the 'super-cycle, was primarily that China continuously increased its volume of traded commodities and also becoming the largest importer of iron ore in the world in 2003, surpassing Japan. Secondly, China also moved towards more distant suppliers of ore. Australia has logically been China's primary supplier; however, over the last five years, Brazil increased their market share at the expense of India; subsequently, increasing tonne-miles and tying up more vessels (Clarksons Research Studies, 2005).

The prolonged period of high freight rates discouraged investors from demolishing vessels and investing in new tonnage, leaving the dry bulk sector extremely vulnerable to a downturn, which eventually arrived in the second half of 2008.

During the first half of the 1990s, the tanker and bulk carrier markets developed very differently, mostly because of investors' perceptions of the two markets. The tanker market peak prior to the 1990s recession spurred investors to orders for 55 million dwt of new tankers, based on three expectations. Firstly, a scrapping spree was expected as the 1970s-built tanker fleet was ageing, creating heavy replacement demand in the mid-1990s. Secondly, since shipbuilding capacity had shrunk throughout the 1980s, many observers expected a shortage when replacements were necessary. Finally, growing oil demand was expected to be met from long-haul Middle East exports, creating rapidly increasing demand for tankers, especially VLCCs. Unfortunately, none of these forecasts were realised and the substantial tanker order book pushed the market into a recession, which lasted from early 1992 to the middle of 1995 (Stopford, 2009).

The 'Asia crisis' also had an impact on the tanker market and by spring of 2008 freight rates came crashing down bottoming out at less than $10,000 a day in September 1999. On the upside, negative sentiment throughout the nineties triggered heavy scrapping of the 1970s-built tankers, and as a result the tanker fleet grew very slowly and freight rates surged to new peaks. Like the dry bulk market, the surge in freight rates were soon dampened by the onset of the dot.com slump, which brought VLCC freight rates back to the low levels of 1999. The terrorist attacks in the United

States of America on the 11th September, 2001, did however make the price of oil shoot up and consequently, tanker rates. However, the knock-on effects of the attacks, the economic slowdown and a warmer than normal winter in the Northern Hemisphere, reduced demand resulting in a decrease in tanker freight rates (Clarksons Research Studies, 2001).

As the recovery began in 2003, a considerable turnaround was witnessed. A market trough coupled with the Organisation of the Petroleum Exporting Countries (OPEC) struggling to keep oil prices above the lower barrier of their $22-$28/bbl preferred price range soon became record earnings and two consecutive cuts in oil production (Clarksons Research Studies, 2004).

With the upturn of the global economy, demand for oil began to increase considerably, notably in China and the USA. However, supply concerns started to grow as the market experienced shock after shock. To begin, OPEC failed to anticipate the demand level, Iraq was blighted with instability, several terrorist incidents in Saudi Arabia, industrial action in Norway and Nigeria, ethnic unrest in West Africa and a presidential recall referendum in Venezuela, all lead oil prices and freight rates to rise considerably (Clarksons Research Studies, 2004). Crude prices continued to rise due to concerns about the potential tight balance between supply and demand in the short-to-medium term (both in terms of volume availability and the relative sweet-sour split) and as Hurricane Katrina rolled into the Gulf of Mexico in the summer of 2005, fears were further heightened (Clarksons Research Studies, 2005).

Crude prices continued to react to fears that production limits were being reached and that energy needs of developing countries were putting further strains on the supply side. The perceived lack of refinery capacity also pushed up product prices.

The same market fundamentals persisted for the next few years, but 2006 and 2007 became synonymous with uncertainty and high oil prices, despite freight rates faring well (Clarksons Research Studies, 2007). By March 2008 oil was at $111/bbl, that

is, with prices adjusted for inflation, it was more expensive than at the time of the second oil crisis after the Iranian revolution. However, by the end of the year, the tanker market could not avoid the repercussions of the financial crisis, despite being more resilient than the dry bulk sector.

2.1 Application to Dry Bulk Markets (1991-2009)

When thinking of investing in the dry bulk market, different classifications can be used: firstly, according to the different employment of the vessel, there is the possibility to make a distinction between three contracts (spot, 1-year time charter and 3-year time charter); secondly, according to the main type of vessels, which leads to a distinction between Capesize, Panamax, Handymax and Handysize vessels. In combining these two classifications, 12 (3x4) different projects could ultimately be considered for which information on earnings, on standard deviation and on the correlation coefficient are required in order to identify the most efficient investment.

Table 2.1 presents the performance (mean and standard deviation) of these 12 different projects derived from their monthly earnings from December 1991 to May 2009. From this table, it appears that estimates are consistent with expectations namely: 1) the shorter the contract duration is, the higher the earnings; and 2) the bigger the size of the vessel is, the less trade routes are available on which to employ the vessel, thereby increasing risk (standard deviation).

Table 2.1 Summary Statistics of Spot, 1-Year, and 3-Year Time Charter Rates for Dry Bulk Vessels.

	Spot Rates		1 Year T/C Rate		3 Year T/C Rate	
Class of Vessel	Mean TCE ($/day)	Standard Deviation	Mean ($/day)	Standard Deviation	Mean ($/day)	Standard Deviation
Capesize	30,488	31,129	28,759	28,401	24,246	19,058
Panamax	18,634	17,463	14,894	13,276	12,000	7,690
Handymax	14,591	11,449	14,584	11,459	12,353	6,991
Handysize	11,240	8,643	11,288	8,035	10,182	5,051

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

The performance of the 4 different vessels will be evaluated for each different contract (3-year time charter, 1-year time charter and spot) in next sub-section. Furthermore, for each individual vessel type, the earnings and standard deviation are

first examined (2.2.1) and the correlation coefficient then estimated (3.2), based on monthly data from 1991 to 2009 derived from Clarksons Shipping Intelligence Network.

2.1.1 Earnings and volatility in 3-year, 1-year and spot bulk markets

Turning first to the 3-year contract, the three-year time charter rate distribution for a Capesize bulk carrier between December 1991 and May 2009 is astronomical for what is perceived as a long term contract. Rates fell to as low as $8,000 per day and rose to $107,500 per day with daily volatility at $19,058. A low charter rate average of $24,246 throughout the entire period meant that earnings volatility accounted for 79% of the mean. Statistically, and at 99% level based on the mean earnings plus three standard deviations, earnings would not exceed $81,420 per day.

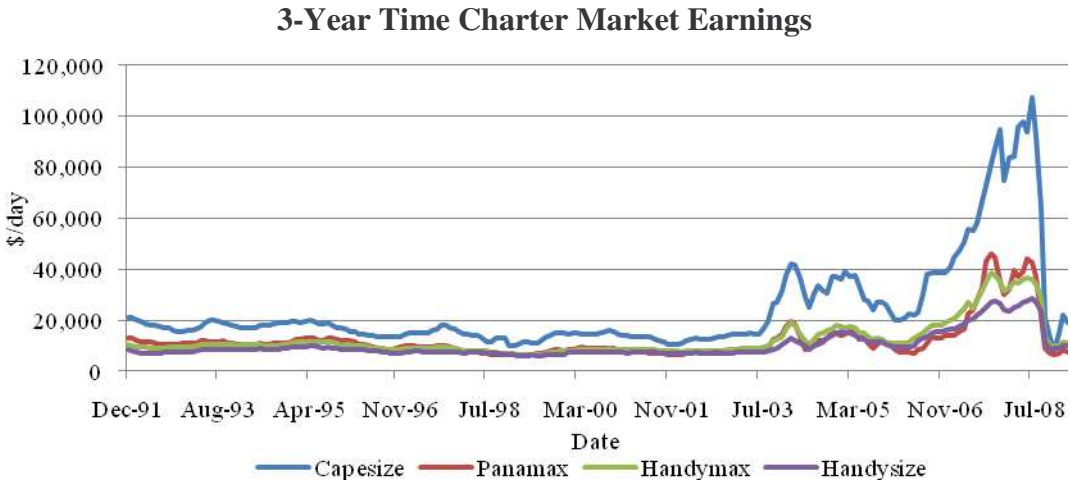

Figure 2.1 Dry Bulk 3-Year Time Charter Rates, 1991-2009
Source: Author and Clarksons Shipping Intelligence Network

Table 2.2 Summary Statistics of 3-Year Time Charter Rates for Dry Bulk Vessels.

Class of Vessel	Mean $/day	Standard Deviation $/day	Standard Deviation % mean
Capesize	24,246	19,058	79%
Panamax	12,000	7,690	64%
Handymax	12,353	6,991	57%
Handysize	10,182	5,051	50%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

An interesting comparison emerges in the three-year time charter rates between the Panamax and Handymax vessels. Panamax bulk carrier rates ranged between $6,150

per day and $46,250 per day between December 1991 and May 2009, while for a Handymax bulk carrier, freight rates varied between $6,500 and $38,500 per day for the same period. It is immediately visible that the lowest earnings for the smaller vessels were above those of a Panamax bulker. Furthermore, on average, the Handymax sector fared better than the Panamax sector as the former had average returns of $12,353 compared to average earnings of $12,000 in the Panamax sector. This was coupled with less volatility experienced in the Handymax sector, at $6,991 per day. However, it must be mentioned that Handymax returns did not reach the highs of the Panamax sector but statistically, and at 99% confidence, the Handymax earnings would not exceed $33,326 per day, while Panamax earnings would not exceed $35,070, a mere $1,744 per day less. With regard to the Handysize sector, the lowest standard deviation was in this sector at $5,051 per day. Throughout the period under scrutiny, the market bottomed out at $6,025 and reached a high of $28,375, well below the lowest earnings of any of the larger sectors. Expected earnings were within a much tighter bracket, and 99% of the time earnings would not top $25,335 per day.

With regards to one-year time charter rates, as expected, the rate distribution for a Capesize bulk carrier between December 1991 and May 2009 is even more impressive than its three-year time charter counterpart. The market's nadir was $7, 800 per day but at times soared to unprecedented rates of $137,200 per day. Throughout this period, earnings per day averaged $28,759 with a substantial fluctuation in earnings per day which was almost the equivalent amount. Furthermore, little assurances were provided statistically, as 99% of the time earnings would not surpass $113,962 per day, which still leaves earnings open to a considerable range (based on the mean earnings plus three standard deviations).

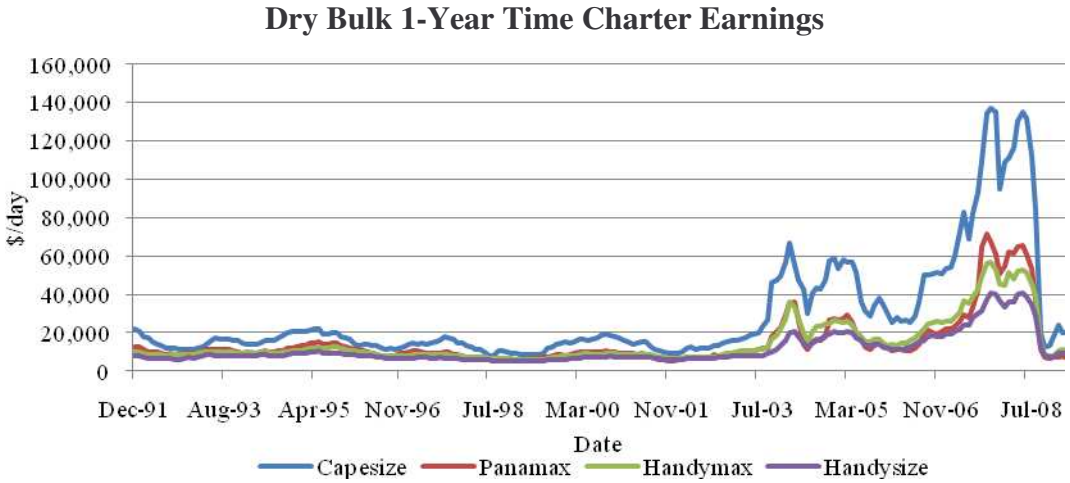

Figure 2.2 Dry Bulk 1-Year Time Charter Earnings, 1991-2009
Source: Author and Clarksons Shipping Intelligence Network

Table 2.3 Summary Statistics of 1-Year Time Charter Rates for Dry Bulk Vessels.

Class of Vessel	Mean $/day	Standard Deviation $/day	Standard Deviation % mean
Capesize	28,759	28,401	99%
Panamax	14,894	13,276	89%
Handymax	14,584	11,459	79%
Handysize	11,288	8,035	71%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

A slight divergence from the pattern in three-year time charter rates can be noted in the one-year time charter earnings when comparing the Panamax and Handymax sectors. The former had higher average earnings for the entire period at $14,894 per day when compared to Handymax average earnings of $14,584 per day. Furthermore, despite the mean earnings for the Panamax sector being a mere $310 higher than the Handymax sector in the one-year time charters, the gap of earnings expected 99% of the time widened to $5,761 in favour of Panamax vessels.

Other similarities did trickle down to shorter term contracts, as the lowest earnings in the Handymax sector ($5,813 per day) were once again higher than those experienced in the Panamax market ($5,063 per day). However, then again there was a difference of almost $15,000 per day between the market peaks in favour of the Panamax sector.

Also, as expected, as vessel size decreases, so does the volatility of earnings and this was indeed the case. The standard deviation for Panamax earnings totalled $13,276 per day as compared to $11,459 per day in the Handymax market. Finally, the Handysize sector proved to be the most stable as the range of earnings was the narrowest of all the markets, with the low point being $5,088 per day and peaking at $40,800 per day. Mean earnings for the entire period were $11,288 per day. With a standard deviation of $8,035 and earnings not expected to exceed $35,393 per day, 99% of the time, the market was offered additional stability as there was a further narrowing of the expected price range.

Finally, for the spot market earnings, a few issues must be first considered. While a spot earnings index and a Time Charter Equivalent (TCE) is readily available for vessels at the larger end of the market, the same is not true for both the Handy classed vessels. Due to the variety of cargoes and the enormous amount of routes on which Handy classed vessels are chartered, it is extremely difficult to set a spot earnings index for all these routes and cargoes. It is for this reason that Clarksons does not provide such data, and therefore trip-time charter rates for the Handymax class and six-month time charter rates for the Handysize sector will be considered.

Once again, the range of earnings experienced in all sectors increased to a dizzying extent, when compared to longer term contracts. However, some unexpected results do also emerge from the findings. To begin with, average earnings and volatility did not increase across the board, as is normally expected with short term contracts in the business world. While the two larger markets seemed to have thrived when trading on the spot market, the same does not seem to be true for the Handy markets.

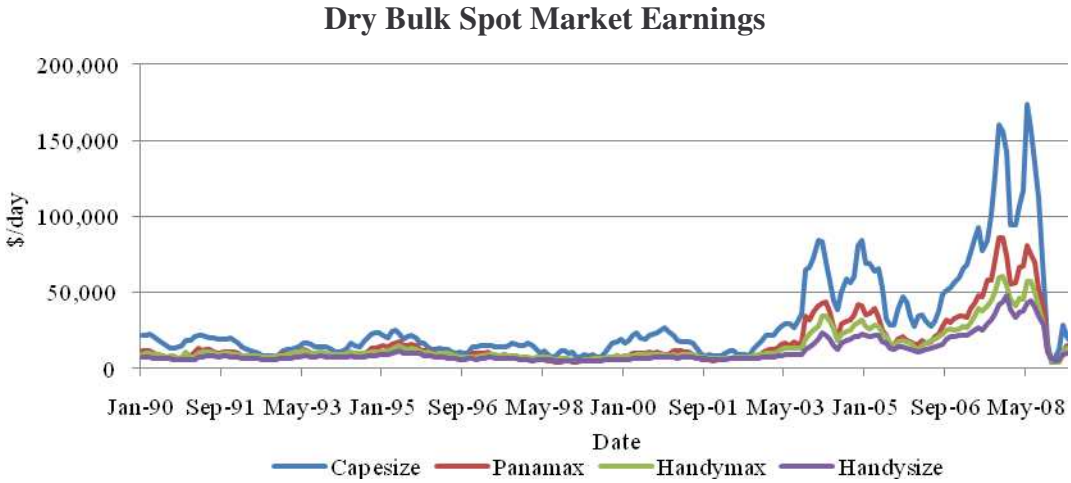

Figure 2.3 Dry Bulk Spot Charter Earnings, 1991-2009
Source: Author and Clarksons Shipping Intelligence Network

Table 2.4 Summary Statistics of Spot Charter Rates for Dry Bulk Vessels.

Class of Vessel	Mean $/day	Standard Deviation $/day	Standard Deviation % mean
Capesize	30,488	31,129	102%
Panamax	18,634	17,463	94%
Handymax	14,591	11,449	78%
Handysize	11,240	8,643	77%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

With regard the rate distribution for a Capesize bulk carrier between December 1991 and May 2009, earnings ranged from a low $4,095 per day to an astronomical height of $173,703 per day, averaging $30,488 per day. While the nadir is the lowest of all three types of charters, likewise the zenith is over $66,000 per day above its one-year time charter equivalent. Even more impressive is that the standard deviation is $31,129 per day, which is even greater than the sector's average earnings! This only compounds the uncertainty in this market as fewer assurances can be provided by freight rate analysis as rates were as likely to reach $123,875 (based on the mean earnings plus three standard deviations), as they were to plummet to below breakeven point. Using the standard deviation as a percentage of the mean earnings it can be seen that the volatility of the monthly spot earnings in the Capesize sector is 102%. If assuming that average earnings are the revenue stream needed to run the business and make a normal profit, shipping companies operating purely in the

Capesize sector could be earning over 100% more than is required or with virtually no income at all. To put this into perspective, according to Stopford (2008), a month-to-month volatility of 10% in most business sectors is considered extreme.

Very similar to the Capesize sector, is the Panamax market, as freight rates dropped to $4,191 per day – the lowest of all charterparties. Likewise, the market peaked at $86,244, almost $40,000 per day more than the peak of the one-year time-charter daily earnings. The standard deviation for earnings also increased to 94% of the mean earnings at $17,463. The biggest increase in average earnings over the entire period was experienced in the Panamax sector, when compared to longer charterparties.

When comparing Panamax spot rates with the Handymax trip charter rates, a more rational and clearer delineation of the markets is apparent. At their lowest point, Handymax earnings were less than earnings at the lowest point in the Panamax sector. Likewise, when the Panamax market peaked, earnings were a good deal higher than maximum earnings at the peak of the Handymax market. The average earnings were also higher in the Panamax sector and the volatility of the freight rates was substantially higher, bringing the Panamax sector more in line with the Capesize sector in this respect.

With regard to the Handymax sector; the average earnings for the entire period increased by a measly $7 per day to $14,591, although a wider range of earnings is clearly visible, dipping to $3,985 per day and rising $61,013 per day.

Daily fluctuations in earnings stood at $11,449, slightly lower than the scenario in the one-year time charter. The slight increase in average earnings, coupled with the minor decrease in earnings' fluctuations, means that the standard deviation as a percentage of the average earnings for the entire period did in fact decrease by 1% compared to that of the one-year time charter.

Finally, when analysing the Handysize earnings, it must be borne in mind that the closest earnings to spot rates are the six-month time charters. Therefore, when

compared to the other sectors' spot earnings, the results may be slightly distorted. Nonetheless, the data from a six-month time charter still provides a credible comparison to the longer term charters in the Handysize sector. The range of earnings broadened even more than that seen in the Handymax trip charter earnings, with rates falling to $4,788 per day and peaking at $48,125 per day. What is interesting is that the average earnings for the entire period were $11,240, falling slightly compared to the one-year time charter result. A slight increase in the daily volatility of earnings translates into 77% of average earnings for the entire period. Therefore, when taken as a percentage of the respective markets' average earnings, the two Handy sectors had a similar standard deviation.

2.2 Application to Tanker Markets (1991-2009)

Similar classifications to the dry bulk market can be used when weighing up the possible investments in the tanker sector. Once again, the first classification is according to the different employment of the vessels, that is, spot market, 1-year time charter and 3-year time charter; secondly, a distinction according to the main type of tankers which is obviously different to that of the dry bulk market. The classification of tankers may vary but for the purpose of this dissertation, four categories for which there is the most data have been selected, and these are: Very Large Crude Carriers (VLCC), Suezmax, Aframax and Products tankers. The combination of these two classifications provides an investor with another 12 (3x4) possible projects for which the same methodology as above would be applied in order to deduce the most efficient investment.

Table 2.5 presents the performance (mean and standard deviation) of these 12 different projects derived from their monthly earnings from December 1991 to May 2009. From this table, it is intriguing to note that estimates are not consistent with all expectations. The increase in earnings as the contract duration decreases is consistent with expectations. However, the volatility of earnings (standard deviation) does not always increase as the size of the vessels increase.

Table 2.5 Summary Statistics of Spot, 1-Year, and 3-Year Time Charter Rates for Tanker Vessels.

	Spot Rates		1 Year T/C Rate		3 Year T/C Rate	
Class of Vessel	Mean TCE ($/day)	Standard Deviation	Mean ($/day)	Standard Deviation	Mean ($/day)	Standard Deviation
VLCC	38,995	29,674	34,495	11,424	32,804	5,396
Suezmax	31,624	22,105	23,958	7,978	22,303	4,621
Aframax	25,524	14,999	18,774	4,701	18,018	2,388
Products	17,508	9,299	14,881	5,118	14,791	3,381

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

The performance of the 4 different vessels will be evaluated for each different contract (3-year time charter, 1-year time charter and spot) in the next sub-section. Based on monthly data from 1991 to 2009, derived from Clarksons Shipping Intelligence Network, the earnings and standard deviation (2.2.1) and the correlation coefficient (3.2) are estimated for each vessel type.

2.2.1 Earnings and volatility in 3-year, 1-year and spot bulk markets

Beginning with an analysis of the 3-Year time charter statistics, the VLCC market ranged from $23,875 per day to $45,250 per day, averaging $32,804 per day. The VLCC market did experience the greatest volatility of all the tanker sectors, with fluctuations averaging $5,396 per day. However, as a percentage of the mean earnings per day this equates to 16% and does not turn out to be the most volatile. Putting this into perspective once again, if the mean earnings are the income needed to run the business and turn a profit, a VLCC operator, more often than not, earns 16% more or less than is required. Considering the volatile nature of the shipping industry, which normally tends to increase with the size of the vessels, the statistics are quite encouraging. Particularly, when set against the Suezmax data which has had a greater standard deviation as a percentage of the mean and a lower average income for almost two decades.

The earnings volatility for the Suezmax sector was $4,621, that is, 21% of the mean earnings. The market earnings experienced the widest range of income ranging from $13,000 per day to $36,125 per day and averaged for the total period $22,303.

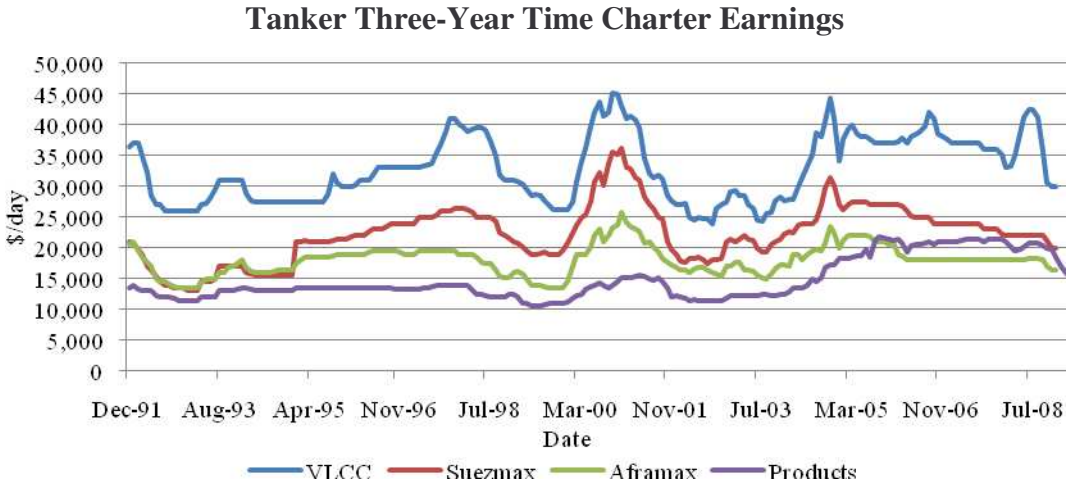

Figure 2.4 Tanker 3-Year Time Charter Rates, 1991-2009
Source: Author and Clarksons Shipping Intelligence Network

Table 2.6 Summary Statistics of 3-Year Time Charter Rates for Tanker Vessels.

Class of Vessel	Mean $/day	Standard Deviation $/day	Standard Deviation % mean
VLCC	32,804	5,396	16%
Suezmax	22,303	4,621	21%
Aframax	18,018	2,388	13%
Product	14,791	3,381	23%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

The range of Aframax earnings were more in line with the Products tanker market, dipping to $13,500 per day and rising to $25,875 per day, averaging $18,018. This sector proved to be the least volatile of all, both with regard to the standard deviation of $2,388 and as percentage of the mean earnings, which was 18% for the analysed period. While 13% may be considered extremely risky in other business sectors, compared to all the other dry bulk and tanker earnings volatility, the Aframax sector proved to be the least volatile over the last two decades. Furthermore, with 99% certainty that rates would not exceed $25,182 per day, just below the maximum earnings, would indicate that the range of earnings seemed to be relatively stable throughout the years.

Interestingly enough, the products tanker sector proved to be the most volatile, with a volatility of 23% of the mean earnings. This equates to a standard deviation of

$3,381 per day within a fairly restricted range of earnings from a low of $10,500 per day to a high of 21,750 per day.

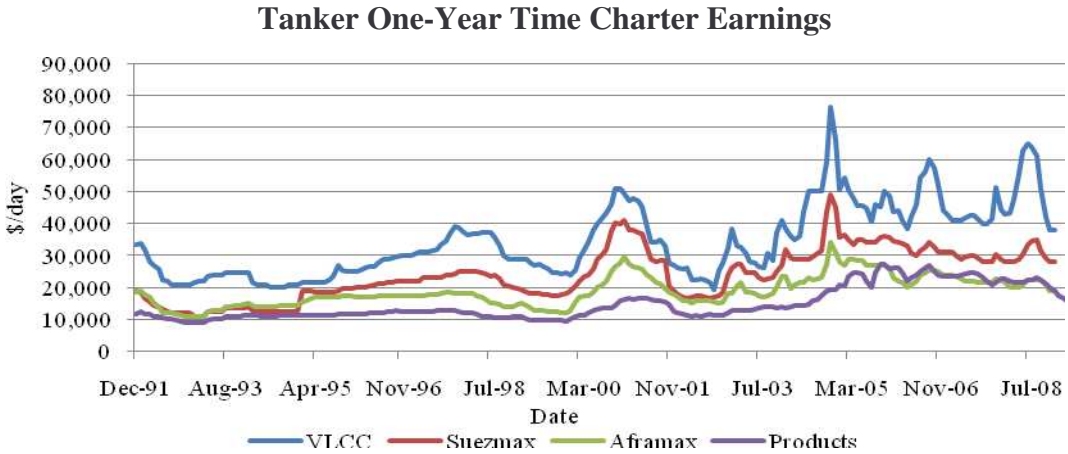

Figure 2.5 Tanker 1-Year Time Charter Rates, 1991-2009
Source: Author and Clarksons Shipping Intelligence Network

Table 2.7 Summary Statistics of 1-Year Time Charter Rates for Tanker Vessels.

Class of Vessel	Mean $/day	Standard Deviation $/day	Standard Deviation % mean
VLCC	34,495	11,424	33%
Suezmax	23,958	7,978	33%
Aframax	18,774	4,701	25%
Product	14,881	5,118	34%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

The range of earnings experienced in all sectors did increase when compared to the three-year time charters, with the widest range of earnings experienced in the VLCC market and narrowing as the vessels size got smaller. A slight increase in the mean earnings as well as the standard deviation can be noted in all tanker sectors. These two characteristics are to be expected as they are natural changes when dealing with shorter term contracts.

With regard to the increase in standard deviation, the most substantial increase was in the VLCC market. Three-year time charter earnings in the VLCC market had a lower standard deviation per day than witnessed in the Suezmax market. However, the considerable increase brings it on par with that of the Suezmax market when dealing with one-year time charter earnings.

The VLCC markets recorded an earnings distribution from a low of $19,438 per day, to a high of $76,250 per day, with an overall average of $34,495. The standard deviation per day was $11,424 per day, that is, 33% of the overall average; more than double that of the three-year time charter equivalent.

In the Suezmax market, earnings volatility as a percentage of the overall period average was equivalent to that in the VLCC market but with substantially less average earnings. Earnings ranged from $11,000 per day to $49,000 per day with an overall average of $23,958.

One trend that does trickle down from the longer time charterparties is that the lowest standard deviation is recorded in the Aframax sector. Once again this market proved to be the least volatile of all the tanker markets both with actual fluctuations which were $4,701 per day and as a percentage of the mean which stood at 25%. This proved to be a steadier market compared to the others, especially when taking into consideration that the market's earning range was much narrower than that of the Suezmax sector and that the market nadir was equivalent to that of the Suezmax market, at $11,000 per day. Average earnings for the entire period under analysis stood at $18,774.

The most interesting details from analysing the one-year time charter earnings of the various tanker sectors emerge from the products tanker sector. Like with the other three sectors, the range of earnings increased, dipping to $9,000 per day and rising to $27,250 per day. However, with regard to the actual fluctuation of earnings, the products sector was more volatile than the Aframax market, with a standard deviation of $5,118 per day. Even more importantly, as a percentage of the average earnings for the entire period, which was $14,881, the products tanker market proved to be the most volatile of all sectors.

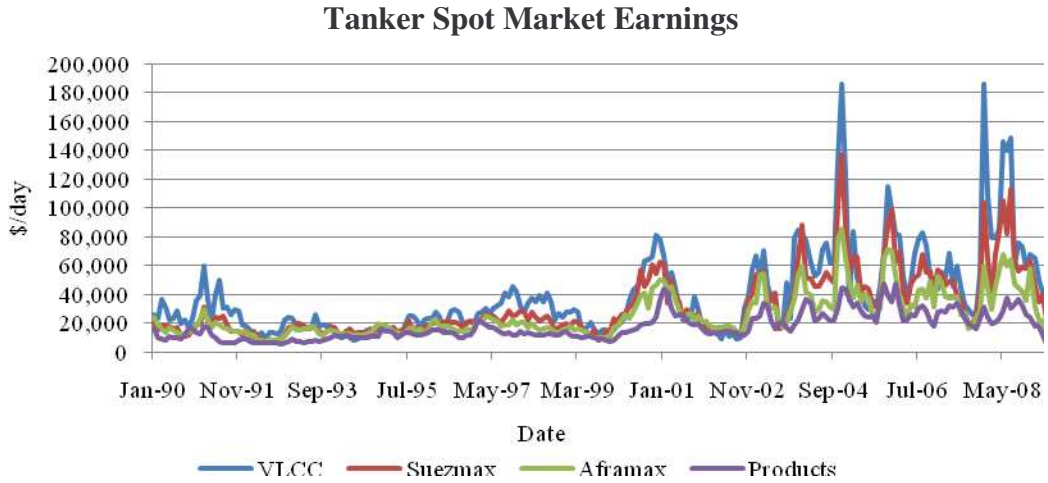

Figure 2.6 Tanker Spot Charter Rates, 1991-2009
Source: Author and Clarksons Shipping Intelligence Network

Table 2.8 Summary Statistics of Spot Charter Rates for Tanker Vessels.

Class of Vessel	Mean $/day	Standard Deviation $/day	Standard Deviation % mean
VLCC	38,995	29,674	76%
Suezmax	31,624	22,105	70%
Aframax	25,524	14,999	59%
Product	17,508	9,299	53%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

Spot earnings over the last two decades were the most representative of traditional views of the various shipping sectors. As is expected, the range of earnings increased across the board, with the three largest tanker sectors increasing the range more than three-fold. Furthermore, peak earnings for all but the products tanker market more than doubled when compared to the peak earnings in the one-year time-charter earnings and all markets reached lower depths. Further, average earnings for the period between January 1990 and May 2009 increased in all sectors.

It could be concluded that in the spot market, the four tanker markets are the most clearly delineated and the most structured; the earnings of the bigger vessels reached heights that the smaller vessels did not, while the smaller vessels reached low points that were not experienced by the larger vessels. Finally, a substantial increase in volatility can be noted it all sectors, but for the first time, volatility increased with the size of vessels without exception.

At times, the VLCC market reached exorbitant levels of $185,964 per day but also experienced lows of $8,478 per day. The sector volatility also increased substantially to $29,674 per day, rising to 76% of the total average – more than double that of one-year time charters. Despite earnings reaching $185,964 there was a 99% chance that earnings would not exceed $128,017 per day.

The standard deviation in the Suezmax market also rose substantially; more than doubling when compared to longer term contracts; however, not to the extent seen in the VLCC market. At 70% of the total mean, the standard deviation for this market was $22,105 per day.

The same situation could be seen in the Aframax market. Losing its status as the least volatile market in the tanker sector, the standard deviation more than doubled, up to 59% of the overall mean which was $25,524.

The only real changes compared to longer term charters were in fact witnessed in the products tanker sectors. The smallest increase, both with regard to range of earnings, overall average and peak earnings was seen in this market. Furthermore, from being the most volatile market, it became the least volatile with a standard deviation of $9,299 per day, that is, 53% of the overall mean of $17,508.

Chapter 3. Assessment of Dry Bulk and Tanker Market Earnings using Portfolio Theory

As stated previously, cycles are an inherent feature of shipping markets. Amongst all tools available to reduce volatility, this chapter investigates to which extent the Portfolio Theory could be used to identify the optimal strategy of shipowners operating in bulk and tanker markets or in both markets at the same time. To do so, a first section briefly presents the portfolio theory focusing on the elements to consider when selecting the relevant investment to include within a portfolio. Section 3.2 will apply the Portfolio Theory to earnings in dry bulk market and section 3.3 to tanker markets. Finally, section 3.4 presents an analysis of bulk and tanker markets all together.

Furthermore, and for the different markets (bulk and tanker), the analysis will differentiate according to the length of time of the contract under which vessels are employed. This approach was selected considering that in shipping different options exist such as diversifying one's portfolio by investing in both the dry bulk sector as well as the tanker sector. Furthermore, the distinction in the period of time for which a vessel is chartered has an impact on both freight and on the volatility of these earnings, and could also represent another potential strategy of diversification.

3.1 Portfolio Theory

The Portfolio Theory, also referred to as the Modern Portfolio Theory (MPT), relies on the principle that risk can be reduced through diversification (investing in different projects), as long as the various projects have some specific characteristics (Cariou, 2009). These characteristics refer not only to how these investments perform in isolation but also to how they interact with one another.

When it comes to the performance of a specific investment in isolation, two parameters are to be used: firstly, the average returns of an asset and the standard deviation of returns that capture the level of risk. According to this theory, a risk

adverse investor would secure the highest possible return for a given level of risk or the least possible risk for a given level of return (Scott, 2003).

When it comes to the performance of a portfolio made from the combination of various assets, three main elements are to be considered: firstly, the respective returns and standard deviation of each individual asset; secondly, the share of investment in the respective investment (x% and (1-x)%) and finally, the interrelation between the various assets which is captured by the correlation coefficient. For instance, and in the case of a two assets portfolio (A and B), the expected return E(rp) and standard deviation (or variance) of a portfolio P is:

$$E(r_p) = x.E(r_A) + (1-x).E(r_B)$$

$$\sigma_p^2 = x^2\sigma_A^2 + (1-x)^2\sigma_B^2 + 2.x.(1-x).p_{AB}.\sigma_A.\sigma_B$$

With : $$\rho_{AB} = \frac{Cov(r_A, r_B)}{\sigma_A.\sigma_B} \Leftrightarrow \rho_{AB} = \frac{1}{n}\sum \frac{(r_A - E(r_A))}{\sigma_A}\frac{(r_B - E(r_B))}{\sigma_B}$$

It appears that the average return of a portfolio is the weighted expected return from each individual asset, and the portfolio variance will be equal to the square of the total weighted sum of the individual asset volatilities (Armbruster, 2009). The correlation coefficient between the two assets (p) which reflects the strength of the linear relation between two variables and can take any value between -1 and +1 is a crucial element to estimate the volatility (risk) of the portfolio. The smaller the correlation coefficient, the smaller the last term is and therefore the standard deviation (the risk). It can even lead to a negative contribution to risk when $p<0$ (Cariou, 2009).

Figures 3.1 and 3.2 illustrate the importance of this last element (p) in selecting assets to build a portfolio. As two assets with a correlation of 1 would effectively move in lockstep (perfect substitutes), it would not make sense to hold them both in the same portfolio. The returns would offset each other, thereby amounting to zero. While this is an oversimplification of the concept (as no assets would exactly move

the same way), it illustrates the case that generally it would not make sense to add securities which are perfectly correlated in the same portfolio.

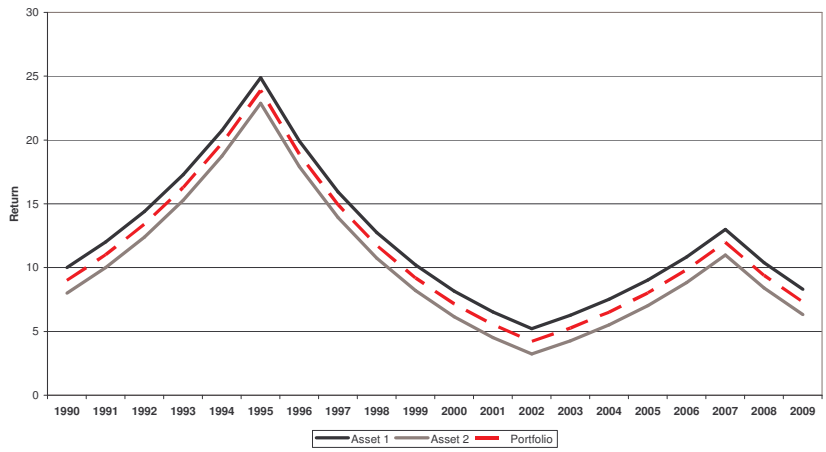

Figure 3.1 Two-Asset Portfolio with p= +1
Source: Prof. Cariou

Figure 3.2 illustrates the situation of perfect negative correlation for which, although the expected return is similar than in former case, the portfolio risk is then reduced to 0.

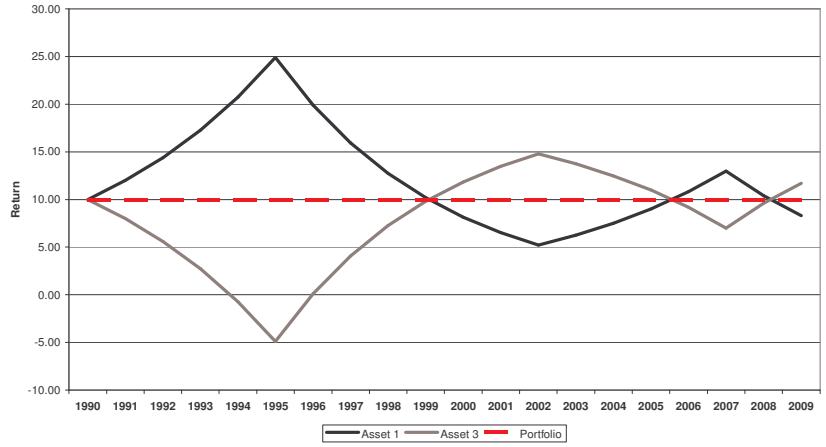

Figure 3.2 Two-Asset Portfolio with p= -1
Source: Prof. Cariou

To conclude from this brief overview of the Portfolio Theory, it appears that the volatility in shipping could be reduced using findings from the Portfolio Theory, in selecting specific assets based on their respective characteristics (earnings, standard deviation) and on their interrelation (coefficient of correlation). Section 3.2 applies this risk management tool to the specific case of bulk markets, section 3.3 provides a similar approach for the tanker markets and section 3.4 combines both markets.

3.2 Application of Portfolio Theory to Dry Bulk Market

As stated in section 3.1, the selection of assets to be included within a portfolio should be based on their respective characteristics (earnings and standard deviation from 2.1.1) and on their interrelation (coefficient of correlation). When focusing on bulk carriers and for various contract durations, it appears that the strength of the correlation between all the dry bulk sectors is overwhelming.

The correlation between the Capesize market and the Handymax market, between the Capesize market and the Handysize market, and between the Handymax market and the Handysize market remained the strongest, regardless of the length of the charterparty. On the other hand, the correlation between the Capesize market and the Panamax market, between the Panamax market and the Handysize market, and between the Panamax market and the Handysize market, was not as strong as the other markets in the three-year time charter earnings; however, they did show a tendency to strengthen as the time of the charterparty decreased.

Table 3.1 Correlation Matrixes for Monthly Earnings of Dry Bulk Sectors for Different Charters, 1991-2009

Earnings in $ for 3 year time charter				
	Capesize	**Panamax**	**Handymax**	**Handysize**
Capesize	100%			
Panamax	95%	100%		
Handymax	98%	95%	100%	
Handysize	98%	93%	99%	100%
Earnings in $ for 1 year time charter				
	Capesize	**Panamax**	**Handymax**	**Handysize**
Capesize	100%			
Panamax	98%	100%		
Handymax	99%	97%	100%	
Handysize	99%	96%	99%	100%
Earnings in $ for the spot market				
	Capesize	**Panamax**	**Handymax**	**Handysize**
Capesize	100%			
Panamax	99%	100%		
Handymax	98%	99%	100%	
Handysize	97%	98%	99%	100%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

Looking first at the three-year time charterparties the correlation between the Panamax earnings and the Handysize earnings was the weakest, thereby indicating the best combination for reducing risk. However, after assuming an investment in these two vessels (complete results in Annex A), it emerges that as a portfolio they would not produce the best results. The expected return for this investment is $11,091 with a standard deviation of $6,242. In fact, the best result is produced by a combination of Handymax and Handysize vessels, with an expected return of $11,267 and a standard deviation of $5,924. As a percentage of the expected returns, the standard deviation is 53%. Therefore, although the Panamax-Handysize combination produces the weakest correlation, the results from the portfolio test indicate that expected returns would be less and standard deviation higher than the best results from the portfolio test. The combination that fared the worst was that of a Capesize and Panamax vessel. Although the correlation between these two vessels is not the strongest, as a portfolio, it has an expected return of $18,123 and a standard deviation of $13,091, that is, 72% of the expected returns.

For the one-year time charter earnings, the most favourable correlation is between a Panamax vessel and a Handysize vessel at 96%. However, different results are produced when applying the portfolio theory. As with the longer term charterparties, a Handymax-Handysize combination proves to be the safest investment, with an expected return of $12,936 and a standard deviation of $9,643, that is, 75% of the expected return. On the other hand, the most discouraging results produced were when the portfolio test was applied to the Capesize-Panamax combination. Although it produces the highest expected returns of $21,827, the standard deviation is also high at $20,254.

Finally, when comparing the spot market to the one-year time charter market, the only change emerges from the results of the market correlations. A Capesize-Handysize investment produced the weakest correlation; however, the result from the portfolio test produces one of the worst results with a standard deviation of 95% of the expected return. The results from a Capesize-Panamax combination produced

the worst results again, with an expected return of $23,833 and a standard deviation of $23,658, an incredible 99% of the expected returns. Once again the best results were produced by a Handymax-Handysize investment. Although the expected returns were the lowest of all sectors at $12,915, so was the standard deviation at 77% of expected earnings.

To conclude, the investigation of the characteristics of investment performance (earnings) for dry bulk vessels and for various contract duration suggests that the high level of correlation between all earnings (the minimum is found to be equal to 93%) would not leave much room for differentiation. It therefore suggests that faced with an unexpected decrease in the market conditions, such as the current financial crisis, one could expect operators specialised in these markets to be highly affected. This includes not only specialised carriers focusing on one market (for instance Capesize and Spot) but also diversified operators in bulk (for instance Capesize and Handymax) as these markets are highly correlated.

3.3 Application of Portfolio Theory to Tanker Markets

In determining which tanker assets form the most suitable portfolio, the same criteria as applied to the dry bulk portfolios are assessed. That is, earnings and standard deviation of the various tanker markets (from section 2.2.1) and on their interrelation (coefficient of correlation). As with the dry bulk market, following an analysis of the correlations of the tanker markets in the three types of charters, the portfolio theory would be applied in order to strengthen or detract from initial results.

It is immediately apparent that the correlations between the different tanker markets are not as strong as those seen in the dry bulk market and the combination of tanker markets produced a wider range of correlation strengths. Upon further scrutiny, it emerges that as the period of the charter decreases, the correlation between the tanker markets strengthens. This is a common trend that is shared with the various dry bulk markets.

Table 3.2 Correlation Matrixes for Monthly Earnings of Tanker Sectors for Different Charters, 1991-2009

Earnings in $ for 3 year time charter				
	VLCC	**Suezmax**	**Aframax**	**Products**
VLCC	100%			
Suezmax	81%	100%		
Aframax	75%	86%	100%	
Products	62%	48%	42%	100%
Earnings in $ for 1 year time charter				
	VLCC	**Suezmax**	**Aframax**	**Products**
VLCC	100%			
Suezmax	91%	100%		
Aframax	86%	94%	100%	
Products	78%	76%	79%	100%
Earnings in $ for the spot market				
	VLCC	**Suezmax**	**Aframax**	**Products**
VLCC	100%			
Suezmax	94%	100%		
Aframax	88%	96%	100%	
Products	74%	81%	87%	100%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

From the tanker earnings of a three-year time charter it is clear that the weakest correlation in the three-year time charter tanker market is between the earnings of an Aframax tanker and a Products tanker. Therefore, in theory, these two vessels as a portfolio would reduce the volatility of their earnings. However, the results of the portfolio tests differ slightly. The Aframax-Products Portfolio (complete results in Annex A) has an expected return of $16,405 with a standard deviation of $2,438 per day, while the optimal combination would produce returns of $25,411 per day with a standard deviation of $3,666 per day – a mere 14% of the expected earnings. This is for a VLCC-Aframax portfolio, which have a substantially stronger correlation. What is even more encouraging about this particular portfolio is that it has the second highest expected returns with the second lowest standard deviation.

The least favourable portfolio was that of a Suezmax-Products combination, with an expected return of $18,547 per day and a standard deviation of $3,392 per day. This result stands out as the correlation between these two tanker earnings is one of the weakest, yet as part of a portfolio they have a volatility of 18% of the earnings.

The remaining three market combinations all have a standard deviation, which is 17% of the expected return. It is worth mentioning that for all possible portfolios, the standard deviations as a percentage of expected earnings are relatively small and only range between 14% and 18%, resulting in a similar volatility. Furthermore, the volatility of the various tanker portfolios pales in comparison to the substantial volatility in the dry bulk portfolios for three-year time charters.

A slight difference in the one-year time charters is that the Suezmax earnings and the Products earnings had the lowest correlation. Theoretically, these two assets should form the least volatile portfolio. However, from the results of the portfolio it transpires that this is the least favourable portfolio. Along with another two portfolios, it has the highest standard deviation as a percentage of the expected earnings at 32%. Worse still, of the three portfolios it has the lowest expected earnings. Despite being the least favourable portfolio again, it can be said that the volatility for this portfolio did not increase as rapidly as the other portfolios as the time of the charter decreased.

On the other hand, the strongest correlation was between the earnings in the Suezmax and Aframax markets, and this portfolio faired modestly well with a standard deviation of 29% of the expected earnings.

Finally, the results of the portfolio test reveal that the most favourable investment would be in a portfolio containing an Aframax tanker and a Products tanker. Although this portfolio does have the lowest earnings per day of $16,828, it also has the lowest standard deviation at $4,637 per day, that is, 28% of the expected returns.

Similar to the results in the three-year time charters, these results reveal quite a narrow range of standard deviation as a percentage of earnings, for all the portfolios, ranging from 28%-32%. Like-for-like, there was a substantial increase in volatility in all portfolios when compared to the three-year time charter counterparts.

Finally, when analysing the results of the spot market portfolios, two categories are created. On the one side, there are two portfolios, namely a VLCC-Products

combination and a VLCC-Aframax combination, which have a standard deviation of less than 70% of the earnings. The VLCC-Products correlation was the weakest at 74% and this result shone through the results of the portfolio test. The portfolio had an expected return of $28,251 per day with a standard deviation of $18,492 per day. This portfolio has the second highest expected earnings with one of the lowest volatilities resulting in a standard deviation of 65% of the expected earnings. This is more than double that of its one-year time charter equivalent, but nonetheless, the lowest increase in volatility of all portfolios. This emphasises the incredible increase in volatility that earnings experience on the spot market.

On the other hand, the four other possible portfolios saw volatility increase more than three-fold. Standard deviation as a percentage of expected earnings was above 95% for all portfolios, the worst being 99% for a Suezmax-Aframax investment. This result is also in line with the correlation between the two sector earnings, which was the highest at 96%. Returns for this portfolio were $18,512 per day with a standard deviation of $18,322 per day.

3.4 Application of Portfolio Theory to Dry Bulk and Tanker Markets

The same methodology that was applied to both the dry bulk and tanker sectors was used to analyse results of portfolios that combine vessels from both sectors. Following an analysis of all the sectors earnings and standard deviation and their interrelation, a common trend emerges. The overall pattern is that the correlations strengthen as the time charter length decreases.

However, a unique pattern emerges in correlations that include a Products tanker and any vessel from the dry bulk sector. From Table 3.3 it is apparent that as the time charter period decreases, so does the correlation between Product tankers earnings and dry bulk vessels earnings.

Table 3.3 Correlation Matrix for Monthly Earnings of Shipping Market Sectors for Different Charters, 1991-2009

Earnings in $ for 3 year time charter				
	VLCC	**Suezmax**	**Aframax**	**Products**
Capesize	36%	10%	10%	68%
Panamax	25%	1%	6%	56%
Handymax	35%	11%	11%	73%
Handysize	40%	14%	14%	77%
Earnings in $ for 1 year time charter				
	VLCC	**Suezmax**	**Aframax**	**Products**
Capesize	61%	46%	46%	66%
Panamax	50%	36%	37%	55%
Handymax	60%	46%	47%	63%
Handysize	62%	47%	48%	69%
Spot Earnings in $ for the spot market				
	VLCC	**Suezmax**	**Aframax**	**Products**
Capesize	65%	64%	64%	55%
Panamax	61%	61%	56%	52%
Handymax	61%	61%	56%	53%
Handysize	63%	62%	57%	53%

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

The correlation between the Suezmax sector and the Panamax sector is clearly the weakest of all possible combinations and therefore the most viable risk-averse investment. However, when put to the portfolio test (complete results in Annex A), this combination slips down the pecking order and is no longer the best option. This portfolio gives an expected return of $17,152 per day with a standard deviation of $4,491 per day. This is equivalent to a standard deviation of 26% of the expected earnings which, out of 16 possible portfolios, is the seventh most risk averse investment.

The best portfolio is a combination of a VLCC tanker and a Handysize bulker. This is an interesting result as these two vessels have a much stronger correlation compared to other combinations, but in fact only have the lowest volatility as a portfolio. Expected earnings are $21,493 per day with a standard deviation of $4,255 per day, that is, 20% of earnings.

The riskiest investment is a Capesize-Products portfolio with a standard deviation of 55% of expected earnings. The standard deviation for such a portfolio is the highest

out of all portfolios, at $10,732 per day, while the expected return of $19,519 per day is not the best. This result is more logical given the relatively high correlation between the two sectors, compared to other markets.

An observation worth making is that the most risk averse portfolio includes the largest of tankers with the smallest of dry bulk vessels. The reverse is true for the least viable portfolio, which combines a Capesize with a products tanker.

Earnings in the Panamax sector and the Suezmax sector had the weakest correlation at 36%, but as has often been the situation, this positive result does not make itself visible when applying the portfolio theory to this combination of vessels. The expected return for this portfolio is $19,426 per day with a standard deviation of $8,862 per day.

The results of applying the portfolio theory to the various combinations revealed that the most risk averse portfolio would include a Handysize dry bulker with an Aframax tanker. The expected returns are $15,031 per day with a standard deviation of $5,533 per day, the lowest of all portfolios. This has the lowest risk as a percentage of the expected earnings, at 37%.

Despite a weaker correlation between the Capesize sector and the Products tanker market, it remained the riskiest investment with a standard deviation of 73% of the expected returns, which were $21,820 per day.

With regard to other portfolios that include a Products tanker, although correlations weakened as charter time decreased, the volatility of the actual portfolios increased. For example, while the correlation between the Panamax earnings and the Products earnings, decreased from 56% to 55%, the standard deviation as a percentage of expected earnings of the portfolio increased from 35%-56%. However, the volatility did not increase as much as other portfolios.

The risk for the various portfolios for a one-year time charter increased across the board and ranged from 37%-73% of expected earnings. This compares to a range of between 20% and 55% of the expected earnings for the three-year time charters.

For the spot market portfolios, the weakening of correlations between Product tankers and vessels from the dry bulk sector had a positive effect on the results of the portfolio tests. The Panamax-Products portfolio became the fifth most viable investment along with Handysize-Products portfolio with a standard deviation of 55% of the expected earnings. The Handymax-Products portfolio fared even better, along with the Handysize-Aframax portfolio, it has a volatility of 57% compared to the expected earnings. Therefore, with an expected return of $16,049 per day and a standard deviation of $9,077 per day, it became the second least volatile portfolio. Better still, a portfolio that includes a Handysize bulker and a Products tanker was the safest portfolio with an expected return of $14,372 per day and a standard deviation of $7,843 per day.

The riskiest portfolio was that which included a Capesize bulker and a Suezmax tanker, with a standard deviation of 78% of the $31,056 per day, expected earnings.

The spot market risk for the various tanker portfolios ranged from 55%-78% of the expected earnings. This is a substantial increase in risk when viewed in comparison to the one-year time charter volatility, which ranged from 37%-73% of expected earnings.

3.5 Results

The results from applying the portfolio theory (Annex A) to an array of vessel combinations produce varying results, favouring certain portfolios over others according to the length of the charterparty.

Table 3.4 Asset Portfolios with the Lowest % StD for Different Time Charters.

Portfolio Theory – Three Year Time Charter					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
VLCC	50%	25,411	13,440,506	3,666	14%
Aframax	50%				

Portfolio Theory – One Year Time Charter					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Aframax	50%	16,828	21,497,858	4,637	28%
Products	50%				
Portfolio Theory – Spot Market					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Handysize	50%	14,374	61,512,728	7,843	55%
Products	50%				

Notes: Sample covers December 1991 to May 2009 (Monthly Data)
Source: Data from Clarksons Shipping Intelligence Network
Calculations: Author

With regards to the three-year time charters, a portfolio consisting only of tankers, that is, a VLCC and an Aframax, would produce the least volatility; this even when compared to the least volatile portfolios of purely dry bulk vessels or portfolios that include one dry bulker and one tanker.

When dealing with one-year time charters, the most risk averse portfolio is once again that which includes two tankers. A portfolio of an Aframax and a Products tanker would produce a standard deviation of 28% of expected earnings. Putting this into perspective, a Handysize-Aframax portfolio has a standard deviation of 37% of earnings, while a Handymax-Handysize portfolio has a staggering volatility of 75% of expected returns.

The scenario changes slightly when operating vessels purely on the spot market. The least volatile portfolio would then be one that involves both a dry bulker and a tanker. A portfolio that includes a Handysize bulker and a Products tanker would have a standard deviation of 55% of expected earnings. This is nonetheless a high degree of volatility, but fares much better then portfolios that include only tankers or dry bulker portfolios. A VLCC-Products portfolio has a standard deviation of 65% of expected returns compared to a Handymax-Handysize portfolio that has a standard deviation of 77% of expected earnings.

Chapter 4. Assessment of Dry Bulk and Tanker Companies' Earnings using Capital Asset Pricing Model

The previous chapter applied the portfolio theory to understand the observed returns (earnings) on the dry bulk and tanker markets. Earnings were expressed for various categories of vessels and the contract duration. One of the main conclusions was that due to market characteristics, dry bulk markets in comparison with tanker markets would generate more earnings for two reasons: not only individual earnings are more volatile (for instance Capesize in comparison with VLCC), but the various earnings within a market are also more correlated (for instance between Capesize and Handymax for dry bulk vessels), not leaving much room for diversification.

This chapter will look at a similar issue (understanding earnings), but focusing this time on earnings at a company level, in terms of share value of 21 shipping companies listed on different stock markets. To analyse these specific returns, findings from the Capital Asset Pricing Model (CAPM) and more specifically the identification of the Beta-values, which are derived from the Portfolio Theory, will be used. This beta-value is particularly suitable to understand the return of securities and will be briefly presented in section 4.1. A second section will present the characteristics together with some descriptive statistics of 21 listed companies that adopted a specialised or diversified shipping strategy. The last three sections present estimates on beta-value and the CAPM model and discuss the results.

4.1 Capital Asset Pricing Model Methodology

The Capital Asset Pricing Model is an extension of the Portfolio Theory and it has been specifically used to understand the return of companies listed on stock markets (securities). The idea is to consider that apart from elements already considered within the Portfolio Theory (earning, standard deviation for volatility and correlation coefficient with other alternative projects), other elements should be considered to take into account alternative investments available on the stock markets: risk-free

assets, such as treasury bonds for instance, and all other assets that are synthesised by the stock exchange index.

It means that the return r from an asset j (r_j) is at a minimum equal to r_f (risk free asset) and can be more or less than other assets on the market [($E(r_M)$-R_f)] according to the Beta-value of a company j. The beta-value depends on the total risk for this asset (capture by the standard deviation σ_j), the risk on the market (σ_M) and on the correlation coefficient between the asset j and the market M (p_{jM})[1] so that:

$$E(r_j) = r_f + [E(r_M) - r_f]\beta_j \quad with \quad \beta_j = \frac{\sigma_j p_{jM}}{\sigma_M}$$

The beta-value is known as the systematic risk and captures the part of the total risk (σ_j) that cannot be reduced through diversification. In other words, the CAPM states that to understand the return of a company, the average and standard deviation is not enough as long as within the standard deviation, a part can be eliminated in investing in other assets available in the market. It means that an investor needs then to be compensated in two ways: time value of money – the risk-free asset (r_f) and a compensation the investor needs for taking on additional risk (Morgenson & Harvey, 2002).

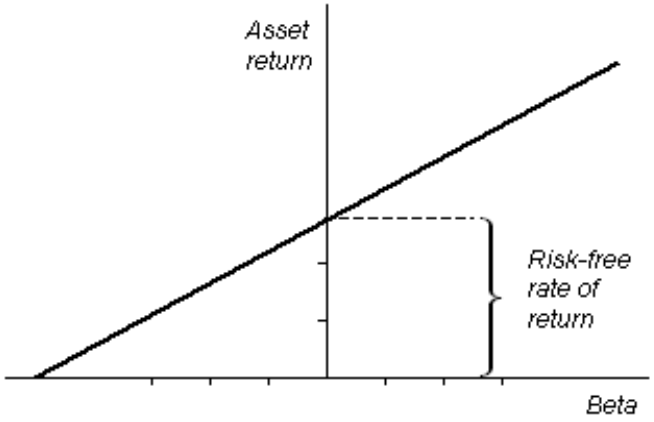

Figure 4.1 Security Market Line
Source: EDinformatics

[1] The CAPM as presented here relies on various restricted assumptions namely that all investors aim to maximize economic utility and: are rational and risk-averse; are price takers, i.e., they cannot influence prices; can lend and borrow unlimitedly under the risk free rate of interest; trade without transaction or taxation costs; deal with securities that are all highly divisible into small parcels; assume all information is at the same time available to all investors; measure risk by standard deviation; have a single-period investment time horizon and all have the same expectation.

By definition, the market itself has an underlying beta of 1.0, and individual stocks are ranked according to how much they deviate from the market. A stock that is more volatile than the market over time, has a beta whose absolute value is above 1.0. On the other hand, if a stock moves less than the market, the absolute value of the stock's beta is less than 1.0 (McClure, 2009). As an example, a stock that has a beta of 2 follows the market in an overall decline or growth, but does so by a factor of 2; meaning when the market has an overall decline of 3% a stock with a beta of 2 will fall 6%. Betas can also be negative, meaning the stock moves in the opposite direction of the market: a stock with a beta of -3 would decline 9% when the market goes up 3% and conversely would climb 9% if the market fell by 3%.

As a result, it can be concluded, and this applies to rises and falls, that high beta shares (beta >1) are more volatile and are therefore considered to be riskier, but are in turn supposed to provide a potential for higher returns. Low beta shares (beta <1) are less risky but tend to underperform the return on the market portfolio (Cariou, 2009).

The systematic risk is caused by factors that affect the prices of virtually all securities, although in different proportions (e.g. changes in interest rates, consumer prices, etc.), and can be related to three main determinants:

1. The sensitivity of the company's revenues to the general level of economic activity and other macro-economic factors;
2. The proportion of fixed to variable costs; and
3. The level of financial gearing and leverage, that is, the amount of interest bearing debt compared to shareholders equity (Cariou, 2009).

On the other hand, unsystematic risk is a risk specific to an industry or firm (e.g. losses caused by labour problems, weather conditions, etc.) and can be reduced by assembling a portfolio with significant diversification so that a single event affects only a limited number of the assets (Scott, 2003).

To conclude, the main addition from the CAPM to the portfolio theory is to suggest that instead of focusing on the relationship between two projects for instance Capesize versus Handymax (as it was done in the previous chapter when dealing with various earnings on bulk markets), the return for a specific security j should be assessed in comparison with all other assets on the stock market. The next sections will apply such methodology in providing first a descriptive analysis of the characteristics and returns of 21 listed shipping companies in bulk and tanker markets that were selected (section 4.2), and then, in estimating the beta-value of these companies.

4.2 Descriptive Statistics of Dry Bulk and Tanker Companies

A total of 21 shipping companies have been selected and are listed on five different stock exchanges in Europe and the United Stated of America. These companies have been chosen as they are mainly active in shipping and they have developed different strategies over the years (specialisation versus diversification). The results could then be related to the analysis carried out in Chapter 3, stressing that it can be expected that a company specialised in dry bulk activities should be subject to more earnings and exposed to more risk (standard deviation in earnings), the latter being mainly systematic (beta-value).

The earnings for these companies are based on the average of their weekly share prices from December 2005 to June 2009 (186 observations). December 2005 was selected for reason of consistency when comparing different companies and knowing that it is the earliest date for which the share prices are available for all the 21 companies. In order to compare the various share prices, data were transformed using an index value based on 100 for December 2005. Creating the index was imperative as stock exchange markets operate in different currencies and to convert share prices into one currency would have created the problem of then having to factor in the weekly average exchange rates for each currency and inflation.

The discussion on the 21 different shipping companies selected will be done in grouping them according to the markets on which they are listed. Five different

markets were used to retrieve the share value of shipping companies: NASDAQ (4 companies) and NYSE (7) for New York, OSL (4) in Oslo, CSE (4) in Copenhagen and EURONEXT (2) in Bruxelles/Paris/Amsterdam.

Starting with companies listed on the NASDAQ, 4 companies were selected: Golar LNG Ltd, DryShips Inc., TopShips Inc. and FreeSeas Inc. (see Figure 4.2).

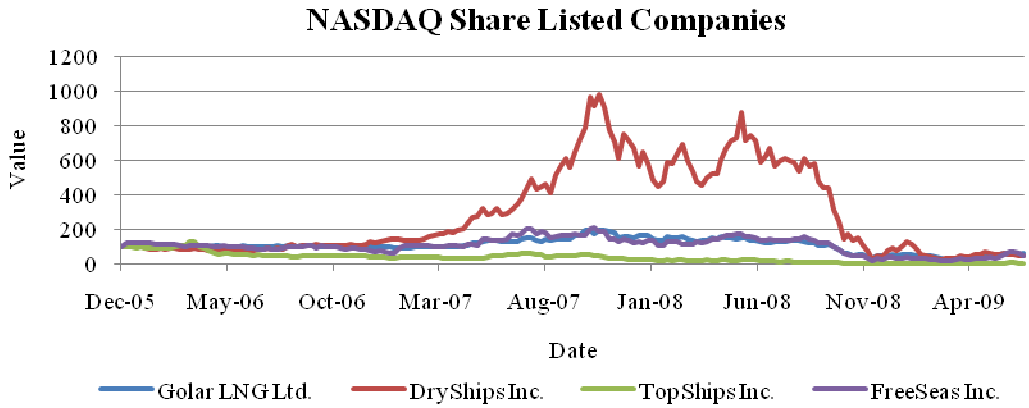

Figure 4.2 NASDAQ Share Listed Companies, 2005-2009
Source: Author and Google Finance

Table 4.1 Summary Statistics of NASDAQ Share Listed Companies.

Company	Mean points/week	Standard Deviation points/day	% mean
Golar LNG Ltd	107	39	36%
DryShips Inc.	287	255	89%
TopShips Inc.	36	28	78%
FreeSeas Inc.	105	45	43%

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

DryShips Inc. has the most imposing figures both in terms of earnings (287 point), and consequently as expected in terms of % of standard deviation to mean ratio (89%). DryShips Inc. also had the highest mean, more than twice that of Golar LNG Ltd. and Free Seas Inc.; this result is mainly explained by performances during 2007 and 2008 that proved to be a bumper year with the share index value reaching 982, more than four times the highest value of FreeSeas Inc. This volatility showed statistically, as based on the mean earnings plus three standard deviations, 99% of the time share value would not exceed 872 points.

A further investigation on the characteristics of DryShips Inc. stresses that the company owns, through its subsidiaries, a fleet of 37 dry bulk carriers amongst which seven are Capesize vessels, 14 Panamax and three Supramax, totalling over three million deadweight tons (DryShips Inc., 2009). The company has diversified slightly through its subsidiaries, which own and operate two ultra-deep water, harsh environment, semi-submersible drilling rigs (Thomson Reuters, 2009).

The company employs its dry bulk vessels under period time charters, on bareboat charters, in the spot charter market and in dry bulk carrier pools, which combine spot market voyages, time charters and contracts of affreightment with freight forward agreements for hedging purposes and to perform vessel scheduling (DryShips Inc., 2009).

Golar LNG proved to have the lowest standard deviation as a percentage of the mean index value, at 36%. Furthermore, the company proved to be fairly stable over the three and a half years, whilst still benefitting from the market boom throughout 2007 and 2008. The mean value of 107 was also more representative of the range of the index value which fell to 22 and rose to 196. The company is engaged in the acquisition, ownership, operation, and chartering of Liquid Natural Gas (LNG) carriers, Floating Storage Re-gasification Units (FSRU) and Floating Power Generation Plant (FPGP) through its subsidiaries, and the development of liquefaction projects. On July 10th 2009, the company's fleet consisted of 13 vessels and a 50% equity interest in a LNG carrier. Vessels are contracted under long-term charters and medium-term, five-year market related charter contracts with Shell. The Golar Mazo, which is jointly owned with the Chinese Petroleum Corporation, is under an 18 year time charter that expires in 2017 (Thomson Reuters, 2009).

TopShips Inc. is worth mentioning, and not for the best of reasons. The mean value was considerably lower than the other companies, yet the company still experienced a 78% standard deviation. More importantly, while all other companies took advantage of the recent super-cycle which translated in higher stock value, TopShips Inc.'s share value showed a steady decline from 2007 to 2009.

This is a relatively diversified shipping company, operating in the two bulk segments: tanker and dry bulk. As of July 27, 2009, the company's fleet consisted of 18 vessels: three Panamaxes, two Handymaxes and eleven Products, with a total carrying capacity of over 0.8 million dwt (Thomson Reuters, 2009). The Product tankers are normally chartered to carry refined petroleum products or crude oil but are geared to transport chemicals also (TOP Ships Inc., 2008).

In order to optimise return on investments their strategy claims to be focused on diversification of their fleet by sector and size segments. Their fleet deployment strategy includes a mix of both period time charters and spot market voyage charters (TOP Ships Inc., 2008).

Finally, FreeSeas Inc. specialises in the dry bulk sector, operating nine vessels through wholly owned subsidiaries. The company focuses on the Handysize and Handymax sectors with an aggregate dwt tons of approximately 268,166 (Thomson Reuters, 2009). FreeSeas employs its vessels in a combination of spot charter market, period time charters and in dry bulk carrier pools and this varies in order to create a balance between a predictable cash flow while also trying to maximise profits during cyclical booms (Free Seas Inc., 2009). Free Seas Inc. shares had a mean of 105 points, higher than that of TopShips over the last three and a half years. Share value peaked in 2007, in line with many shipping companies as the BDI was booming.

Turning to NYSE, seven shipping companies were selected. Figure 4.3 represents the development in their share value from December 2005 to July 2009, while Table 4.2 presents their performance in terms of mean value of index (base 100 in December 2005), standard deviation and % of standard deviation to mean value.

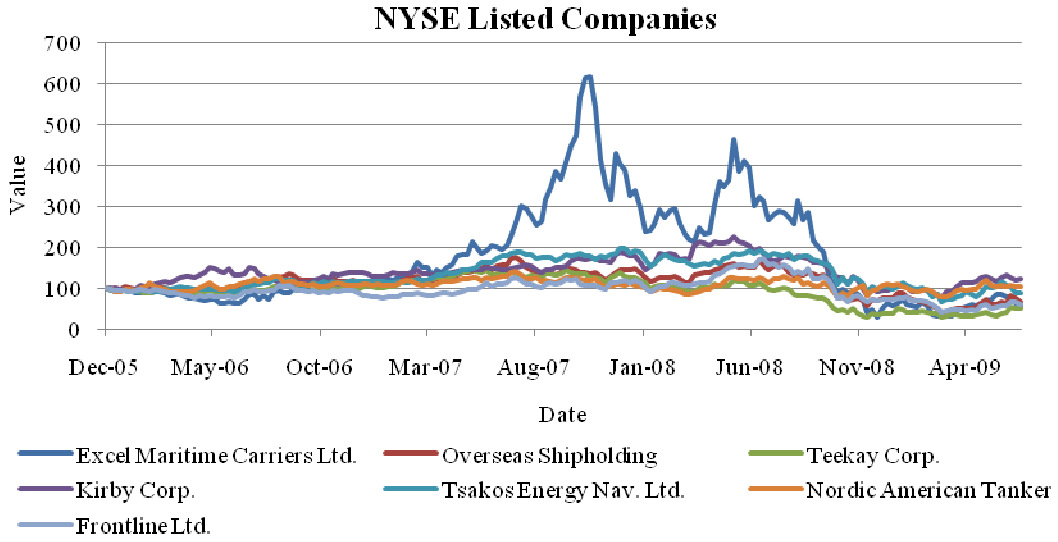

Figure 4.3 NYSE Share Listed Companies, 2005-2009
Source: Author and Google Finance

Table 4.2 Summary Statistics of NYSE share listed companies.

Company	Mean points/day	Standard Deviation points/day	% mean
Excel Maritime	175	127	73%
Overseas Hlding	113	31	27%
Teekay Corp.	93	32	34%
Kirby Corp.	140	32	23%
Tsakos Energy	133	37	28%
Nordic American	108	13	12%
Frontline Ltd.	96	27	28%

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

Excel Maritime Carriers Ltd. specialises in owning and operating dry bulk cargo vessels worldwide. As of 16th June 2009, the company's fleet totalled 47 vessels, consisting of five Capesize, 14 Kamsarmax, 21 Panamax, two Supramax and five Handymax, with a total carrying capacity of approximately 3.9 million dwt tons. The employment strategy for the vessels is a combination of spot market fixtures and long term charters. The large majority of vessels are fixed on long term charters and in recent years, some 17 vessels have been chartered to one single charterer and accounted for approximately 23% of Excel's earnings in 2008 (Excel Maritime Carriers Ltd, 2005).

Throughout 2007 and 2008 Excel Maritime clearly outperformed the other selected shipping companies from the NYSE. Throughout this two year boom Excel Maritime share value reached a peak of 615 points on the index, more than twice the peak Kirby Corporation reached throughout this period. The mean value of Excel Maritime for the entire three and a half years was 175 points, well below the peak reached during the boom, which indicates that 2007 and 2008 was truly an extraordinary period for the company.

However, Excel Maritime also had the highest standard deviation, which stood at 75% of the mean. To put this into perspective, the second most volatile company is Teekay Corporation which had a standard deviation of 34% of the mean – considerably lower than Excel Maritime. Though, Teekay's mean share average was also substantially lower at 93 index points.

Teekay Corporation is quite different to Excel Maritime, both with regard to the shipping sectors in which it operates and the shipping strategy utilised. The company provides marine services to the oil and gas companies, helping them link their upstream energy production to their downstream processing operations. It operates in four business segments: offshore segment, liquefied gas segment, spot tanker segment and fixed-rate tanker segment. As of August 2009, Teekay had a total fleet of 169, which includes managed vessels. This includes one VLCC, 28 Suezmaxes, 50 Aframaxes, 13 Product tankers, 40 Shuttle tankers, six Liquid Petroleum Gas (LPG) carriers, 19 LNG carriers, five Floating Production, Storage and Offloading (FPSO) units and five Floating Storage and Off-take (FSO) units (Teekay Corporation, 2009). Teekay also jointly owns with A/S Dampskibsselskabet TORM, OMI Corporation, an international owner and operator of tankers.

Teekay fixes its various crude oil tankers and product carriers on a spot-market basis or short-term, fixed rate contracts (contracts with an initial term of less than three years) and on long-term, fixed-rate, time charter contracts. Some of these vessels also form part of three pools, which are either solely or jointly managed by Teekay. The company earnings for 2007 put the importance of each sector into perspective.

The offshore segment accounted for approximately 47% of net revenues; 9% from liquefied gas segment; 34% from the spot tanker segment and 10% from the fixed-rate tanker segment (Thomson Reuters, 2009).

The least volatile of all the 21 companies is Nordic American Tanker Shipping Limited with only 12% volatility when compared to the mean share value. The share index produces some interesting results which justify the stability of the company's value. While the share price never reached the peaks reached by the other companies, neither did the shares dip to the low levels of the other companies. This means that the company traded within the narrowest share value range of all the companies and that the mean value of 108 points is indicative of the overall value throughout the period. The company is an international tanker company that owns and operates a fleet of double-hull Suezmax tankers averaging approximately 155,000 dwt tons each. As of 27th July 2009, the company owned 13 tankers with a chartering policy that has certain ships on the spot market and others fixed for long term charters, usually to oil majors (Nordic American Tanker Shipping, 2009).

The remaining four listed companies showed similar activity throughout the period under scrutiny. All experienced a standard deviation of between 23%-27% of the respective companies' mean, which ranged from 96 to 140 points. These companies all had relatively similar shipping strategies, spreading out assets within the overall tanker sector. Kirby Corporation is worth mentioning, for the highest mean of this cluster of companies with the lowest standard deviation. An explanation for the company's good performance is that it has business interests outside marine transportation services.

The company's diesel engine services segment is engaged in the overhaul and repair of medium-speed and high-speed diesel engines and reduction gears, and related parts sales through Kirby Engine Systems, Inc., a wholly owned subsidiary of the company.

In the shipping branch of the company, their strategy focuses on inland transportation of petrochemicals, black oil products and agricultural chemicals by tank barges, which require some highly specialised vessels and the offshore transportation of dry bulk cargoes by barge. The following is Kirby Corp.'s fleet as of February 2009: 914 active inland tank barges and four offshore dry cargo barges which provide the freight services and 234 active inland towboats, four offshore tugboats and one offshore shifting tugboat provide the power source. With regards the tank barges, 868 are owned by the company and 46 leased (Thomson Reuters, 2009).

Tsakos Energy Navigation Limited provides international seaborne transportation of crude oil, petroleum products and also LNG. Through its subsidiaries, the company owns a fleet of 46 double-hull tankers and one LNG. Three VLCCs, ten Suezmaxes and eight Aframaxes are dedicated to the transportation of crude oil, while three Aframaxes, thirteen Panamaxes and eight Products tankers are involved in the clean/products trade, approximately 4.9 million dwt and an average age of 6.3 years (Tsakos Energy Navigation Limited, 2009). The company operates its vessels worldwide, for national and other independent oil companies and refineries under long, medium and short-term charters (Thomson Reuters, 2009).

Frontline Limited's core business is the ownership and operation of vessels within the two larger tanker markets and oil/bulk/ore (OBO) carriers. The company makes use of different financing mechanisms to ensure fleet growth and also charters in vessels and commercially manages vessels for third parties. As of August 2009 Frontline's fleet therefore included, 46 VLCCs, 30 Suezmaxes and 8 OBOs (Frontline, 2009).

With regard to their shipping strategy, the company fixes its vessels on the spot market, time charters of varying length and Contracts of Affreightment (COA) (Thomson Reuters, 2009).

Overseas Shipholding Group, Inc. is a bulk shipping company engaged primarily in the ocean transportation of crude oil and petroleum products. As of 30th April 2009,

the company owned and operated 120 vessels. 98 of these vessels are spread out over all tanker sectors, FSO units and LNG carriers, which are operated in the international market. Another 22 vessels are operated in the United States Flag market (Overseas Shipholding Group, Inc., 2009). Overseas' vessel operations are organized into business units and focused on market segments, each of which serves crude oil, refined petroleum products, United States Flag vessels and gas. The company employs a portfolio mix of owned and chartered-in vessels, and fixes them on spot and time charters based on market dynamics and contributes to various tanker pools (Overseas Shipholding Group, Inc., 2009).

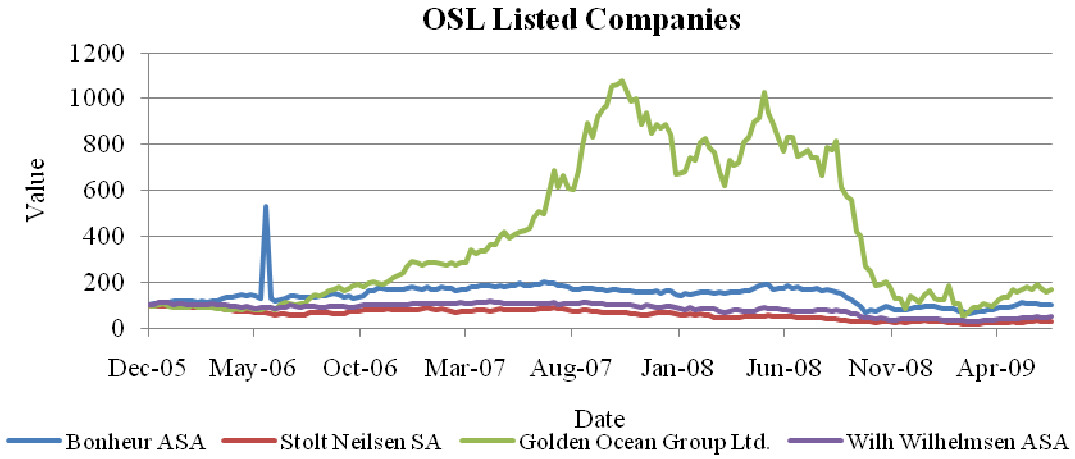

Figure 4.4 OSL Share Listed Companies, 2005-2009
Source: Author and Google Finance

Table 4.3 Summary Statistics of OSL share listed companies.

Company	Mean points/day	Standard Deviation points/day	% mean
Bonheur ASA	145	46	32%
Stolt Nielsen SA	60	23	38%
Golden Ocean	397	313	79%
Wilh Wilhelmsen	84	26	31%

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

Golden Ocean Group Limited is primarily involved in the ownership and operation of dry bulk vessels. The company owns ten Capesizes, ten Panamaxes and eleven Kamsarmaxes. The fleet is further supplemented by one Capesize, 13 Panamaxes and one Kamsarmax, which are either chartered in on a minimum of three months or

on bareboat charter. Golden Ocean also commercially manages vessels for third parties and currently operates two Capesizes and eight OBOs, purely for dry cargo transportation (Golden Ocean Group Limited, 2009).

As part of the company's strategy, Golden Ocean uses a combination of spot market fixtures and period charters of varying lengths to maximise returns. Forward freight agreements are traded for the purpose of managing exposure of vessels to spot market rates and for speculating. It is also part of the company's strategy to seek financing for vessels, which includes an attractive combination of debt and equity.

Without a doubt Golden Ocean Group Limited is the company that performed the best throughout the period being analysed. Barring a brief period in February 2009, from September 2006 through to June 2009 Golden Ocean share value was above that of the other three companies taken from the Oslo Stock Exchange. Like many other shipping companies in the dry bulk sector, Golden Ocean experienced a massive boom throughout 2007 and 2008 as the super-cycle was in full swing.

Throughout the last three and a half years Golden Ocean shares had a mean index value of 397 with a daily fluctuation of 313 points per day. Therefore, with a 79% standard deviation of the mean, Golden Ocean was more than twice as volatile as any of the OSL listed companies. However, the heights reached by Golden Ocean's shares were also more than twice as high as those of the next highest, which were of Bonheur ASA.

On the other hand, despite having a better mean value and reaching greater share values than Stolt Nielsen SA, Wilh Wilhelmsen ASA proved to be the least volatile investment throughout the entire period being analysed. However, it is fair to say that Bonheur ASA, Stolt Nielsen SA and Wilh Wilhelmsen ASA could all be regarded as similar investments in this respect as the standard deviation for each company was between 31% and 38% of the mean value. Even with regard to their company strategies, they have all opted for a highly diversified business portfolio with investments not exclusively kept to seaborne transportation.

Before going into Bonheur ASA's share statistics, reference must be made to the rapid and brief spike in share value in the last week of May 2006, as this episode distorts the results slightly. The only available reason for this irregular index activity is that Bonheur was planning two consecutive 4:1 stock splits, which were concluded within a week, when the share price dropped once again. Bonheur ASA fared the best of the three companies, with a mean share index of 145 over the last three and a half years, with a standard deviation of 46 points. Without this brief episode the range of share values would be much narrower with a lower standard deviation.

Bonheur's investments are largely carried out jointly with Ganger Rolf ASA and currently have direct or indirect ownership of Fred. Olsen Energy ASA (offshore drilling); Fred. Olsen Production ASA (floating production); Fred. Olsen Renewables AS (renewable energy); Fred. Olsen Cruise Lines Ltd. (cruise industry); First Olsen Ltd.; OceanLink Ltd. and Windcarrier AS (shipping). Bonheur also has investments in media, property and fish farming. The floating production and transportation services are focused on the tanker sector (Bonheur ASA, 2009).

Wilh. Wilhelmsen ASA is engaged in the provision of logistics solutions and maritime services internationally. The company conducts industrial shipping activities, and is engaged in the transportation of rolling cargo. Together with its partners, the group controls 160 car and roll-on, roll-off carriers, operating in a global network of trades (Thomson Reuters, 2009). Vessels are deployed on predetermined routes or routes tailored to customers' needs, which include manufacturers of cars, construction and agricultural machinery. The vessels are either owned or chartered-in and deployed in the fleets operated by subsidiaries. Wilh. Wilhelmsen also offers on-land terminal and technical, inland transport procurement and supply chain management services (Wilh. Wilhelmsen, 2009).

Finally, Stolt-Nielsen SA's business interests include bitumen services, sea farms, tank containers, tankers and terminals. The tanker interests centre on the worldwide transportation, storage, and distribution of bulk liquid chemicals, edible oils, acids, and other specialty liquids (Thomson Reuters, 2009). As of June 2009, Stolt Nielsen

fleet totalled 141 vessels, equivalent to more than 2.2 million dwt. The fleet is employed on a combination of spot market fixtures, time charters and within pools (Stolt Nielsen SA, 2009).

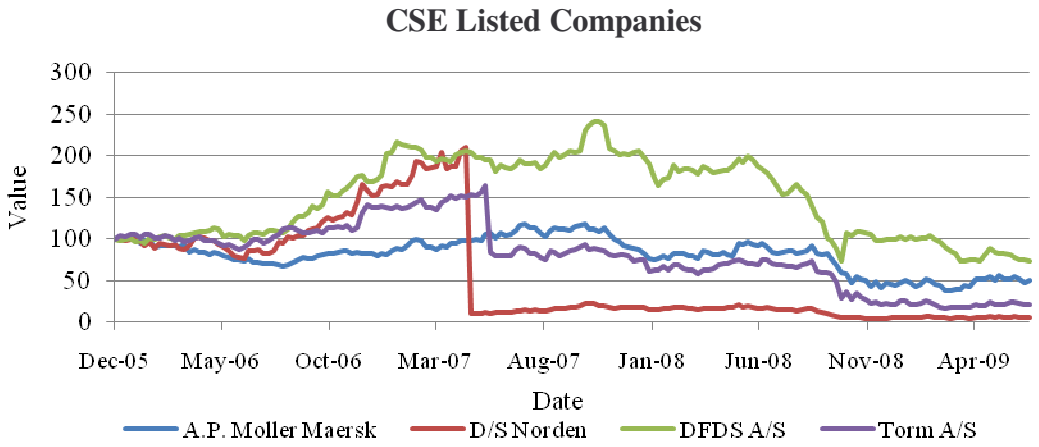

Figure 4.5 CSE Share Listed Companies, 2005-2009
Source: Author and Google Finance

Table 4.4 Summary Statistics of CSE share listed companies.

Class of Vessel	Mean points/day	Standard Deviation points/day	% mean
A.P. Moller Maersk	82	20	24%
D/S Norden	56	60	107%
DFDS A/S	148	48	32%
Torm A/S	81	38	47%

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

What is impressive about these four shipping companies listed on the Copenhagen Stock Exchange is that three of the companies share value fell below the one hundred point base rate during the height of the super-cycle. A.P. Moller Maersk, D/S Norden and Torm A/S all began 2008 below the December 2005 value. Throughout 2006 and 2007 all four companies were on a steady recovery which was only sustained by DFDS A/S. All four companies have adopted diversified shipping strategies, albeit to different extents.

Without a doubt, A.P. Moeller-Maersk A/S is probably the most widely diversified company of all with business interests in banks, airlines, retail services, steel yards, logistics services, which in all comprise approximately 1,100 companies in 130

countries. Their maritime business interests are just as diversified, including marine transportation, oil production, terminals and shipbuilding (Thomson Reuters, 2009).

Even when focusing purely on marine transportation, the same diversified strategy has been utilised. Maersk Line, a fully owned subsidiary, is the largest individual owner and operator of container vessels, ranging from feeder size to the largest Post-Panamax class in operation. Other vessels that are owned and/or operated include 76 tankers spread out over all sectors, 22 Gas Carriers and 5 LNG carriers. Other subsidiaries own drillships, FPSOs and supply vessels (Maersk Tankers, 2009). This diversification shone through the results as A.P. Moller Maersk proved to be the most stable of all with a standard deviation of 20 points per day and a mean value of 82 points. The company's shares also traded within the narrowest range of the CSE listed companies reaching a low of 39 points and rising to 119 index points.

Dampskibsselskabet Norden A/S and Torm A/S share some common elements in their shipping strategies. They have both chosen to focus their business concerns on marine transportation and have chosen quite a diversified portfolio within this business sector. Both companies own and/or operate vessels in both the dry bulk and tanker sectors and have also undertaken the same business strategy with regard to ownership of vessels and augmentation of the operating fleet.

Norden A/S operates a fleet of 100 vessels comprising five Capesizes, 24 Panamaxes, 34 Handymaxes, and 12 Handysizes in the dry bulk sector; and three Aframaxes and 30 Products in the tanker market (Dampskibsselskabet NORDEN A/S, 2009). As can be seen the company has chosen a diversified size-segment strategy within both bulk sectors. The core fleet is owned by the company and is further supplemented with long-term charters and short-term charters, as well as with vessels chartered for individual voyages. The product tanker activities are operated through the Norient Product Pool, which is managed by the 50%-owned Norient Product Pool A/S (Thomson Reuters, 2009).

Despite this diversified strategy, the most drastic collapse is witnessed in this company's share value, in April 2007, falling 200 points. However, it must be noted that the company implemented a 20:1 stock split during this period, which is most probably the cause of this freefall. Furthermore, this episode may have contributed to the company having the lowest mean value of all the CSE listed companies, while having an incredible standard deviation of 107%, making this company the most volatile in this respect.

Torm A/S was another company that experienced a considerable drop, with a 49% decrease in share value in May 2007, decreasing from 165-85 index points. Share value continued to decrease slightly for just over a year before another drop in value was experienced as the effects of the economic crisis began to be felt in October 2008. These sudden decreases contributed to an overall mean of 81 index points per day with 47% volatility.

As stated above, Torm A/S is involved in the ownership and operation of vessels that carry both wet and dry commodities. The company operates all its vessels worldwide but have different asset portfolio strategies for the tanker and dry bulk sector. The dry bulk department is much specialised, with seventeen Panamaxes, ranging between 69,000-84,0000dwt, on their books (Torm A/S, 2009). A different strategy to that utilised by Norden A/S. The tanker portfolio strategy on the other hand is based on diversification. Torm operates 57 Handymaxes, 28 Panamaxes, and 43 Aframaxes which are mainly employed for the transportation of refined products (Torm A/S, 2009). This fleet comprises vessels that are fully owned and chartered-in on short and long-term time charters. It also includes vessels that are commercially managed by Torm as the manager of a pool or through contracts with third-party owners. Up till the end of 2008, the company owned just over 50% of the fleet and chartered in about 20% of the vessels. The rest of the fleet was commercially managed for third-party owners and charterers (Thomson Reuters, 2009).

The company has been constantly developing a strategy to become a more globalised company in order to gain access to more markets, with an increased focus on time charters and paper trading (Torm A/S, 2009). By forming part of pools the company can achieve its desire to expand as pools offer flexibility and ensures that there is ample tonnage in the major regions. It is no coincidence that Torm operates the largest product tanker pool in the world (Torm A/S, 2009).

Finally, DFDS A/S is worthy of a mention for three reasons. To begin with it was the only company whose share value showed the prosperity of the market from 2006 to mid-2008, albeit with substantial volatility. Secondly, the impact of the financial crisis seemed to have had an effect on DFDS share prices a few weeks prior to the other listed companies. DFDS share value began to decrease in the first week of August 2009 while the other companies and the S&P500 index continued to rise for the next three weeks. Lastly, following this initial decline, DFDS share value recovered slightly hovering around the hundred mark base rate before dipping once again in February 2009. DFDS shares seemed to have shown more resilience to market conditions than other companies.

DFDS A/S is engaged within five business areas, which extend beyond sea transportation. The Ro-Ro shipping, the container shipping and the passenger shipping are responsible for activities in the route network, while the terminal services and the trailer services support the network by port terminal operations and trailer activities (Thomson Reuters, 2009). The entire fleet therefore consists of a wide array of vessels, namely 23 freight vessels, five passenger ships, eight side-port/container ships, seven container ships, ten tramp vessels and 16 tourist boats (DFDS A/S, 2009). It is also worth mentioning, that unlike almost all the other companies, DFDS's operations are very region specific, concentrating on routes between Scandinavian countries and the United Kingdom. The average share value was 148 for the entire period, with a 32% volatility – which is at the lower end of the scale when compared to the 20 other companies being analysed.

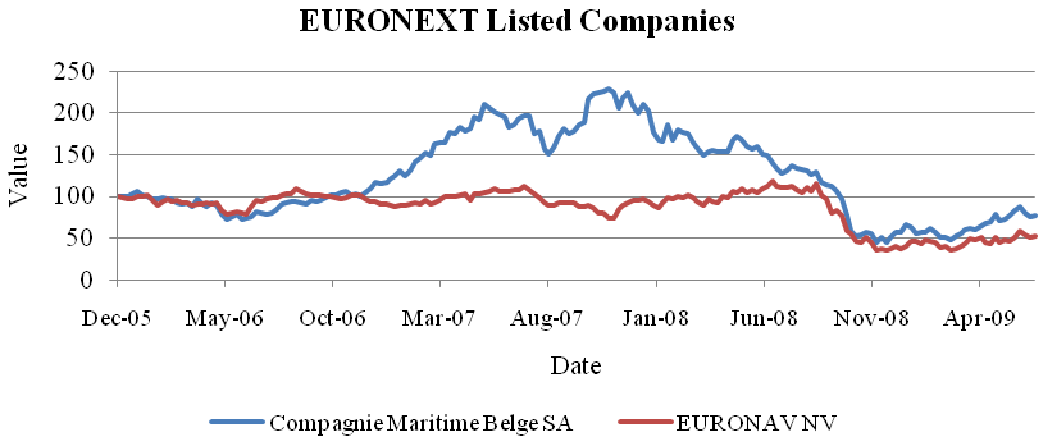

Figure 4.6 EURONEXT Share Listed Companies, 2005-2009
Source: Author and Google Finance

Table 4.5 Summary Statistics of EURONEXT share listed companies.

Class of Vessel	Mean points/day	Standard Deviation points/day	% mean
CMB SA	124	51	41%
EURONAV NV	86	23	27%

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

EURONAV NV owns and operates a fleet of modern large tankers. The management of the fleet is carried out through various fully owned subsidiaries, and these services are also extended to third parties. Therefore, the fully owned fleet is augmented by vessels that are chartered-in. EURONAV's core fleet has an average age of just over five years (Thomson Reuters, 2009). The total fleet as at August 2009 comprised of 17 VLCCs, 24 Suezmaxes and two FSO units employed on a mix of spot market fixtures and time charters (EURONAV NV, 2009). EURONAV shares proved to be the least volatile over the three and a half year period under scrutiny, with a standard deviation of 27% of the 86 point mean. This compares to Compagnie Maritime Belge SA, which had a standard deviation of 41% of the 124 point mean.

Compagnie Maritime Belge SA, also known as CMB, is engaged in the sea transportation of dry bulk goods through its wholly owned subsidiary, Bocimar. As of 29th July 2009, its fleet consisted of 16 wholly or partially owned vessels, 14 of

which are Capesizes, one Handymax and one Handysize. Through another subsidiary they also own 50% of a Panamax tanker (Compagnie Maritime Belge SA, 2009). However, CMB, through other subsidiaries is also involved in aviation operations, services and leasing activities, real estate and logistics services (Thomson Reuters, 2009). While EURONAV shares traded within a much narrower range, at no time did they reach the share value highs of Compagnie Maritime Belge, which rose to almost twice those of EURONAV.

4.3 Estimation of Beta Value of Dry Bulk and Tanker Companies

As stated in section 4.1, the entire market has an underlying Beta (β) value of 1.0 while the existence of systematic risk for a company might explain why its beta value might be more or less than 1. This last section estimates the beta value of the 21 shipping companies as described in the previous section (4.2) using the S&P 500 Index as representative of the overall market performance. The estimation of the beta value was derived (section 4.1 equation Y) using statistics on the total risk for a specific company measured by the standard deviation (σ_j), the risk on the market (σ_M) and on the correlation coefficient between the asset j and the market M (p_{jM}) from December 2005 to June 2009 so that:

$$\beta_j = \frac{\sigma_j p_{jM}}{\sigma_M}$$

The results (Table 4.6) using S&P 500 as index for the market for the 21 companies listed on various stock market from December 2005 to June 2009 are presented in Table 4.6.

Table 4.6 Summary Statistics of Listed Companies.

Company	Index	Correl-Coef	Systematic Risk	Beta Value	Stock market
Golden Ocean	**S&P500**	55%	171	9.72	OSL
DryShips Inc.	**S&P500**	54%	136	7.74	NASDAQ
Excel Maritime	**S&P500**	61%	77	4.90	NYSE
EURONAV	**S&P500**	86%	74	4.19	Euronext
CMB	**S&P500**	82%	41	2.35	Euronext
DFDS A/S	**S&P500**	81%	38	2.18	CSE
FreeSeas Inc.	**S&P500**	84%	38	2.14	NASDAQ
Teekay	**S&P500**	96%	31	1.98	NYSE

Golar LNG Ltd.	**S&P500**	86%	34	1.91	NASDAQ
Bonheur ASA	**S&P500**	70%	32	1.80	OSL
Overseas	**S&P500**	87%	26	1.69	NYSE
Torm A/S	**S&P500**	77%	29	1.66	CSE
Tsakos Energy	**S&P500**	62%	23	1.45	NYSE
Wilh Wilhelmsen	**S&P500**	91%	23	1.33	OSL
D/S Norden	**S&P500**	35%	21	1.20	CSE
Kirby Corp.	**S&P500**	58%	19	1.19	NYSE
A.P. Moller	**S&P500**	91%	19	1.06	CSE
Frontline Ltd.	**S&P500**	60%	16	1.03	NYSE
Stolt Nielsen SA	**S&P500**	77%	17	0.99	OSL
TopShips Inc.	**S&P500**	49%	13	0.77	NASDAQ
Nordic American	**S&P500**	58%	7	0.46	NYSE

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

Concentrating on the top of the table, it appears that the OSL listed company Golden Ocean Group Limited was the one performing the best on all markets (see previous section), and is also found to have the highest beta value (9.72). It was not, however, the company with the highest standard deviation (standard deviation of 79% to the mean share value against 89% for Dryship.inc). This result is in-line with theory suggesting that companies with higher standard deviation are not automatically the one with the highest return, as a part of this risk could be diversified away. The two following companies found with high systematic risks are DryShip.Inc (beta value of 7.74) and Excel Maritime Ltd. (beta value of 4.90).

It is interesting to notice that the first three companies do share one common element as shown in the previous section. They have all employed similar strategies, that is, they are all specialised in the dry bulk market with the majority of vessels all above 70,000dwt. All three companies fixed their vessels on a combination of long-term time charters and on the spot market. This result appears to confirm conclusions from the former chapters on the behaviour of earnings of the dry bulk market. It was stated that due to the characteristics of these markets, they move in a similar way (between spot and time charter as well as between different vessel size), making differentiation difficult to achieve whilst retaining high returns.

Interestingly EURONAV NV, is the only company specialised in the tanker sector that has a strong correlation with the overall market and still has a beta value of more

than four. This is in stark contrast to the three specialised dry bulker companies. However, it must be remembered that EURONAV share values were nowhere close to those of Golden Ocean, DryShips or Excel Maritime.

CMB, DFDS and FreeSeas all have a beta value above two and shared a strong correlation with the S&P500. CMB and DFDS are both highly diversified companies and the lower risk and close correlation with the market is a reasonable outcome. The results of FreeSeas Inc. are more surprising as the company is highly specialised in the Handymax and Handysize sectors.

Many companies which have a beta value between 1.0 and 1.99, all shunned specialisation to a certain degree. Kirby, A.P. Moller, Wilh. Wilhelmsen and Bonheur are all highly diversified in many sectors which include both seaborne transportation and non-related industries. The fleets owned and operated by Torm A/S and Norden are made up of various dry bulk carriers and various tankers, which indicates a high degree of diversification within the seaborne transportation industry. Teekay, Overseas and Frontline adopted a strategy of diversification, operating vessels within tanker sectors, supplemented by OBOs, FSOs, LNG and LPG carriers.

Tsakos Energy and Golar LNG were the only companies which specialised though the explanation for the low beta value is the very long term charters under which both companies operate their vessels are operated.

A similar picture emerges for two of the companies that underperformed when compared to the entire market. Stolt Nielsen SA and TopShips Inc., as is seen earlier, both adopted diversified shipping portfolios.

Nordic American Tanker Shipping Limited returned the most surprising results. with a beta value of 0.46. As was discussed above the company is highly specialised in the tanker sector, owning and operating 13 double-hull Suezmax tankers averaging approximately 155,000 dwt each. The chartering policy was to operate certain ships on the spot market while fixing other vessels for long term charters, usually to oil majors. Nordic American was the company that experienced the least volatility

throughout the three and a half year period, with only 12% standard deviation, which is considerably lower than the volatility experienced by any other company that was analysed. The company's share value also fluctuated within the narrowest range of all the listed companies, with only 67 index points between either ends of the share value. Once more, this result seems to be consistent with former findings from Chapter 3, stressing that due to tanker market characteristics, risk reduction through specialisation could be achieved, which could explain low beta values (and low earnings) for companies operating and specialising their activities within this sector.

4.4 Application of Capital Asset Pricing Model

Having analysed the systematic risk associated with each company, by determining the correlation between each company and the overall market, the next step is to establish the most appropriate portfolio for a certain type of investor. This will be determined on the basis of a two asset portfolio, that is, to split portfolio in x=50% in A and (1-x)=50% in B. From the 21 companies that have been analysed, 210 possible portfolios (Annex B) are available to an investor. The most worthwhile investments would differ according to the type of investor. A risk averse investor would look at very different aspects of a particular portfolio than say an investor who is more inclined to taking risks.

If an investor is risk averse, than the parameters to determine the most appropriate portfolio would be based on the lowest standard deviation, that is, the risk involved. In order to compare risk of the various portfolios the standard deviation was taken as a percentage of the expected returns. The results of the five portfolios with the lowest percentage were selected and presented in the Table 4.7.

Table 4.7 Portfolios with the Lowest Standard Deviation.

Companies	% Invest.	E(Return)	Variance	StD	% StD
Nordic American	50%	94.57	213.64	14.62	15%
A.P. Moller	50%				
Nordic American	50%	123.78	370.02	19.24	16%
Kirby Corp.	50%				
Nordic American	50%	96.72	239.77	15.48	16%
EURONAV	50%				
Nordic American	50%	101.74	309.73	17.6	17%
Frontline	50%				

Nordic American	50%	83.82	211.75	14.55	17%
Stolt Nielsen	50%				

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

Immediately, it is discernible that each of the portfolios includes Nordic American, the company which underperformed compared to the overall market and with the lowest beta value of all the companies at 0.46. Furthermore, apart from the portfolio that includes EURONAV N/V, all portfolios combine companies with some of the lowest beta values.

It also, transpires that the expected returns do not necessarily increase as the risk increases. Therefore, the first two portfolios would be most likely considered by a risk averse investor. The third, fourth and fifth portfolios would not be worthwhile, as the other two portfolios could ensure more earnings with less risk.

To begin with, the portfolio that includes investments in Nordic American Tanker Shipping Limited and A.P. Moller Maersk has the lowest standard deviation as a percentage of expected returns. As was outlined above, A.P. Moller Maersk is a highly diversified company, while Nordic American has adopted the complete opposite strategy, specialising in the Suezmax tanker sector. Looking at the individual companies in detail, the low beta values for both companies is a justification for the low risk factor of the portfolio. While A.P. Moller Maersk had a beta value of 1.06, which is practically equivalent to that of the entire market, the Nordic American beta value was below that of the market. Furthermore, share prices for both companies had the lowest share volatility as a percentage of all the companies (Nordic American 12%; A.P. Moller Maersk 24%).

Further, A.P. Moller Maersk has one of the highest correlations with the S&P 500, that is, the entire market. So, investing in the entire market or A.P. Moller Maersk will produce very similar results. On the other hand, Nordic American's correlation with the overall market was much less at 58%, which indicates that its share prices

follow a different pattern to that of A.P. Moller Maersk and results in a substantial diversification within the portfolio.

What is interesting is that despite having the lowest standard deviation as a percentage of earnings, this portfolio is by no means the portfolio with the lowest expected returns, making it even more appealing to a risk averse investor.

Nordic American combined with Kirby Corp. proved to be the only other worthwhile investment for a risk averse investor. The mean value of Kirby Corp.'s shares was by far the highest of all the companies included in these five low risk portfolios and with a relatively low volatility. Kirby Corp. did have a slightly higher beta value than that of A.P. Moller Maersk but an interesting aspect emerges when the correlation to the overall market is factored in.

A.P. Moller Maersk had a strong correlation with the S&P 500 which indicated that diversification of A.P. Moller's shares and those of Nordic American reduced the portfolio risk. However, Kirby Corp.'s correlation with the S&P 500 is exactly the same as that between Nordic American and the overall market. This would seem to debunk the strong effect the correlation of A.P. Moller Maersk with the S&P 500 had on the portfolio risk.

The second and third portfolios contain the same amount of risk, although the portfolio of Nordic American and EURONAV has lower returns. What stands out about this portfolio is that EURONAV is the only company within the five lowest risk portfolios that has such a high beta value. Other company statistics show that the EURONAV is very similar with regard to the mean share value and standard deviation to other companies.

From a different perspective, the most suitable portfolios for a risk neutral investor would be extremely different. Such an investor is indifferent to risk and only seeks to maximise his returns when selecting an investment (Investopedia, 2009). However, as was discussed earlier on in the chapter, an investor would generally seek to be rewarded for taking on additional risk.

Assuming an investor is risk neutral, the top five portfolios from the possible 210, would be very different from those selected by the risk averse investor assumed under the CAPM. The Table 4.8 outlines the five portfolios with the highest expected earnings.

Table 4.8 Portfolios with the Highest Expected Earnings.

Companies	% Invest.	E(Return)	Variance	StD	% StD
Golden Ocean	50%	341.67	79466.04	281.9	83%
DryShips	50%				
Golden Ocean	50%	285.81	47307.01	217.5	76%
Excel	50%				
Golden Ocean	50%	272.57	30578.53	174.87	64%
DFDS A/S	50%				
Golden Ocean	50%	270.67	27974.49	167.26	62%
Bonheur ASA	50%				
Golden Ocean	50%	268.38	28880.73	169.94	63%
Kirby Corp.	50%				

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

From the outset, it is apparent that for the top five highest earning portfolios, the standard deviation does not decrease as the expected returns decrease. However, since a risk neutral investor only seeks to maximise returns, all five portfolios would be considered, but the first four would be most worthwhile.

The two highest earning portfolios consist of companies with very similar shipping strategies, specialising in the larger dry bulk sectors with a mix of long-term and spot market charters. These companies had the highest peak earnings and beta values of all the companies assessed and as was discussed in the previous sections, these elements are conducive with markets in which the three companies trade and comes as no surprise. The companies also have a correlation with the overall market of 54%-61%, which indicates that they do not have the strongest of correlations with the market, and would react slightly differently to the overall market.

Another aspect that was discussed in Chapter 3 and earlier in this chapter is that despite the possibility of astronomical earnings, the dry bulk sector also brings with it the highest risk of all. Such is the case with the leading portfolio as the standard

deviation is 281.9, an incredible 83% of the expected returns. It is worth mentioning that despite these high returns, this portfolio is not the riskiest of the possible 210.

The other three portfolios that conclude the top five highest earners add another dimension to these types of portfolios. Golden Ocean, the high risk – high earning, specialised company, remains the common company in all three portfolios. The other three companies, DFDS A/S, Bonheur ASA and Kirby Corp. unlike DryShips Inc. and Excel Maritime, all utilise a strategy of diversification, albeit to varying degrees. As seen in the various company analyses in Table 4.8, these three companies have produced the same returns over the last three and a half years, with similar means and standard deviations.

A thought provoking issue, is the rise in standard deviation in the portfolio containing Golden Ocean and Kirby Corp. Kirby Corp. has the lowest beta value of all the three diversified companies. Furthermore, the share value volatility was 10% less than that of DFDS and Bonheur, which both stood at 32%. The only logical explanation for this rise in portfolio risk seems to result from the lower correlation between Kirby Corp. and the S&P 500.

Table 4.9 Summary Statistics of Listed Companies.

Company	Index	Corel-Coef	Systematic Risk	Beta Value	Stock Market
DFDS A/S	**S&P500**	81%	38	2.18	CSE
Bonheur ASA	**S&P500**	70%	32	1.80	OSL
Kirby Corp.	**S&P500**	58%	19	1.19	NYSE

Notes: Sample covers December 2005 to June 2009 (Weekly Data)
Source: Data from Google Finance
Calculations: Author

With a correlation with the overall market of 58%, Kirby Corp. is more similar in this respect to DryShips and Excel Maritime than it is to the two diversified companies. DFDS and Bonheur have stronger correlations with the S&P500 than any other companies within these five higher earnings portfolios. One can deduce from this that by having two companies with weaker correlations to the market is likely to increase the volatility of a portfolio's earnings.

4.5 Results

To conclude, the results of the analysis infer that the companies that specialised in the dry bulk sector were the most volatile. However, the results of the beta values indicate that when there is a market upturn, these specialised companies are at the forefront to reap incredible returns. Such was the case during 2007-2008, with the world economy booming, when the dry bulk shipping companies outperformed all other companies and the market as a whole. However, the old adage seemed to ring true for these companies: 'the higher you climb the harder you fall'. The onset of the economic crisis brought the share value of the three most specialised companies in the dry bulk sector into a free fall. Golden Ocean Group Limited saw 90% of its share value disappear within the last quarter of 2008.

On the other hand, companies that have chosen to diversify, and companies that have focused on the tanker markets showed less volatility. The large majority of these companies all grew in share value during the market upturn, but nowhere close to the growth experienced by the dry bulk-specialised companies. These companies too were not able to avoid the dire effects brought on by the financial crisis; however, the decrease in value was not as drastic as that experienced by companies such as Golden Ocean, Excel Maritime and DryShips.

Chapter 5. Conclusion

The study of the freight rates of the various markets (Chapters 2 and 3) coupled with the analysis of the listed companies (Chapter 4) was imperative in order to establish the effectiveness of a specialised strategy when compared to a diversified strategy. By establishing a relationship between the freight rates, the correlation of dry bulk and tanker sectors and the share value of the listed companies, the most appropriate strategy can be deduced for both risk averse and risk neutral investors.

However, before drawing any conclusions from the results in the previous chapters, it must be borne in mind that other factors are likely to come into play. The 21 companies that have been analysed are from five different stock exchanges, each with its own parameters for listing companies, operating in different countries and with different currencies. Furthermore, each company has different management styles and is exposed to a wide array of risks. Finally, shipping strategies are constantly evolving, which makes it impossible to group companies too rigidly for the 20 year period under scrutiny. For example, a company may be classified as one that has adopted a strategy of specialisation within the dry bulk sector but the ratio of ships owned and chartered-in and the importance given to a particular class of vessels over another varies greatly. To further compound the situation, vessels may be chartered for as little as a few weeks to as much as the lifespan of the vessel. Once these elements are all factored in, over the two decades being studied, each company's strategy may have morphed countless times.

Ultimately, investors often act irrationally, either in an attempt to beat the market or as a knee-jerk reaction to unfavourable news. Technology has made information free and quickly accessible making the share value of a company rather volatile.

From the results in Chapters 3 and 4, it transpires that there is a close relation between a company's performance and its shipping strategy. Companies like Golden Ocean Group Ltd., DryShips Inc. and Excel Maritime all developed a specialised

strategy, focusing on owning and operating large vessels in the dry bulk market. The share value of these companies increased and decreased as dry bulk freight rates peaked and collapsed. Furthermore, the share value of these companies increased much more than any of the other companies over the last five years, which is representative of the astronomical freight rates experienced in the dry bulk market.

Another characteristic which is unique to the dry bulk sector is the extremely strong correlation between the markets. This coupled with the high standard deviation of earnings, makes specialisation with the dry bulk sector a very risky investment. This was confirmed in the data analysis of the listed companies as the three companies with the highest beta values are the companies specialising in the dry bulk sector.

Conversely, companies that developed a diversified strategy, generally recorded low beta values. Companies such as A.P. Moller-Maersk, Kirby Corp., Wilh Wilhelmsen, Stolt Nielsen SA and Bonheur ASA have business interests beyond the maritime transportation industry. These companies all recorded a beta value below 2, therefore performing very similar to the overall market. The results indicate that such a diversified strategy will substantially reduce risk but this comes at the cost of a considerably lower mean share value. Apart from a spike in Bonheur's share value prior to a substantial share split, these companies all recorded relatively low mean share values. Due to the highly diversified strategy of these companies, it is hard to gauge the contribution of the shipping interests towards each company's risk and return; however, they provide a relevant comparison.

Other companies chose a diversified strategy within the maritime transportation industry and as was expected managed to reduce their risk. Companies such as D/S Norden, TopShips Inc. and Torm A/S own and operate fleets which consist of vessels from both the dry bulk and the tanker sectors. A combination of voyage charters and time charters are then utilised in order to strike a balance between income stability and maximising profits during market peaks. From the summary statistics of the time charter earnings for all the bulk carrier vessels, it emerged that as the duration

of the time charter period increases, the freight rate volatility decreases. Also, the results of the Portfolio Theory indicate that when fixing vessels on the spot market the ideal way to reduce risk is through diversification.

Finally, the summary statistics of Nordic American, Frontline Ltd. and Teekay prove how through specialisation risk does not necessarily increase. Not only did these companies all record low beta values, Nordic American's beta value was below 1. As was explained in Chapter 3, the relatively weak correlation between the tanker sectors made specialisation a sensible shipping strategy. Further, these three companies all have a considerable part of their respective fleets on long term charters in order to further reduce risk. This confirms the results of the Portfolio Theory, as the asset portfolio with the lowest risk included two tankers.

From these results it can be concluded that despite the countless elements that can be factored in when determining the correct strategy for a shipping company, the summary statistics remain a very valid indicator. By and large, the pattern of the share value of the companies analysed mirrored the pattern of the freight rates of the ships that the company owned and/or operated.

The results of the Portfolio Theory and the Capital Asset Pricing Model made it abundantly clear that a specialised portfolio can be more worthwhile than a diversified portfolio, depending on the investor's risk strategy. What the results of the Portfolio Theory and the Capital Asset Pricing Model do not reveal is that, a diversified strategy may have very different implications for onshore personnel than a specialised strategy may have.

In order to establish the effects that either strategy may have on a company's onshore personnel, an online questionnaire (Annex 3) was drawn up and submitted to ship-owning/-managing companies worldwide. The questionnaire consisted of 12 multiple choice questions and was submitted in five different languages, including four of the official and working languages of the International Maritime Organisation (IMO).

The purpose of the questionnaire was to unearth whether companies that owned and/or managed ships chose to have in-house departments to operate the vessels. Therefore a question was set in order to determine whether companies had any or all of the following departments: an Operations Department, a Technical Department and a Chartering Department. From the 84 responses that were submitted only 1% of the companies had none of these departments.

The questionnaire was then set out in order to discover how companies managed these departments. For example, whether the superintendents within the operations department are assigned to particular types of vessels or whether they were assigned vessels randomly. The results of the questionnaire reveal that a large majority of companies tend to assign jobs to personnel within these departments according to the type of vessel. 75% of respondents stated that operations superintendents are assigned to particular types of vessels, for example, either to dry bulk vessels or to tankers. Furthermore, 62% declared that if superintendents were to be assigned to a different type of vessel, than additional training is a company requirement. Very similar results were also produced for technical superintendents. Within the chartering department, this strategy is not as clear cut. 54% of respondents do assign charterers to fix specific types of vessels and 48% have a policy of training personnel should they be assigned to a different class of vessels.

More than two-thirds of the companies that submitted a response share the same strategy when it comes to crewing. 83% of the companies assign crew to specific types of vessels and should crew be employed on a different type of vessel it is company policy to have crew undergo some sort of training.

Apart from the results of the chartering department, it is clear that companies tend to lean towards a specialised regime within the operations and technical departments and in the manner in which they man the vessels. By applying this strategy to the results of the correlation between the various bulk sectors it can be deduced that there are advantages to be gained from specialisation in certain sectors. While a specialised dry bulk strategy is only recommended for risk neutral investors, the

same is not true for a specialised tanker strategy. The correlation between the tanker sectors was not so strong and in Chapter 2 it emerged that in the one-year and three-year time charters, Aframax freight rates were the least volatile but not with the lowest earnings.

Specialisation could actually lead to a situation whereby a company is more flexible to change its shipping strategy and more responsive to changes in market conditions. If a company chose to change its shipping strategy from one of diversification to one of specialisation or vice versa, the results of the questionnaire reveal that a substantial part of on-shore personnel and crew would have to undergo training. However, a company that chooses to specialise within one sector could shift personnel between different types of vessels more easily. For example, should a company that owns a fleet of tankers choose to adopt a less risky strategy, the Aframax tankers on time charters of over one year would be the best option. Therefore, as the company shifts towards increasing its Aframax fleet, on shore personnel could easily be assigned the new vessels and crew retention could be maintained. This would be done without the additional time and money needed to train personnel and offers further job security. It could also be argued that a specialised company would benefit from less overheard costs through downsizing of onshore personnel.

By understanding the freight rates and the respective volatility, an investor can quantify and control risk, thereby managing to alter the risk profile according to the prevailing market conditions and risk preference. Ultimately, there is no one ideal shipping strategy. A risk averse investor may prefer a strategy which involves vessels chartered on a long term basis while a risk neutral investor would be more inclined to invest in the dry bulk market, as to reduce risk often means to lock in a low return. What is interesting is that a specialised tanker strategy may now offer a relatively low risk investment with additional on-shore gains; a strategy that has never really been viewed as synonymous with risk reduction but could in fact offer stability to an otherwise volatile industry.

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Annex A: Portfolio Theory Results in Order of % StD

Three Year Time Charter

Portfolio Theory-Dry Bulk/Tanker					
Vessel	% Investment	E(Return)	Variance	StD	% StD
Capesize	50%	19,519	115,159,752	10,731	55%
Products	50%				
Capesize	50%	21,132	94,119,872	9,702	46%
Aframax	50%				
Capesize	50%	23,275	100,195,282	10,010	43%
Suezmax	50%				
Capesize	50%	28,525	116,119,446	10,776	38%
VLCC	50%				
Panamax	50%	13,396	24,754,385	4,975	37%
Products	50%				
Handymax	50%	13,572	23,584,380	4,856	36%
Products	50%				
Handysize	50%	12,486	15,714,754	3,964	32%
Products	50%				
Panamax	50%	15,009	16,665,017	4,082	27%
Aframax	50%				
Panamax	50%	17,152	20,169,255	4,491	26%
Suezmax	50%				
Handymax	50%	17,328	19,184,879	4,380	25%
Suezmax	50%				
Handymax	50%	15,186	14,520,472	3,811	25%
Aframax	50%				
Panamax	50%	22,402	27,188,238	5,214	23%
VLCC	50%				
Handymax	50%	22,579	26,064,856	5,105	23%
VLCC	50%				
Handysize	50%	16,242	13,285,129	3,645	22%
Suezmax	50%				
Handysize	50%	14,100	8,622,475	2,936	21%
Aframax	50%				
Handysize	50%	21,493	18,963,951	4,355	20%
VLCC	50%				
Portfolio Theory - Tanker Sector					
Vessel	% Investment	E(Return)	Variance	StD	% StD
Suezmax	50%	18,547	11,508,685	3,392	18%
Products	50%				

VLCC	50%	27,554	22,573,487	4,751	17%
Suezmax	50%				
VLCC	50%	23,798	15,716,235	3,964	17%
Products	50%				
Suezmax	50%	20,161	11,448,712	3,384	17%
Aframax	50%				
Aframax	50%	16,405	5,941,950	2,438	15%
Products	50%				
VLCC	50%	25,411	13,440,506	3,666	14%
Aframax	50%				

Portfolio Theory - Dry Bulk Sector					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Capesize	50%	18,123	171,376,833	13,091	72%
Panamax	50%				
Capesize	50%	17,214	143,508,312	11,979	70%
Handysize	50%				
Capesize	50%	18,300	161,388,549	12,704	69%
Handymax	50%				
Panamax	50%	12,177	52,314,342	7,233	59%
Handymax	50%				
Panamax	50%	11,091	38,967,661	6,242	56%
Handysize	50%				
Handymax	50%	11,267	35,091,693	5,924	53%
Handysize	50%				

One Year Time Charter

Portfolio Theory-Dry Bulk/Tanker					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Capesize	50%	21,820	255,059,048	15,971	73%
Products	50%				
Capesize	50%	23,767	236,591,889	15,382	65%
Aframax	50%				
Capesize	50%	26,359	268,112,290	16,374	62%
Suezmax	50%				
Capesize	50%	31,627	330,939,396	18,192	58%
VLCC	50%				
Panamax	50%	14,888	68,899,019	8,301	56%
Products	50%				
Handymax	50%	14,732	57,438,597	7,579	51%
Products	50%				

Panamax	50%	19,426	78,534,498	8,862	46%
Suezmax	50%				
Panamax	50%	16,834	60,739,061	7,794	46%
Aframax	50%				
Handysize	50%	13,084	36,739,273	6,061	46%
Products	50%				
Panamax	50%	24,695	114,233,637	10,688	43%
VLCC	50%				
Handymax	50%	19,271	69,285,974	8,324	43%
Suezmax	50%				
Handymax	50%	16,679	50,659,091	7,118	43%
Aframax	50%				
Handymax	50%	24,539	103,914,912	10,194	42%
VLCC	50%				
Handysize	50%	17,623	46,755,345	6,838	39%
Suezmax	50%				
Handysize	50%	22,891	76,638,606	8,754	38%
VLCC	50%				
Handysize	50%	15,031	30,615,989	5,533	37%
Aframax	50%				

Portfolio Theory - Tanker Sector					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
VLCC	50%	29,227	89,437,520	9,457	32%
Suezmax	50%				
VLCC	50%	24,688	61,765,529	7,859	32%
Products	50%				
Suezmax	50%	19,420	37,860,968	6,153	32%
Products	50%				
VLCC	50%	26,635	60,965,728	7,808	29%
Aframax	50%				
Suezmax	50%	21,366	38,865,251	6,234	29%
Aframax	50%				
Aframax	50%	16,828	21,497,858	4,637	28%
Products	50%				

Portfolio Theory - Dry Bulk Sector					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Capesize	50%	21,827	410,236,461	20,254	93%
Panamax	50%				
Capesize	50%	20,024	328,918,729	18,136	91%

Handysize	50%				
Capesize	50%	21,672	370,224,355	19,241	89%
Handymax	50%				
Panamax	50%	14,739	150,037,270	12,249	83%
Handymax	50%				
Panamax	50%	13,091	111,131,867	10,542	81%
Handysize	50%				
Handymax	50%	12,936	92,991,360	9,643	75%
Handysize	50%				

Spot Market

Portfolio Theory – Dry Bulk/Tanker					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Capesize	50%	31,056	583,696,486	24,160	78%
Suezmax	50%				
Capesize	50%	23,998	341,839,494	18,489	77%
Products	50%				
Capesize	50%	28,006	447,057,393	21,144	75%
Aframax	50%				
Panamax	50%	28,086	435,037,975	20,858	74%
VLCC	50%				
Handysize	50%	25,117	318,523,782	17,847	71%
VLCC	50%				
Panamax	50%	24,401	298,597,200	17,280	71%
Suezmax	50%				
Handymax	50%	26,793	355,588,875	18,857	70%
VLCC	50%				
Capesize	50%	34,741	520,394,106	22,812	66%
VLCC	50%				
Handymax	50%	23,107	230,526,073	15,183	66%
Suezmax	50%				
Handysize	50%	21,432	199,395,682	14,121	66%
Suezmax	50%				
Panamax	50%	21,351	192,092,293	13,860	65%
Aframax	50%				
Panamax	50%	17,343	128,554,398	11,338	65%
Products	50%				
Handymax	50%	20,057	136,300,198	11,675	58%
Aframax	50%				
Handysize	50%	18,382	111,359,529	10,553	57%
Aframax	50%				
Handymax	50%	16,049	82,393,085	9,077	57%

Products	50%				
Handysize	50%	14,374	61,512,728	7,843	55%
Products	50%				
Portfolio Theory – Tanker Sector					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Suezmax	50%	18,512	335,690,120	18,322	99%
Aframax	50%				
VLCC	50%	25,834	646,630,708	25,429	98%
Suezmax	50%				
Aframax	50%	12,123	137,690,639	11,734	97%
Products	50%				
Suezmax	50%	15,668	226,395,580	15,046	96%
Products	50%				
VLCC	50%	32,259	469,317,136	21,664	67%
Aframax	50%				
VLCC	50%	28,251	341,948,776	18,492	65%
Products	50%				
	50%				
Portfolio Theory – Dry Bulk Sector					
Vessel	**% Investment**	**E(Return)**	**Variance**	**StD**	**% StD**
Capesize	50%	23,833	559,721,457	23,658	99%
Panamax	50%				
Panamax	50%	14,209	155,262,951	12,460	88%
Handysize	50%				
Capesize	50%	20,864	389,828,862	19,744	95%
Handysize	50%				
Capesize	50%	22,539	447,750,557	21,160	94%
Handymax	50%				
Panamax	50%	15,884	192,819,440	13,886	87%
Handymax	50%				
Handymax	50%	12,915	99,908,367	9,995	77%
Handysize	50%				

Annex B: CAPM Results In Order of Expected Earnings

Companies	% Invest.	E(Return)	Variance	StD	% StD
Golden Ocean	50%	341.67	79466.04	281.9	83%
DryShips	50%				
Golden Ocean	50%	285.81	47307.01	217.5	76%
Excel	50%				
Golden Ocean	50%	272.57	30578.53	174.87	64%
DFDS A/S	50%				
Bonheur ASA	50%	270.67	27974.49	167.26	62%
Golden Ocean	50%				
Golden Ocean	50%	268.38	28880.73	169.94	63%
Kirby Corp.	50%				
Golden Ocean	50%	264.71	30047.86	173.34	65%
Tsakos	50%				
Golden Ocean	50%	260.38	31525.36	177.55	68%
CMB	50%				
Golden Ocean	50%	255.12	28104.24	167.64	66%
Overseas	50%				
Golden Ocean	50%	252.19	25272.38	158.97	63%
Nordic American	50%				
Golden Ocean	50%	251.83	29759.08	172.51	69%
Golar LNG	50%				
Golden Ocean	50%	250.98	30251.04	173.93	69%
FreeSeas	50%				
Golden Ocean	50%	246.34	27727.45	166.52	68%
Frontline	50%				
Golden Ocean	50%	244.92	27597.73	166.13	68%
Teekay	50%				
Golden Ocean	50%	241.32	26046.05	161.39	67%
EURONAV	50%				
Golden Ocean	50%	240.38	25591.27	159.97	67%
Wilh Wilhelmsen	50%				
Golden Ocean	50%	239.18	26265.19	162.07	68%
A.P. Moller	50%				
Golden Ocean	50%	239.03	24809.08	157.51	66%
Torm A/S	50%				
DryShips	50%	230.68	35869.25	189.39	82%
Excel	50%				
Golden Ocean	50%	228.42	24628.11	156.93	69%
Stolt Nielsen	50%				
Golden Ocean	50%	226.34	21672.09	147.21	65%
D/S Norden	50%				

Companies	% Invest.	E(Return)	Variance	StD	% StD
DryShips	50%	217.44	20985.12	144.86	67%
DFDS A/S	50%				
Golden Ocean	50%	216.29	23753.24	154.12	71%
TopShips	50%				
Bonheur ASA	50%	215.54	18991.12	137.81	64%
DryShips	50%				
DryShips	50%	213.25	19869.74	140.96	66%
Kirby Corp.	50%				
DryShips	50%	209.58	20766.89	144.11	69%
Tsakos Energy	50%				
DryShips	50%	205.25	21860.94	147.85	72%
CMB	50%				
DryShips	50%	199.99	19197.42	138.55	69%
Overseas	50%				
DryShips	50%	197.07	16859.95	129.85	66%
Nordic American	50%				
Golar LNG	50%	196.7	20685.25	143.82	73%
DryShips	50%				
DryShips	50%	195.85	21123	145.34	74%
FreeSeas Inc.	50%				
DryShips	50%	191.21	19022.06	137.92	72%
Frontline	50%				
DryShips	50%	189.79	18745.07	136.91	72%
Teekay	50%				
DryShips	50%	186.2	17536.29	132.42	71%
EURONAV	50%				
Wilh Wilhelmsen	50%	185.25	17130.4	130.88	71%
DryShips	50%				
DryShips	50%	184.05	17677.54	132.96	72%
A.P. Moller	50%				
DryShips	50%	183.9	16501.35	128.46	70%
Torm A/S	50%				
Stolt Nielsen	50%	173.3	16364.45	127.92	74%
DryShips	50%				
DryShips	50%	171.21	13995.18	118.3	69%
D/S Norden	50%				
Excel	50%	161.58	6853.57	82.79	51%
DFDS A/S	50%				
TopShips	50%	161.16	15852.47	125.91	78%
DryShips	50%				

Companies	% Invest.	E(Return)	Variance	StD	% StD
Bonheur ASA	50%	159.68	5755.28	75.86	48%
Excel Maritime	50%				
Excel Maritime	50%	157.39	5848.44	76.48	49%
Kirby Corp	50%				
Excel Maritime	50%	153.72	6370.77	79.82	52%
Tsakos Energy	50%				
Excel	50%	149.39	7303.75	85.46	57%
CMB	50%				
Bonheur ASA	50%	146.44	1766.16	42.03	29%
DFDS A/S	50%				
Kirby Corp.	50%	144.16	1311.88	36.22	25%
DFDS A/S	50%				
Excel Maritime	50%	144.13	5631.92	75.05	52%
Overseas	50%				
Bonheur ASA	50%	142.25	1142.47	33.8	24%
Kirby Corp.	50%				
Excel Maritime	50%	141.21	4415.55	66.45	47%
Nordic American	50%				
Golar LNG	50%	140.84	6477.45	80.48	57%
Excel	50%				
Tsakos Energy	50%	140.48	1539.74	39.24	28%
DFDS A/S	50%				
FreeSeas	50%	139.99	6816.18	82.56	59%
Excel	50%				
Bonheur ASA	50%	138.58	1244.71	35.28	25%
Tsakos Energy	50%				
Tsakos Energy	50%	136.3	906.67	30.11	22%
Kirby Corp.	50%				
EURONAV	50%	136.15	2290.72	47.86	35%
DFDS A/S	50%				
Excel Maritime	50%	135.35	5406.98	73.53	54%
Frontline	50%				
Bonheur ASA	50%	134.25	1838.97	42.88	32%
CMB	50%				
Excel Maritime	50%	133.93	5562.2	74.58	56%
Teekay	50%				
Kirby Corp.	50%	131.96	1446.07	38.03	29%
CMB	50%				
OverSeas	50%	130.89	1358.03	36.85	28%
DFDS A/S	50%				

Companies	% Invest.	E(Return)	Variance	StD	% StD
Excel	50%	130.34	4748.97	68.91	53%
EURONAV NV	50%				
Wilh Wilhelmsen	50%	129.39	4722.89	68.72	53%
Excel	50%				
Bonheur ASA	50%	128.98	1201.67	34.67	27%
Overseas	50%				
Tsakos Energy	50%	128.29	1726.85	41.56	32%
CMB	50%				
Excel	50%	128.19	4912.50	70.09	55%
A.P. Moller	50%				
Excel	50%	128.04	4585.40	67.72	53%
Torm A/S	50%				
Nordic American	50%	127.97	757.72	27.53	22%
DFDS A/S	50%				
Golar LNG	50%	127.6	1659.05	40.73	32%
DFDS A/S	50%				
FreeSeas	50%	126.75	1827.29	42.75	34%
DFDS A/S	50%				
Overseas	50%	126.7	845.09	29.07	23%
Kirby Corp	50%				
Bonheur ASA	50%	126.06	695.5	26.37	21%
Nordic American	50%				
Bonheur ASA	50%	125.69	1414.13	37.6	30%
Golar LNG	50%				
Bonheur ASA	50%	124.85	1621.05	40.26	32%
FreeSeas Inc.	50%				
Nordic American	50%	123.78	370.02	19.24	16%
Kirby Corp	50%				
Golar LNG	50%	123.41	1104.26	33.23	27%
Kirby Corp.	50%				
Tsakos Energy	50%	123.03	1028.34	32.07	26%
Overseas	50%				
FreeSeas	50%	122.56	1262.19	35.53	29%
Kirby Corp.	50%				
Frontline	50%	122.12	1086.87	32.97	27%
DFDS A/S	50%				
Teekay	50%	120.69	1462.13	38.24	32%
DFDS A/S	50%				
Bonheur ASA	50%	120.21	972.75	31.19	26%
Frontline Ltd.	50%				

Companies	% Investment	E(Return)	Variance	StD	% StD
Tsakos Energy	50%	120.11	494.69	22.24	19%
Nordic American	50%				
Golar LNG	50%	119.74	1287.4	35.88	30%
Tsakos Energy	50%				
FreeSeas	50%	118.89	1484.76	38.53	32%
Tsakos Energy	50%				
Bonheur ASA	50%	118.79	1274.22	35.7	30%
Teekay Corp.	50%				
OverSeas	50%	118.7	1490.77	38.61	33%
CMB	50%				
Frontline Ltd.	50%	117.93	759.68	27.56	23%
Kirby Corp	50%				
Stolt Nielsen	50%	117.44	4318.64	65.72	56%
Excel	50%				
CMB	50%	117.1	1172.39	34.24	29%
DFDS A/S	50%				
Teekay Corp	50%	116.5	796.17	28.22	24%
Kirby Corp	50%				
Wilh Wilhelmsen	50%	116.16	1115.82	33.4	29%
DFDS A/S	50%				
Nordic American	50%	115.78	847.69	29.12	25%
CMB	50%				
Golar LNG	50%	115.41	1877.87	43.33	38%
CMB	50%				
Excel	50%	115.35	3693.28	60.77	53%
D/S Norden	50%				
Bonheur ASA	50%	115.19	964.13	31.05	27%
EURONAV	50%				
A.P. Moller	50%	114.95	1023.78	32	28%
DFDS A/S	50%				
DFDS A/S	50%	114.8	1408.24	37.53	33%
Torm A/S	50%				
FreeSeas	50%	114.56	2074.04	45.54	40%
CMB	50%				
Tsakos Energy	50%	114.26	913.19	30.22	26%
Frontline	50%				
Bonheur ASA	50%	114.25	1041.3	32.27	28%
Wilh Wilhelmsen	50%				
Bonheur ASA	50%	113.04	903.24	30.05	27%
A.P. Moller	50%				

Companies	% Investment	E(Return)	Variance	StD	% StD
Bonheur ASA	50%	112.9	1346.45	36.69	33%
Torm A/S	50%				
Kirby Corp.	50%	112.91	577.77	24.04	21%
EURONAV	50%				
Teekay	50%	112.83	973.44	31.2	28%
Tsakos Energy	50%				
Wilh Wilhelmsen	50%	111.97	532.17	23.07	21%
Kirby Corp.	50%				
Kirby Corp.	50%	110.76	509.44	22.57	20%
A.P. Moller	50%				
Kirby Corp.	50%	110.61	689.05	26.25	24%
Torm A/S	50%				
Nordic American	50%	110.51	407.82	20.19	18%
Overseas	50%				
Golar LNG	50%	110.15	1124.45	33.53	30%
Overseas	50%				
Frontline	50%	109.92	1215.12	34.86	32%
CMB	50%				
FreeSeas	50%	109.3	1339.8	36.6	33%
Overseas	50%				
Tsakos Energy	50%	109.24	675.68	25.99	24%
EURONAV	50%				
Teekay	50%	108.5	1605.16	40.06	37%
CMB	50%				
Wilh Wilhelmsen	50%	108.3	645.36	25.4	23%
Tsakos Energy	50%				
Golar LNG	50%	107.22	539.56	23.23	22%
Nordic American	50%				
Tsakos Energy	50%	107.09	652.55	25.54	24%
A.P. Moller	50%				
Tsakos Energy	50%	106.94	749.65	27.38	26%
Torm A/S	50%				
FreeSeas	50%	106.38	710.89	26.66	25%
Nordic American	50%				
Golar LNG	50%	106.01	1690.57	41.12	39%
FreeSeas Inc.	50%				
TopShips	50%	105.3	4099.69	64.03	61%
Excel	50%				
CMB	50%	104.91	1117.96	33.44	32%
EURONAV	50%				

Companies	% Investment	E(Return)	Variance	StD	% StD
Frontline	50%	104.66	763.05	27.62	26%
Overseas	50%				
Stolt Nielsen	50%	104.2	928.48	30.47	29%
DFDS A/S	50%				
Wilh Wilhelmsen	50%	103.96	1216.75	34.88	34%
CMB	50%				
Teekay	50%	103.24	920.88	30.35	29%
Overseas	50%				
EURONAV	50%	102.76	1155.38	33.99	33%
A.P. Moller	50%				
EURONAV	50%	102.61	1419.32	37.67	37%
Torm A/S	50%				
Bonheur ASA	50%	102.29	890.61	29.84	29%
Stolt Nielsen	50%				
DFDS A/S	50%	102.12	1677.69	40.96	40%
D/S Norden	50%				
Nordic American	50%	101.74	309.73	17.6	17%
Frontline	50%				
Golar LNG	50%	101.37	950.2	30.83	30%
Frontline Ltd.	50%				
FreeSeas	50%	100.52	1156.48	34.01	34%
Frontline	50%				
Teekay	50%	100.31	424.26	20.6	21%
Nordic American	50%				
Bonheur ASA	50%	100.21	1725.47	41.54	41%
D/S Norden	50%				
Stolt Nielsen	50%	100.01	395.94	19.9	20%
Kirby Corp.	50%				
Golar LNG	50%	99.95	1173.5	34.26	34%
Teekay Corp.	50%				
OverSeas	50%	99.64	648.32	25.46	26%
EURONAV	50%				
FreeSeas	50%	99.1	1373.76	37.06	37%
Teekay	50%				
Wilh Wilhelmsen	50%	98.7	661.86	25.73	26%
Overseas	50%				
Kirby Corp.	50%	97.93	926.48	30.44	31%
D/S Norden	50%				
OverSeas	50%	97.5	581.04	24.1	25%
A.P. Moller	50%				

Companies	% Investment	E(Return)	Variance	StD	% StD
OverSeas	50%	97.35	890.81	29.85	31%
Torm A/S	50%				
Nordic American	50%	96.72	239.77	15.48	16%
EURONAV	50%				
Golar LNG	50%	96.35	828.42	28.78	30%
EURONAV	50%				
Stolt Nielsen	50%	96.34	497.87	22.31	23%
Tsakos Energy	50%				
Wilh Wilhelmsen	50%	95.78	281.2	16.77	18%
Nordic American	50%				
FreeSeas	50%	95.51	1015.62	31.87	33%
EURONAV	50%				
Wilh Wilhelmsen	50%	95.41	882.95	29.71	31%
Golar LNG	50%				
Nordic American	50%	94.57	213.64	14.62	15%
A.P. Moller	50%				
Wilh Wilhelmsen	50%	94.56	1066.96	32.66	35%
FreeSeas	50%				
Teekay	50%	94.46	697.24	26.41	28%
Frontline	50%				
Nordic American	50%	94.43	498.88	22.34	24%
Torm A/S	50%				
Tsakos Energy	50%	94.26	825.94	28.74	30%
D/S Norden	50%				
Golar LNG	50%	94.21	807.5	28.42	30%
A.P. Moller	50%				
Golar LNG	50%	94.06	1058.26	32.53	35%
Torm A/S	50%				
FreeSeas	50%	93.36	1012.13	31.81	34%
A.P. Moller	50%				
FreeSeas	50%	93.21	1225.12	35	38%
Torm A/S	50%				
TopShips	50%	92.06	778.56	27.9	30%
DFDS A/S	50%				
Stolt Nielsen	50%	92.01	1022.48	31.98	35%
CMB	50%				
Frontline	50%	90.87	522.53	22.86	25%
EURONAV	50%				
Bonheur ASA	50%	90.16	833.74	28.87	32%
TopShips	50%				

Companies	% Investment	E(Return)	Variance	StD	% StD
Wilh Wilhelmsen	50%	89.93	475.14	21.8	24%
Frontline	50%				
EURONAV	50%	89.92	1472.91	38.38	43%
D/S Norden	50%				
Teekay	50%	89.44	685.63	26.18	29%
EURONAV	50%				
Frontline	50%	88.72	443.03	21.05	24%
A.P. Moller	50%				
Frontline	50%	88.57	646.94	25.44	29%
Torm A/S	50%				
Wilh Wilhelmsen	50%	88.5	791.25	28.13	32%
Teekay	50%				
TopShips	50%	87.87	377.04	19.42	22%
Kirby Corp.	50%				
Teekay	50%	87.3	659.86	25.69	29%
A.P. Moller	50%				
Teekay	50%	87.15	1074.32	32.78	38%
Torm A/S	50%				
Stolt Nielsen	50%	86.74	524.21	22.9	26%
Overseas	50%				
Wilh Wilhelmsen	50%	84.91	529.51	23.01	27%
EURONAV	50%				
OverSeas	50%	84.66	1157.67	34.02	40%
D/S Norden	50%				
TopShips	50%	84.2	444.69	21.09	25%
Tsakos Energy	50%				
Stolt Nielsen	50%	83.82	211.75	14.55	17%
Nordic American	50%				
CMB	50%	83.7	411.05	20.27	24%
A.P. Moller	50%				
CMB	50%	83.56	674.93	25.98	31%
Torm A/S	50%				
Stolt Nielsen	50%	83.45	724.01	26.91	32%
Golar LNG	50%				
Wilh Wilhelmsen	50%	82.76	499.83	22.36	27%
A.P. Moller	50%				
Stolt Nielsen	50%	82.61	899.84	30	36%
FreeSeas	50%				
Wilh Wilhelmsen	50%	82.61	970.42	31.15	38%
Torm A/S	50%				

Companies	% Investment	E(Return)	Variance	StD	% StD
Nordic American	50%	81.74	943.95	30.72	38%
D/S Norden	50%				
A.P. Moller	50%	81.41	733.03	27.07	33%
Torm A/S	50%				
Golar LNG	50%	81.37	1213.34	34.83	43%
D/S Norden	50%				
FreeSeas	50%	80.52	1318.45	36.31	45%
D/S Norden	50%				
TopShips	50%	79.87	1403.85	37.47	47%
CMB	50%				
Stolt Nielsen	50%	77.97	367.04	19.16	25%
Frontline	50%				
Stolt Nielsen	50%	76.54	653.91	25.57	33%
Teekay	50%				
Frontline	50%	75.89	920.68	30.34	40%
D/S Norden	50%				
TopShips	50%	74.61	508.07	22.54	30%
Overseas	50%				
Teekay	50%	74.46	1416.28	37.63	51%
D/S Norden	50%				
Stolt Nielsen	50%	72.95	430.84	20.76	28%
EURONAV	50%				
Stolt Nielsen	50%	72.01	562.8	23.72	33%
Wilh Wilhelmsen	50%				
TopShips	50%	71.69	242.97	15.59	22%
Nordic American	50%				
Golar LNG	50%	71.32	734.86	27.11	38%
TopShips	50%				
CMB	50%	70.87	988.88	31.45	44%
D/S Norden	50%				
Stolt Nielsen	50%	70.8	411.42	20.28	29%
A.P. Moller	50%				
Stolt Nielsen	50%	70.65	858.77	29.3	41%
Torm A/S	50%				
TopShips	50%	70.47	925.59	30.42	43%
FreeSeas Inc.	50%				
Wilh Wilhelmsen	50%	69.93	1496.93	38.69	55%
D/S Norden	50%				
A.P. Moller	50%	68.72	1142.79	33.81	49%
D/S Norden	50%				

Companies	% Investment	E(Return)	Variance	StD	% StD
D/S Norden	50%	68.57	2165	46.53	68%
Torm A/S	50%				
TopShips	50%	65.83	397.28	19.93	30%
Frontline	50%				
TopShips	50%	64.41	644.81	25.39	39%
Teekay	50%				
TopShips	50%	60.81	469.58	21.67	36%
EURONAV	50%				
Wilh Wilhelmsen	50%	59.87	609.22	24.68	41%
TopShips	50%				
TopShips	50%	58.67	459.83	21.44	37%
A.P. Moller	50%				
TopShips	50%	58.52	873.23	29.55	50%
Torm A/S	50%				
Stolt Nielsen	50%	57.97	1425.99	37.76	65%
D/S Norden	50%				
Stolt Nielsen	50%	47.91	581.04	24.1	50%
TopShips	50%				
TopShips	50%	45.83	1469.19	38.33	84%
D/S Norden	50%				

Ship Management Policy Questionnaire

Please enter the country in which your headquarters are established. *

Which of the following best describes your company? *

- ☐ Ship-owning Company
- ☐ Ship-management Company
- ☐ Both

Which of the following ships currently form part of the company fleet? *

- ☐ Dry Bulk
- ☐ Tanker
- ☐ Container
- ☐ LNG
- ☐ Reefer
- ☐ PCC/PCTC
- ☐ Other

Which of the following departments form part of the company? *

- ☐ Operations Departments
- ☐ Technical Department
- ☐ Chartering Department
- ☐ None of the above

Are operations superintendents assigned to particular types of vessels (e.g. dry bulk; or tankers; or LNG; etc.)? *

- ○ Yes
- ○ No
- ○ click to edit

If an operations superintendent's responsibility changes from one type of vessel to another, is any sort of additional training a company requirement? *

- ○ Yes
- ○ No
- ○ No operations department within the company

Are technical superintendents assigned to particular types of vessels (e.g. dry bulk; or tankers; or LNG; etc.)? *

- ○ Yes
- ○ No
- ○ No technical department within the company

If a technical superintendent's responsibility changes from one type of vessel to another, is any sort of additional training a company requirement? *

- ○ Yes
- ○ No
- ○ No technical department within the company

Are charterers assigned to particular types of vessels (e.g. dry bulk; or tankers; or LNG; etc.)? *

- ○ Yes
- ○ No
- ○ No chartering department within the company

Are charterers assigned to particular types of vessels (e.g. dry bulk; or tankers; or LNG; etc.)? *

- ○ Yes
- ○ No
- ○ No chartering department within the company

If a charterer's responsibility changes from one type of vessel to another, is any sort of additional training a company requirement? *

- ○ Yes
- ○ No
- ○ No chartering department within the company

Are crew employed onboard vessels assigned to particular types of vessels (e.g. dry bulk; or tankers; or LNG; etc.)? *

- ○ Yes
- ○ No

If a crew member where to be assigned to a different type of vessel, is any sort of additional training a company requirement? *

- ○ Yes
- ○ No

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