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**How do the futures markets influence the prices of equities?  
- An analysis of the dry bulk company Diana Shipping**

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**Master thesis for the MSc in economics and business administration,  
specialisation in financial economics**

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## **Abstract**

**Title:** How do the futures markets influence the prices of equities? –An analysis of the dry bulk company Diana Shipping

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**Purpose:** The purpose of the thesis is to examine listed companies within the salmon farming, shipping and oil production industries and their respective futures market in order to estimate the value of these companies with the futures market as the exogenous variable. The thesis will also take an econometric approach in order to examine if stock prices and the futures market are co-integrated. Hopefully, this will lead to additional insight into the movement of the stock price and possibly a relationship that can be used for speculative arbitrage.

**Methodology:** The thesis will employ qualitative methods in the fundamental valuation of the shipping company Diana Shipping. Primarily we will apply net asset value and a discounted cash flow valuation. In the final part of the study, quantitative methods will be applied, mainly ordinary least squares and error correction modeling.

**Theoretical perspectives:** The theoretical part first includes theory on arbitrage and basis risk. We also examine econometric theory relevant for the regression analysis as well as a closer investigation of co-integration and error correction modeling. Finally we study different valuation techniques.

### **Conclusions:**

The thesis concludes that shipping equities are easier to value on the basis of the future market than oil production and salmon farming companies. This is because it is easy to forecast operating expenses and the ships have a definite time period in active operation.

The fundamental valuation indicates that the listed dry bulk company Diana Shipping was an overpriced company in the modeling period, last quarter of 2008 and first quarter of 2009, on the basis of a cash flow valuation and net asset value. It also shows that a valuation of shipping equities can be easily performed with the rates in the futures market as the only exogenous variables.

The econometric study of the relationship between Diana Shipping and the futures market show that they are co-integrated. There are two important factors that make the relationship between Diana Shipping and the futures markets not ideal for speculative arbitrage strategies. First, the error correction is significant, but slow, with a factor of about 0.3 % per day. Secondly, the hedging ratio is varying at different stock price levels. We still find the relationship between Diana Shipping and the futures market a high-quality input for investment decisions.

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# **1 Introduction**

In this chapter, the background for the problem to be addressed and some of the challenges will be presented. I will also clarify how the paper will encounter the problem introduced in the headline: “How do the futures markets influence the prices of equities?”

## **1.1 Background**

Valuation and speculative arbitrage will be the main focus of this paper. There has been performed many similar studies, but this study has no close connection with other work in the area. I have strong interest in the financial markets and their pattern or way of functioning. I find the topic chosen very interesting and also very similar to assignments that can be expected in working life.

Secondly, the subject chosen make me able to employ several of the skills that we have learned during the master’s degree. In addition to familiar methods from earlier courses, I learn and apply many econometric techniques, co-integration and error correction modeling (ECM), that I have not used in any of the earlier master courses.

## **1.2 Discussion of problem**

A company’s stock price will be influenced by the development in commodities or services that are important inputs for the company. We can for example expect the stock price of Statoil to correlate with the price of oil and gas and Norsk Hydro with the price of aluminum, because the price of these commodities is decisive for the revenue of the companies. The illustration on the next page shows a clear correlation between the spot price of light sweet crude oil at NYMEX, the stock price of StatoilHydro and a widely followed oil index consisting of companies involved in exploration and production of oil (XOI). Often the market for a commodity or service is efficient and liquid. This may lead to opportunities for simple valuation models, for example with oil and gas prices as the only inputs in a valuation of Statoil. There may potentially also be prospects for short-long strategies based on these relationships. This thesis will try to investigate these motivating opportunities.

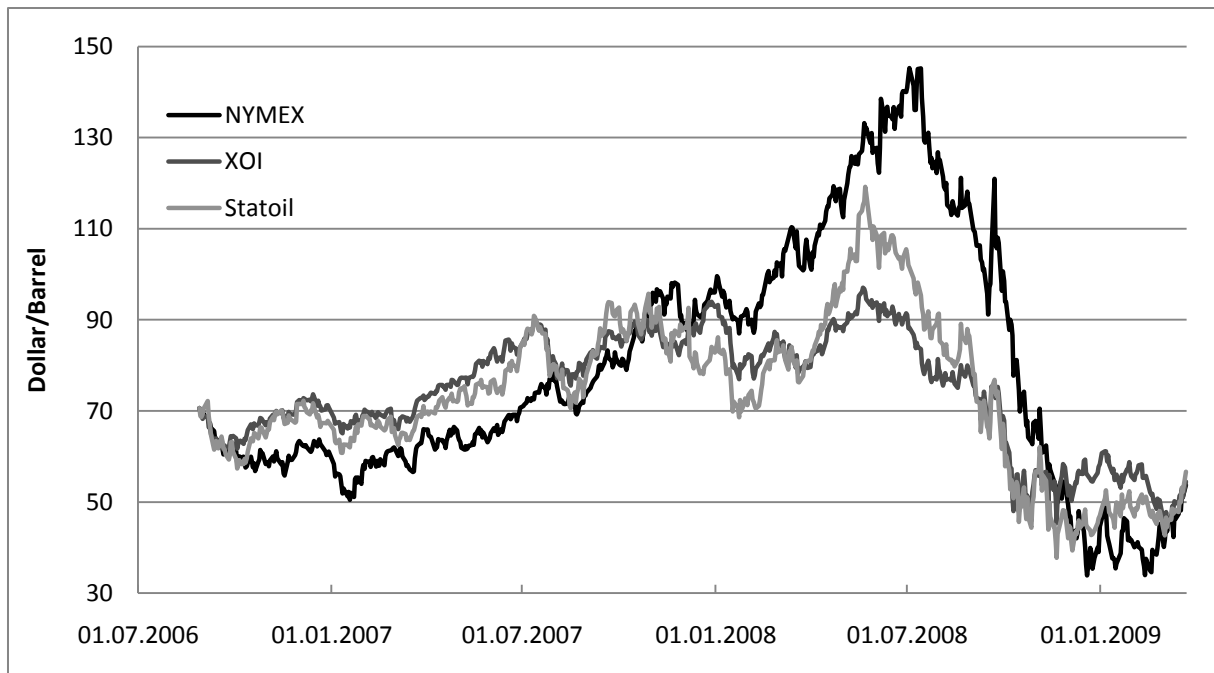


Illustration 1: The price development of StatoilHydro (Statoil) and the American stock exchange oil index (XOI) relative to light sweet crude oil (NYMEX) from 28.08.2006 to 23.03.2009 (Source: Datastream).

### 1.3 Selection process

Although the stock price of a company may be correlated with a commodity market, there are many other factors influencing the stock price of a company that can influence value. During the latest financial turmoil investors have fled several assets. Some assets are more hit than others. To find a consistent relationship between stock price and future market there are some risk factors listed below that one should be specially observant to. These factors can destroy a reliable relationship as the bankruptcy risk increases in a downturn.

- Financial flexibility
  - Financial leverage
  - Liquidity
- Operating risk
  - Place on the cost curve
  - Counterparty risk

In the latest downturn, investors have moved to safer assets. Companies with high leverage, negative cash flow and high counterparty risk have been hit particularly hard. The stock prices of several shipping companies where investors feared for bankruptcy, fell more than 95 %

over a few months, for example Dryships and Golden Ocean. To avoid increased bankruptcy risk during crises, we will look for a company with low unsystematic risk and a low cash breakeven level. That is, a mature company that has:

- A competitive position on the cost curve
- A high equity ratio

Initially, the thesis looked at three alternatives for a company and futures markets that could be appropriate both for fundamental valuation and possibly mispricing strategies. All of the markets are common in Norway:

- An oil company and oil futures: The oil market is a very liquid futures market and the energy sector represents about 50 percent of the Norwegian stock market.
- A salmon company and salmon futures: Several of the largest salmon companies in the world are listed on Oslo stock exchange, but the futures market for salmon is a new market with limited liquidity.
- A shipping company and shipping futures: The market for shipping futures has grown to a nominal value of several \$100 million per month (Imarex.com).

### **Oil production companies**

What resembles many of the small independent exploration and production companies on Oslo Stock Exchange is a low equity ratio coincident with large investment programs. Several are also takeover candidates by larger companies.

StatoilHydro and the six majors are more mature oil production companies. Rather, they are integrated oil companies (Downey). This means that they are producing both oil and gas, and some have downstream business like refineries and petrol stations. In addition, some also have investments in other energy sources, e.g. wind and solar power. Exxon for example, has a considerable chemical business. This makes them difficult to value on the basis of the futures market. Also the cost curve is difficult to predict as well as uncertainty about total oil reserves.

### **Salmon farming companies**

The market for salmon futures is relatively newly established and there could be an opportunity to exploit an immature market. The salmon companies are still very vulnerable to salmon diseases. This makes their cost levels and production volumes unpredictable. Many of

the companies are producing significant volumes of fish feed. Almost all of the revenues from SalMar and Marine Harvest are from salmon and trout, but Marine Harvest has a high debt level and difficulties with their Chilean business. SalMar on the other hand still has decent margins, but has a significant VAP business (They process a large part of the fish volumes before export).

### **Shipping companies**

Shipping companies often have series of sister ships with definite operating lifetime (Industry standard is 25 years). The shipping industry has zero taxes, a decent future market for the most popular vessel sizes and insurance limits risks to ship losses. Given that we are able to find a company with a small number of new buildings and a healthy balance sheet, the cash flow valuation on the basis of the futures market ought to be reasonably straight forward.

### **Selection**

From this investigation, the conclusion is that shipping companies are easier to value on the basis of the futures curve, compared with oil and salmon farming companies. That is why we choose to look at a shipping company and shipping futures in the following.

First the paper will perform a cash flow valuation of the listed shipping company Diana Shipping (Description of the company in appendix one) on the basis of the futures curve. Given that we can approximate a company's cost curve and future production volume, we should be able to make a valuation of a company on the basis of the futures market as the only exogenous variable.

Secondly, the paper will put forward an econometric valuation model on the basis of an OLS-regression between the stock and the futures market.

## **1.4 Application**

We will combine a fundamental valuation of Diana Shipping with a relative pricing viewpoint.



In the first part of the analysis, a standard cash flow and NAV valuation of Diana Shipping is performed and can be used as a high-quality input for an investment decision in the shipping markets.

Hopefully, the findings in the second part of the analysis (Econometric analysis) can be used for speculative arbitrage. Capital always has an opportunity cost. That is one of the most important facts in finance. Looking for arbitrage opportunities regardless of the assets in question, will contribute to the efficiency of the financial markets and that capital flow to its best use. Speculative arbitrage is also a typical hedge fund strategy.

There are several reasons why speculative arbitrage strategies are applicable:

- Low market risk: Returns are not correlated with the overall market performance.
- Low upfront cash
- Risk free arbitrage is not feasible. Even with access to debt at favorable interest rates and high volumes to reduce transaction cost, risk free arbitrage is difficult to exploit.

## **1.5 Outline**

Chapter 2: In this part of the study, selected parts of theory that is important to understand the analysis is described and explained. This includes some theory on hedging ratio and basis risk as well as econometric technique. Finally, we will describe different methods for valuation.

Chapter 3: In this chapter we examine the data sources. What kind of data has been used and are they reliable and valid?

Chapter 4: In the fourth chapter, the results established are analyzed. The chapter is split in two parts. First, the fundamental valuation with discounted cash flow and net asset value analysis are presented. In the second part, the paper will look at the correlation between the stock price of Diana Shipping and the futures market from an econometric perspective through OLS, co-integration and error correction modeling.

In chapter five the conclusions are presented and in chapter six and seven references and appendix are available.

## 2 Selected theory and methodology

This section contains the theory most useful for the discussion and analysis in the thesis.

### 2.1 Hedging ratio and basis risk

Let us divide arbitrage into three categories (Damodaran):

- Pure arbitrage: You risk nothing and earn more than the risk free rate.
- Near arbitrage: You have two identical or almost identical cash flows, trading at different prices, but there is no guarantee that the prices will converge. (E.g. are dual listed stocks, A and B shares and convertible arbitrage).
- Speculative or pseudo arbitrage: Investors take advantage of what they see as mispricing of similar assets. Selling the expensive one and buy the cheaper one. Even if assets are similar, there may be no convergence in prices.

If there is no basis risk, hedging is straightforward, short the same amount of the asset as you possess. However, if basis risk exists, it is necessary to find an optimal hedging ratio. And it is this basis risk that we take on when entering a speculative arbitrage position on the basis of mispricing. Consider an investor who buys one unit of asset A and shorts N units of asset B. The net profit on this position at date t is given by:

$$(1) \quad \pi_t = (A_t - A_0) - N(B_t - B_0) = \Delta A - N\Delta B$$

The variance of this profit is:

$$(2) \quad \sigma_{\pi}^2 = \sigma_A^2 + N^2\sigma_B^2 + 2NCov(\Delta A, \Delta B)$$

This is minimized when:

$$\frac{\partial \sigma_{\pi}^2}{\partial N} = 2N\sigma_B^2 + 2Cov(\Delta A, \Delta B) = 0 \quad \rightarrow \quad N = \frac{Cov(\Delta A, \Delta B)}{\sigma_B^2} = \frac{\sigma_{\Delta A}}{\sigma_{\Delta B}} \rho = \beta_A(\text{On } B)$$

where  $\rho$  is the correlation coefficient. According to the definition of the optimal hedge ratio,  $N$  can be estimated from a regression of the returns on asset A against the returns on asset B. The slope of this regression gives the minimum variance hedge ratio. The  $R^2$  of this regression gives the systematic link between asset A and B. Thus,  $(1 - R^2)$  gives a measure of the basis risk, i.e. the risks that still remain after the hedge has been put in place.

To feasibly exploit mispricing between two assets we should find a consistent relation, i.e. a hedging ratio that stays robust as the overall market goes up or down. If the hedging ratio changes, we will have to adjust the hedging ratio as the forward market goes up or down, much like delta hedging of options. This could be the case if the futures price comes close to the cost of production. Then the bankruptcy risk will increase, and consequently the basis risk increases. Then the change in percentage terms will likely be much higher for the stock than for the forward price as the futures market doesn't go bankrupt.

Thus, we must emphasize that the spot market for tank and dry bulk services can yield negative rates, as voyage cost is excluded on a TCE-basis. Ship owners may be willing to take cargoes at rates that don't cover all of the voyage cost and this can lead to negative TCE-rates. However, if we use the front month, negative rates are very unlikely.

## **2.2 Econometric analysis**

As the relation between stock prices and forward prices is important in this assignment, we will look briefly at the theory behind the econometric methods employed here. We already looked briefly on basis risk and hedging. And we noted that  $N$  can be found by doing a regression on asset B by A.

Econometrics is a development of statistical methods for estimating economic relationships. We will look at time series data in the thesis.

### **2.2.1 Ordinary least squares (OLS)**

If there is a relation between the variables, the dependent variable ( $Y$ ) can be described as a function of the independent variable ( $X$ ):

$$(3) Y = \beta_0 + \beta_1 X + e$$

The method is called ordinary least squares. The function of X is the line that best fits the data. OLS minimizes the vertical distance between the observed and the predicted values.

With time series data, we often use lags to find the lag distribution and the long run multiplier. We can also use binary or dummy variables to adjust for special events or seasonal variations. A finite distributed lag model of order two and with one dummy variable is written as:

$$(4) Y = \beta_0 + \beta_1 X_t + \beta_2 X_{t-1} + \beta_3 X_{t-2} + \theta Dummy + e_t$$

### 2.1.2 Measures

When we are performing a regression analysis, the regression package will report measures of correlation, elasticity and statistical significance level.

R-squared is a measure of goodness-of-fit and estimate the share of variation in Y explained by the independent variable (X). R-squared is defined as  $R^2 = 1 - SSR/SST$ . SSR is the sum of squared residuals and SST is the total sum of squares. The R-squared obtained from time series at levels, can be artificially high and result in misleading conclusions.

The p-value gives the statistical significance of the regression coefficients. For example we would reject the null hypothesis at a 0.05 significance level if the p-value is lower than 0.05.

The elasticity is the percentage change in Y given a percentage change in X. Often we use the natural logarithm of X and Y to estimate the elasticity.

### 2.1.3 Model assumptions

Serial correlation is the correlation between the error terms (e) in different time periods. Serial correlation violates the model assumption for time series (assumption five below). Time series often violate the model assumption of no serial correlation. This can make the usual statistical inference unreliable. Hence, OLS estimators are no longer the best linear unbiased estimators (BLUE).

Classical Linear Model Assumptions for time series regression:

- Assumption 1: Linear in parameters: The stochastic process follows a linear model.
- Assumption 2: No perfect collinearity: No explanatory variable is a linear combination of the others.
- Assumption 3: Zero conditional mean: Error terms have zero expected value.
- Assumption 4: Homoskedasticity: Error terms have a constant variance.
- Assumption 5: No serial correlation: Error terms are not correlated over time.
- Assumption 6: Normality: Error terms are normally distributed.

#### 2.1.4 Co-integration and error correction modeling

A time series is stationary if its mean, variance and covariance are constant over time. A process that is not stationary is said to be non-stationary.

I(0): The process is stationary.

I(1): The process is stationary if differentiated once.

I(2): The process is stationary if differentiated twice.

I(1) is normal for time series data. We can differentiate a I(1) process to get a stationary process, but in consequence we lose information. To test if a series is stationary we use a unit root test, the augmented Dickey-Fuller test (ADF).

As a general rule we should not use non-stationary variables in a regression model to avoid the spurious regression problem. If however, there is a linear combination of X and Y which is stationary, the two prices are co-integrated. That is, there exists a long run equilibrium towards which the two will gravitate.

How to establish a linear combination of X and Y if both X and Y are I(1):

- Restricted: Defined co-integration vector.
- Unrestricted: Estimated co-integration vector.

$$(5) Y - \beta_0 + \beta_1 X = e$$

If  $e$  is stationary, then  $X$  and  $Y$  are co-integrated.

To be able to use co-integration for mispricing strategies we have to test if the convergence is fast and significant. That is, to see if the change in  $Y$  in time period  $t$  ( $\Delta Y_t$ ) is negatively correlated with the error term in time period  $t-1$  ( $e_{t-1}$ ). To do this we use Granger's representation theorem. The short run change can be modelled in an Error Correction Model (ECM):

$$(6) \Delta Y_t = \beta_0 + \beta_1 \Delta X_t + \rho e_{t-1} + \varepsilon_t$$

If  $\rho$  is  $-1$  we have immediate correction. If  $\rho = 0$  it takes forever. The procedure for co-integration and ECM testing is illustrated below (Illustration 2):

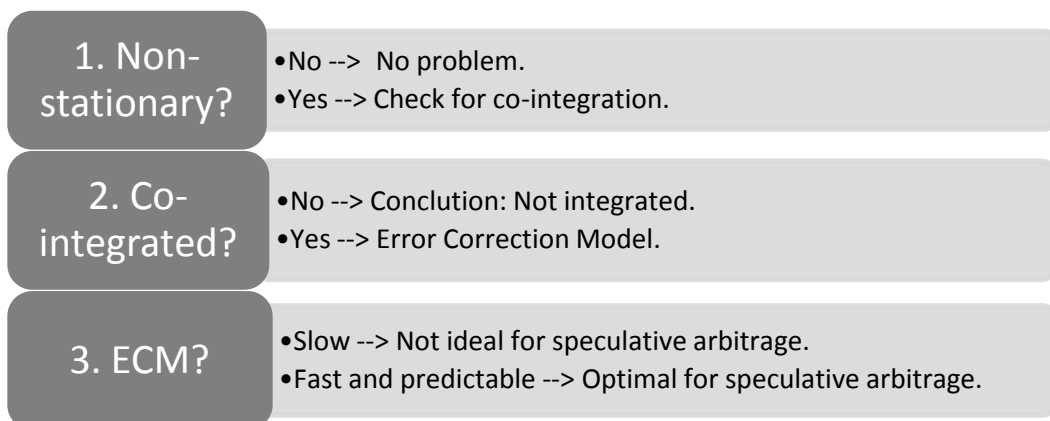


Illustration 2: The procedure to test if two different time series are co-integrated.

## 2.3 Valuation and tax shield

The paper will look at Diana Shipping both fundamentally and from an econometric perspective. There are several pricing models available:

- Absolute pricing models

- Net asset value (NAV):

NAV is calculated as the market value of assets less the market value of debt.

This approach is often used for companies with liquid assets like real estate and shipping.

$$(7a) \text{ Value} = \text{Value of assets} - \text{Debt}$$

- Discounted cash flow (DCF):

This is the most employed and accepted method for valuation. The value is seen as the sum of free cash flows from operating assets of the company, discounted at weighted average cost of capital (WACC), alternatively using adjusted present value (APV). Finally, we adjust for debt and other financial assets.

$$(7b) \sum PV[FCF] - \text{Net debt}$$

- Dividends ( $\sum PV[\text{Dividends}]$ ):

From an investors point of view it may be more interesting to consider the cash flow actually paid out directly through dividends or stock buyback, discounted at the cost of equity. Often a constant growth rate or terminal value is employed.

$$(7c) \text{ Value} = \frac{\text{Dividend}}{k_e - \text{growth}}$$

- Earnings:

A potential approach is to divide the earnings between a static value and the value of growth opportunities (PVGGO), if the company is able to reinvest above the cost of capital.

$$(7d) \text{ Value} = \text{Static value} + \text{PVGGO} = \text{Book} \left( \frac{ROE}{k} \right) + \frac{\text{Investment} \left( \frac{ROE}{k} - 1 \right)}{k - g}$$

- Option pricing models: If the debt level becomes very high compared with the equity, a binary outcome scenario can be constructed. Next, the equity can be regarded as a call option and valued with option pricing models.

- Relative pricing: Before an investment decision, it is important to observe the relative value of different companies, also called peer review. Although, the valuation is positive from an absolute pricing point of view, there may be other more attractive investment opportunities.

We will mention two techniques to find the cost of capital:

- Adjusted present value (APV):
  - Find a reasonable asset beta and calculate the cost of capital:  
 $r_{riskfree} + \beta_{asset} \times Market\ premium$
  - Value the company assuming all equity
  - Add the value of financial side effects, like tax shield and agent cost.
- Weighted average cost of capital (WACC):

$$\frac{D}{EV} r_{debt} (1 - T_c) + \frac{E}{EV} (r_{riskfree} + \beta_{equity} \times Market\ premium)$$

### **Tax shield valuation**

Frequently, the tax shield is considered the financial side effect with greatest impact on value. To find the value of the tax shield we have to make assumptions about debt level and the riskiness of the tax shield:

- Fixed amount of debt
- Fixed leverage ratio
- Debt paid off
- Riskiness of tax shield equals that of the operating assets
- Riskiness of tax shield equals that of the debt

We can also differentiate between real and nominal costs of capital, thus the valuation should yield the same result.

Usually, we assume a fixed amount of debt while the riskiness of the tax shield equals the riskiness of the debt. Consequently, we obtain this formula for the value of a company:

$$(8a) \quad EV_{Debt} = EV_{No\ debt} + D \left[ 1 - \frac{(1-T_c)(1-T_e)}{(1-T_d)} \right]$$



Where:

$T_c$  = Corporate tax

$T_e$  = Personal tax on equity

$T_d$  = Personal tax on debt

If personal tax on debt equals personal tax on equity we get the easier formula:

$$(8b) \quad EV_{Debt} = EV_{No\ debt} + D * T_c$$

These two equations apply in a country where interest is tax deductible. Hence, theoretically, because interest is tax deductible, a higher debt level will decrease the WACC and, thus, increase the estimated value of the company.

An article by Graham (The Journal of Finance, 2000) concludes that the tax benefit of debt is below five percent at the personal level, i.e. after personal taxes, net to the investor. A Deutsche Bank report on capital structure (Tufano and Servaes, Jan 2006) points out that in practicality, the ability to keep investing and to keep the firms credit ratings is more important than the tax shield. There are also several other issues to consider, and there are mixed opinions about the advantages of debt in academia.

### **3 The data**

By request we received daily futures data from International Maritime Exchange (Imarex) for the period 1.1.2007-1.4.2009. The data includes all futures for the panamax and capesize segments. We also received futures data for the BDI index which is an index consisting of all the four dry bulk segments: Handysize, supramax, panamax and capesize. However, the BDI futures are traded since 13.06.2008 only and are not used in any calculations. Daily stock prices for Diana Shipping are downloaded from DataStream.

#### **Data reliability**

The data are received from dependable sources like DataStream and Imarex. The PM4TC and CS4TC FFAs are among the most traded dry bulk futures at Imarex. Monthly nominal trade value for dry bulk FFAs are usually in the range from \$100 million to \$1000 million. We believe that the data collected are reliable and give a representative picture of market conditions. We consider internal validity to be good. The spot market for shipping has performed extremely well in the whole model period (1.1.2007 to 01.10.2008) compared with the historical average. That could cause the data to be biased. Furthermore, these are real data, not a controlled experiment, where you are able to manage for all factors influencing results.

We must be careful to the extent we generalize the results (External validity). In that case, more experiments on different companies, futures and time periods ought to be performed.

#### **Particulars**

There is around ten days in the dataset where either the dry bulk futures or the stock prices for Diana Shipping are omitted. As most of the work is at levels his should not influence the results.

The times of closing for the data are not equal. The stock price closes eight hours after the dry bulk data from the Baltic Exchange are released. Diana shipping is quoted on the NYSE in New York. The NYSE closes at 2200 CET. The Imarex dry bulk futures are set on the basis of data from the Baltic Exchange in London, which are released 1400 CET. This can lead to some inaccuracy in the data set.

## 4 Analysis

### 4.1 Fundamental valuation model

#### The shipping industry

Historically, before the last years with a very good market, the shipping business has given low returns compared with the high volatility in the shipping markets (Illustration 3 below). With fixed supply in the short run, shipping services has been very vulnerable to downturns in the world economy. The following analysis focus on Diana Shipping, which is operating in the dry bulk segment.

<i>Portfolio</i>	<i>Period</i>	<i>Average ROI per cent per annum</i>	<i>Standard Deviation per cent per annum</i>
Treasury bills	1926–85	3.5	3.4
Long term govt bonds	1926–85	4.4	8.2
Corporate bonds	1926–85	5.1	8.3
Common stock	1971–90	11.0	17.0
Bulk shipping	1971–90	9.0	35.0
Tanker shipping	1980–94	5.2	30.0

Illustration 3: The table shows a comparison between bulk-, tanker shipping and other assets. Source: Brealey and Myers, 1988, p 131 and Stopford, 1995, Table 1

#### Why Diana Shipping?

Shipping companies are fairly straightforward to value. In addition, Diana Shipping has three series of sister vessels and is only operating in the dry bulk segment, which make the valuation clearly set out. There are some long term contracts, but it is uncomplicated to adjust for this. In addition, we find the company's business model to be easy and predictable. The company has limited gearing and an excellent cash flow. This adds up to a model which reduces the residual risk factors considerably compared with other shipping companies, and is a good starting point for a potential speculative arbitrage strategy.

## Valuation model of Diana Shipping

For the fundamental valuation of Diana shipping we will apply a discounted cash flow valuation (Eq. 7b):

$$Value = \sum PV[FCF] - Net\ debt$$

The only exogenous variables are the shipping futures. This leads to a simple approach where OPEX, G & A and cash flow from scrapping are held fixed. As mentioned, Diana Shipping has a relatively new fleet with three series of sister ships which makes the DCF relatively straightforward.

### Model assumptions

The discount rate for the operating assets is set to nine percent (Three percent risk free rate, five percent market premium and beta of 1.2). We don't find this conservative. Theoretically, given the financial turmoil in the model-period, the cyclical nature of the shipping market as well as a high opportunity cost of capital in the model-period one can argue that it could be higher. For example, a Seadrill convertible bond traded at around 20 percent yield to maturity (Maturity 2012) during the winter (Stamdata.no). This shows some of the difficulties when calculating a theoretical discount rate, especially during times of intense financial turmoil. We used nine percent to be more in line with the stock price. The tax is close to zero as the ships are registered in countries with very low or zero tax.

The analysis assumes 25 years as the operating lifetime for the ships and which is the industry standard. The dry bulk service is homogeneous with many suppliers, and it is difficult build a competitive advantage. It is assumed that the ship owners reinvest at the cost of capital which offer zero present value of growth opportunities in the valuation.

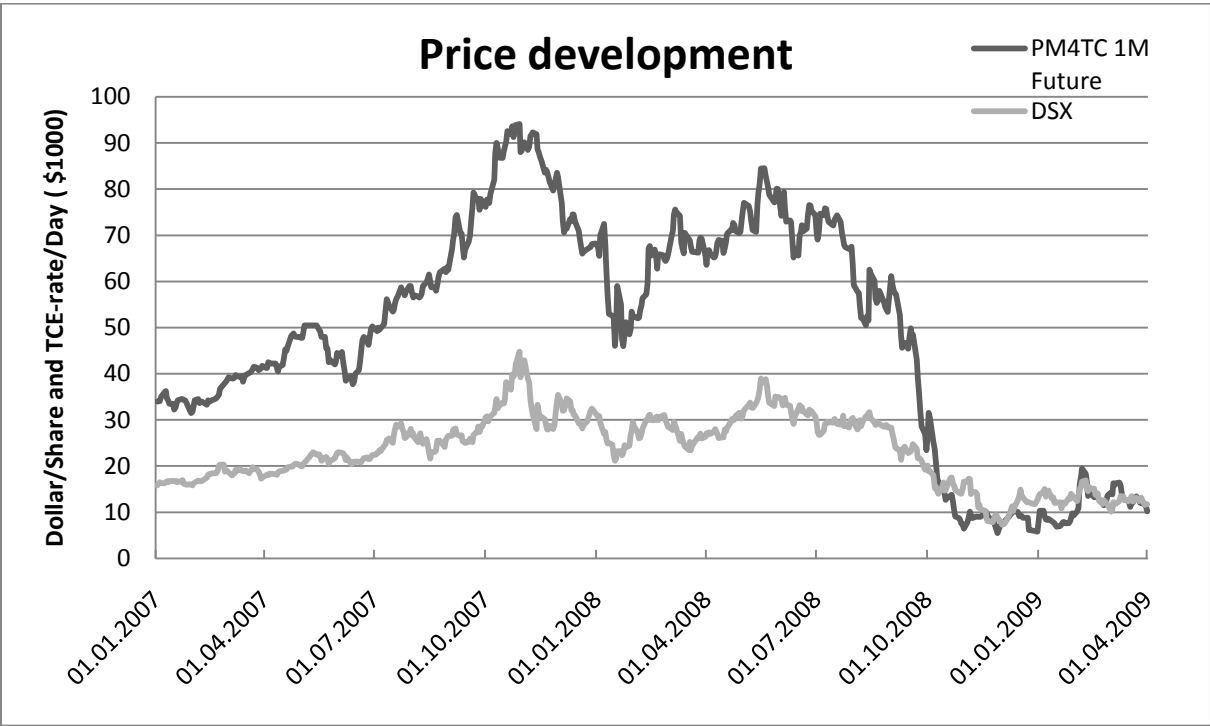
The revenue for the typical ship is expected to fall at about 2-3 % per year (Vabo, R., Fearnley Fonds) and their operating cost to increase somewhat. The analysis employs a fall in income of 1.25 % per half year compared to futures market, from year seven for the panamax vessels and from year ten for the capesize vessels. This is partly because the way the PM4TC and CS4TC indexes are constructed. The PM4TC index doesn't include ships more than

seven years old and the CS4TC doesn't include ships over ten years old (The Baltic Exchange).

It is assumed a stay of 25 days in dry dock every fifth year with a cost of \$2.5 million (Vabo, R., Fearnley Fonds), and there will not be assumed any off hire beyond that. The operating expenses are set to \$5000/d for the panamax vessels and \$7800/d for the capesize vessels (Severinsen, A., Lorentzen & Stemoco). Operating expenses are expected to increase at the same rate as inflation. The debt adds to around 300 MUSD as committed installments for the two capsize new builds with delivery in 2010 are added (Diana Shipping, annual report 2008).

**Development**

As we see from the graph below, there has been a very good market for panamax vessels the last two years mirrored in unusually high rate levels. We see that after two peaks in the autumn of 2007 and May 2008 the market has come down to between 10000 and 20000 dollars per day. That is close to break even for most panamax vessels.

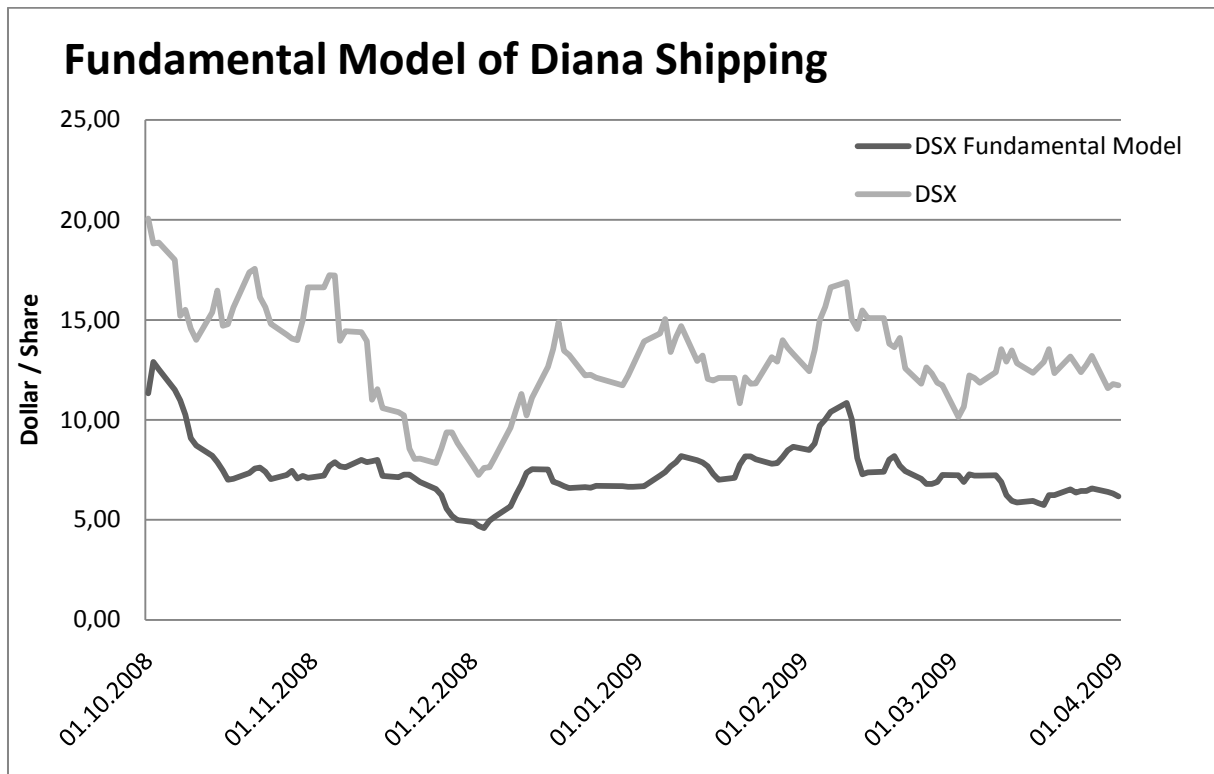


Graph 1: An overview of daily panamax one month future and the stock price of Diana shipping for the whole dataset (1.1.2007-1.4.2009).

## Procedure

For the fundamental valuation, the thesis will consider the third quarter of 2008 and the first quarter of 2009 with the futures market as the only exogenous variable. The model uses the following futures: PM4TC Q1+Q209, PM4TC Q3+Q409, PM4TC CAL10, PM4TC CAL11, PM4TC CAL12, PM4TC CAL13, PM4TC CAL14, and the similar futures for the capsize vessels. The futures are changed in the model for every working day from 1.10.2008 to 1.4.2009 to give the results that are shown in graph two below. Also shown in the graph, is the real stock price development of Diana Shipping.

From the graph the modelled stock price seems to correlate well with the real stock price of Diana Shipping (Graph 2). That indicates that the change in the futures curve is a good indicator of the changes in the stock price. Still, the real stock price trades significantly higher than the modelled price, between 50 and 100 percent higher most of the period. The divergence is significant.



Graph 2: Fundamental model of Diana Shipping.

## Net asset value

To further investigate the discrepancy, we also choose to calculate the net asset value of Diana Shipping. Net asset value (NAV) is the market value of assets less the market value of debt and is often used for shipping and real-estate companies (Eq. 7a):

$$Value = Value\ of\ assets - Debt$$

Table 1: The table show additional NPV of long time charters on several of the vessels (Discount rate 9 %). The PV is on the basis of end February long term T/C rates of around \$23500 for capesize and \$13000 for panamax vessels.

CS-vessels	NPV of contracts
Sideris GS	9,4
Semirio	9,7
Boston	27,3
New York	28,2
Aliki	18,2
Salt Lake City	35,4
Norfolk	62,8
PM-vessels	
Protefs	44,1
Alcyon	26,3
Sum	MUSD 261,4

The NAV calculation is performed on the basis of the sale and purchase market the last part of March 2009 as an approximation, and in addition to the DCF-valuation. Market capitalization of the company in last part of March is around \$950 million (12.5 dollars per share and 75.4 million shares). The average age of the ships is about five years for the 13 panamax ships, and the eight capesize vessels has an average age of about two to three years. The market price for these ships at the end of March 2009 would be around \$55 million for a capesize carrier and around \$30 million for a five year old panamax carrier (Source: Golden Ocean q1 report, but the uncertainty is high with few transactions at the time). In addition to the ships there is also positive NPV from the long contracts Diana Shipping has on several of the capesize vessels and two of the panamax vessels (Table 1 above), as the contracts are above the market rates at the time. We could consider applying a lower discount rate for the contracts, but given the high counter-party risk involved I decide to use a discount rate of nine percent which is the same as for the assets. Adding the value of ships of about \$830 million and the NPV of the contracts of around \$250 million, less the debt of about \$300 million gives a NAV of around \$780 million, or \$10.5 per share. This is approximately 15 percent below the market capitalization at the time period in question. We note that the NAV valuation is more in line with the stock price, than the DCF valuation, which is around six dollars the last part of March.

## Conclusions

What could cause the difference between DCF valuation on the basis of the futures market (Six dollar/share), NAV (10.5 dollar/share) and the stock price (12.5 dollar/share)?

What partly explains the difference in pricing is the liquidity in these markets. While the stock market is very liquid, the sale and purchase market and the futures market are not as liquid. Still, the difference is too large to be fully explained by the liquidity factor.

Stock and ship owners can have higher expectations to future shipping rates than the participants in the futures market. Let us assume that the value of a vessel is the NPV of the cash flows from operating the ship over its lifetime. On the basis of the future market at the last part of March (Approximately \$22000/day), the value of a new capesize vessel is around \$40 million from a DCF-valuation with nine percent discount rate. This suggests that asset values are still too high compared with futures market. From my point of view, either dry bulk futures have to improve or the stock and asset prices have to be reduced. Interestingly, if we increase the rates to around \$30000 for the lifetime of the vessel, the value of the cash flows increase to around \$67 million and \$40000 gives a NPV of \$100 million. Through most of 2007 and 2008 the rates stayed above \$40000 (Graph 1). Maybe stock and ship owners expect these rate levels to return as the economy improves again. Anyway, that is not reflected in the futures markets.

The stock market may assume a lower discount rate. The high amounts of leverage in the shipping business may have turned more focus to internal rate of return (IRR) relative to WACC or APV valuations. There has been up to 80 percent debt financing of ships in recent years. Also, some debt financing has been without recourse with the ship as only collateral (Source: Ship Finance presentation in Shipping Economics – INB426). This can provide a lower cost of capital for the ship owners and lead to higher asset prices. Also, increased debt financing can lead to moral hazard, and the share price can be valued as a call option.

The stock market may focus on positive short term cash flow, high dividend payments and low trailing multiples. Diana Shipping has currently significant positive cash flow as a result of several longer contracts at high rates. Furthermore, the stock market may consider the present value of growth opportunities. Diana Shipping may be able to take advantage of its knowledge about the market and its strong balance sheet in a difficult market.



From a fundamental point of view, the cash flow is the driver of asset prices. If dry bulk rates fall, we expect investors to seek other assets with higher return. Thus, a cash flow analysis is most appropriate when one is not planning to sell the assets directly. We have three markets for shipping: The sale and purchase market, the futures market and shipping companies. One can expect market forces to drive the fundamental valuation of the markets towards one another, to offer more consistency. For an investor who wants exposure to the shipping market the futures market clearly look as the most attractive investment at end march levels.

## 4.2 Econometric valuation model

In addition to the fundamental valuation, an econometric approach is chosen in order to examine if the stock price of Diana Shipping correlates with the Imarex futures market at levels. We use levels because we lose information when we differentiate to changes. To investigate, we are running a linear regression between Diana Shipping and spot rates for panamax (PM4TC) and capesize vessels (CS4TC) (Model 1 and 2). We are also running a regression analysis between Diana Shipping and one month futures for panamax vessels (Model 3). We hope that the models can provide a better understanding in how the market values Diana Shipping opposed to, or in addition to, the more fundamental approach in the previous chapter.

The model is on the form: 
$$Y = \beta_0 + \beta_1 X + e \quad (\text{Eq. 3})$$

where Y is the stock price and X is the appropriate shipping rate.  $\beta_0$  (Also called alpha or constant) is the intersection with the y-axis.  $\beta_0$  can also be partly seen as a call option value of the stock since the stock holders have limited liability. A first-class linear model will therefore have a positive  $\beta_0$ . For one month panamax futures, one has to roll the contract at the end of each month, so there can be small jumps in the data. The regressions are for the period 1.1.2007-1.10.2008.

In addition to the linear regression, we will check for co-integration using the residual from the regression on Y.

$$Y - \beta_0 + \beta_1 X = e \quad (\text{Eq. 5})$$

If  $e$  is stationary, then  $X$  and  $Y$  are co-integrated.

To be able to use co-integration for speculative arbitrage strategies, we have to test if the convergence between the futures markets and the stock price is fast and predictable. To do this, we use Granger's representation theorem. The short run change can be modelled in an Error Correction Model:

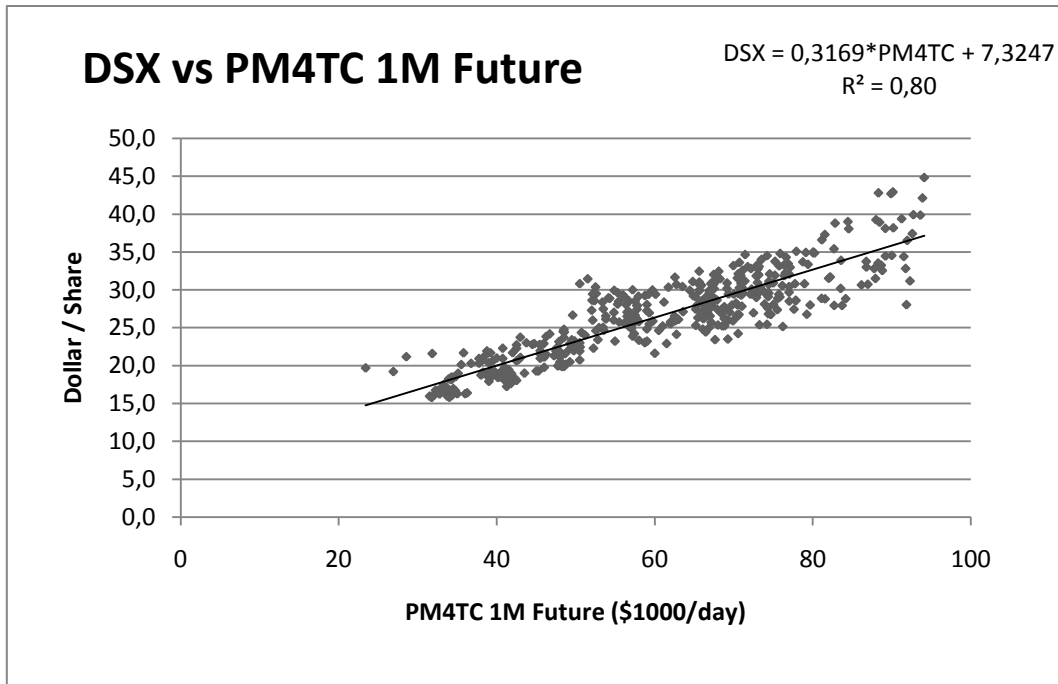
$$\Delta Y_t = \beta_0 + \beta_1 \Delta X_t + \rho e_{t-1} + \varepsilon_t \quad (\text{Eq. 6})$$

If  $\rho$  is -1 we have immediate correction. If  $\rho = 0$  it takes forever.

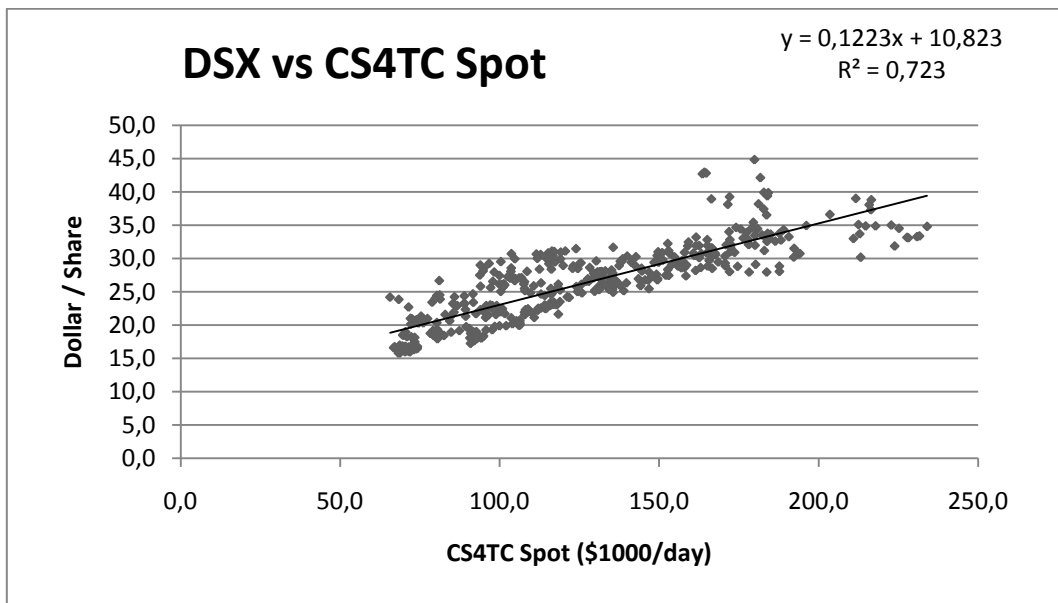
In the end of this chapter we will use the results from the regression analysis for the period 1.1.2007-1.10.2008 to forecast the stock price the next six months from 1.10.2008 to 1.4.2009.

### **Linear regression**

The scatter plots (Graph 3 and 4 below) for PM4TC one month future and CS4TS spot illustrates that the relationship with the stock price fits well into a linear model. The PM4TC one month future fits slightly better than the spot CS4TC. The variance seems to increase when the spot rates become above \$150000/day for capesize and \$80000/day for panamax vessels. Since we look at absolute prices, the relative changes are not necessarily increasing, but it indicates some heteroskedasticity in the data (Increasing variance).



Graph 3: The panamax front month contract (PM4TC) compared with the stock price of Diana Shipping (01.01.2007-01.10.2008).



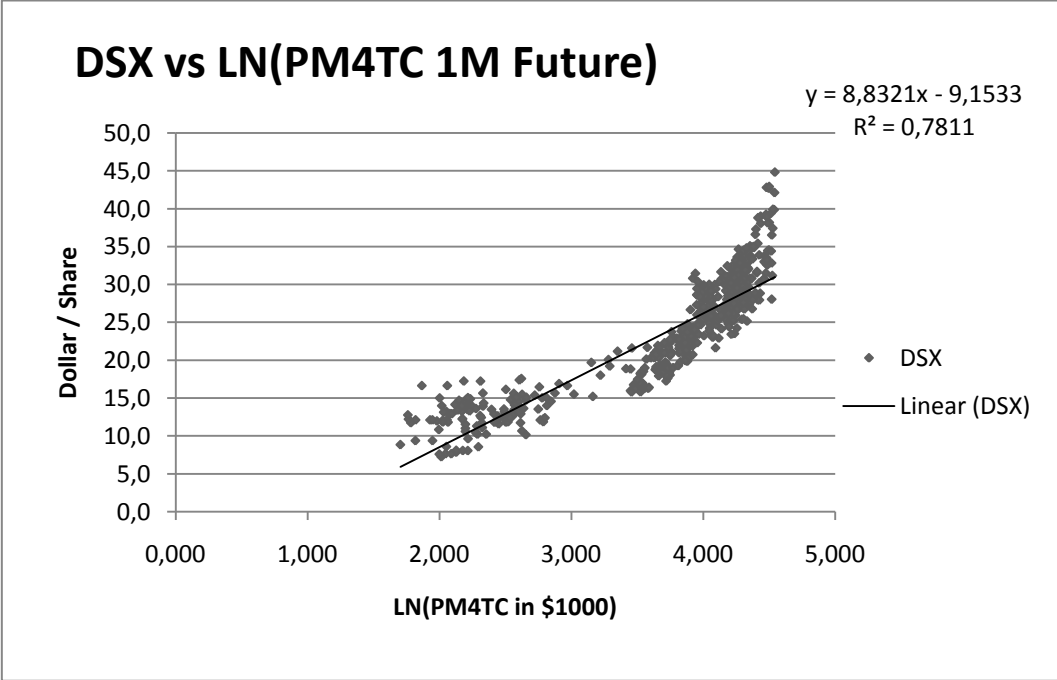
Graph 4: The capesize (CS4TC) spot rate compared with the stock price of Diana Shipping (01.01.2007-01.10.2008).

### Objections to a linear model

We are looking at spot rates. From a fundamental viewpoint, we can expect the stock price to level out at high spot or front month rates, and that the stock price turn out to be a concave function of short term shipping rates. This would be logical as we would expect rates to

decline in the not too distant future as more ships are entering the market, both new ships and conversion from tankers, given the high margins and low barriers to entry in the shipping markets. More supply would again put pressure on rates towards marginal cost. For most panamax vessels, cash cost break even is well below \$20000 per day on a TCE-basis, with operating expenses at \$5000/day plus capital expenses.

To incorporate this “fundamental logic” in the model, we can model the stock price on the natural logarithm of the panamax futures which is a concave function. The scatter plot below illustrates a clear pattern and does not look random (Graph 5). We consequently choose to only go forward with the linear approach in the following discussion. Anyway, we find it interesting that a linear model appear to fit the data much better than a concave model. The stock holders should not only be concerned with short term profits. Short term cash flows are more important given the discount rate, but the stock holders seem to have expected high rates for a long time. This can indicate some bubble tendencies or strong momentum effects in the dry bulk shipping market in the model period. This is easy to observe in hindsight and the linear relation may not repeat itself should a similar upturn in short term rates occur.



Graph 5: The panamax front month contract (PM4TC) compared with the stock price of Diana Shipping (01.01.2007-01.10.2008).

We could consider adding additional variables in the model, like currency, interest rates and order book. In this paper we assume that this information to a large extent is represented by the dry bulk shipping rates.

**Regression results**

The regression results show an R-squared of between 0.7 and 0.8 (Table 2). The t-values are significantly different from zero. The one month future seems to fit the stock prices best with the lowest standard deviation and highest r-squared. The constant of \$10.84 for model two seems too high. Remember that R-squared at levels can show a misleadingly high value if the data are non-stationary, which is generally the case with time series data. The total sum of squares often become disproportionate compared with the residual sum of squares. That is also the case in this dataset. Both the shipping rates and the stock price of Diana Shipping are not stationary at the five percent level.

<b>OLS-LEVELS (Y = DSX)</b>	$\beta_0/\beta_1$	T-value		
<b>Model 1 (PM4TC)</b>			R <sup>2</sup> : 0.77	$\sigma$ : \$2.78
Constant	\$7.89	14.7		
PM4TC (\$1000)	0.31	38.1		
<b>Model 2 (CS4TC)</b>			R <sup>2</sup> : 0.72	$\sigma$ : \$3.07
Constant	\$10.84	22.0		
CS4TC (\$1000)	0.12	33.2		
<b>Model 3 (PM4TC_Front Month)</b>			R <sup>2</sup> : 0.80	$\sigma$ : \$2.59
Constant	\$7.18	15.1		
PM4TC_Front_Month (\$1000)	0.32	41.8		

Table 2: The table shows regression of DSX on PM4TC and CS4TC spot rate as well as on PM4TC one month future. The model is on the form:  $DSX_t = \alpha + \beta \times PM4TC_t + \epsilon$ . The period is from 1.1.2007-01.10.2008.

An augmented Dickey-Fuller-test is utilized on the residuals to test for stationarity (Table 3), i.e. an unrestricted co-integration vector. The residuals are a linear combination of the two variables. If the residuals are stationary, we conclude that the two variables from the regression are co-integrated. This procedure is also explained in the theoretical part on page 13 and 14.

<b>ADF-test</b>	T-value	beta
1 % significance level (0 lags)	-3.45	
Model 1: Residuals_PM4TC_Spot	-4.19	0.92
Model 2: Residuals_CS4TC_Spot	-3.72	0.93
Model 3: Residuals_PM4TC_Front_Month	-4.43	0.91

Table 3: Augmented Dickey Fuller test to test for stationarity. All three series are stationary at the one percent significance level.

The residuals from model one, two and three turn out to be stationary at a one percent significance level. That is a clear result.

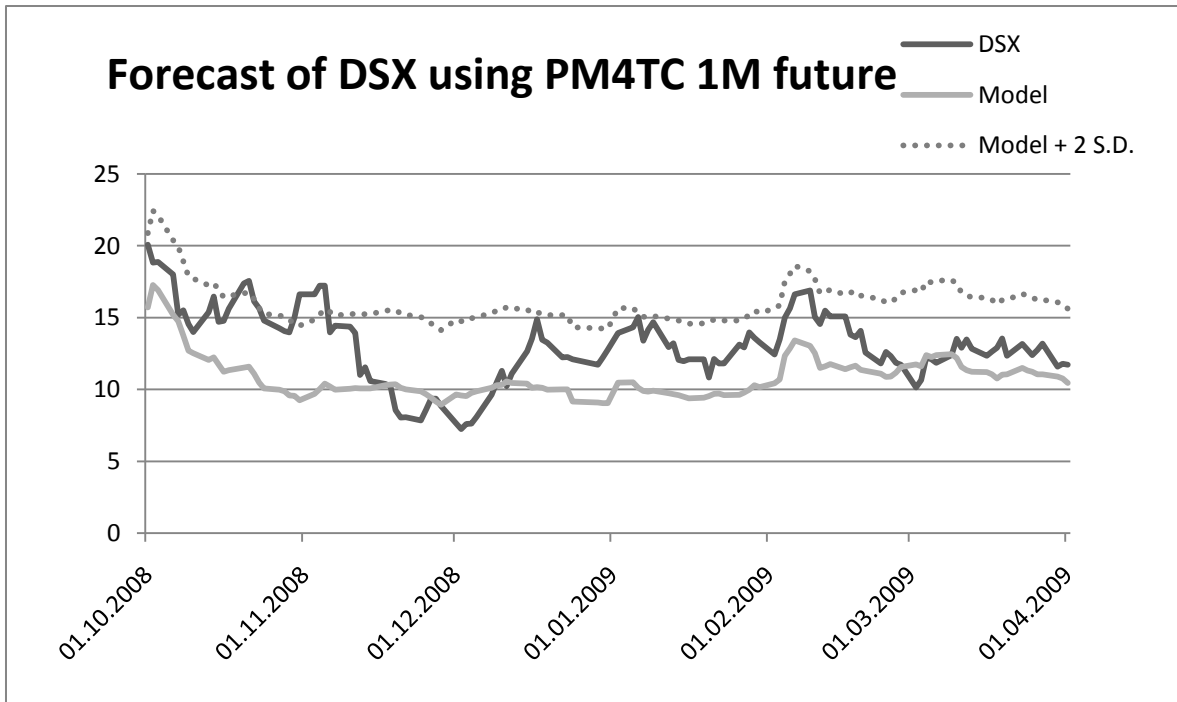
By performing an Error Correction Model (Eq. 6), we can test if the co-integration is fast and predictable (Table 4). The change in the stock price is clearly significantly negatively correlated with the residuals at the one percent level. That is what we would expect. The one month future has the highest t-value with 4.3. However, the correction is very slow, with only 0.2 percent of the residual per day with spot prices and 0.3 percent with the PM4TC one month future. This suggests that while the stock and future has a linear relationship, the relationship is not very strong in the short term. It can be that the correction is stronger when the residuals have a higher absolute value.

<b>ECM - Model 1</b>	$\beta_1/\rho$	T-value	p-value
Return_PM4TC	0.25	2.67	
Residuals_PM4TC_1	-0.002	-3.55	0.00
<b>ECM – Model 2</b>			
Return_CS4TC	0.20	3.47	0.001
Residuals_CS4TC_1	-0.002	-2.73	0.007
<b>ECM – Model 3</b>			
Return_PM4TC	0.28	5.87	0.00
Residuals_CS4TC_Front_Month_1	-0.003	-4.30	0.00

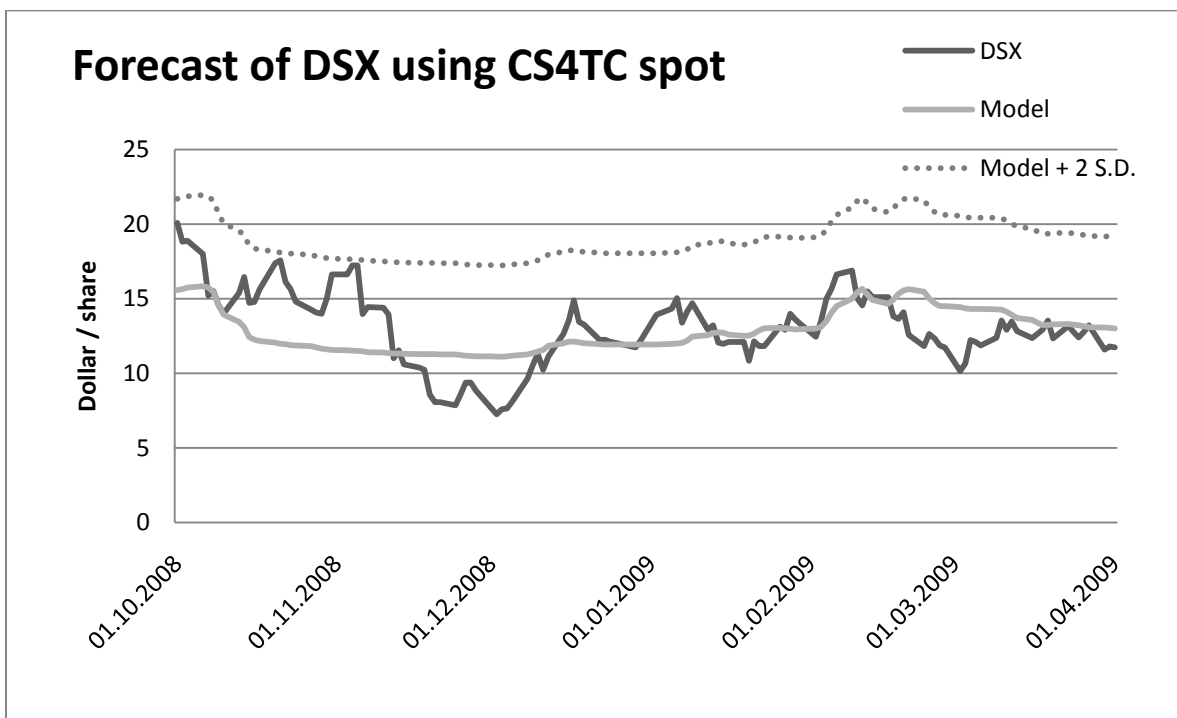
Table 4: This table shows the results from error correction modelling.

**Forecasting**

On the basis of the model period (1.1.2007-1.10.2008), we can forecast the next six months in order to see how well the historic relationship can predict the future. The forecast of Diana Shipping with PM4TC one month future and CS4TC spot are presented in graphs six and seven. We see that the modelled stock price on the basis of the linear relationship from the regression analysis fits the data well. The prices for both stock and futures have been outside the range from the model period (Graph 3) in the whole forecasting period, with the stock price below \$20 and PM4TC below \$20000/day. Still, the linear relationship seems to stay robust. The CS4TC seems to fit the data better (Graph 7). However, we find the PM4TC model best with a lower constant and more in line with the fundamental analysis. That about two thirds of Diana Shipping’s ships are panamax ships, is also an argument.



Graph 6: Forecast of Diana Shipping using the front month contract, PM4TC, for q4 2008 and q1 2009.



Graph 7: Forecast of Diana Shipping using the CS4TC spot, for q4 2008 and q1 2009.

## Speculative arbitrage

Since the stock price of Diana shipping and the PM4TC one month future turn out to be co-integrated, we can suggest a trading strategy. For example, when the residuals become larger than two standard deviations, we could sell the stock and buy the one month future and hold that position to the residual comes close to zero.

## Slow ECM

There are a couple of difficulties to this strategy. In the forecasting period the stock price stays above the modelled stock price for long periods of time, e.g. from start of December 2008 to end February 2009 for PM4TC one month future. In this case, we would have to roll over the one month futures two times if we are waiting for the residual to come close to zero. This is in agreement with the low  $\rho$  we found in our ECM.

## Hedging ratio

The econometric relation between DSX and one month futures (PM4TC) gives the sensitivity reported in table 5. We find that due to the high constant of 7.18 the relative percentage changes between DSX and PM4TC 1M future are not constant at different stock price levels. The relationship seems more predictable when the stock price is higher.

Stock price	Stock price change	Futures change
10	+50 % (10 to 15)	+167 % (9000 to 24000)
	-50 % (10 to 5)	- 167% (9000 to -6000)
20	50 % (20 to 30)	77 % (40000 to 71000)
	-50 % (20 to 10)	-77.5 % (40000 to 9000)
30	50 % (30 to 45)	+68 % (71000-119000)
	-50 % (30 to 15)	-66 % (71000 to 24000)

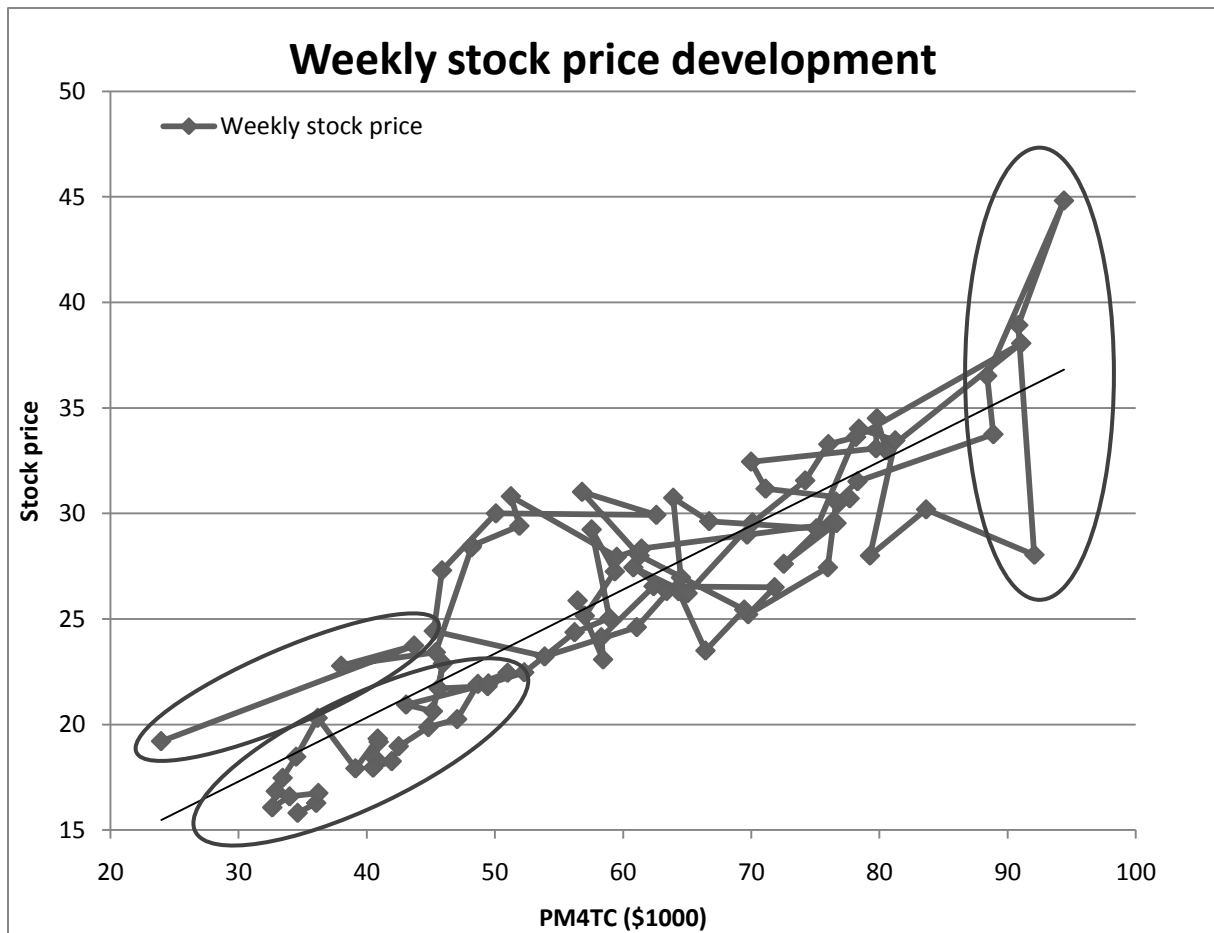
Table 5: Given a change in the stock price of 50 %, what is the change of the PM4TC one month future?

At a ten dollar stock price we would have to buy or sell futures for below one-third of the nominal value of stocks. At a 30 dollar stock price this ratio is around three-fourths. This additionally complicates a speculative arbitrage strategy with the stock and the future market.

## Pattern of stock price correction

To further illustrate the slow error correction, the stock price movement from week to week is shown in graph 8 on the next page. To exploit a speculative arbitrage, we would desire more of the vertical movements demonstrated in the oval on the right side of the scatter plot. But we find that the stock price often moves along the modelled price for long periods of time (Ovals on the left side).





Graph 8: The PM4TC weekly spot (Every Monday) compared with the stock price of Diana Shipping (01.01.2007-01.10.2008).

**Extra: Adding basis**

As basis we are using the longest future minus the spot price. In this case, the longest future is PM4TC CAL14 which is the contract for the average price in 2014. The basis indicates the shape of the futures curve. If the futures market is trading below the spot market, the basis is negative and vice versa.

As the basis adds additional information to the spot price, we expect the model to fit better. Table six shows that r-squared increases to 0.92 and the standard deviation fall to 2.34.

OLS-LEVELS (Y = DSX)	$\alpha/\beta$	T-value		
<b>Model 1 (PM4TC)</b>			$R^2: 0.92$	$\sigma : 2.34$
Constant	0.27	0.2		
PM4TC (\$1000)	0.99	11.3		
Basis	0.82	8.25		

Table 6: The table show regression of DSX on PM4TC spot rate and basis. The model is on the form:  $DSX_t = \alpha + \beta \times PM4TC_t + \epsilon$ .

The linear combination of the two variables is stationary at the five percent significance level (Table 7):

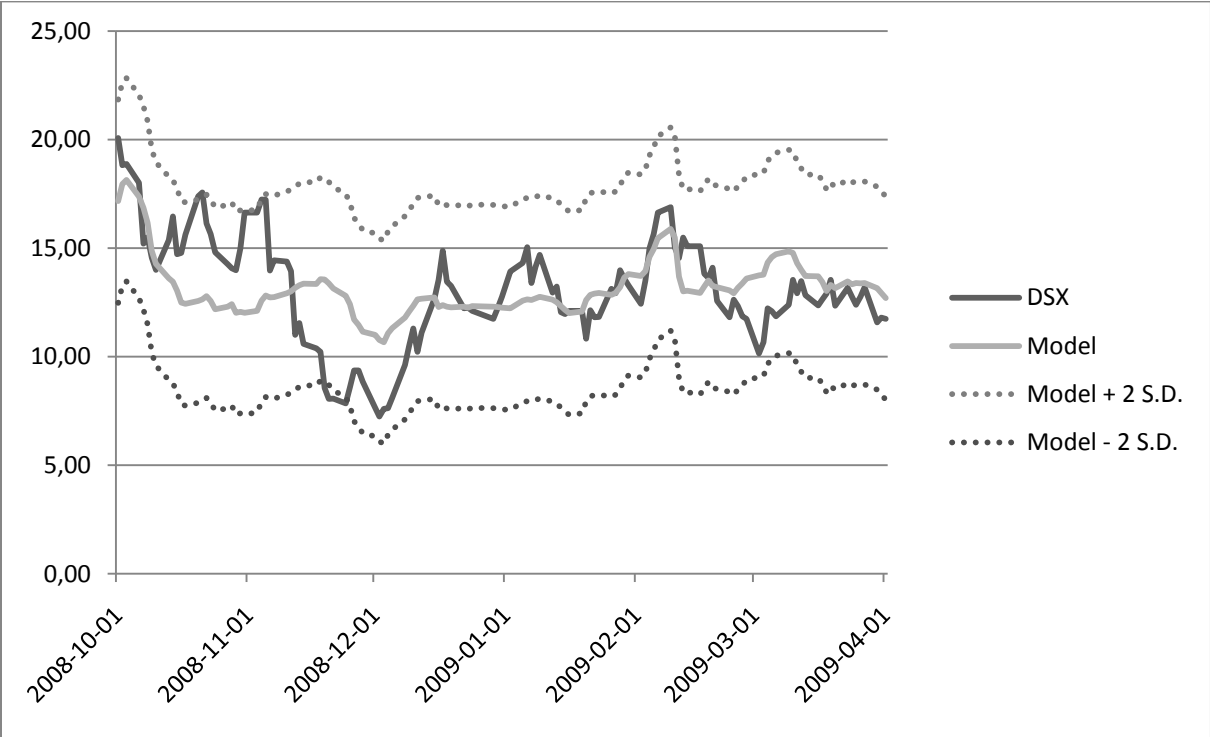
ADF-test	T-value	beta
5 % significance level (0 lags)	-2.88	
Residuals_PM4TC_and_Basis	-3.34	0.90

Table 7: Augmented Dickey Fuller test to see if the series are stationary

ECM: The correction is significant, but slow with only 0.3 percent per working day.

ECM - Model 1	Beta	T-value	p-value
Residuals_Basis_1	-0.003	-1.95	0.05

Table 8: The residuals are nearly significant at the 5 % level. I have not added PM4TC and basis as they are highly correlated with each other.



Graph 9: Forecast/Model of Diana Shipping using the PM4TC spot and basis, for q4 2008 and q1 2009.

Adding basis improves the forecasting of the stock price slightly (Graph 9), but the ECM and ADF-test are not as significant.

We also looked at weekly data. The results were very similar with the same plots and error corrections.

## 5 Conclusions

The thesis concludes that shipping equities are easier to value on the basis of the future market than oil production and salmon farming companies. This is because it is easy to forecast operating expenses and the ships have a definite time period in active operation.

The fundamental valuation indicates that the listed dry bulk company Diana Shipping was an overpriced company in the modeling period, last quarter of 2008 and first quarter of 2009, on the basis of a cash flow valuation and net asset value. It also shows that a valuation of shipping equities can be easily performed with the rates in the futures market as the only exogenous variables.

The econometric study of the relationship between Diana Shipping and the futures market show that they are co-integrated. There are two important factors that make the relationship between Diana Shipping and the futures markets not ideal for speculative arbitrage strategies. First, the error correction is significant, but slow, with a factor of about 0.3 % per day. Secondly, the hedging ratio is varying at different stock price levels. We still find the relationship between Diana Shipping and the futures market a high-quality input for investment decisions.

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Imarex: <http://www.exchange.imarex.com>

Wikipedia: <http://www.wikipedia.com>

### Oral sources:

The thesis has applied two oral sources due to the practical nature of some of the inputs in the fundamental model. The sources are Anders Severinsen from Lorentzen & Stemoco and Rikard Vabo from Fearnley Fonds.

### Company reports, presentations and web page:

Cermaq ASA, Det norske oljeselskap ASA, Diana Shipping Inc., D/S Norden A/S,

Interoil Exploration & Production ASA, Marine Harvest ASA, Noreco ASA,

Norse Energy Corp. ASA, PA Resources AB, Rocksource ASA, SalMar ASA,

StatoilHydro ASA

## 7 Appendix

### Appendix 1 Definition of variables

#### Diana shipping

Diana Shipping Inc. (Ticker DSX) through its subsidiaries provides shipping transportation services. The company focuses on the transportation of dry bulk cargo, such as iron ore, coal, grain, and other materials along worldwide shipping routes. As of December 31, 2008, its shipping fleet consisted of 13 panamax dry bulk carriers and six capesize dry bulk carriers with a combined carrying capacity of approximately two million deadweight tonnage. The company also has two capesize vessels for delivery in 2010. Diana Shipping charters its vessels to various national, regional, and international chartering companies. The company was formerly known as Diana Shipping Investments Corp. and changed its name to Diana Shipping Inc. in February 2005. Diana Shipping was founded in 1999 and is based in Athens, Greece (Diana Shipping Inc., 2009).

#### Capesize and panamax ships

Capesize ships are cargo ships originally too large to transit the Suez Canal (I.e. larger than both panamax and suezmax vessels). To travel between oceans, such vessels used to have to pass either the Cape of Good Hope or Cape Horn. Vessels this size can now transit the Suez Canal as long as they meet the draft restriction (18.91m as of 2008). The term "cape-size" is most commonly used to describe bulk carriers rather than tankers. A standard capesize bulker is around 175,000 dwt. Panamax ships are of the maximum dimensions that will fit through the locks of the Panama Canal. A typical panamax ship is around 70 000 to 75 000 dwt. Bulk carriers are constructed to carry dry commodities, primarily iron ore, coal and grain. (Wikipedia, 2009)

In this paper, the phrase capsize and panamax ship or vessel represents a *dry bulk vessel*.

#### Voyage costs

These are costs that are variable for each voyage like bunkers, port dues, port clearance and canal costs (Stopford, 1997).

## Imarex

Imarex is a regulated market for freight derivatives with main office in Oslo.

### FFA - Forward Freight Agreement

A financial instrument used as a hedging tool to manage volatility in freight rates. It is a contract between two parties involving an agreed future price for transporting cargo by sea for a particular type of vessel and route. No real cargo or ships are involved (D/S Norden, 2009).

### Freight derivatives

Freight derivatives include Forward Freight Agreements (FFAs) and options based on these. They are financial instruments for trading in future levels of freight rates, for dry bulk carriers and tankers. These instruments are settled against various freight rate indices published by the Baltic Exchange (Wikipedia, 2009).

### Capesize and panamax futures /FFAs

We apply the CS4TC and PM4TC futures which are two indexes that are an average measure of four representative shipping routes in the capesize and panamax segment (See illustration 4 below). The index is measured in time charter equivalent rate per day (TCE). TCE is revenue adjusted for voyage cost. The CS4TC and PM4TC are average price futures.

C8	172000mt Gibraltar/Hamburg trans Atlantic RV	25%	}	<b>CS4TC</b>
C9	172000mt Continent/Mediterranean trip Far East	25%		
C10	172000mt Pacific RV	25%		
C11	172000mt China/Japan trip Mediterranean/Cont	25%		
P1A	74000mt Transatlantic RV	25%	}	<b>PM4TC</b>
P2A	74000mt SKAW-GIB/FAR EAST	25%		
P3A	74000mt Japan-SK/Pacific/RV	25%		
P4	74000mt FAR EAST/NOPAC/SK-PASS	25%		

Illustration 4: The CS4TC and PM4TC indexes.