NTNU – Trondheim
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Currency Hedging in Norwegian Listed Companies: Strategies and Effects on Exposure

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Oppstartsdato **16. jan 2012**	Innleveringsfrist **11. jun 2012**
Oppgavens (foreløpige) tittel **Hedging in Norwegian Listed Companies: Strategies and Effects on Value Creation**	
Oppgavetekst/Problembeskrivelse Review and discussion of theoretical and empirical literature related to corporate hedging. Research on different approaches to hedge market risk. Formulation of testable hypotheses followed by discussion and analysis of data with the intention of gaining new insights regarding corporate hedging among companies listed on Oslo Stock Exchange. Overall assessment of the implications of the empirical study.	
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4. Bedømmelse

Kandidatene skal ha *individuell* bedømmelse
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Preface

This master's thesis is written as the conclusion of the MSc-program in Industrial Economics and Technology Management at the Norwegian University of Science and Technology (NTNU), spring 2012. We have specialized in Financial Engineering.

The text in the paper has been edited in Microsoft Word, while numerical analysis was conducted in Microsoft Excel. The regression analysis has been performed in OxMetrics, which is an integrated statistical package software. We would like to thank our academic supervisor Einar Belsom in the Department of Industrial Economics and Technology Management at NTNU for valuable guidelines and discussions.

Trondheim, June 4th 2012

Christoffer Skaarer Gustav Martinsen

ABSTRACT

We investigate hedging strategies and foreign exchange rate exposure of Norwegian companies in the seafood and offshore support industries. Factor models building on the Capital Asset Pricing Model are used to analyze stock returns. Results suggest that currency exposure is affected both by company specific features and market wide effects, including oil price influence and speculation in the NOK. Systematic factors, surprisingly, lead to negative exposure to depreciations of the NOK for a majority of the firms in the offshore service sector. Hedging strategies, mostly based on forward contracts and debt in foreign currencies, vary significantly between and within sectors. Foreign currency denominated debt is found to be the most effective means to reduce exposure to currency fluctuations. The findings add useful information to financial managers of Norwegian exporters and investors in the Norwegian stock market.

SAMMENDRAG

Vi undersøker hedgingstrategier og valutakurseksponering hos norske selskaper i sjømat- og offshore supportsektoren. Faktormodeller som bygger på kapitalverdimodellen brukes til å analysere aksjeavkastning. Resultatene tyder på at valutarisikoen er påvirket både av bedriftsspesifikke egenskaper og markedsomfattende effekter, inkludert oljeprisens innflytelse og spekulasjon i den norske kronen. Systematiske faktorer fører, overraskende nok, til negativ eksponering mot svekkelse i kronen for et flertall av bedriftene i offshoresektoren. Sikringsstrategier, for det meste basert på terminkontrakter og gjeld i utenlandsk valuta, varierer betydelig mellom og innen sektorene. Gjeld i utenlandsk valuta er funnet å være det mest effektive middelet for å redusere eksponering mot valutasvingninger. Funnene kan være nyttig informasjon for økonomifunksjonen i norske eksporterende selskaper samt investorer i det norske aksjemarkedet.

I. Introduction

A. *Background and Motivation*

Corporations use financial risk management to protect themselves from risk related to interest rates, foreign exchange rates and commodity prices. In a small economy, like the Norwegian, large currencies and important commodities are highly correlated with the stock market (Næs, et al., 2009). Furthermore, the Norwegian economy relies heavily on exports, which again leads to a strong connection to the global economy (Statistics Norway, 2010). As a result of this, companies listed on the Oslo Stock Exchange (OSE) are exposed to foreign exchange rate fluctuations in more than one way.

Firstly, the domestic value of cash flows generated by a Norwegian company in foreign currencies is directly depending on exchange rates. This is a firm specific risk caused by the level of foreign sales. Secondly, a Norwegian firm will be affected indirectly by the currency effects on the entire Norwegian market, posing a systematic risk. Both these factors will be investigated in this paper in order to determine how exporters in the seafood industry and offshore support vessel (OSV) sector are exposed to foreign exchange rates.

Large equity markets in the US and UK are extensively analyzed in previous literature, but few papers exist on hedging in small open economies. Effects of exchange rate fluctuations are highly sensitive to what type of economy the research is conducted in. An analysis of Norwegian exporters should therefore add new and useful information to the otherwise widespread literature on currency hedging.

B. *Primary Purpose of the Study*

Mapping Foreign Currency Exposure

The purpose of this research paper is three fold. First, we wish to map the foreign currency (FC) exposure of a sample of Norwegian exchange listed firms. We examine companies with a high portion of foreign sales to be able to identify foreign exchange (forex) exposure. Both

revenue from sales, EBITDA and stock returns are examined. The top line currency exposure is important to map in order to understand firms' initial exposure issues, before hedging activities and other financial measures are examined. When assessing the forex exposure of revenue and EBITDA, it should be simpler to reveal currency effects, and to allocate them to various company specific characteristics. It represents the base point for all risk management within a firm, and provides a base for understanding general currency market effects on firms' cash flows. Stock returns are highly important to assess because they represent the market view of firm risk management. Investor opinion through stock returns is a reflection of value creation in any corporation. Stock performance reveals the real effects of potential hedging activities, and is thus an important part of our analysis. Comparisons with top line cash flows might also add further insight.

Investigating Hedging Strategies

Secondly, we investigate different approaches to risk management within our sample firms. Both intentions stated by the management as well as actual measures taken are examined through the period from the year of IPO in order to gain insight in risk management strategies in the respective companies. An interesting perspective is to observe the relationship between stated hedging strategies and actions taken from year to year. There is without doubt more than one road to successful hedging, and different strategies can also be compared towards the initial currency exposure.

Effects of Hedging Activities

Thirdly, we aim to investigate the net effects of the initial exposure and the different hedging strategies through time for the various companies. Hence, we will observe whether or not hedging strategies are successful in terms of reducing currency exposure, and how certain results are. From the results it will also be possible to imply if risk management is really worth the effort put down by the company management.

C. Methodology and Expectations

The data sample analyzed consists of firms operating in sectors that have a large part of revenues in countries outside of Norway. With this in mind it is reasonable to expect that these firms' top line revenues will be positively exposed to depreciation of the NOK as the

direct effect of such a currency movement is that cash flows in foreign currency become more valuable. Further, we expect that stock exchange excess returns also will be correlated with depreciation in the NOK for the same reasons and due to the expectation that most firms do not hedge entire expected cash flows, and hence will still be exposed to forex fluctuations.

In order to analyze the financials of the sample firms, we make use of an ordinary least squares (OLS) regression model. We base our model on the Capital Asset Pricing Model (CAPM) (Sharpe, 1964), as in previous research, and include an additional factor to reveal currency effects. The OLS regression model is well suited when working with time series, cross sectional and panel data which is the case in this paper. Both time series data for individual firms as well as panel data for entire sectors is used to obtain the desired results. Within established theoretical frameworks, some experiments are conducted in order to optimize the quality of the model.

D. Relation to Previous Research

Methodology and areas of focus vary in previous research. A number of papers focus on operational versus financial hedging and the effect on currency exposure, such as Allayannis and Ofek (1997). Bodnar et al. (1995) map hedging activities by assessing the use of various types of derivatives. Allayannis and Weston (2001) investigate the relation between foreign sales and financial hedging.

Some work focuses on the determinants important in the hedging decision, such as Warner (1977) and He and Ng (1998). These investigate how factors as firm size, leverage and liquidity affect the need of and decision to hedge. Clark and Judge (2009) examine short-term versus long-term hedging strategies and instruments.

Further, several studies map the effects of different strategies and activities on currency exposure. Chowdhry and Howe (1999), Lim and Wang (2001) and Jorion (1990) examine the effects of operational and financial hedging on exposure as well as the possibility to combine the two. Also, they argue whether the two strategies function as supplements or complements to each other.

Finally, a number of papers research the effect of risk management on firm value. Allayannis and Weston (1998), among others, use Tobin's Q as a measure of firm value when comparing a large sample of non-financial companies. Kim et al. (2006) and Bartram et al. (2009) analyze how financial and operational hedging individually, and together, affect firm value. Aspects like the equity cost of capital are also assessed as a measure of revealing effects (Gay, et al., 2011).

This paper adopts ideas from previous research with different perspectives on hedging. We focus on financial hedging in our analyses, and do not directly compare operational and financial hedging as have been done previously. Specifically, we map the effects of derivatives and foreign debt on stock returns as well as an assessment of the various strategies. Hence, we use ideas from a number of papers such as Allayannis and Ofek (1997), Clark and Judge (2009) and Allayannis et al. (2001). Compared to much of the previous work, little focus is put on the effects from hedging on firm value. Regarding the specific model used, this is a factor model formerly used by various authors such as Jorion (1990) and Mathieson and Moles (1998).

The remainder of the paper is organized as follows. Section II provides an overview of previous literature from similar research. Section III presents the model used and relevant methodology. Section IV presents the data material used in the regression analyses. Section V includes results from the empirical analyses as well as discussion and reflections, while Section VI concludes.

II. Previous Literature on Hedging and Currency Exposure

A. Theoretical Background

There are several theoretical arguments for why corporations should conduct risk management and limit the exposure to market risks. Following, we present a review on the most important topics

Debt Overhang Problem

Myers (1977) discusses the so called debt overhang problem. The basic intuition is that firms limit their ratio of debt to equity due to agency costs. The author shows that a company might pass up future investment opportunities with positive net present value to maximize shareholders wealth. If debt holders' claims are sufficiently high, the potential profits from the investment will in some cases only benefit this class of investors. As managers are contracted to work in the interest of shareholders, promising opportunities are wasted. Bartram (2000) argues that this problem is reduced when cash flows from investment opportunities are less volatile. Hence, risk management has a potential for value creation through reducing agency costs and aligning the interests of creditors and shareholders. Empirical research does indeed find that companies with high debt to equity ratios and high growth opportunities hedge currency and interest rate exposure to a greater extent (Graham & Rogers, 1999).

Risk Shifting

Another so called agency cost between debt and equity owners, is the risk shifting problem. Jensen and Meckling (1976) explains this issue as shareholders of a company at times will be interested in taking on high risk, negative NPV, projects. The reason for this is the call option like nature of equity, as the downside is limited to zero and the upside is infinite. Reducing the risk of the cash flows will in this instance also reduce or eliminate the magnitude of the agency costs.

The review above shows that risk management in theory can add value to a firm by aligning the incentives of different stakeholders. There are, however, other means to mitigate these problems. Debt covenants, i.e. conditions in the contract between shareholders and creditors, can limit the risk taken by the management (Leland, 1994). The empirical results do, on the other hand, indicate that hedging is in fact conducted by firms to reduce agency costs (Nance, et al., 1993).

Pecking Order Theory

Modigliani and Miller's (1958) assumption about perfect capital markets implies equivalence between internally and externally generated funds. This effectively means that firms are able to finance any positive NPV projects regardless. The pecking order theory (Myers, 1984), argues that companies in reality prefer to finance projects with internal funds. Due to information asymmetries between existing financiers and new investors, issuing new capital

will be more expensive than retaining earnings. Furthermore, decreasing volatility of cash flows will increase the chance of having available capital to finance new projects. Accordingly, risk management can add value to the firm by making internal financing more predictable (Froot, et al., 1992).

Gay et al. (2011) present a modern implication; that firms which are hedging can take more positive NPV projects as they would have the short-term cash flow to overcome initial investments. When firms increase in value by increasing cash flows, it should be because they take more positive NPV projects they could not do elsewise, and this increase exceeds the cost of hedging. Another value increasing effect is that hedgers can handle more debt due to cash flow stability and thus get a larger debt tax shield (Stulz and Leland, 1996).

Bankruptcy Costs

Other than the costs associated with information problems and differences of interest, risk management can help mitigate more tangible costs. In an uncertain world virtually every firm faces the risk of bankruptcy. Modigliani and Miller treated this as a costless event, where creditors were paid back the value of the bankrupt company in its entirety. The reality is, however, that defaults create substantial transaction costs (Kraus & Litzenberger, 1973). Between the fees of lawyers and accountants, and transaction costs from selling off company assets, firm value of the remains will decrease significantly. Consequently, means to limit the probability of default, such as risk management, has the potential to increase the value of a company.

Tax Frictions

Taxes are also relevant frictions in today's financial markets. In tax regimes where the marginal tax rate is an increasing function of profits, volatile cash flows are less desirable. The reason is that total taxes paid will be higher for a stream of cash flows that alternates between very high and very low, compared to a scenario with more stable profits (Smith & Stulz, 1985). Jensen's inequality proves this mathematically as it states that a secant line between two points on a convex graph always lays above the graph itself (Jensen, 1906).This makes an obvious argument for the use of risk management. The tax rate for companies in Norway, where we conduct our study, is on the other hand flat at 28% (Altinn, 2011). Decreased volatility in cash flows can, however, still be beneficial, as the tax regime have

indirect convexities. For example will limits on carrying losses forward have the same effects as progressive taxation (Bartram, 2000).

Through the limitations in the assumptions made by Modigliani and Miller, we see that the theoretical background indicates that hedging has potential to add value to firms. A factor that works in the opposite direction of the items discussed above is transaction costs associated with risk management. Empirical research does, on the other side, indicate that firms are only modestly concerned with bank fees when entering derivative contracts (Bodnar, et al., 1995). Accordingly, theory seems to support financial risk management, as limiting exposure increases competitiveness. In the following Section we will review literature on how firms manage risk and empirical results from previous research.

B. Hedging Strategies and Effects on Currency Exposure

Operational and Financial Hedging

We separate hedging activities in two main groups, operational and financial hedging. Operational or natural hedging is achieved by multinational firms with activities in foreign countries. Specifically, when achieving an operational hedge, both input costs and output revenues occur in foreign currency (Al Shboul, 2007). This is obtained by e.g. production facilities abroad along with sales in the same country, or by separate subsidiaries consolidated in the mother company. The hedge is naturally achieved as only the net result of foreign costs and sales is consolidated into the firm. Dispersion of subsidiaries and foreign activity across regions and currency zones naturally affect the operational hedge.

Financial hedging refers to using financial derivatives to hedge cash flows. Long and short positions in forwards, futures, options and swaps are entered with the goal of reducing foreign exchange risk. Also, debt can be issued in foreign currencies in order to create interest cost in a foreign currency and thus a hedge towards revenue from foreign sales (Al Shboul, 2007).

Foreign Exchange Exposure

Jorion (1990) propose a twofold decomposition of foreign exchange exposure. One part is the value of net monetary assets with fixed nominal payoffs. Unlike domestic monetary assets,

such foreign assets are fully exposed to foreign currency. This is referred to as the translation exposure. On the other side there are real assets, which will be affected under any circumstances. The author provides a clear rationale. Even through domestic assets owned by a nationally operating firm, exposure is present due to competition from importing firms, fluctuating prices on input factors and on demand due to exchange rate fluctuations. Assets abroad producing products sold domestically will affect currency exposure, so will the fact that those assets will be sold some day creating a translation exposure into the domestic currency.

Hedging Activities

Much research is done on how different methods of hedging are used by international firms, and to what extent hedging affects foreign currency exposure. The use of financial derivatives versus operational hedging and the effect of this on the level of currency exposure is one main focus. Allayannis and Ofek (1997) find in their sample that 14.5% of foreign sales are on average hedged with derivatives. Also, they find that 42.7% of the companies use foreign exchange derivatives, while only 21.8% issue foreign debt. A survey by Bodnar et al. (1995) finds that among a large sample of US non-financial firms, 47% of financial derivatives used were forwards.

In a time period from 1990-1995, Allayannis and Weston (2001) find an increasing number of firms with foreign sales engaging in financial hedging, while the number of foreign activity firms not hedging decreased. They find that about 60% of firms with foreign sales were hedging, although the number could have been higher as smaller firms with little foreign sales are less interested in hedging. When addressing firms without foreign sales, 82% of these did not engage in financial hedging. In terms of the degree of hedging, they find that 13% of foreign sales in 1993 specifically were hedged with derivatives.

In the sample in Clark and Judge (2009), 52.2% of firms report using FC derivatives, 63.3% report use of FC debt. 85.8% of all firms use debt for hedging, but in 5.7% of the cases, FC debt increased foreign exchange exposure. In that case, firms use FC swaps to convert cash flows into domestic currency. 70.4% are classified as FC hedgers, 57.6% of these use both derivatives and debt, while about 21% use only either one. The mean level of foreign sales in their sample is 35%.

Determinants Affecting Hedging Strategies

Amongst others, Mian (1996) argues that firm size affects the decision to hedge and the optimal degree of hedging. The author finds that hedging activities show economies of scale, i.e. that larger sized firms should utilize financial hedging opportunities more, and that they do. Allayannis and Ofek (1997) find similarly that larger firms are more likely to issue foreign debt due to the same reason, however smaller firms issue more debt when first engaging due to relatively high startup costs. Warner (1977) shows that small firms are more likely to engage in financial hedging due to higher default risk and relative bankruptcy costs. He and Ng (1998) find that foreign exchange exposure also increases with size, as larger firms tend to operate internationally.

The research also argues that firms with high financial leverage or low short-term liquidity are less exposed to currency risks as these have minimized risk through hedging in order to survive. Graham and Rogers (2002) present an interesting paradox; that highly levered firms hedge more than others, at the same time as hedgers increase leverage. Gay et al. (2011) find that in countries with strong external corporate governance, e.g. strong shareholder rights, hedging is more rewarded than elsewhere. The paper also concludes that hedging is more valuable in countries with floating exchange rates, i.e. where currency risk is real.

Clark and Judge (2009) focus on short-term versus long-term hedging when assessing firm value effects. Specifically, they investigate if and how the type of exposure i.e. long or short-term affects the method used in hedging. Forwards, futures and options by and large represent short-term instruments, while swaps represent long-term hedging. The short-term instruments commonly have short term durations and are thus good for hedging short-term uncertain cash flows from import and export, while swap contracts can be made for longer durations in time. The authors point out the timing issue in particular as a challenge in short-term hedging. Cash flows may not occur when expected and might not match maturities of financial derivatives, creating a time gap and thus volatility in cash flows. With long term FC debt and swaps, this is far easier as swap foreign exchange payments can be matched against interest payments. Firms seem to prefer hedging foreign assets with FC debt over FC derivatives, even though they find economies of scale effects with derivatives, as well as the finding that firms newly established abroad prefer derivatives as FC debt is a large commitment.

Regarding swaps, it is important to distinguish between firms swapping into domestic debt which is called synthetic domestic debt, and the opposite, which is called synthetic foreign debt. In the paper, the authors test the proposition that domestic into foreign currency swaps are substitutes to FC debt while foreign into domestic swaps are complements. The rationale is that FC debt serves as a hedge towards foreign long-term assets and should thus function as a substitute to synthetic foreign debt, while for firms creating synthetic domestic debt, FC debt is a complement. Firms with non-existing foreign long-term assets might issue FC debt and create synthetic domestic debt at the same time to obtain a hedged net position.

Interestingly, Clark and Judge (2009) come to that FC debt and swaps work as substitutes to each other. Larger firms seem to prefer foreign currency swaps over debt, perhaps as operations in several markets with use of several currencies make swaps more practical than issuing debt in several currencies. Significant results also show that firms with increasing foreign sales are less likely to make synthetic domestic debt, in order to maintain a balanced exposure, and that firms with decreasing foreign assets are more likely to create domestic synthetic debt. Hence, FC debt and swaps do not always function as substitutes and can work in a complementary fashion. Swaps do offer several advantages over debt. Financial instruments are faster and more flexible to engage and disengage in, and in terms of changes according to interest rate levels in different countries. The authors also point out arbitrage opportunities as conditions in the swap and debt markets may differ. FC debt can in certain cases be hard to access due to poor credit ratings or poorly functioning debt markets abroad.

Several papers find conclusive evidence of FC debt also functioning as a hedge, among them Allayannis and Ofek (2001), Elliot et al. (2003), Keloharju & Niskanen (2001) Kedia and Mozumdar (2003) and Bartram et al. (2009). The two first mentioned find that FC debt is a substitute to derivatives. Aabo (2006) find that both FC debt and derivatives are used, FC derivatives mostly used for short-term and debt for long-term hedging, so they function as complements.

Further, Clarke and Judge (2009) argue that leverage is important in the choice of hedging strategy. Firms with high leverage naturally have a lower debt increasing capacity than those with lower leverage, and will thus more likely depend on FC swaps to obtain a similar hedging effect as FC debt. They also argue that cash rich, high liquidity firms are more likely

to use FC swaps rather than FC debt in managing currency risk, as would be unnecessary due to the large cash reserves.

The literature on hedging strategies from American and European markets suggests that both derivatives and debt in foreign currencies are used to manage currency risk. Conclusions vary as to which of the two that is most widely used and which one is more effective in reducing exposure. This provides an interesting setting to investigate currency risk management in Norwegian exporters.

Effects of Hedging Strategies

Many quite similar regression based models are developed in order to spot currency exposure. Specifically, many researchers mainly focus on the degree of foreign sales, debt, activities and use of financial derivatives in their models. Chowdhry and Howe (1999) argue that operational hedges do not efficiently reduce foreign exchange exposure, but combined with financial hedges this effect is obtained. However, the authors find that operational hedges are efficient towards long-term exposure, as these risks are more stable, predictable and easier to hedge. Lim and Wang (2001) showed similarly that operational and financial hedges are supplements to each other. They argue that financial hedging applies for the common component of risk i.e. market risk, while firm specific risk can be hedged with operational hedging. Jorion (1990) affirm these results, and make a point of the opportunity multinational firms have to hedge without using financial derivatives.

The mentioned papers, along with papers such as Simkins and Laux (1997) and Allayannis et al. (2001), found that a higher foreign sales ratio increases foreign currency exposure. Some pieces of research conclude more ambiguously, however. Pantzalis et al. (2001) find similar effects, but also that firms with geographically concentrated subsidiaries, although numerous, faced higher risk exposure.

Further, market share is affected by foreign currency exposure. Williamson (2001) shows that market share varies with currency exposure. If one firm has production facilities abroad, depreciation of the foreign currency would lower sales cash flows in the national currency as well as costs, while firms without foreign production would only suffer from poor sales cash flow. Thus, market share would implicitly fall as the firm would have a disadvantage and would have to raise prices to maintain cash flow in domestic currency. For the firm with

foreign production, Williamson argues cash flows would increase as long as income, due to increased market share, exceeds the loss from the weaker foreign currency, measured in domestic money. In a research summary, Bartram (2008) argues that although many conclusions point in the same direction, only few studies conclude with significant results on the topic.

Kim et al. (2006) use a sample of 424 firms, where half are operationally hedged and the other half are not. The paper investigates specifically the relationship between operational and financial hedging and their effect on foreign exchange risk and firm value. Results point out that, in accordance with other papers, operational and financial hedging strategies and actions are complementary, and are robust to different proxies for operational hedging as well as various econometric techniques. Also, this paper argues that financial hedging is good for short-term hedging and operational for long-term hedging. It is stated that even though large multinational firms face large risk, they use limited amount of FC derivatives due to the natural hedging through operational diversification.

Hedging and Speculating

To widely understand and correctly interpret the results of currency exposure regression analyses, one must understand the intentions of company financial managers. Allayannis and Ofek (1997) investigate whether firms use derivatives to simply hedge risk or to speculate. They define exchange rate exposure as firm value sensitivity to exchange rates, and the hypothesis is that derivative use reduces exposure. The authors find significant and robust results also when individual currencies are used, not only an index of several currencies. Results point to that hedging is the true reason for using derivatives, and that foreign sales and trade seem to be the only determinants to decide the degree of hedging. The foreign sales risk exposure also determines the choice to issue foreign debt and the level of it (Allayannis & Ofek, 1997).

C. Empirical Results on Firm Value

In the following we will assess the issue related to derivative usage versus firm value. The question raised by several previous works is whether hedging activities in fact do increase firm value, and which determinants are the most important. The effect of hedging on firm

value is an investor top priority and hence of paramount importance for any corporation, and is one of the main determinants in firms' hedging decision processes. All research on hedging activities is to a certain extent relevant for firm value. Despite not being the main focus of this research, a presentation of previous findings is presented. Aspects such as operational versus financial hedging, type of derivative used, foreign debt level, leverage, firm size, and foreign operations involvement, among others, all affect impact on firm value when hedging.

Allayannis and Weston (1998) examine 720 large US non-financial firms to find effects of hedging on firm value. Value is measured by the Tobin's Q measure, which is the ratio between the equity market value plus book value of liabilities and book value of equity plus book value of liabilities. One benefit of using Tobin's Q is that it makes comparing firms easier, as this is a simple ratio and one does not have to risk adjust for volatility which is the case when comparing stock returns. The authors find a gap of 7% in Tobin's Q between those firms using financial derivatives and those not doing so. In terms of firm value, this represents a premium of 5.74% on average, and in terms of market value in the sample of 720 firms, it represents $ 152.5 million. Alternative methods of assessing firm performance are also proposed, such as the Price-To-Book multiple, Price-To-Sales, or the five alternative methods based on Tobin's Q suggested by Perfect and Wiles (1994).

Allayannis et al. (2001) find that operational hedging which is previously described, only increase value along with FC derivatives. Kim et al. (2006), find that both financial and operational hedging increase value. However, in contradiction to Allayannis et al. (2001), they find that operational hedging increase value five times more than financial hedging. Finally, Bartram et al. (2009) find a positive, significant effect on firm value for all hedging companies together, but not when separating the different types of hedging. Jin and Jorion (2006) do not find significant increases in firm value due to hedging, while Graham and Rogers (2002) and Mackay and Moeller (2007) find between 1 and 3% increased value.

Clark and Judge (2009) examine the 500 largest non-financial firms from 1995 with a slightly different approach. The hypothesis is that the choice and effect on value of financial instruments depend on the time horizon of operations and cash flows. Using Tobin's Q, they find that FC derivatives generate about a 14% increase in firm value, while debt yields no value premium. However, they increase value by 12% when combined, in a range from 11 to

34%. The premium is highest for swap users where it is more than doubled. Compared to FC debt, swaps may incur lower costs and higher flexibility, as well as the barrier of entering foreign debt markets. The authors conclude that the market rewards long-term hedging through swaps more than short-term hedging, and that FC debt is rewarded no more than its actual effect on exposure since it gives no strong signal effects to the market.

Gay et al. (2011) investigate risk management and use the equity cost of capital (ECC) as a measure of success. Fama and French's (1993) three factor model is used to estimate the required return on equity. They use both univariate and pooled regressions and find a 24-78 basis point premium for hedgers. In the overall sample, they find a 60 basis point lower ECC. An event study is also conducted, where the authors examine firms newly engaging in a hedging program. For these firms, Gay el al. (2011) find a significant decline in the ECC of 93 basis points for the first year of a derivative program in the period from 1992-1995, and 55 basis points from 2001-2004.

The SMB and HML values also decreased. In terms of the factors in the three factor model, hedgers are found to have a 4.9% lower market beta, and a 40.5% lower SMB beta. From this, it is concluded that the SMB factor contains information about default risk, as this is something that would be lowered by risk management activities. Broken down in size terciles for firms, the ECC is 88 basis points lower and significant for small sized users than non-users and insignificant for medium sized companies. Interestingly, it is significantly larger for the largest tercile companies.

Gay et al. (2011) find that, among various derivatives, currency instruments account for most of the reduction in the ECC. The paper also states that more diversified firms operating in more segments see a smaller potential for achieving benefits through hedging. Allayannis and Weston (2001) use a sample of 720 non-financial firms between 1990 and 1995, and investigate whether FCD users are rewarded with a higher market value. They find a premium of 4.87%, robust to several proxies.

When it comes to industrial diversification, much evidence exists for both positive and negative effects on firm value. Conglomerates by some means diversify risk by operating within different industries, however, competence, efficiency and thus profit might be lost

when operating like this, so the net effects are unclear. When it comes to geographical diversification, evidence is still giving various results. Morck and Yeung (1992) and Bodnar et al. (1999) find that multinationality is positively correlated with firm value. For this, Allayannis and Weston (2001) add a dummy variable in addition to the continuous variable for foreign sales. An industry effect is also added, as some industries have higher Q's than other i.e. they are traded at higher levels of the Price-To-Book multiple. A weight-adjusted, industry specific Q is created and subtracted each firm's multi segment weighted Q. Valuation in firms with official credit ratings from bureaus like S&P and Moody's might be affected by these, which should also be taken into account.

Several previous works, such as Myers (1977) and Smith and Watts (1992), argue that firm value is dependent on future investment opportunities, and Allayannis and Weston (2001) add capital expenditures by sales as a proxy for growth opportunities. As with Gay et al. (2011), they find that firms that start hedging increase in value compared to those who remain unhedged, and that, similarly, those who seize to hedge decrease in value compared to those that continue.

Previous research confirms that currency hedging affects both exposure to exchange rates and firm value. Most results indicate that various methods of hedging does in fact increase shareholder wealth.

III. Modeling of Currency Exposure and the Effects of Hedging

To identify how hedging strategies affect the currency exposure of the companies in the data sample, we first have to measure how these are exposed to fluctuations in exchange rates. This can generally be done in two ways; either indirectly by analyzing stock returns or directly by analyzing cash flows. Models building on the former approach are well documented in the literature (Allayannis & Ofek, 1997), primarily because the data needed for these types of analyses are quite easy to access through databases such as Bloomberg and Ecowin Reuters. Consequently, this will be our primary model. The limited size of our firm sample does, however, enable us use the direct approach. We can extract data manually from annual reports for individual firms, providing us with a more complete picture of currency exposure. Detailed descriptions of the models are found in this Section.

A. Expectations

The data sample that is analyzed consists of firms that operate in sectors that have a large part of revenues in countries outside of Norway. With this in mind it is reasonable to expect that these companies will be positively exposed to depreciation of the Norwegian Krone (NOK) as the direct effect of such a currency movement is that cash flows in foreign currency become more valuable. The fluctuations in exchange rates must, however, be seen in a bigger picture in order to predict the total effect of depreciation. In particular is a rise in the price of oil usually accompanied by a strengthening of the NOK (Naug, 2003). For companies operating in the oil service sector, this fact is highly relevant. Despite the increasing value of cash flows resulting from a depreciating NOK, this effect might be washed out if there is a general weakening of the oil market at the same time. Consequently, the currency exposure of oil service companies might be difficult to detect or even negative. How strong this effect turns out to be is, however, difficult to have strong opinions on. Further analysis must be conducted before concluding. We also suspect to see a difference in the exposure between the seafood exporting companies and the oil service firms. This is due to the fact that the market for salmon should be less correlated with the NOK than oil.

Furthermore, the time series we analyze are heavily influenced by the financial crisis of 2008-2009. Kholer (2010) shows how currencies from small advanced economies, like Norway's, moved against the dollar during the crisis. It is apparent that the high uncertainty following the crash of Lehman Brothers led to investors fleeing small, illiquid currencies like the NOK. The decrease in demand again led to the Krone depreciating in value. This trend was sharply reversed as the markets calmed. Figure I shows that international equity prices showed a similar pattern in this time span. The link between appreciation of the NOK and a rebound in world equities may have an adverse effect on a currency exposure model running an OLS regression on stock prices. To better understand the impact of the macroeconomic factors, we also conduct a brief analysis of the foreign exchange exposure of the OSEBX.

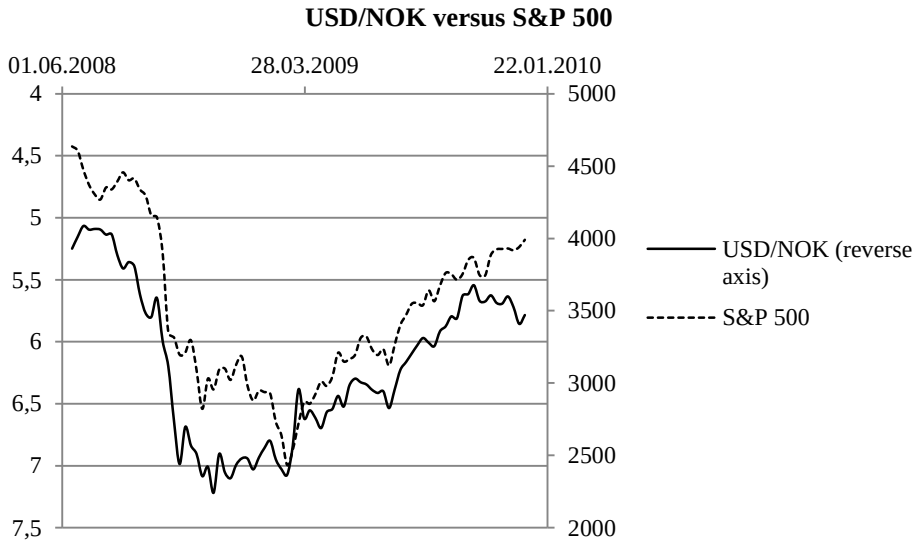

Figure I: American Equities and the NOK during the Financial Crisis

The chart shows strong correlation between the NOK and the S&P 500 during the market turmoil of the last half decade. Curves are smoothed using weekly data.

Regardless of the sign and magnitude of currency exposure, we expect that both foreign currency derivatives and foreign currency denominated debt will make the response of stock returns to depreciation of the NOK more negative/less positive. The balance sheet values of both these assets are decreasing in such an event, which again should trigger a negative response in the market value of the firm. Finally we expect that the cash flows of the firms in our sample, which all have large exports, will be positively correlated to depreciation of the NOK.

B. Stock Return Model for Currency Exposure

According to the efficient market hypothesis (Fama, 1970) in its strong and semi-strong form, stock prices should reflect all publicly available information. Furthermore, prices will adjust to any new information rapidly. Assuming that this hypothesis holds for the Norwegian stock market, the stock price of a company that is exposed to foreign exchange rates should be correlated with the return to an index that is tracking the NOK. For the companies in our data sample we investigate whether this contemporaneous relation is present.

An index that is tracking movements in the NOK can be found from different sources. The Norwegian central bank (Norges Bank) has constructed, and gives daily quotations on, an index that is based on the exchange rates between the NOK and Norway's 25 most important trade partners. The KKI (Konkurransekursindeksen) is a trade weighted geometrical average of the above mentioned currency crosses, set to 100 in 1990 (Norges Bank, 2006). Using this index is advantageous because it is easily accessible, but it might not capture the real exposure of individual companies. This is because the weights in the index are based on the trades of the entire Norwegian economy, which may or may not reflect a single company's operations. The alternative approach is to construct an index that is specific to each company. With the right information, the latter technique should yield more reliable results. We choose individual indices as our primary approach, as our data sample is not too big to make this unfeasible. For the few companies where information on geographical presence is absent or very limited, we do, however, use the KKI as the best proxy for currency exposure.

The Model

To model the currency exposure for the firms in our sample we build on work by Adler and Dumas (1984). They define economic exposure to exchange rate movements as the regression coefficient of the firm value on the exchange rate. The model is well documented in the literature, and is used in several studies both in the US (Jorion, 1990) and European markets (Mathieson & Moles, 1998). It is an extension of the CAPM with the usual market factor and the economic currency exposure factor proposed by Adler and Dumas. The difference between models (1) and (2) below is merely the index used to model the returns to the NOK. Weekly data is utilized as noise effects will be reduced compared to daily frequency data. Also, the number of data points is adequate also with weekly data.

$$\mathrm{r}_{\mathrm{i,t}} - r_t^f = \alpha_{\mathrm{i}} + \beta_{\mathrm{i}}^m\left(\mathrm{r}_t^m - r_t^f\right) + \beta_{\mathrm{i}}^{FX}\mathrm{KKI} + \varepsilon_{i,t} \quad (1)$$

$$\mathrm{r}_{\mathrm{i,t}} - r_t^f = \alpha_{\mathrm{i}} + \beta_{\mathrm{i}}^m\left(\mathrm{r}_t^m - r_t^f\right) + \beta_{\mathrm{i}}^{FX}\mathrm{FXI}_{\mathrm{i,t}} + \varepsilon_{i,t} \quad (2)$$

The following data is used as input for the regression model on foreign exchange rate exposure. Market premium (r^m) is calculated by taking the return on the Oslo Stock Exchange Benchmark Index (OSEBX, total return, close, weekly) and subtract the risk free rate (r^f). The latter is the 3-month Norwegian Inter Bank Offered Rate (NIBOR). NIBOR is used

instead of short term government bills because this part of the Norwegian government debt market is rather illiquid.

In equation (1), the currency index returns used to measure the returns to the NOK is Norges Bank KKI. Positive returns to the KKI are equivalent to depreciation of the Krone. In equation (2), the KKI is switched with individual currency indices for each company (FXI_i). The FXI is constructed by the taking the weighted arithmetic average of the geometric returns to each currency a company trades in. The weights express what percentage of revenues the company generates in the different currencies. This information is found from annual reports, and consequently the weights will differ from year to year. If information on what currencies a company has sales in is either incomplete or unavailable, other proxies that contain information regarding international presence are used. Refer to part F for further information. ($r_{i,t}$) is the return to company *i* in period *t*.

C. The Effect of Hedging on Currency Exposure

After mapping how the firms in our sample are exposed to fluctuations in the exchange rate, we investigate how this relates to operational characteristics and different hedging policies. To do this we look at the cross section of firms, but also differences over time. In the time period our data span, most of the firms see substantial variations both in the percentage of foreign sales and in how these cash flows are hedged. This pose as a good opportunity for a panel data analysis. The model includes the following factors proposed by Allayannis and Ofek (1997):

$(\frac{FS}{TS})_{i,y}$ The ratio of foreign sales to totals sales for firm *i* in year *y*

$(\frac{FCD}{TA})_{i,y}$ The ratio of foreign currency derivatives to total assets for firm *i* in year *y*

We also include two additional factors:

$(\frac{FD}{TA})_{i,y} = (\frac{FD}{TD})_{i,y} * (\frac{TD}{TA})_{i,y}$ The ratio of foreign denominated debt to totals assets for firm *i* in year *y*

$(\frac{FCD}{TS})_{i,y}$ The ratio of foreign currency derivatives to total sales for firm *i* in year *y*

The first of the two additional factors is included to capture the effect of foreign debt as an instrument to hedge against movements in exchange rates. Foreign debt is divided by total assets to gain an overview of the foreign debt situation of the companies. Where the Debt-to-Total Assets ratio is low, the Foreign Debt-to-Total Debt ratio might appear high though the actual FC debt exposure is in fact moderate. Finally, the ratio of derivatives to total sales is a substitute for derivatives divided by total assets. As forward contracts are mainly used to hedge cash flows from sales, we suspect that the ratio of derivatives to sales is the more relevant of the two. Notice that we compare derivative use to total sales, in order to map the exposure in terms of total sales. By dividing $(\frac{FCD}{TS})_{i,y}$ with $(\frac{FS}{TS})_{i,y}$, the reader can examine the foreign sales hedging ratio. We run the model with both the $(\frac{FCD}{TA})_{i,y}$ and $(\frac{FCD}{TS})_{i,y}$ factors, as it might be advantageous to have the same denominator in both hedging proxies when analyzing the results.

The factors explained above are combined to form the following panel data regression equations:

$$\hat{\beta}_{i,t}^{FX} = \alpha_1 + \alpha_2(\frac{FS}{TS})_{i,t} + \alpha_3(\frac{FCD}{TA})_{i,t} + \alpha_4(\frac{FD}{TA})_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$\hat{\beta}_{i,t}^{FX} = \alpha_1 + \alpha_2(\frac{FS}{TS})_{i,t} + \alpha_3(\frac{FCD}{TS})_{i,t} + \alpha_4(\frac{FD}{TA})_{i,t} + \varepsilon_{i,t} \quad (4)$$

$\hat{\beta}_{i,t}^{FX}$ is found from equations (1) or (2) for each year company *i* has been listed on the OSE. This gives an unbalanced panel with yearly data. The regressions will be run for each of the two sectors we analyze, in order to reveal the effects different hedging strategies have on foreign exchange rate exposure. Finally, we combine the two panels into one and run the two regressions for all firms together.

D. Alternative Models for Revealing Currency Exposure and Effects

The stock return model is as explained the primary model of this paper. However, it is and will always be important to enlighten issues and results of empirical studies from various angles, in order to gain a better picture of the reality. Additional analysis might also function

as a mere quality reassurance of the main research. Consequently, we perform further empirical analysis. As mentioned, a cash flow model for currency exposure is conducted, in order to clarify firms' initial currency exposure and thus add value to results from the stock return model. Further, an efficient market analysis is performed in order to test the degree of efficiency in the Norwegian stock market.

D.1 Cash Flow Model for Currency Exposure

Through the regressions in equation (1) and (2) we measure the exposure to foreign exchange rates indirectly. Many factors may have an effect on stock returns, and we therefore expect some noise in our results. In the event that the firms in our sample actually hedge their exposures fully, a regression on stock returns will not provide information on currency exposure. To gain additional information on the effect exchange rates have on companies, we propose a model to measure the currency exposure of sales and operational results (EBITDA). The intuition behind the model is quite simply that when exchange rates moves, the value of sales income in foreign currency will change (Børsum & Ødegaard, 2005). Ceteris paribus, a cash flow to a Norwegian based firm in USD increase in value if the NOK depreciate against the dollar. The advantage of using sales and EBITDA instead of net income is that the effects of financial hedging are not included in the numbers, as financial income and expenses enter the profit and loss statement below these items. Operational hedging, on the other hand, could reduce the currency exposure of the EBITDA, but not sales. We therefore expect the more geographically diverse firms to have less exposure in EBITDA.

Although this model does not give us explicit information on the effects of financial hedging, it can be helpful to understand the currency exposure exporters are facing. Seen together with the results from the stock return model, we should be able to understand more about how effective the hedging practices of individual companies actually are. The data needed for this analysis is only available through quarterly reports, so the time series have quarterly intervals:

$$REVENUE_{i,q} = \alpha_i + \gamma_i^1 PRICE_{i,q} + \gamma_i^{FX} \mathrm{FXI}_{i,\mathrm{q}} + \varepsilon_{i,\mathrm{q}} \quad (5)$$

$$EBITDA_{i,q} = \alpha_i + \gamma_i^1 PRICE_{i,q} + \gamma_i^2 REVENUE_{i,q} + \gamma_i^{FX} \mathrm{FXI}_{i,q} + \varepsilon_{i,\mathrm{q}} \quad (6)$$

$REVENUE_{i,q}$ and $EBITDA_{i,q}$ are the respective numbers from the income statement of firm i in quarter q. $PRICE_{i,q}$ is the average price of the relevant commodity in the sector company i operates in for quarter q. For the seafood companies this is the price of fresh salmon, and for offshore supply companies it is the price of North Sea (Brent) oil. $\mathrm{FXI}_{i,\mathrm{q}}$ is the average value of the currency index for quarter q.

D.2 Model for Currency Exposure in Capital Markets with Imperfect Information

In academia, there has been widespread criticism of the efficient market hypothesis (Malkiel, 2003). In particular is the claim that prices reflect all information and adjust rapidly to new information highly contested (De Bondt & Thaler, 1985). If the critics are right, the consequence is that a model measuring forex exposure using contemporaneous returns might not yield reliable results. The model assuming market efficiency will reveal signs of whether or not currency fluctuations are incorporated in share prices continuously. We therefore propose another quite similar model, where we investigate the lagged effect of changes in the FXI and KKI.

Currency exposures are in many cases difficult for investors to assess accurately. While information on what currencies companies have sales in is to a varying extent disclosed in annual reports, the net cash flows might not be explicitly stated. The actual day to day operations will also differ from the numbers in the annual reports, so it is not easy for investors to interpret and value currency rate changes accurately. Also, even though investors learn about a company's exposure through previous reports, this exposure can change rapidly with demand changes and engagement in new markets. The degree of financial hedging also provides uncertainty as policies and practice might change within a quarter.

It is consequently hard to know exactly how changes in foreign exchange rates will translate to the profit and loss statements, especially for less advanced investors. Some of the sample stocks are less liquid with potentially fewer and less professional investors, which makes the question of efficiency even more relevant. Assuming that investors are unable to correctly assess the day to day effect of foreign exchange rates, accumulated currency effects will to a certain extent be reflected in prices after the cash flow statements are disclosed along with other financial data at the quarterly reporting dates. We therefore suspect that stock returns the

same trading day and day directly following the release of quarterly reports might be correlated with currency movements in the previous quarter.

If performing a regular OLS model for the two day periods, coefficients from CAPM might be biased as the data points in the model are chosen specifically, and do not represent the entire stock return pattern. Also, data points are relatively few in number. To compensate for this, a regression based on daily data is conducted first, yielding the correct and statistically significant α and β values (equation (8)). An endogenous abnormal return variable is obtained by using the constant α and β values from the regression and following the CAPM (equation (9)). The exogenous variable is the accumulated 60-day currency index return (KKI or FXI), representing currency information not incorporated in the share prices. Each data point from the altered FXI or KKI index is thus the sum of the 60 day previous return. Successively, a regression is performed with the abnormal return as the endogenous variable and the composed variable as the exogenous.

$$AR_{i,t} = \beta_i^{FX} \sum_{s=t-60}^{0} FXI_{i,s} + \varepsilon_{i,t} \qquad t \in Quarterly\ reporting\ date + 1\ day \tag{7}$$

$$r_{i,t} - r_t^f = \alpha_i + \beta_i^m \left(r_t^m - r_t^f\right) + \varepsilon_{i,t} \tag{8}$$

$$AR_{i,t} = (r_{i,t} - r_t^f) - \hat{\alpha}_i - \hat{\beta}_i^m \left(r_t^m - r_t^f\right) \tag{9}$$

E. Construction of Currency Basket

The company specific currency indices (FXI_i) is constructed in the following way: First we map which currencies the company is exposed to according to the annual report. Then each currency is given a weight using the formula below:

$$W_{c,y} = \frac{Revenue_{c,y}}{\sum_{C=1}^{n} Revenue_{c,y}}$$

$Revenue_{c,y}$ is the revenue in currency c in year y, and $W_{c,y}$ is the weight given to the returns to currency c relative to the NOK. N is the number of currencies firm *i* is exposed to in year *y*. If specific data on revenue is unavailable, we find alternative ways to measure the exposure.

Usually, segment information is given in annual reports providing a geographical distribution of revenue. From this, we estimate the exposures to specific currencies. Alternatively, for years where information on geographical segments is lacking, we use the weights from the previous year. After the weighting of the currencies are determined, we find the return to company i's FXI in period t with the formula below.

$$FXI_{i,t} = W_{1,y} * \ln\left(\frac{\left(\frac{NOK}{Currency_1}\right)_t}{\left(\frac{NOK}{Currency_1}\right)_{t-1}}\right) + \cdots + W_{n,y} * \ln\left(\frac{\left(\frac{NOK}{Currency_n}\right)_t}{\left(\frac{NOK}{Currency_n}\right)_{t-1}}\right)$$

Each annual currency weight is multiplied with the NOK/currency exchange rate for all n currencies for each company, yielding the company specific index. Currency rates are updated weekly on an end of period basis, while the currency weights are updated annually. To construct an actual index we set the value of the FXI to 100 at the first date we have stock price quotes for the company.

F. Weaknesses and Limitations

The results from the OLS model must of course be seen in context with the available data for use in the analyses. Probably the main weakness of the currency exposure model, which also is a result of the data material and general OLS methodology limitations, is that results are hampered by some level of noise.

Regarding the currency indices, the KKI and FXI, it is certain that none of them provide a completely correct picture of the currency exposure for any of the companies in the sample. Some firms match the composition of the KKI better than others, yielding imperfect results. The FXI index is constructed using all available data, however this index will not mirror real exposure perfectly either.

Although previously broadly used and researched, the exposure model is used in different variants in this paper, giving a few implications regarding model quality. In the search for a model with the ability to isolate and reveal currency effects, which is the purpose of the study, experiments with various variables were conducted with different results. Various variables

such as the inclusion of commodity prices might contribute to isolating currency effects, although they could also bring other effects to the results which are difficult to observe when analyzing results. Similarly, the financial data proxies included in the EBITDA and revenue models can yield unwanted effects such as multicollinearity. However, empirical models are developed to give the best possible results within a theoretical framework, but it is impossible to protect the OLS model against all unwanted effects. Further information on OLS assumptions and testing is elaborated on in appendix E.

IV. Presentation of Data

A. Presentation of Data Sample

A relatively small sample of companies has built the foundation for the data set. Furthermore, a variety of sources and techniques have been utilized to obtain a sufficient data in order to conduct the quantitative analyses this paper is based on.

We use a sample of firms from two sectors in the Norwegian stock market i.e. the Oslo Stock Exchange. One is the seafood sector, which is important at the OSE, representing one of Norway's most important export commodities. The sector consists of 19 companies within farming, processing, equipment & services and biotech (Oslo Stock Exchange, 2012). We focus on the 13 companies within white fish and salmon farming. Our final subsample consists of seven actors meeting our criteria for inclusion, which will be discussed later. Specifically, the sample consists of Aker Seafoods (AKS), Austevoll Seafood (AUSS), Cermaq (CEQ), Codfarmers (COD), Grieg Seafood (GSF), Marine Harvest (MHG) and Lerøy Seafood (LSG).

The other sample sector is the offshore support vessel (OSV) industry. As a part of the oil service sector, it is of great importance for the OSE. It consists of 10 companies (Oslo Stock Exchange, 2012), operating several types of OSVs, among them platform supply vessels (PSV), anchor handling and tug support (AHTS) vessels as well as different types of construction support (CSV) vessels (Farstad Shipping, 2010). Our final subsample from the sector consists of seven companies. These are Bergen Group (BERGEN), DOF (DOF),

Eidesvik Offshore (EIOF), Farstad Shipping (FAR), GC Rieber Shipping (RISH), Havila Shipping (HAVI) and Solstad Offshore (SOFF).

Sample time periods are important factors for analysis results. We use varying lengths of time periods on a company specific basis, based on available data. Stock data are pulled out from when the respective companies were stock exchange listed until the present in order to yield the best possible basis for analysis. For some of the sample companies, history reaches back to the 1990's, while some were listed only few years ago. General market data from the OSE is available to an extent where it is not a limiting factor for any of the sample firms. This also applies for interest rate and currency data. These data are extracted with daily, weekly and quarterly frequencies. Further, data for the oil and salmon prices is gathered in a similar fashion. The oil price used is for North Sea Brent oil, and the salmon price is for Norwegian farm bred fish, fresh or chilled.

Currency data for all relevant currencies are also extracted with the same frequencies. The KKI functions as a basket index for Norwegian export companies, and is available with history exceeding those of the sample companies. The currency data part of the FXI is available daily from the date of each company's IPO, while trade weights are updated annually.

Lastly, a selection of company specific accounting data is included in our analyses. Numbers include revenue, EBITDA, the degree of foreign sales, foreign debt and assets as well as the amounts of derivatives used. When assessing the value of currency forwards, the notional amount is summed up to obtain the net value of derivatives. Occasionally, when forwards with the opposite structure are entered, positions are netted to gain the desired net effect. Revenue and EBITDA are available on a quarterly basis from company reports.

B. Source Discussion

Data has been gathered from several sources to achieve an adequate platform for in-depth analysis. Market- and currency data for the desired time periods and frequencies have all been gathered from Reuters Ecowin Pro database platform through a license (Thomson Reuters, 2011). This includes OSE market data, interest rates and commodity prices. The KKI and

exchange rates are publically available from the Norwegian Central Bank (Norges Bank, 2006). The mentioned company specific data such as EBITDA and foreign sales is extracted from quarterly and annual financial reports available through the respective companies' web sites or through those of the Oslo Stock Exchange.

We consider all sources used for analysis in this research paper credible. Ecowin Pro is a licensed database platform available through NTNU and is assumed to provide correct time series data. Data extracted from company financial reports are also considered credible as all numbers are audited upon statutory publications. However, human errors might occur and affect some data points.

C. Reasoning for Choice of Data

Much consideration has been put into the choice of the various data samples in this research. First of all, the two sample sectors were chosen due to their assumedly, for this research, relevant currency exposure. Both sectors have a strong international presence in terms of sales and/or operations. The offshore support sector has this through vessel operations across the entire globe from the North Sea to South America and South East Asia, yielding exposure to many of the world's largest currencies and in terms of trade and supply. Some have subsidiaries and departments abroad while some base their entire operation from Norway, however all are exposed to foreign currency as their customers, oil- and other oil service companies, often pay in other currencies than the NOK.

The seafood sector is based along the Norwegian coastline as well as abroad through subsidiaries, and export significant parts of their production to consumers world-wide who naturally pay in their domestic currencies. Common for both sectors is, in addition to high foreign sales, that a high portion of the total cost base is denominated in NOK as they are based in Norway. Although some companies accrue costs in foreign currencies through subsidiaries, most face the majority of costs in NOK through Norwegian operations such as farming, food production, personnel and management costs. The conclusion is that companies within OSV and seafood see a net cash flow exposure to foreign exchange rates which is why they build the foundation for this research.

Of further interest, the use of the FXI requires some explanation. The KKI index, which is technically constructed in the same way, is a general index for Norwegian export firms. However, individual adaption can possibly yield far inferior results, which is the background for the FXI. For 2012, the Euro accounts for 41.2% of the weight and the Nordic countries for about 1/3 of the weight combined (Norges Bank, 2012). The OSV companies face vast exposure towards the US Dollar and British Pound along with the Euro, while the seafood sector faces a heavier exposure towards the USD, GBP and Euro than the KKI, along with the Chilean Peso (CLP) for some companies. Hence, the individualized FXI will most likely yield better results than the KKI and is therefore adopted.

Further, certain key commodity prices and index values might be important to include when modeling stock returns and currency exposure, as some single factors have large significance for the movement of a stock or variation in revenue. The oil and salmon prices are such variables for the sample companies, and are included to attempt to explain some of the behavior of the endogenous variable. Revenue and EBITDA is used to reveal certain aspects of the currency exposure which might be difficult to observe when assessing stock return only. This also applies for different forex exposure proxies such as foreign sales and debt. More about this is included in the methodology Section.

D. Extent of Data

Certain limitations to the data sample have come naturally and of choice, and some are due to a lack of desired data. Regarding the company sample, more companies could have been included to obtain a broader base for the analyses. However, after starting out with all companies in the two sectors and assessing each, some were excluded from the sample for not meeting certain criteria.

One aspect is functional currency. For companies to be relevant for analyses conducted in this research, functional currency should be NOK. Also, too many foreign subsidiaries with independent operations and hedging activities might blur the picture enough to disqualify results as interesting. Several foreign based companies apply for listing at the OSE simply because of its attractiveness as a “maritime” stock exchange, attracting attention and capital from investors world-wide interested in investing in oil service and seafood stocks. These face no or little exposure to the NOK. Thus, some companies were excluded due to these reasons.

Further, some stocks within OSV and seafood at the OSE are rather illiquid, including periods with no trade and thus no return. In turn this yields poor results from regressions, and disqualifies another set of companies. A last reason for determining the extent of the company sample is available company specific accounting data. Lacking data on capital structure, more specifically debt and asset allocation, as well as financial hedging strategies and derivative usage will complicate or render vital analyses such as panel data analyses.

E. Potential Deficiencies and Limitations in the Data Set

Commonly when working with empirical material and analyses, certain deficiencies and flaws in the data material occur. First of all, the time series for the various companies do not coincide. Exchange listing dates naturally vary with the respective companies, so some firms have longer histories than others, with the effects that naturally follow. One is the pure effect on the quality of the analyses in terms of the number of data points, especially when handling weekly or less frequently updated time series. Another effect is the bias which occurs when certain companies were listed before others so that certain time series are affected by market wide, external effects in periods before other firms were listed. This effect might be considered as a variant of the survivorship bias (Brown, et al., 1992). The survivorship bias is also present in its original meaning for the relevant time series as firms which for some reason have been delisted from the OSE are not included in our sample. Also, the sample time period in itself represents a natural bias, as results only can account for observations within this period.

Regarding the FXI index, it is constructed by foreign sales data extracted from annual reports. So is other accounting information such as foreign debt and derivative usage. Some data points, especially for earlier years as well as for 2011 and 2012, is lacking for a few companies, which to a certain extent lower data quality. However, estimates are made for the relevant missing data points, so the effect should be minimal.

V. Empirical Findings and Discussion on Currency Exposure

In the discussion of our results we start with the presentation of macroeconomic factors' influence on the OSE. Secondly come the results from currency exposure models and finally we present hedging strategies and effects.

A. Systematic Currency Exposure on the OSE

The results in table I show the regression of the OSEBX on the risk free rate, the return to the oil price in dollars and the return to the KKI. In panel A, the return to the FTSE 100 is also included. The FTSE 100 is included as a factor to mimic the movement of international equities because it is the foreign index found to influence the OSE the most. The latter comes from the fact that the FTSE 100 has the highest explanatory power (highest R^2) of the OSEBX. For the entire period the FX index is insignificant with both specifications. By breaking the sample down into two periods we can shed more light on this result. The OSEBX shows a significant positive exposure to depreciation of the NOK for the first half of the last decade. This is consistent in both panels. In panel B this coefficient changes to negative and significant at the 1% level. If the FTSE 100 is included the factor becomes insignificant. The high correlation between the NOK and international equity markets during the financial crisis is shown in figure I (p. 17). This is a likely explanation for the fact that the FTSE 100 eliminates the explanatory power of the KKI.

Table I: Foreign Exchange Rates and the OSEBX

The table shows the results from the following regression:

$$r_t^m = \alpha + \delta_1 r_t^f + \delta_2 r_t^{OIL} + \delta_3 r_t^{FTSE} + \delta_4 r_t^{KKI}$$

In panel B, the return to the FTSE 100 index is not included. The same model is run for the entire period 2000-2011 and for the two sub-periods (2000-2005 and 2006-2011).

OSEBX

Panel A	R_f	OIL	FTSE 100	KKI
2000-2011	-3.363*	0.163***	0.955***	0.032
(p-values)	*(0.056)*	*(0.000)*	*(0.000)*	*(0.685)*
2000-2005	-4.979**	0.102***	0.680***	0.297**
(p-values)	*(0.019)*	*(0.000)*	*(0.000)*	*(0.012)*
2006-2011	-5.210	0.204***	1.127***	0.011
(p-values)	*(0.112)*	*(0.000)*	*(0.000)*	*(0.912)*

Panel B	R_f	OIL	KKI
2000-2011	-8.895***	0.254***	-0.172
(p-values)	*(0.001)*	*(0.000)*	*(0.138)*
2000-2005	-8.525***	0.110***	0.407***
(p-values)	*(0.001)***	*(0.000)*	*(0.006)*
2006-2011	-12.971**	0.427***	-0.425***
(p-values)	*(0.021)*	*(0.000)*	*(0.009)*

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

These findings are relevant for the analysis in this paper because of the fact that Norwegian listed companies seem to be positively affected by depreciation of the NOK when the FX markets are in a relatively normal state (2000-2005). This makes good sense for an economy that is relying heavily on exports (Statistics Norway, 2010). During the recent financial crisis, on the other hand, this effect is reversed due to the co-movement of the NOK and world equities. Not only is the OSE strongly driven by macroeconomic factors, but the Norwegian Krone as a currency is vulnerable to dips in the market sentiment as the supply and liquidity is limited compared to larger currencies such as the USD and Euro. Consequently, investors exit their NOK positions and find "safe havens" in e.g. the USD. Thus, it seems that exporters in small open economies to a certain extent are hedged naturally from currency fluctuations in

times of high uncertainty in the global financial markets. This is interesting because it could mean that companies that have a high degree of currency hedging might be negatively affected by depreciation of the NOK.

B. Stock Return Models

B.1 Offshore Support Sector

Presented in table II are the results from the stock return regressions for the supply sector, as well as the currency related exposure proxies.

Table II: Currency Exposure for OSV Companies

Table II shows the results from equation (1) or (2) for the supply companies. These are the market beta β_m and the foreign exchange beta β_{FX}. The latter is found from the FXI (Eq. (2)) if available or the KKI (Eq. (1)) if not. Bergen Group and GC Rieber do not have a FXI. Also, average values for the hedging and foreign sales proxies are included in the table. The abbreviations are as follows: FS= Foreign Sales, TS= Total Sales, FCD = Foreign currency Derivatives, TA=Total Assets, FD=Foreign Debt and TD=Total Debt

OSV Companies

Company	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
Bergen Group	0.558***	-0.802**	27%	4%	8%	0%	0.55
(p-values)	*(0.000)*	*(0.039)*					
DOF	0.664***	-0.311***	72%	4%	19%	45%	0.62
(p-values)	*(0.000)*	*(0.008)*					
Eidesvik	0.461***	*-0.050*	50%	16%	73%	49%	0.50
(p-values)	*(0.000)*	*(0.559)*					
Farstad	0.598***	-0.001	93%	1%	2%	45%	0.56
(p-values)	*(0.000)*	*(0.990)*					
GC Rieber	0.084	0.021	60%	4%	24%	84%	0.33
(p-values)	*(0.128)*	*(0.904)*					
Havila	0.459***	-0.072	60%	13%	74%	11%	0.55
(p-values)	*(0.000)*	*(0.693)*					
Solstad	0.702***	*0.076*	65%	3%	12%	59%	0.53
(p-values)	*(0.000)*	*(0.470)*					

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

Market betas are all significant at 0% and vary from 0.46 to 0.70, except for GC Rieber for which liquidity is poor. Looking at the forex beta, we observe that both Bergen Group and DOF display significant coefficients, both negative. These are also the strongest in magnitude. Other coefficients are rather small in magnitude, signalizing that net currency exposure on stock returns is limited for this sector. Three other results are also negative, though not significant. The results suggest that a stronger Norwegian Krone yields higher stock prices, which at first thought seems somewhat illogical. The intuition is as earlier discussed that a weaker currency should provide higher income in the domestic currency. The situation observed in this case can be attributed to the particular situation of the Norwegian stock market and economy, which is discussed in part A of this Section. The fall in demand and following weakening of the NOK through the financial crisis might hence be the reason for the results.

Figure II illustrates much of the same as the regressions in part A. The figure shows the development in the oil price versus the KKI. The correlation is strong at 0.89 and proves the effects which probably contribute to the slightly unexpected results on exposure. Moving in the same direction, market related and currency related effects will occur at the same time with opposite effect, however it seems like the general global market effects dominate and yield the results discussed. Many firms show varying exposure directions through time, which again can be attributed to the indirect effects (see Appendix A). For example, Solstad shows a significant negative coefficient in 2006 and a positive significant in 2007. However, hedging activities will impact stock return sensitivities so further investigation is necessary to conclude based on the results above. This is discussed later on.

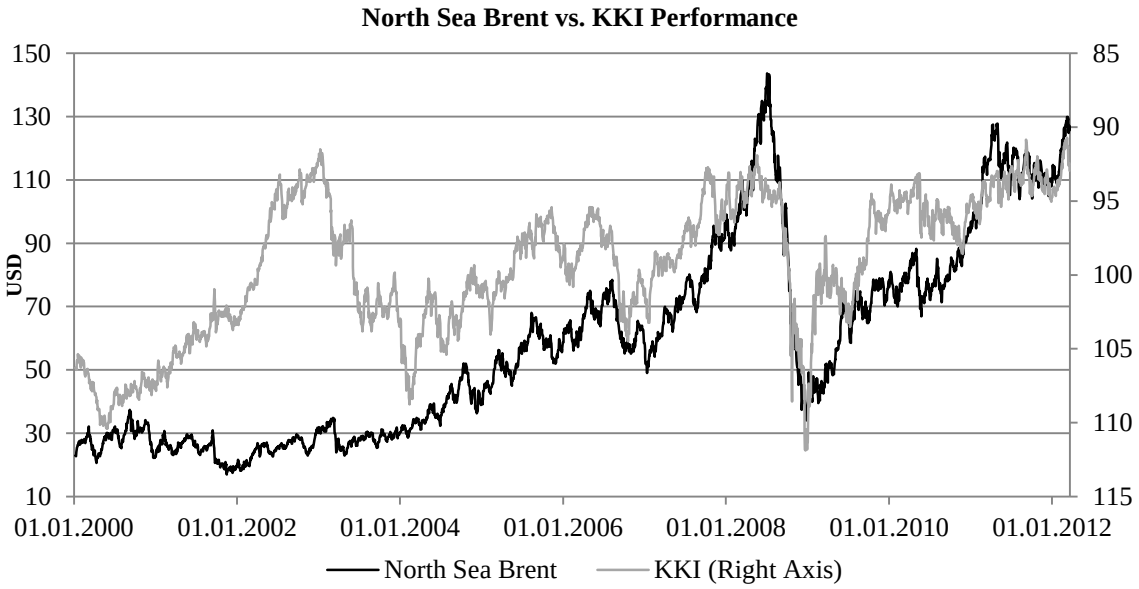

Figure II: The Price of Oil and the KKI

Figure II graphs North Sea Brent oil against the KKI. Stronger NOK yields a lower KKI value. The two indices are strongly correlated at 0.89.

B.2 Seafood Sector

Below we find the results from equation (1), here including the seven sample companies in the seafood sector. For information purposes, the currency exposure proxies are added to the right of the regression results.

Table III: Currency Exposure for Seafood Companies

Table III shows the results from equation (1) or (2) for the seafood companies. These are the market beta β_m and the foreign exchange beta β_{FX}. The latter is found from the FXI (Eq. (2)) if available or the KKI (Eq. (1)) if not. Also, average values for the hedging and foreign sales proxies are included in the table. The abbreviations are as follows: FS= Foreign Sales, TS= Total Sales, FCD = Foreign currency Derivatives, TA=Total Assets, FD=Foreign Debt and TD=Total Debt

Seafood Companies

Company	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
Aker Seafoods	0.400***	1.280**	62%	10%	12%	4%	65%
(p-values)	*(0.000)*	*(0.046)*					
Austevoll	0.870***	0.270	71%	4%	8%	25%	54%
(p-values)	*(0.000)*	*(0.310)*					
Cermaq	0.920***	*0.420***	56%	7%	8%	67%	21%
(p-values)	*(0.000)*	*(0.029)*					
Codfarmers	0.780***	0.470	82%	0%	0%	0%	35%
(p-values)	*(0.000)*	*(0.420)*					
Grieg Seafood	0.810***	0.070	65%	3%	3%	37%	56%
(p-values)	*(0.000)*	*(0.710)*					
Marine Harvest	0.860***	-0.440	93%	27%	42%	97%	46%
(p-values)	*(0.000)*	*(0.500)*					
Lerøy	0.640***	*0.340**	86%	12%	12%	1%	49%
(p-values)	*(0.000)*	*(0.060)*					

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

Firstly, we observe that the market beta coefficients are significant with a 0% p-value. They vary from 0.4 for Aker Seafoods to 0.92 for Cermaq. The interesting results from the main regression are, of course, the β_{FX} coefficients. All but Marine Harvest show a positive value, i.e. a positive correlation between stock returns and depreciation in the NOK. Also, Aker Seafoods and Cermaq show significant betas at the 5% level, Lerøy at the 10% level. The magnitude of the coefficients shows that Aker is far more exposed to currency fluctuations than Cermaq and Lerøy. In all, results are as expected, as a weaker NOK will yield stronger cash flows when foreign currencies are translated into the Krone. This means that some of the effects seen for the OSV sector do not apply for seafood companies, or at least to a smaller extent.

Generally for the sector, the salmon price is correlated with the KKI as seen in figure III. Although positive, the correlation is not very strong at 0.13, and far weaker than between the

oil price and KKI as discussed above. This means that market and currency effects might wipe each other out to a certain extent, but not in the same degree at for the OSV sector. Company specific effects related to hedging will be elaborated later on.

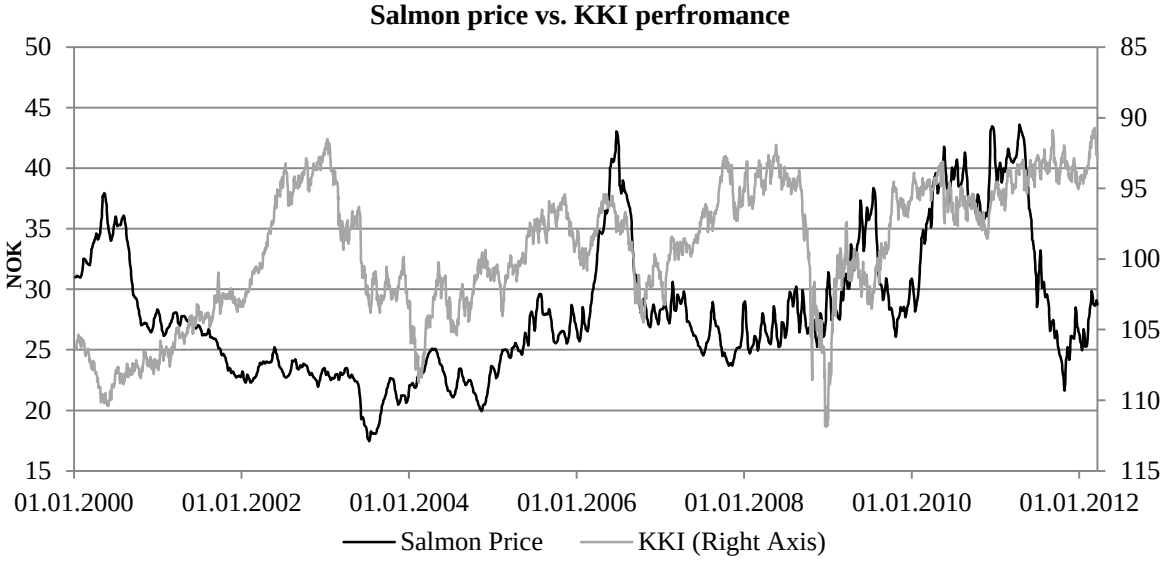

Figure III: The Price of Salmon and the KKI

Figure III graphs the salmon price (Norwegian, fresh or chilled) against the KKI. Stronger NOK yields a lower KKI value. Prices are moderately correlated at 0.13.

C. Alternative Models for Revealing Currency Exposure

In the following part we present the results from alternative models for analyzing currency exposure.

C.1 Cash Flow Models

Seafood Sector

Presented below are the results from the EBITDA regression for the seafood sector, see equation (6). Results for the revenue regressions are found in Appendix D.

Table IV: Currency Exposure of Cash Flows

The table shows how EBITDA reacts to changes in the price of salmon and changes in the exchange rates. $\gamma_1$is the coefficient for the price of salmon, $\gamma_2$the coefficient for revenue in the period and $\gamma_{FX}$the coefficient for the value of the currency index. Positive values for the latter means that the respective cash flow increases when the NOK depreciates. Column n gives the number of data points used in the time series regressions.

Company	γ_1	γ_2	γ_{FX}	n
Aker Seafoods	0.288	0.038	0.243	33
(p-values)	*(0.778)*	*(0.229)*	*(0.884)*	
Austevoll Seafoods	12.84***	0.165***	3.844	25
(p-values)	*(0.002)*	*(0.000)*	*(0.442)*	
Cermaq	15.25***	0.083**	-1.338	33
(p-values)	*(0.002)*	*(0.043)*	*(0.845)*	
Codfarmers	0.026	-0.067	0.866**	24
(p-values)	*(0.924)*	*(0.548)*	*(0.016)*	
Grieg Seafoods	8.018***	0.142**	-1.114	24
(p-values)	*(0.000)*	*(0.018)*	*(0.674)*	
Marine Harvest	49.25***	0.353***	-1.667	24
(p-values)	*(0.000)*	*(0.003)*	*(0.899)*	
Lerøy	14.41***	0.128***	2.67	40
(p-values)	*(0.000)*	*(0.000)*	*(0.301)*	

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

Assessing the EBITDA model, we observe five significant price betas, all positive. In fact, also the non-significant betas are positive so results all point in the same direction. Only Aker Seafoods and Codfarmers stand out with non-significant salmon price betas. The salmon price does, of course, suit the companies involved with salmon best. Aker Seafoods is a white fish company, while Codfarmers are involved with cod. While the supply and demand for different fish are related, it is plausible that the lack of salmon price exposure for these companies explain the lacking significance. The same results apply for the revenue betas. All results are positive, and the same two companies lack significant betas. The others obtain 0% level significance for the revenue factor. Results so far are in line with intuition. The forex coefficient is more ambiguous across the sector, only Codfarmers display a significant beta. The value is positive, signalizing a positive relation between EBITDA and a stronger NOK. Non-significant results are varying in terms of the sign of correlation.

When comparing stock returns with EBITDA results in terms of forex exposure, the former yields results more in hand with initial expectations. One obvious reason is the amount of data which is much greater when analyzing weekly data rather than quarterly. Aker Seafoods shows consistency between the revenue and stock return regressions, both significant and positive. Other companies also display consistent exposure directions, although not significant. Cermaq shows a change in direction between the regressions; however the standard deviation of the FX beta is very high and might explain the changes.

Offshore Support Sector

Presented in table V is the EBITDA model from (6) for the supply sector. Results for the revenue regressions are found in Appendix D

Table V: Currency Exposure of Cash Flows

The table shows how EBITDA reacts to changes in the price of oil and changes in the exchange rates. $\gamma_1$is the coefficient for the price of oil, $\gamma_2$the coefficient for revenue in the period and $\gamma_{FX}$the coefficient for the value of the currency index. Positive values for the latter means that the respective cash flow increase when the NOK depreciates. Column n gives the number of data points used in the time series regressions.

Company	γ_1	γ_2	γ_{FX}	n
Bergen Group	-138	0.15***	-6.873*	16
(p-values)	*(0.417)*	*(0.003)*	*(0.052)*	
DOF	1427***	0.28***	-3.649***	40
(p-values)	*(0.004)*	*(0.000)*	*(0.002)*	
Eidesvik	-57	0.74***	0.536	27
(p-values)	*(0.746)*	*(0.000)*	*(0.270)*	
Farstad	-287	0.46***	-1.325	40
(p-values)	*(0.571)*	*(0.000)*	*(0.616)*	
GC Rieber	-118	0.36***	-2.222	28
(p-values)	*(0.627)*	*(0.000)*	*(0.198)*	
Havila Offshore	-373	0.54***	2.292	27
(p-values)	*(0.434)*	*(0.000)*	*(0.177)*	
Solstad	794	0.54***	6.484**	40
(p-values)	*(0.269)*	*(0.000)*	*(0.027)*	

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

Oil price coefficients are somewhat vague, only DOF shows a significant and positive value. Of three significant results, two of the forex exposure betas are negative. The results from the EBITDA and stock return regressions are consistent for DOF and Bergen Group, suggesting that the effects seen on EBITDA are passed on to stock returns through all financial activities without intervention by the management drastically changing results. A possible explanation for negative forex coefficients is the earlier discussed oil service sector dependence of the world economy.

The financial items that come between revenue and net income in the annual reports are vital. Hedging activities affect results in potentially all directions and with large magnitudes. Hence, in order to understand the results better, sector and company specific strategies must be examined. Along with further data analysis from panel data, it will be possible to add additional value to the results from the regressions above.

C.2 Model for Inefficient Market

To complete and verify other analyses in this paper, and for examining the Norwegian stock market in general, a test for market efficiency is conducted. The idea is, as earlier explained, to reveal whether or not currency fluctuation effects on firm value are priced into share prices continuously. Firstly, we assess the seafood sector, where the results are presented in appendix B.

Results are somewhat unclear; two companies show positive and significant results, one displays significant and negative returns. For Cermaq and Grieg Seafood, investors apparently detect new information at reporting dates and perform share price corrections accordingly. Results suggest that a stronger NOK in the previous period hurt net income. For Aker Seafoods, however, results were the opposite.

In the supply sector, Eidesvik and Farstad display negative and significant coefficients at the 5% level. Eidesvik's value is however only marginally negative. Results, although not overwhelming, suggest as earlier that macroeconomic factors might have a larger influence on results than currency fluctuations alone. From this experiment, we cannot fully reject or confirm the idea of complete market efficiency, as some significant results do exist, although betas vary in direction.

The findings in part C are to some extent consistent with results from the stock return model. However, uncertainty in cash flow model results, through significant statistical variation, suggests that further analysis should be based on the stock return model from part B.

D. Hedging Strategies and Activities

In order to draw the lines between financial hedging and the currency exposure of the companies in our data sample, information on hedging and foreign operations has been gathered from annual reports. The average results for the years each company has been listed are presented in tables II and III along with the results on exposure. Most of the firms have substantial variations in hedging activity over time. Yearly information is found in appendix A.

Hedging by Derivatives versus Foreign Debt

The left part of figure IV shows a scatter plot of the use of foreign debt and foreign currency derivatives. The picture clearly shows that there are large variations in the extent of hedging activity. The chart does not take into account the extent of foreign operations. All the companies except for Bergen Group do, however, have more than 50% of sales in foreign markets.

Only three firms hedge more than 30% of total sales, meaning that it is uncommon to hedge foreign cash flow in its entirety with derivatives, consistent with Allayannis and Ofek (1997). Eidesvik and Havila are the only two above 50%, and both hedge on average about three quarters of total sales. Compared to the level of foreign sales, the two companies' derivatives contracts are actually, on average, above 100%. These numbers are substantially higher than what is found in other studies (Allayannis & Weston, 2001). Eidesvik is the supply company with the most financial hedging in total. The average use of derivatives is driven by a few years (2006 and 2007) with particularly extensive hedging.

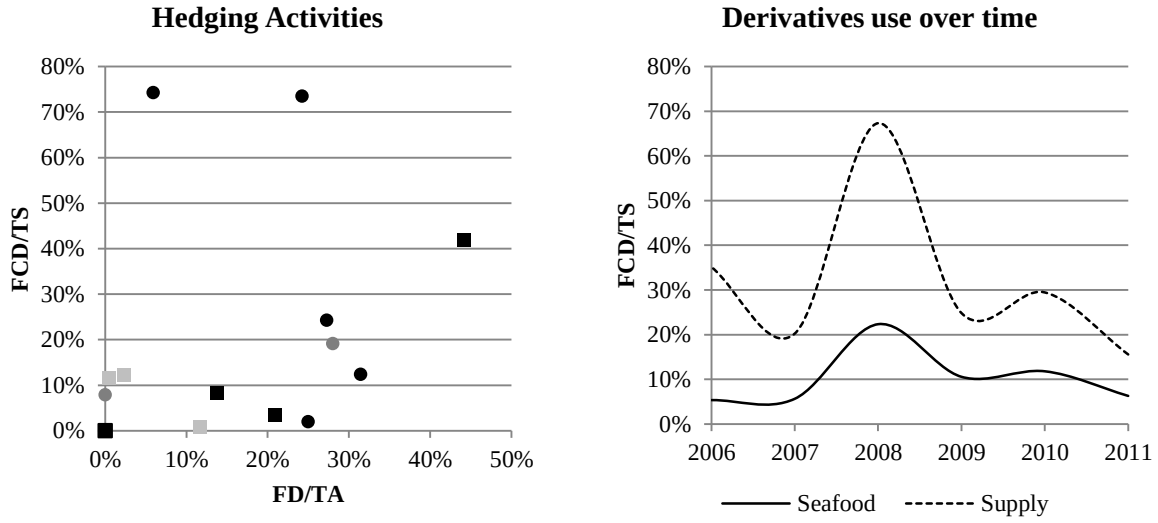

Figure IV: Hedging in Norwegian Listed Companies

Left graph: The scatter plot shows the use of derivatives (vertical axis) and foreign denominated debt (horizontal axis). The squares are companies in the seafood industry, and dots are offshore supply firms. Light gray coloring indicate that the company has a significant positive exposure to foreign exchange rates, dark gray negative significant exposure and black insignificant.
Right graph: Shows the development in derivatives usage from 2006-2011 for each of the sectors. Curves are smoothed, annual data is used.

The equal weighted average of 14% derivatives to foreign sales ratio in the seafood sector is, on the other hand, more in line with previous findings (Allayannis & Ofek, 1997). Only Marine Harvest hedge more than 20% of foreign sales with these types of instruments. The reader should note that Marine Harvest is the most geographically diverse firm, resulting in a fair amount of operational hedging. Some of its forward contracts are between two foreign currencies to hedge cash flows of foreign subsidiaries, making it difficult to assess the impact of hedging on foreign exchange exposure. On the other end, Codfarmers is the only firm in the sample not using financial hedging instruments at all. This is inconsistent with the findings of Warner (1977) that smaller firms tend to use more derivatives. Havila and Eidesvik however, as two of the smallest firms in the sector, act consistently with those findings. Marine Harvest, as the by far largest company in its sector, shows both extensive derivative and foreign debt use consistent with Mian (1996) and Allayannis and Ofek (1997).

The use of foreign currency denominated debt is quite variable in the seafood industry, varying from close to 0 to 40%. The offshore supply companies show less variance in their use. 25%-30% is normal, but Bergen Group and Havila have considerably less than this. The former is probably explained by limited foreign sales, while the latter seems to rely more on

derivatives, as it is the firm with the highest ratio of derivatives to sales in the sample. Hence, our sample companies do rely less on foreign debt hedging than results from Clark and Judge (2009) suggest. Hedging is on average more extensive among the offshore companies. Interestingly, this is not reflected in the amount of foreign sales (the seafood sector averages 71% foreign sales, the same number in OSV is 61%).

Comparing the two sectors in terms of hedging preferences, some realities make differences easier to understand. OSV companies make extensive use of various charter contracts. This applies for all vessels not operating in the spot market. For vessels on contracts, future cash flows can be determined with certainty. Hence, currency derivatives such as forward contracts are well suited as the timing of cash flows versus derivatives' maturities is easy to control (Clark & Judge, 2009). Seafood companies are more dependent on the consumer market where demand from period to period is harder to determine.

Derivative Use over Time

On the right hand side of figure IV the use of derivatives over the last five years for the firms in the sample is mapped. The two sectors show a very similar development as the hedging ratio increase substantially in response to the financial crisis of 2008. This trend is rapidly reversed when the markets calm in 2009. The reaction is natural in the sense that firms become more focused on eliminating risk factors as uncertainty increases. A decline in sales, due to a contraction in the real world economy, might also contribute to the larger derivatives to sales ratio. It was, however, only 4 out of 14 firms that saw a decline in revenues from 2007 to 2008. The co-movement of the NOK exchange rate and international markets in the same period (See part A for further discussion) could, furthermore, result in the increased hedging activity having an unintended effect on exposure to currency risk.

Derivative Classes and Usage

The different categories of derivatives companies take use of vary. One common observation is however that both seafood and supply sector companies limit hedging activities to include vanilla derivatives; few or none exotic derivatives are used when hedging. In practice, forward contracts account for the majority of derivative holdings, while currency options also are used to a certain extent. In contrast, previous research on other markets suggest only half of derivatives used are forwards (Bodnar, et al., 1995). Interest rate swaps are also used however not dealt with in this research. Forward contracts are mainly entered for purchasing

NOK and selling currency at maturity, obtaining the desired hedging effect for future revenue in forex. Regarding options, both puts and calls are used along with combinations to achieve certain hedges. However, the use of these is limited, and forwards do indeed dominate the derivative usage.

E. The Effects of Hedging on Exposure

To link the level of currency exposure to the hedging strategies mentioned in the previous part, regression equations (3) and (4) were run separately on the firms in each sector. The same model run on the entire data set in one panel can be seen in appendix C. The results of the unbalanced panel regressions provide significant information about hedging and exposure. The endogenous variable in the model is the FXI beta where it was constructed, and the KKI beta for the remainder.

Table VI: Effect of Hedging on Currency Exposure

The table shows the results from regression equation (3) and (4) for each of the sectors. The endogenous variables are the FX betas from equation (1) and (2) found for each year the companies have been listed. Hedging proxies are found from annual reports. The models are run with individual dummies. Including individual dummies is equivalent to running a fixed effect panel data regression (Stock & Watson, 2007).

BETA FX (w/individual dummies**)**

Sector	Constant	FS/TS	FCD/TA	FD/TA	FCD/TS
Seafood	0.292	1.570*	0.19	-5.94***	-
(p-values)	*(0.434)*	*(0.086)*	*(0.845)*	*(0.000)*	-
Seafood	0.286	1.554*	-	-6.12***	0.33
(p-values)	*(0.431)*	*(0.054)*	-	*(0.000)*	*(0.284)*
OSV	-0.228	0.393	-0.72**	-1.01*	-
(p-values)	*(0.422)*	*(0.180)*	*(0.031)*	*(0.087)*	-
OSV	-0.23	0.38	-	-1.00*	-0.13*
(p-values)	*(0.420)*	*(0.188)*	-	*(0.096)*	*(0.062)*

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

Looking at the ratio of foreign sales to total sales the expectation was that this factor should be positively correlated with the exposure factor. In the seafood sector the factor is positive

and significant at the 10%-level. This is also consistent with previous research (Simkins & Laux, 1997) and (Allayannis, et al., 2001). The coefficient is relatively high, compared to the OSV sector, at 1.5. Looking at the foreign sales beta for the offshore sector, it is also positive but not significant at traditional levels. The latter might be explained by the aforementioned correlation between the NOK and global equity markets. Although little research exist on companies in the salmon industry, it is reasonable to assume that the supply sector is more affected by the market sentiment. While oil is an integral ingredient in the output of most industrialized countries (Hamilton, 2008), salmon is of less importance. Consequently, it is not unreasonable that a global recession hit the supply sector harder than the salmon exporters. The numbers in the FS/TS column of table VI support this view.

As for the three hedging proxies, we expected that these factors would have a negative impact on the exposure to depreciation of the Krone. The ratio of Debt-to-Total Assets has a clear negative sign regardless of sector and model specification. Particularly for the seafood companies, this factor has a large coefficient and strong significance. This is somewhat contradictory to Chowdhry & Howe (1999). In the supply table, on the other hand, the results are only weakly significant. The intuition behind this difference could be in the fact that foreign debt is used to finance widely different assets in the two sectors.

Supply companies use foreign debt to finance vessels they buy in foreign currencies. This is a highly competitive market, and as exchange rate changes the market value of the vessels follows. The result is that if currency fluctuations lead to decreasing face value of foreign debt, the market value of the fleet denominated in foreign currency will decrease equivalently (in the home currency). As foreign debt often is raised with mortgage in vessels paid for in foreign currency, actual amounts of debt and vessel market value are assumed to be relatively equal. The book value of vessels is also assumed to follow market conditions. These offsetting effects can explain the weaker significance of debt in the supply sector.

Assets in the fish farming industry are primarily the biomass in the ocean and production facilities along with licenses (Cermaq, 2010). Although the value of these to some extent is affected by exchange rates, it is not unreasonable to think that they do not follow currency fluctuations as closely as the supply vessels. A production facility is usually depreciated over many years, and not marked to market in the same manner as a supply vessel. This could

explain the stronger negative effect foreign debt has on exposure for companies in the seafood sector.

The effects of the foreign currency derivatives are not completely as expected. In the supply sector there is, as expected, a negative and quite significant coefficient for this factor. Quite surprisingly, however, it is positive (not significant) for the seafood companies. As long as these contracts are long NOK and short a foreign currency, which is the case for the majority of the firms in the sample, this result seems counterintuitive. Understanding the hedging strategies in the fish farming industry can help to explain the results.

From figure IV in the previous part it can be seen that debt in general is a more applied hedging instrument than derivatives for seafood companies. Furthermore, there is a slightly negative relation between the use of derivatives and foreign debt (excluding Marine Harvest, see part D for further explanation). This indicates that the two types of instruments are used as substitutes, consistent with the analysis of the foreign debt factor and with previous studies on the topic (Elliott, et al., 2003). Also, it is the companies with the lowest foreign debt ratio that have significant positive exposure to foreign exchange rates (positive FXI/KKI beta in equation (1)). The positive factor for the use of derivatives should therefore be seen in context with the companies using them. It seems like the seafood companies achieve a more neutral position to foreign exchange rates using foreign debt rather than solely relying on derivatives.

Financial Crisis- and other Time Specific Considerations

Although the time series regressions on the data divided into each year in general gives results with weak significance, there are several results that support the analysis above. The complete tables for all companies in the sample are found in appendix A.

In the review of hedging strategies it was shown that the use of derivatives during the financial crisis increased sharply. This was particularly true for the supply companies. As the actual currency exposure of these companies is found to decrease in the same year, this should result in negative FXI betas. Despite the weak significance of the results, probably due to yearly time series of weekly returns only consist of 52 data points, all except one supply company has a negative coefficient in 2008. For DOF this result is significant at the 1%-level, coinciding with more than a doubling of the derivatives to sales ratio for this company. The results in the seafood sector for the same year are less uniform. Hence it seems that the

reaction of entering derivative contracts in response to market turmoil make the supply companies more exposed to changes in the NOK exchange rate. Any CFO would probably argue that hedging the actual cash flows is more important than the fluctuations of the stock prices in challenging times. The complete results of our analysis do, however, indicate that such actions make the company more exposed.

Aker Seafoods sold its foreign operation in 2010, and thereafter only had domestic sales in 2011. At the same time the FXI beta changed from positive and close to one in previous years to -0.91 (not significant) in 2011, providing further support to the notion that firms on the OSE have an indirect negative exposure to a NOK depreciation. All the other firms in the seafood industry had positive exposure in the same year, consistent with the low derivatives usage in 2011 shown in figure IV. Finally, the degree of operational hedging in Marine Harvest makes its correlation with movements in the NOK exchange rate low.

VI. Conclusion

At a general level, findings on currency exposure can be presented twofold. Firstly, there is the external impact on the Norwegian stock market. We find that the OSEBX was positively correlated to depreciation of the NOK in the relatively calm markets from year 2000 to 2005. During the crisis in the last half decade, on the other hand, this effect is reversed. Consequently, the global market sentiment appears to function as a systematic natural currency hedge when investors are jittery.

Secondly, some differences are found observing the two sectors. The supply sector displays mostly negative and partially significant results. While this might be explained by the above mentioned effects, the seafood sector show near exclusively positive effects, of which some are significant. Quantitative and qualitative analysis point in direction of the offshore support sector being much more influenced by indirect effects on the Norwegian market than the seafood sector.

Hedging practices in the two sectors are quite different. Overall, OSV companies have substantially more financial hedging instruments, both when it comes to derivatives and

foreign currency denominated debt. Also, the market turmoil of 2008 led to a substantial increase in the use of currency derivatives. The consequence of the increase was that the sample showed particularly negative exposure to depreciation of the NOK this year. The effect was particularly strong for the OSV firms, indicating that some of these actors were over-hedged.

Examining different financial hedging strategies, foreign debt had the bigger negative effect on currency exposure. Results for currency derivatives were more ambiguous. In the OSV sector these instruments had a significant negative effect, while for seafood the results were inconclusive. We suspect the latter is due to the relatively limited use of derivatives among these companies. Regarding derivative usage, it is fairly non-exotic including mostly long NOK forwards and call options.

Results on currency exposure are, especially for the supply sector, somewhat surprising. Indirect factors prove to play a more important role than initially expected. Consequently, Norwegian firms should take sector specific aspects into account when laying down hedging strategies. Previous research shows that, in comparison to our sample, more advanced strategies including other derivative structures and instruments might yield more flexibility to adapt to the rapidly changing market environments (Clark & Judge, 2009). These strategies should be explored by Norwegian companies.

Our results can be of interest to investors in the Norwegian stock market seeking further knowledge on stock exposure to foreign exchange rates. Further research should attempt to link the above results to firm value. Also, our findings show that smaller sample sizes might yield more visible results due to heterogeneity within different sectors. Finally, the dynamic nature of indirect currency exposure is something to be aware of for those involved with corporate risk management.

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VIII. Appendices

A. Yearly Currency Exposure

In this appendix we present the results from yearly regressions of equation (1) and (2). Discussion of the results is found in Section V. The FX betas found in the tables are used as the endogenous variable in equation (3) and (4), and the proxies make up the exogenous variables.

Table A-I: Yearly Currency Exposure for Seafood Companies

Aker Seafoods

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011*	0.449***	-0.910	0%	0%	0%	0%	71%
(p-values)	*(0.002)*	*(0.453)*					
2010	0.313*	0.963	73%	13%	13%	5%	62%
(p-values)	*(0.066)*	*(0.251)*					
2009	0.662	*3.152*	78%	9%	13%	6%	66%
(p-values)	*(0.129)*	*(0.239)*					
2008	0.329**	0.893	79%	24%	27%	6%	62%
(p-values)	*(0.027)*	*(0.416)*					
2007	0.642**	0.728	73%	7%	9%	5%	66%
(p-values)	*(0.024)*	*(0.654)*					
2006	0.408**	0.978					
(p-values)	*(0.049)*	*(0.448)*					

*Aker sold its foreign branch in 2011

Austevoll

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	1.024***	0.614	72%	5%	7%	16%	50%
(p-values)	*(0.000)*	*(0.247)*					
2010	0.706***	-0.678	72%	6%	9%	13%	52%
(p-values)	*(0.002)*	*(0.220)*					
2009	0.556**	*1.362**	72%	7%	10%	17%	56%
(p-values)	*(0.012)*	*(0.066)*					
2008	0.975***	0.378	72%	6%	24%	18%	65%
(p-values)	*(0.000)*	*(0.528)*					
2007	0.211	-0.348	67%	0%	0%	34%	52%
(p-values)	*(0.298)*	*(0.464)*					
2006			72%	0%	0%	55%	47%
(p-values)							

Cermaq

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.851***	0.108	55%	1%	0%	59%	15%
(p-values)	*(0.000)*	*(0.808)*					
2010	0.921***	0.846**	50%	1%	1%	76%	15%
(p-values)	*(0.000)*	*(0.023)*					
2009	0.576***	*0.355*	52%	0%	0%	53%	13%
(p-values)	*(0.007)*	*(0.517)*					
2008	0.918***	0.627	55%	2%	0%	47%	25%
(p-values)	*(0.000)*	*(0.206)*					
2007	0.764**	-0.059	60%	3%	0%	58%	21%
(p-values)	*(0.023)*	*(0.922)*					
2006	1.113***	-0.294	64%	2%	2%	94%	19%
(p-values)	*(0.000)*	*(0.394)*					

Codfarmers

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.665*	0.683	81%	0%	0%	0%	34%
(p-values)	*(0.087)*	*(0.627)*					
2010	0.998**	1.958	89%	0%	0%	0%	47%
(p-values)	*(0.048)*	*(0.105)*					
2009	0.786*	*-0.031*	82%	0%	0%	0%	53%
(p-values)	*(0.072)*	*(0.984)*					
2008	0.726***	-1.109	88%	0%	0%	0%	43%
(p-values)	*(0.000)*	*(0.109)*					
2007	0.332	-0.415	69%	0%	0%	0%	25%
(p-values)	*(0.172)*	*(0.480)*					

Grieg Seafood

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	1.218***	1.178***	49%	3%	3%	7%	39%
(p-values)	*(0.000)*	*(0.003)*					
2010	0.547**	0.038	80%	11%	11%	54%	51%
(p-values)	*(0.014)*	*(0.866)*					
2009	1.061***	*0.754*	70%	-1%	-1%	39%	61%
(p-values)	*(0.008)*	*(0.259)*					
2008	0.351**	-0.777***	68%	4%	4%	42%	70%
(p-values)	*(0.040)*	*(0.008)*					
2007	0.235	-0.477	59%	0%	0%	46%	57%
(p-values)	*(0.574)*	*(0.302)*					

Marine Harvest

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	1.055***	0.994	96%	17%	24%	98%	29%
(p-values)	*(0.000)*	*(0.160)*					
2010	0.705***	0.341	92%	23%	36%	97%	47%
(p-values)	*(0.004)*	*(0.553)*					
2009	0.463*	*0.927*	91%	27%	37%	96%	44%
(p-values)	*(0.051)*	*(0.254)*					
2008	0.711***	-0.564	92%	51%	86%	98%	58%
(p-values)	*(0.001)*	*(0.482)*					
2007	1.529***	-0.196	93%	16%	26%	95%	46%
(p-values)	*(0.001)*	*(0.837)*					

Lerøy

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.843***	0.486	80%	2%	10%	2%	28%
(p-values)	*(0.000)*	*(0.263)*					
2010	0.790***	0.176	85%	10%	13%	1%	47%
(p-values)	*(0.001)*	*(0.659)*					
2009	0.473**	*0.828*	83%	13%	14%	1%	48%
(p-values)	*(0.017)*	*(0.257)*					
2008	0.317*	1.306	83%	12%	16%	1%	52%
(p-values)	*(0.092)*	*(0.177)*					
2007	0.547**	0.354	84%	4%	5%	2%	52%
(p-values)	*(0.038)*	*(0.650)*					
2006	1.161***	-0.641	85%	14%	14%	0%	58%
(p-values)	*(0.000)*	*(0.535)*					
2005	0.603**	*1.531*	90%	22%	14%	0%	49%
(p-values)	*(0.014)*	*(0.142)*					
2004	0.274	3.199***	85%	16%	8%	0%	54%
(p-values)	*(0.301)*	*(0.010)*					
2003	0.562**	-2.571	93%	22%	14%	0%	56%
(p-values)	*(0.035)*	*(0.101)*					
2002	0.709***	-2.750	92%	8%	8%	0%	46%
(p-values)	*(0.000)*	*(0.209)*					

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

Table A-II: Yearly Currency Exposure for OSV Companies

Bergen Group

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.424**	-0.726	36%	0%	0%	0%	0.60
(p-values)	*(0.026)*	*(0.263)*					
2010	0.582*	-0.624	22%	3%	7%	0%	0.48
(p-values)	*(0.077)*	*(0.442)*					
2009	0.536	*-1.153*	27%	0%	0%	0%	0.57
(p-values)	*(0.123)*	*(0.323)*					
2008	0.520***	-0.568	16%	11%	23%	0%	0.48
(p-values)	*(0.007)*	*(0.458)*					
2007	-0.260	-0.153	32%	6%	10%	0%	0.63
(p-values)	*(0.275)*	*(0.765)*					

DOF

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.659***	-0.471	81%	2%	8%	32%	0.71
(p-values)	*(0.004)*	*(0.390)*					
2010	0.271*	-0.351	87%	6%	30%	26%	0.65
(p-values)	*(0.072)*	*(0.218)*					
2009	0.344**	*-0.280*	64%	6%	33%	28%	0.61
(p-values)	*(0.032)*	*(0.469)*					
2008	0.574***	-1.457***	66%	5%	23%	44%	0.62
(p-values)	*(0.000)*	*(0.000)*					
2007	0.586***	0.594*	70%	2%	10%	38%	0.59
(p-values)	*(0.001)*	*(0.065)*					
2006	0.455***	-0.273	70%	2%	10%	58%	0.53
(p-values)	*(0.004)*	*(0.492)*					
2005	1.175***	*0.075*	58%	0%	0%	44%	0.62
(p-values)	*(0.000)*	*(0.837)*					
2004	0.853***	0.322	93%	0%	0%	64%	0.61
(p-values)	*(0.000)*	*(0.147)*					
2003	0.549**	-0.422	63%	10%	60%	71%	0.65
(p-values)	*(0.013)*	*(0.201)*					
2002	1.215***	-0.184					
(p-values)	*(0.000)*	*(0.682)*					

Eidesvik

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.429***	0.123	40%	1%	7%	49%	0.55
(p-values)	*(0.001)*	*(0.533)*					
2010	0.400**	0.147	46%	5%	23%	46%	0.57
(p-values)	*(0.046)*	*(0.564)*					
2009	0.452***	*-0.051*	55%	5%	22%	46%	0.60
(p-values)	*(0.001)*	*(0.850)*					
2008	0.443***	-0.180	58%	48%	233%	55%	0.66
(p-values)	*(0.000)*	*(0.361)*					
2007	0.450***	0.037	50%	15%	87%	36%	0.52
(p-values)	*(0.004)*	*(0.869)*					
2006	0.304**	-0.236	50%	35%	137%	55%	0.28
(p-values)	*(0.012)*	*(0.278)*					
2005	0.455**	*-0.028*	50%	1%	5%	53%	0.32
(p-values)	*(0.043)*	*(0.928)*					

Farstad

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.808***	-0.161	93%	2%	3%	30%	0.63
(p-values)	*(0.000)*	*(0.617)*					
2010	0.292**	-0.413	93%	2%	3%	29%	0.50
(p-values)	*(0.036)*	*(0.109)*					
2009	0.482***	*0.436*	93%	1%	2%	15%	0.48
(p-values)	*(0.000)*	*(0.206)*					
2008	0.429***	0.075	93%	2%	6%	43%	0.48
(p-values)	*(0.000)*	*(0.788)*					
2007	0.561***	0.057	95%	0%	1%	41%	0.48
(p-values)	*(0.001)*	*(0.870)*					
2006	0.846***	-0.134	92%	1%	1%	43%	0.51
(p-values)	*(0.000)*	*(0.734)*					
2005	0.700***	*0.144*	93%	0%	1%	45%	0.58
(p-values)	*(0.000)*	*(0.600)*					
2004	1.129***	-0.561	93%	1%	1%	62%	0.63
(p-values)	*(0.000)*	*(0.121)*					
2003	0.517**	-0.424	93%	1%	1%	66%	0.68
(p-values)	*(0.017)*	*(0.236)*					

GC Rieber

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.194	-0.278	43%	2%	11%	100%	0.45
(p-values)	*(0.377)*	*(0.715)*					
2010	-0.055	-0.601	61%	9%	53%	82%	0.36
(p-values)	*(0.822)*	*(0.321)*					
2009	-0.057	*-0.644*	69%	2%	9%	70%	0.37
(p-values)	*(0.822)*	*(0.255)*					
2008	-0.078	-0.303	65%	2%	0%	73%	0.24
(p-values)	*(0.396)*	*(0.423)*					
2007	-0.577*	1.478*	65%	2%	0%	73%	0.20
(p-values)	*(0.078)*	*(0.051)*					

Havila

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.222	-0.213	52%	11%	65%	3%	0.51
(p-values)	*(0.168)*	*(0.653)*					
2010	0.240	-0.023	66%	14%	88%	7%	0.49
(p-values)	*(0.187)*	*(0.951)*					
2009	0.124	*0.107*	57%	17%	88%	10%	0.52
(p-values)	*(0.625)*	*(0.891)*					
2008	0.582***	0.012	62%	32%	173%	23%	0.60
(p-values)	*(0.000)*	*(0.976)*					
2007	0.497**	0.493	62%	2%	14%	7%	0.60
(p-values)	*(0.023)*	*(0.242)*					
2006	0.651***	-0.387	62%	4%	17%	15%	0.55
(p-values)	*(0.000)*	*(0.291)*					

Solstad

Year	β_m	β_{FX}	FS/TS	FCD/TA	FCD/TS	FD/TD	D/TA
2011	0.932***	0.384	65%	3%	14%	50%	0.67
(p-values)	*(0.000)*	*(0.346)*					
2010	0.666***	0.128	59%	0%	3%	45%	0.62
(p-values)	*(0.001)*	*(0.680)*					
2009	0.493***	*0.347*	70%	4%	20%	49%	0.57
(p-values)	*(0.003)*	*(0.406)*					
2008	0.749***	0.191	59%	4%	13%	46%	0.52
(p-values)	*(0.000)*	*(0.589)*					
2007	0.476***	0.553*	44%	4%	21%	48%	0.52
(p-values)	*(0.005)*	*(0.084)*					
2006	0.406***	-0.614**	56%	8%	38%	56%	0.54
(p-values)	*(0.001)*	*(0.030)*					
2005	0.984***	*0.340*	60%	3%	16%	60%	0.34
(p-values)	*(0.000)*	*(0.354)*					
2004	1.242***	0.072	74%	0%	0%	74%	0.50
(p-values)	*(0.000)*	*(0.835)*					
2003	-0.044	-0.003	81%	0%	0%	81%	0.53
(p-values)	*(0.866)*	*(0.994)*					
2002	0.806***	0.060	82%	0%	0%	82%	0.51
(p-values)	*(0.000)*	*(0.921)*					

****Significant at the 1% level*

***Significant at the 5% level*

**Significant at the 10% level*

B. Quarterly Reporting Currency Exposure

Table B-II: Quarterly Reporting Currency Exposure

The table shows the results from regression (7). The endogenous variable is the abnormal return from the CAPM regression conducted. Thus, market beta value is from the CAPM regression. The exogenous variable is the 60-day accumulated return of the FXI.

Offshore Support Sector

Company	β_m	β_{FX}
Bergen Group	0.292***	-0.266
(p-values)	*(0.000)*	*(0.204)*
DOF	0.476***	-0.001
(p-values)	*(0.000)*	*(0.987)*
Eidesvik	0.278***	*-0.107***
(p-values)	*(0.000)*	*(0.023)*
Farstad	0.468***	-5.079**
(p-values)	*(0.000)*	*(0.042)*
GC Rieber	-0.011***	0.104
(p-values)	*(0.000)*	*(0.413)*
Havila	0.458***	2.310
(p-values)	*(0.000)*	*(0.378)*
Solstad	0.521***	*0.007*
(p-values)	*(0.000)*	*(0.905)*

Seafood Sector

Company	β_m	β_{FX}
Aker Seafoods	0.280***	-0.378*
(p-values)	*(0.000)*	*(0.065)*
Austevoll	0.449***	-0.089
(p-values)	*(0.000)*	*(0.345)*
Cermaq	0.292***	*0.235***
(p-values)	*(0.000)*	*(0.011)*
Codfarmers	0.428***	0.067
(p-values)	*(0.000)*	*(0.885)*
Grieg Seafood	0.409***	0.122*
(p-values)	*(0.000)*	*(0.094)*
Marine Harvest	0.915***	0.175
(p-values)	*(0.000)*	*(0.210)*
Lerøy	0.475***	*0.004*
(p-values)	*(0.000)*	*(0.976)*

C. Panel Data Regressions

In this appendix are the results from a panel data regression on all the firms in our sample in one panel. The results are mostly consistent with the effects found for each individual sector (see Section V part F). The majority of the coefficients are, however, less significant than when the panel is divided. This is most likely due to the vast difference in exposure and hedging strategies between the two sectors.

Table C-I: Effect of Hedging on Currency Exposure (complete panel)

The table shows the results from regression equation (3) and (4) for all companies. The endogenous variables are the FX betas from equation (1) and (2) found for each year the companies have been listed. Hedging proxies are found from annual reports. The same models are run with and without individual dummies. Including individual dummies is equivalent to running a fixed effect panel data regression (Stock & Watson, 2007).

BETA FX *(w/o dummies)*

Index	Constant	FS/TS	FCD/TA	FD/TA	FCD/TS
FXI/KKI	-0.146	0.605	0.25	-1.13*	
(p-values)	*(0.662)*	*(0.203)*	*(0.553)*	*(0.073)*	
FXI/KKI	-0.118	0.605		-1.08*	-0.09
(p-values)	*(0.736)*	*(0.222)*		*(0.083)*	*(0.271)*

BETA FX *(w/individual dummies)*

Index	Constant	FS/TS	FCD/TA	FD/TA	FCD/TS
FXI/KKI	-0.916***	1.085	-0.46	-2.42***	
(p-values)	*(0.000)*	*(0.173)*	*(0.238)*	*(0.003)*	
FXI/KKI	-0.913***	1.041		-2.40***	-0.13
(p-values)	*(0.000)*	*(0.174)*		*(0.004)*	*(0.133)*

D. Revenue model regressions

Table D-I: Seafood sector revenue model regressions

Seafood Companies

Panel A	γ_1	γ_{FX}	n
Aker Seafoods	2.401	21.75**	33
(p-values)	*(0.687)*	*(0.019)*	
Austevoll Seafoods	123.59***	-48.1	25
(p-values)	*(0.005)*	*(0.456)*	
Cermaq	35.66*	-68.16**	33
(p-values)	*(0.078)*	*(0.026)*	
Codfarmers	-1.72***	-0.116	24
(p-values)	*(0.000)*	*(0.862)*	
Grieg Seafoods	11.65*	-21.54**	24
(p-values)	*(0.056)*	*(0.029)*	
Marine Harvest	32.26*	30.72	24
(p-values)	*(0.062)*	*(0.254)*	
Lerøy	73.47***	-36.65*	40
(p-values)	*(0.000)*	*(0.072)*	

Assessing the revenue model, we observe that results are quite significant regarding the salmon price exposure. All but one of the fish companies, Aker Seafoods, have significant price betas. Significance levels vary but are overall strong. We notice that Codfarmers shows a negative and significant beta value, elsewise all of companies have positive betas. This is as expected. The magnitude of the coefficients are vastly varying, however as absolute monetary values are used, magnitudes are difficult to analyze and compare without in-depth company analysis. Regarding the forex beta, we achieve four significant results of which three are negative, i.e. that revenue is positively correlated with appreciation in the NOK. Aker Seafoods stands out again, with a significantly positive beta. The number of observations is relatively similar in the sample and reaches from 24 to 40. Four of the forex exposure betas are significant from the sales regressions, three of them positive

Table D-II: OSV sector revenue model regression

OSV Companies

Panel A	γ_1	γ_{FX}	n
Bergen Group	-460	44.057**	16
(p-values)	*(0.695)*	*(0.035)*	
DOF	8193***	17.887**	40
(p-values)	*(0.006)*	*(0.011)*	
Eidesvik	-190	-0.687	27
(p-values)	*(0.809)*	*(0.749)*	
Farstad	2779**	-18.780***	40
(p-values)	*(0.030)*	*(0.004)*	
GC Rieber	1376**	7.131*	28
(p-values)	*(0.019)*	*(0.090)*	
Havila Offshore	2153*	3.671	27
(p-values)	*(0.060)*	*(0.375)*	
Solstad	3279**	-8.735	40
(p-values)	*(0.036)*	*(0.167)*	

E. Tests of Assumptions in the OLS

In order to ensure that the results from our regression using the Ordinary Least Squares (OLS) method are valid we test the basic assumptions. OxMetrics, the computer program used for the regressions, provide functionality for all tests. We focus the testing on the stock return model, as this is the main part of our analysis.

1. We control for linearity in parameters using the Ramsey Regression Equation Specification Error Test (RESET) (Ramsey, 1969). The null hypothesis of RESET is that non-linear combinations of the estimated variables do not help explain the endogenous variable in the model. OxMetrics include the result of the test along with other OLS results

2. Collinearity between independent variables is calculated by OxMetrics. Output of the resulting collinearity matrix is chosen in the model specification window. According to (Wooldridge, 2009), an independent variable should be dropped if the correlation with another variable is above 0.8. We follow this rule in our models.

3. We assume zero conditional mean without testing (Taylor, 2005)

4. OxMetrics uses the White test to establish whether the residual variance in the regression is constant (White, 1980). The null hypothesis is that the residuals are homoscedastic, i.e. constant variance.

5. The Bera-Jarque test (Jarque & Bera, 1987) is used to test for normality in the residuals. The null hypothesis is that residuals are normal.

6. Testing for serial correlation in the residuals is done by using the Portmanteau statistic (Ljung & Box, 1978) for 40 day lags. The null hypothesis is no autocorrelation in residuals.

The result of the RESET test varies between companies, from being significant at the 1% level to being insignificant. This result is surprising given that the factors in the stock return model we use are constructed for linear use. We believe that the specifications in the factor model are correct, and keep the original model. Previous research has, however, suggested that non-linear relationships exist in factor models (Allen, et al., 2009). For the tests of items 4-6 in the above list, the null hypothesis is rejected for some of the regressions. In particular is the normality condition for the residuals breached in most cases. This means that there is some uncertainty regarding the standard deviations in the regression results. As a consequence the t-statistics and significance levels might be biased. The reader should be aware of this weakness in our results.

F. Market Capitalization and Liquidity in the Sample Firms

Table F-I: Market capitalization development of seafood companies from the year of IPO

	Market Cap (Mean, million NOK)						
Year	**Aker Seafoods**	**Austevoll**	**Cermaq**	**Codfarmers**	**Grieg Seafood**	**Marine Harvest**	**Lerøy Seafood Group**
2011	655 012	6 554 502	7 368 603	341 887	1 430 280	15 884 581	7 005 048
2010	635 705	8 345 440	5 790 333	402 989	1 801 436	18 889 863	7 630 544
2009	499 503	5 102 535	3 702 873	1 351 322	1 096 821	12 179 630	4 774 645
2008	1 679 862	5 440 854	4 551 723	7 984 708	1 186 091	10 080 769	4 785 396
2007	2 906 317	10 165 547	8 697 137	14 296 233	2 255 613	22 423 670	6 691 349
2006	2 472 237	7 536 562	6 979 098	10 825 581		19 462 264	5 743 117
2005	2 618 043		4 437 674				2 632 563
2004							1 922 957
2003							1 281 262
2002							1 340 278

Table F-II: Market capitalization development of seafood companies from 1997

Market Cap (Mean, million NOK)							
Year	**Bergen Group**	**Dof**	**Eidesvik Offshore**	**Farstad Shipping**	**GC Rieber Shipping**	**Havila Shipping**	**Solstad Offshore**
2011	409 531	4 678 508	1 032 868	6 311 128	1 301 190	1 061 255	4 092 846
2010	500 748	4 711 983	1 019 764	5 902 250	1 340 134	1 348 620	4 371 401
2009	359 327	3 736 512	695 513	4 290 609	1 218 210	912 978	3 425 678
2008	907 833	5 345 043	1 009 724	4 824 300	1 627 836	1 660 116	4 338 575
2007	1 937 884	6 917 320	1 634 731	5 658 691	1 449 563	1 807 057	5 793 396
2006		5 612 341	1 588 643	4 509 334	959 846	1 127 594	4 384 287
2005		3 037 607	1 350 283	3 314 415	742 940	841 770	3 224 377
2004		1 914 566		2 578 937	749 887		2 193 142
2003		1 277 834		1 991 426	510 419		1 411 422
2002		1 006 939		1 689 398	538 167		1 459 665
2001		996 921		1 553 697	558 126		1 501 744
2000		862 845		1 248 186	484 536		1 253 520
1999		635 699		871 069	346 772		867 292
1998		931 481		1 220 420	433 525		1 235 678
1997		1 259 789		1 271 966			1 606 405

Figure F-I: Trading in OSV Companies

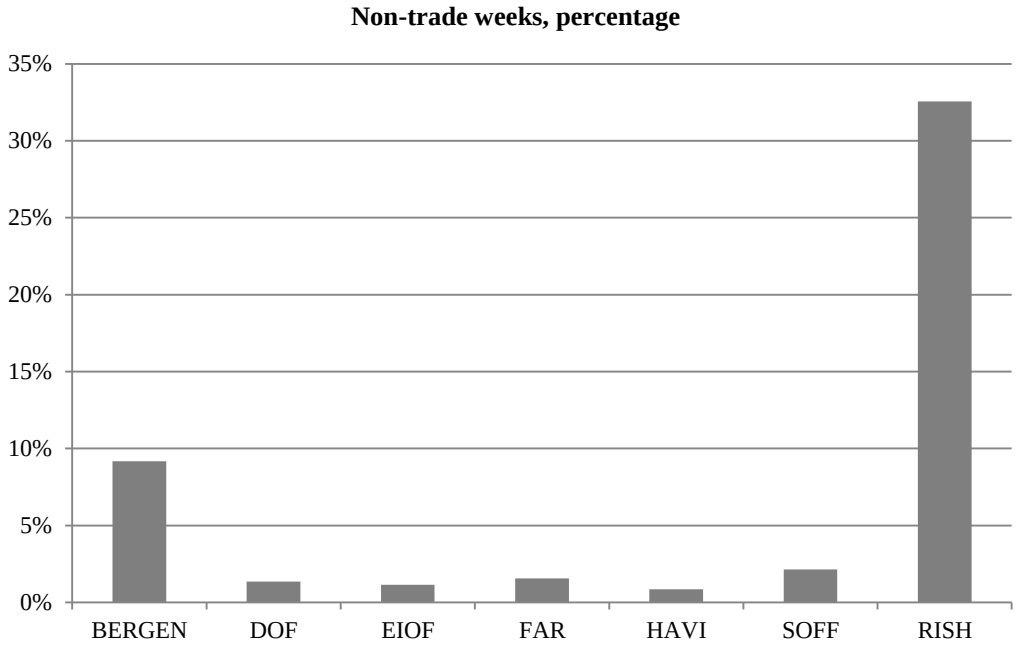
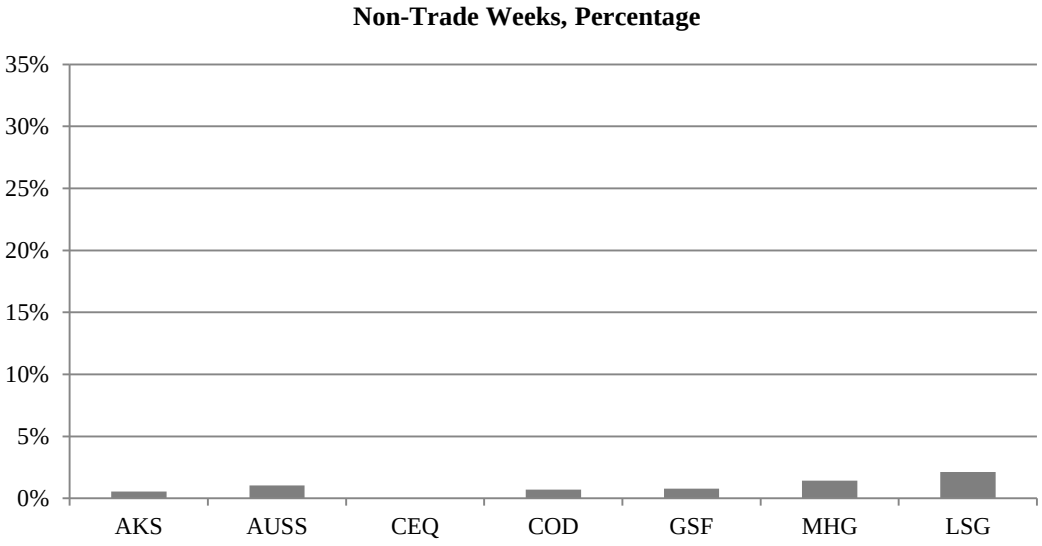


Figure F-II: Trading in Seafood Companies



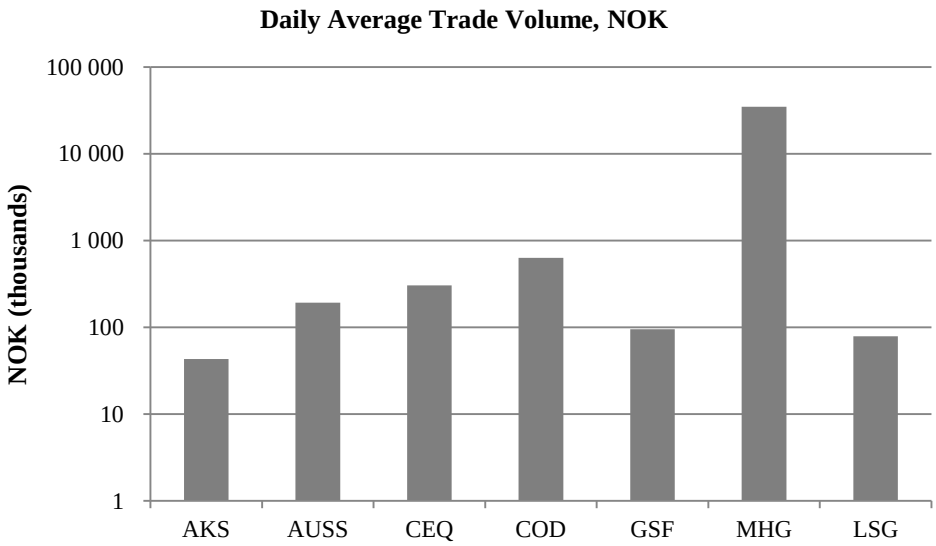


Figure F-III: Trading in Seafood Companies

The vertical axis is logarithmic due to high variation among the sample companies

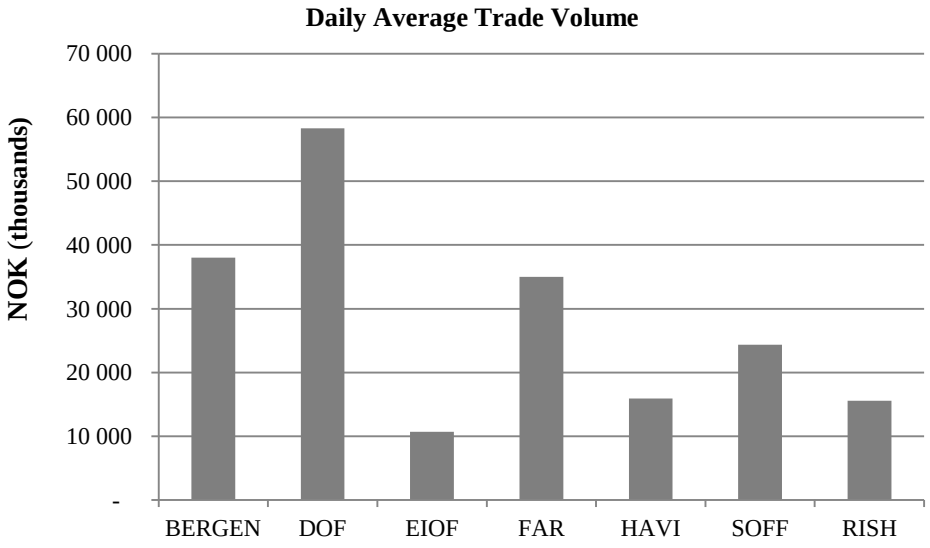


Figure F-IV: Trading in Seafood Companies