Currency hedging in the Norwegian seafood industry

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Preface

This master thesis represents the conclusion of our MSc-program in Business and Administration at the Faculty of Social Sciences, University of Stavanger Business School with a specialization in Applied Finance.

Working with this project has been tough and demanding. However, this process has been very rewarding and we have learned and gained experience about currency hedging and the seafood industry. We have also understood some of the complexities that one encounters when researching real world finance.

We would like to thank our supervisor Bård Misund for valuable guidance and advice throughout the work with our thesis.

Fredrik Helland

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Abstract

This paper examines the effect of currency hedging on the financial results, stock prices and firm value on ten seafood companies listed on the Oslo Stock Exchange. Running Monte Carlo simulations on a firm's financial result, we find no financial gains associated with hedging. However, we find evidence that hedging reduce the volatility of foreign revenue. Regressing stock returns as the dependent variable we find little evidence of that currency fluctuations and hedging activities have any significant effect on stock prices. Using Tobin's Q as a proxy for firm value we find a positive association with hedging, however we fail to confirm this effect using more advanced panel data techniques.

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1 Introduction

In 2015, the seafood industry reported record high exports of 72 billion NOK, where 58% consist of salmon. This is 8% of Norway's total export, which makes seafood an important industry for the Norwegian economy. This highly growing industry is competitive and very exposed to the international market. Annual reports reveal that most production is exported, which leaves the companies exposed to currency fluctuations. A key financial service for the seafood industry is derivatives. We find that the companies in the industry vary the usage, where forwards are commonly used and options barely used. In this competitive market, it can be crucial to be one step ahead of the competition. We believe that risk management can be the deciding factor to achieve profitability, and to gain a competitive edge. Both knowledge and rationality towards derivatives can be game changers, as derivatives directly affect operations and financial performance of a firm.

1.1 Background

One could say that every financial discussion starts with Modigliani and Miller (1958) theorem, "In a world with perfect capital markets risk management should be irrelevant." Naturally, many researchers disagree with this theorem, and argue that there exist frictions in the real world, which makes it inefficient. If there actually are frictions in the market, it can be beneficial to participate in risk management using derivatives. The functionality of derivatives is to control for risk, and a firm's risk can be located in contracts, deals, prices, currency, supply, or demand. Naturally, it is reasonable to think that risk management could be beneficial. There have been several research paper's that discuss risk management, Allayannis and Weston (2001) researched if currency hedging were value increasing for a firm. They found that firms using derivatives to cover currency exposure have 4.87% higher firm value. While Jin and Jorion (2006) examined the oil industry, and found that hedging weren`t value increasing. More industrial specific research in the Norwegian seafood industry is done by Asche and Misund (2015). They research the hedging efficiency of Atlantic salmon, and provide evidence that using futures available on Fish Pool, reduce the risk of farmed Atlantic salmon. Moreover there is limited research regarding currency hedging in the seafood industry, our contributions to the field is that we will try to investigate if currency hedging is beneficial for the Norwegian seafood industry.

1.2 Motivation and selection of thesis

Our motivation for the thesis was piqued by an interest in derivatives and we were inspired by the functionality of how derivatives can be used to eliminate and control for risk within a firm. What gained our main interest were variables that could affect revenue and costs within a firm. It was always clear that derivatives should be the topic to research. To select which market and the methodology to approach the thesis, we read several research papers. Two that inspired us were Allayannis and Weston (2001) and Jin and Jorion (2006). The first paper concerning currency hedging, while the other one, focused more on hedging effects within one particular industry. In our analysis, we implemented some of their methodology to build our thesis. Further, we were inspired by the much-depreciated NOK, our belief was that the depreciated NOK would be beneficial for Norwegian export companies. We also found it relevant to study the seafood industry, as this industry exports large amounts, internationally, with much uncertainty associated with currency risk. Therefore, our topic to research was "Does currency hedging increase firm value in the Norwegian seafood industry?"

1.3 Problem description

Our main problem to solve in this thesis:

"Does currency hedging increase firm value in the Norwegian seafood industry?"

We approach this problem by answering the following sub-questions:

1. How does hedging foreign revenue with currency forwards and options affect the result?
2. Are companies that hedge foreign exchange rates traded with a premium in the stock market?
3. Is hedging associated with higher firm value?

To approach this problem, we use a sample of 10 seafood companies, which represent the seafood industry listed on the Oslo Stock Exchange. We use annual reports to locate foreign revenue in order to calculate hedge percentage of exposure. Further, we use historical exchange rates, and stock prices to enlighten our problem. In order to investigate if currency hedging is value-increasing, we locate relevant financial data to isolate the effect of hedging.

1.4 Relevance of the study

The topic of risk management and firm effects, has been thoroughly examined in international studies. Most of the research has been on large samples of firms, few concerning industry specific effects of risk management. We therefore believe that a study of the Norwegian seafood industry is relevant for this research. The Norwegian economy is relative small, open, and dependent on export. We believe that the Seafood Company's current market position is unique, as large parts of the Norwegian economy have suffered huge losses the past year, especially the oil industry, where the oil price has been strongly decreasing, while the seafood industry consists of highly increasing stock prices, and a volatile exchange market. The exchange rates and commodity prices is also highly correlated with the stock market (Ødegaard, 2009). Which makes our research more relevant as we investigate the impact of currency hedging. Our focus on one industry also allows us to dig more into details, and develop a better data set to research the effect of currency hedging. According to Jin and Jorion (2006), however, samples within one industry alleviates the endogeneity problem and can be seen as an advantage.

1.5 Structure of thesis

The thesis consists of two main parts. The first section consist of chapter (2) Market presentation, (3) Literature review and (4) Theory section. These chapters are constructed to create the foundation of our thesis. In order to put our thesis in the present market context and to evaluate the necessity of the research problem, we have the market presentation. The literature review aims to set our research in the context of modern finance and discuss the relevance of our research problem. Lastly, the theory section is to develop an understanding of the basics. The second section of the thesis consists of the following methods and quantitative analysis:

1. Monte Carlo simulation

This simulation is to research the effect of currency exposure on a firm's financial result. We also explore the effects of hedging, with forwards and options, on the firm's financial result. The importance of this analysis relates to exploring the dynamics between a firm's revenue, its exposure, and its hedging policies. By researching this dynamic, we can explore the benefits and consequences of participating in hedging activities.

2. Regression series 1: "The sensitivity of stock returns to currency risk and hedging activities"

This is an exploratory series of regression to find the best fitting model to explain if hedging activities affects stock prices. The series starts to research the relationship between stock returns and currency returns (i.e., to map the exposure of the companies). By establishing the currency exposure of stock returns, we can find the connection between stock prices and hedging activities. Because stock prices reflect the market's assessment of a firm's approach to risk management, it is an important approach to explore the true value of hedging activities.

3. Regression series 2: "The relationship between firm value and hedging"

This is a series of regression, which attempts to find the relationship between hedging and firm value. By utilizing Tobin's Q as a proxy for value and the dependent variable, we explore factors that affect the value of the firm. Using this method, we can find and isolate the effect that hedging of currency risk has on firm value.

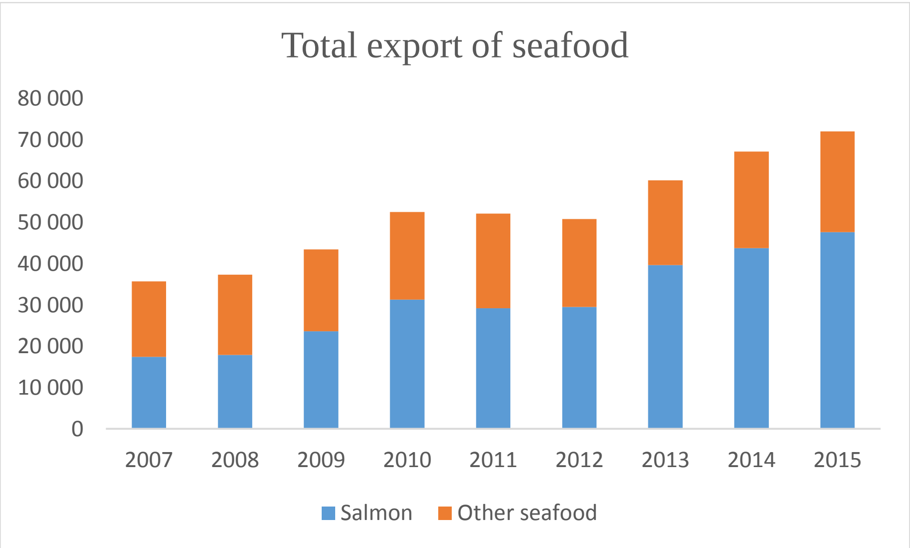
2 Market presentation

The purpose of this chapter is to establish context and relevance to our research problem. To accomplish this, we divide the chapters into three parts: Presentation of the seafood market, currency market in Norway and hedging in the seafood industry. Through the seafood and currency industry presentation, we aim to illustrate risk factors and the increasing complex environment corporate risk management operates in today. Hedging in the seafood industry refers to the results we have found through extensive reading of annual reports, concerning the hedging behavior firms incorporate today.

2.1 Seafood market

About 70% of the earth is covered by water, where we find many valuable resources like oil, gas and seafood. These three resources are crucial for the Norwegian export economy. We believe that seafood has been and will continue to be important for Norway's economy. The seafood market, in general, is sensitive towards interest rates, exchange rates, and commodity prices. The value of the Norwegian seafood industry's exports in 2015 was a record 72 billion NOK, which we find impressive, considering the export restriction with Russia in 2014. The industry exports all kinds of seafood. Salmon exports account for most of the exports. During the last decade, the annual turnover of seafood has doubled (Figure 2.1).

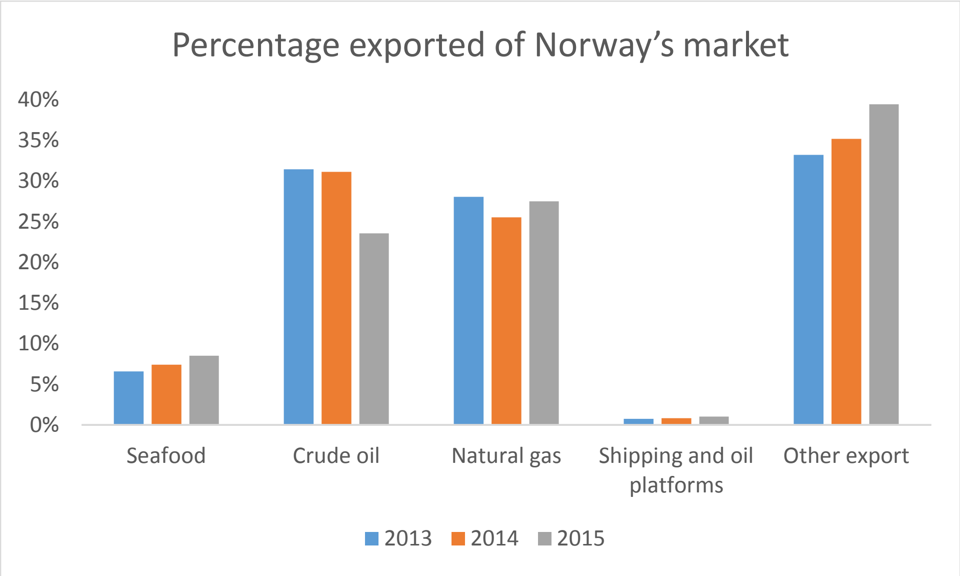
Figure 2.1 Export of seafood in period 2007–2015



Source: SSB (2015), values are in millions of NOK.

The seafood industry represents 8% of Norways total marketshare in exporting. It is the third largest export source, after crude oil and natural gas. During the period 2013–2015 seafood claimed a larger marketshare, from 7 to 8%, which could imply that the seafood industry is growing more than other export industries in the Norwegian economy are (Figure 2.2).

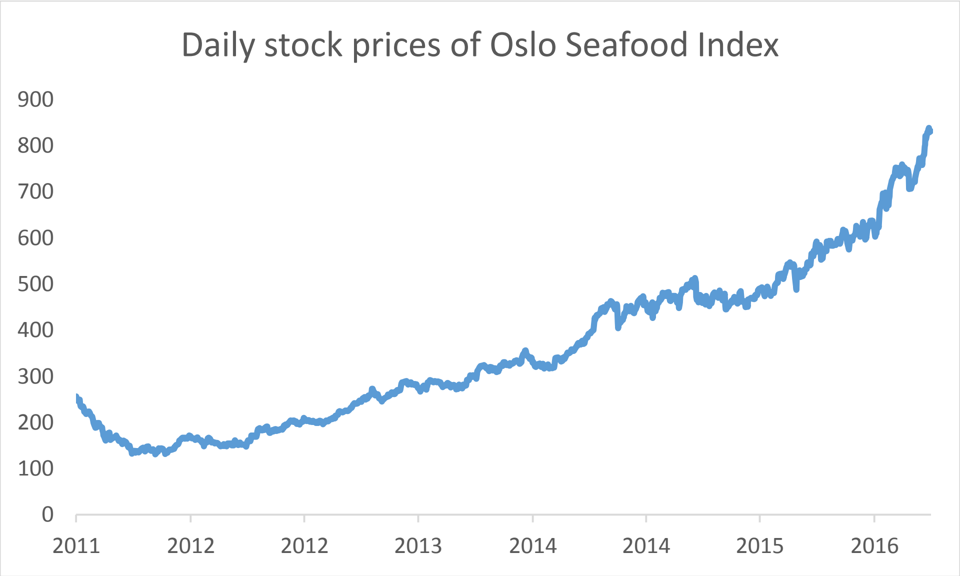
Figure 2.2 Percentage of the Norwegian export market in the period 2013–2015



Source: SSB (2015)

In our thesis, we analyze 10 seafood companies listed on the Oslo Stock Exchange. After 2012, average stock prices across the industry have been upward sloping. The average measure reveals that stock prices have been strongly increasing, from about 200 to 800 NOK for the period (Figure 2.3).

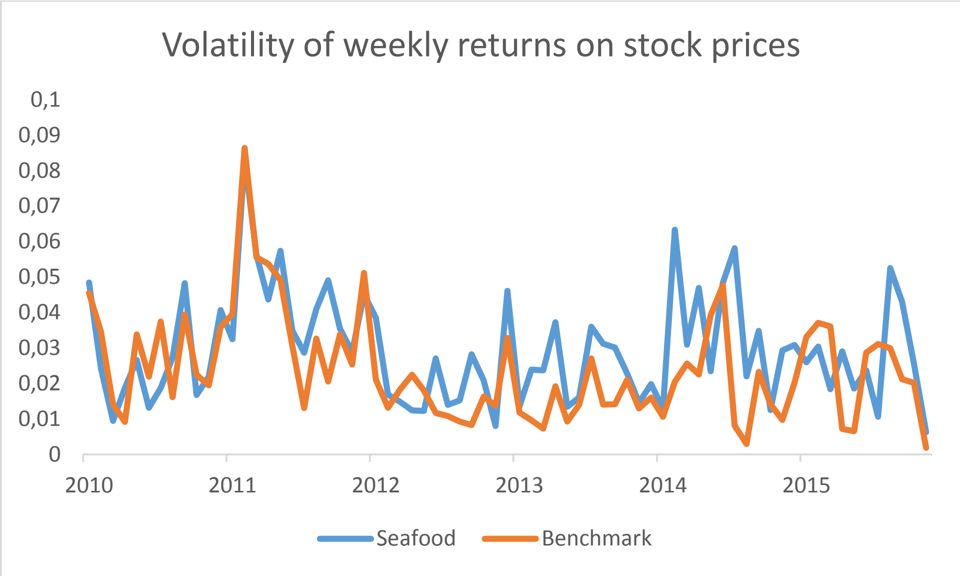
Figure 2.3 Daily stock prices of the Oslo Seafood Index



Source: Oslobors (2016); *Note*: The Oslo seafood index is composed of the following companies: Akva Group, Austevoll Seafood, Bakkafrost, Grieg Seafood, Havfisk, Hofseth Biocare, Lerøy Seafood Group, Marine Harvest, Norway Royal Salmon, SalMar, and The Scottish Salmon Company.

The industry has been very volatile the past years, especially since 2013. Seafood stocks have been more volatile than the benchmark of the Oslo Stock Exchange. During 2010 to 2012 seafood stocks volatility are close to equal to the benchmark. After this period the movements varies, and the past two years the seafood stocks seems to be more volatile (Figure 2.4).

Figure 2.4 Volatility of weekly stock prices, seafood vs. benchmark of the Oslo Stock Exchange



Source: Oslobors (2016)

2.1.1.1 Summary of the industry

The seafood industry is a growing market, with increasing market share of Norway's export industry, where salmon claims the higher market share. The stock prices have been highly increasing and volatile. The seafood industry faces many different risk factors, and we suspect a big source of risk stems from the export business and the associated foreign exchange risk. To investigate the area further we scrutinize the currency market, to see if we can find volatile exchange rates where seafood companies operate.

2.1.2 Currency market and the seafood industry

The seafood industry is highly exposed towards currency fluctuations. Currency exposure can directly affect a company`s operations. Especially if the currency market is volatile. The annual reports for each seafood company listed on the Oslo Stock Exchange contain information about the currency exposure. According to the annual reports, most of the companies are mainly exposed towards EUR, USD and GBP. Lerøy is one of the companies we analyzed, and is exposed towards several currencies. Where EUR is the main exposure (Table 2.1), Lerøy's currency exposure towards foreign revenue is 70%, if not controlled with derivatives, subsidiary companies, or currency accounts.

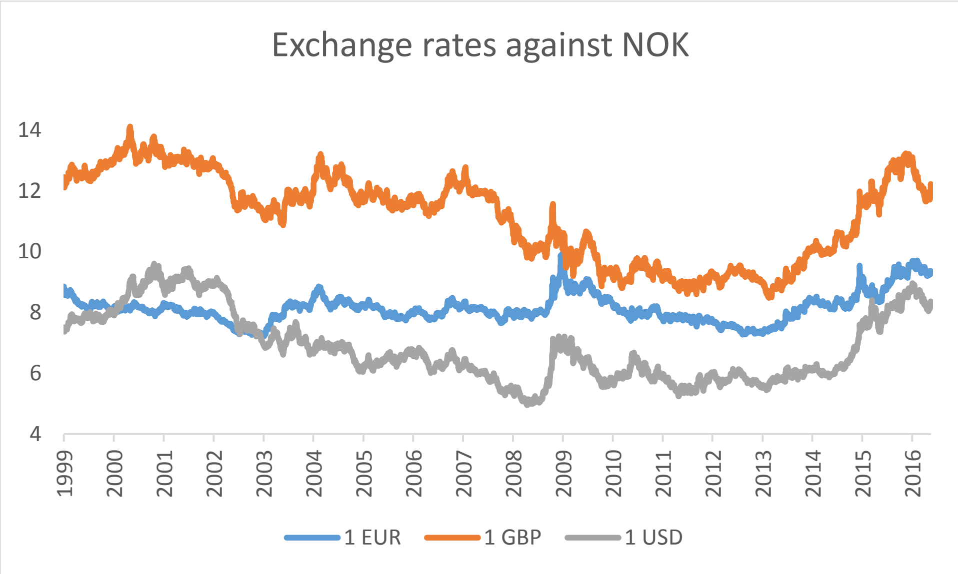
Table 2.1 Potential currency exposure of Lerøy's revenue

Lerøy Revenue	2015	Percentage
NOK	4 052 219	30 %
SEK	948 841	7 %
GBP	494 398	4 %
EUR	5 333 048	40 %
USD	1 890 953	14 %
JPY	553 957	4 %
Other currencies	177 309	1 %
Exposure	9 398 506	70 %
Total	13 450 725	

Source: Lerøy (2015) annual report

EUR, USD and GBP are the most exposed exchange rates in the seafood industry. These exchange rates have depreciated since 2013. Naturally, the seafood companies could benefit from the much-depreciated NOK. During 1999–2016, the exchange rates changes a lot, which imply a volatile exchange market (Figure 2.5).

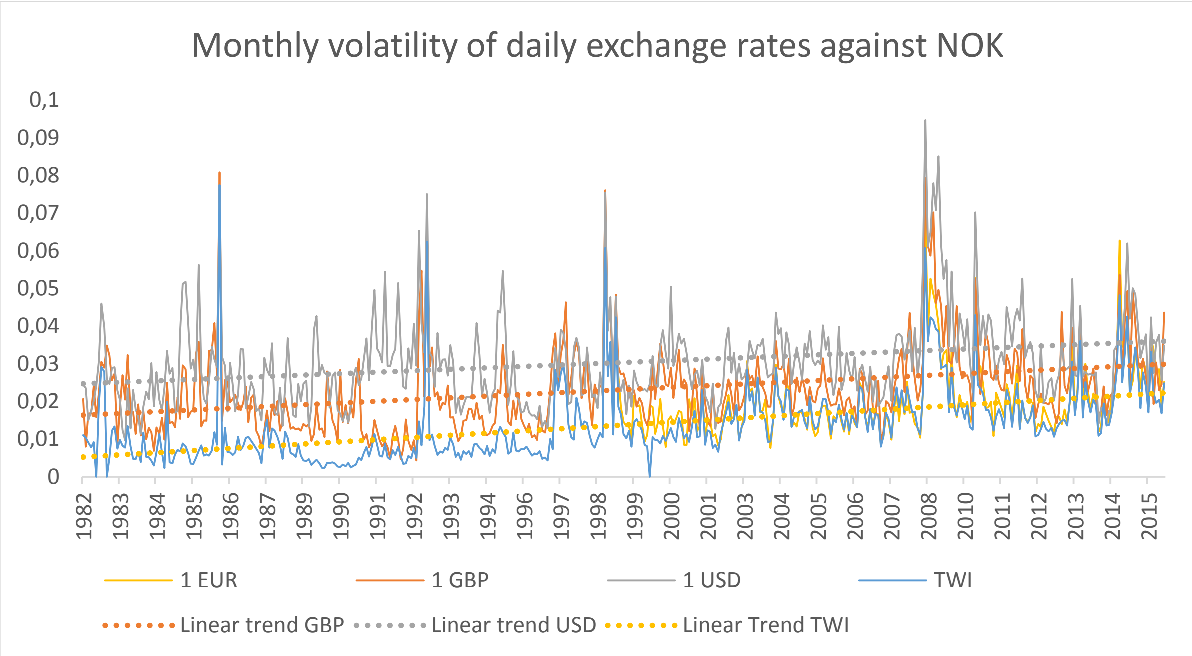
Figure 2.5 Relevant exchange rates for the seafood industry



Source: NorgesBank (2016)

To illustrate the volatile exchange market, we measured the volatility for the most relevant exchange rates and the Norwegian trade weighted index. A trend line for EUR is excluded, because EUR was introduced in 1999. We observe the exchange market as volatile, with several spikes since 1982. Some of these spikes are because of large financial events. In 1998, one of the spikes can be linked to the "dotcom bubble," and for 2008, fits in the period of the recent financial crisis. The trend lines for the given exchange rates are all clearly upward sloping, which implies an increasing volatility in the exchange market (Figure 2.6).

Figure 2.6 Monthly volatility of relevant exchange rates and TWI

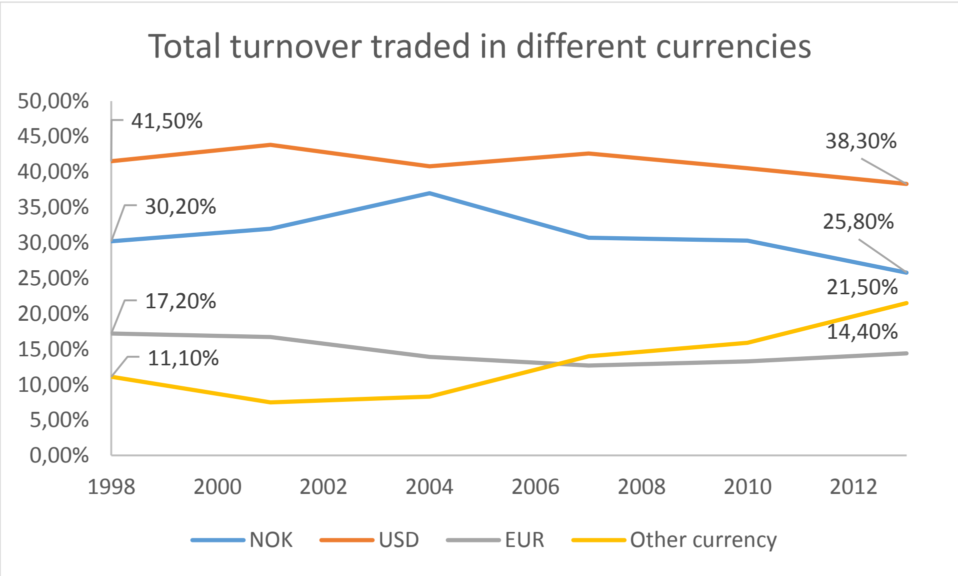


Source: NorgesBank (2016); exchange rates are calculated using daily data, using log transformation to calculate the monthly volatility.

To cover the trading activity of the Norwegian exchange market, we use the result of a survey analysis covered by NorgesBank (2013). This survey is executed every third year and claims to cover at least 90% of the Norwegian trading activity.

In the Norwegian exchange market, the USD and the EUR trade most often. In 2013, Norway traded more USD than EUR. We also observe an increasing trend in the trading activity of foreign currency, as the Norwegian Krona has been traded 30.2% of turnover in 1996 and decreased to 25.8% in 2013, while “other currencies” have been traded more, and an increase of 11.1%–21.5%. With an increase of the trading in foreign currency, the Norwegian economy is increasing in terms of exposure toward the exchange rates (Figure 2.7).

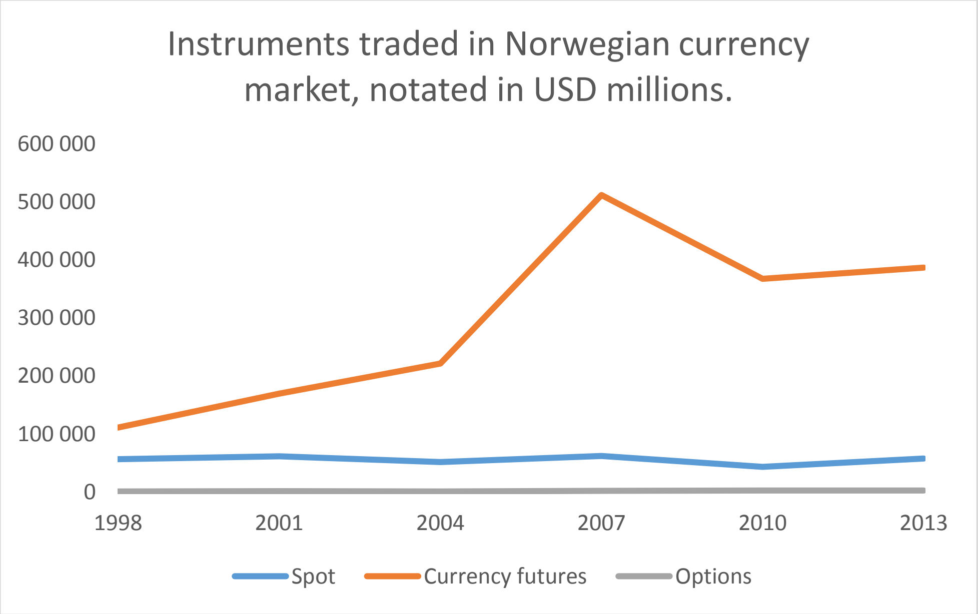
Figure 2.7 Total turnover traded in different currencies



Source: Norges Bank: Activity in the Norwegian exchange market

Usage of derivatives has been increasing from 1998 to 2007. Decreased from 2007 to 2010, we suspect it might reflect the financial crisis and the skepticism towards derivatives. After 2010, we have an increasing trend again. Since 1998 the instrument that is most traded is future contracts, option trading is uncommon and spot trading has remained constant (Figure 2.8).

Figure 2.8 Instruments traded in Norwegian currency market



Source: Norges Bank, trading activity in the Norwegian exchange market

2.2 Hedging in the seafood industry

The companies in the seafood industry have the opportunity to hedge currency exposure with derivatives, subsidiary companies, and currency accounts. The annual reports do not highlight which hedging strategy each company use to account for currency exposure. However, the usage of derivatives varies across the industry, and the skepticism towards options remains constant and barely utilized. While forward contracts are commonly used, we suspect that some of the firms use the "hedge-as-they-come approach." If a company has an incoming payment from the United States of three million in one year, they lock down the price with a short forward of three million, to immediately hedge all currency exposure for the given contract. Some might even use home currency as invoicing currency, to lock down the price, if the buyer of the products agrees. The buyer may see it as a disadvantage when invoicing currency could contain extra costs. We also see a trend of using subsidiary companies abroad, to obtain natural hedges. The annual report does not contain information about all incoming payments. Often, these payments are reported in a total for the year, with geographical divisions, where actual revenue traded in is not reported. Forward contracts information reveals the timeframe and the amount traded for the given contract. True exposure and hedged amount of the exposure will often be inaccurate to calculate.

3 Literature review

The purpose of this chapter is to present past research within the topic of risk management, which we find relevant for our thesis. We have divided the literature review into three segments, (1) identifying currency risk and exposure, (2) hedging incentives, and (3) value-increasing hedging. The purpose of this segmentation is to get a better overview of the research, where we present each part separately to gradually point out why it is relevant for our thesis.

3.1 Identifying currency risk and exposure

Knowledge of risk and exposure is important, in order to do a proper analysis of the subject of risk management. Ignorance of the basic theory might lead to inaccurate calculations and insignificant analysis when identifying the exposure of a firm. We find it essential to present some past research and acknowledgement of this field in order to understand risk management.

Adler and Dumas (1984) created a model that explains currency exposure as the sensitivity of the dollar value of the firm to changes in exchange rates. This paper discusses the complex statistical properties of exposure, and the difficulty of hedging true exposure due to this complexity. Further, they express clear definitions that currency risk is not the same as currency exposure. Jorion (1990) extended the research of Adler and Dumas (1984) and created a model that defined exposure as the sensitivity of stock returns to change in foreign exchange rates. Exposure was found correlated positively with the degree of foreign investment. Jorion identifies cross-sectional differences in the relationship between the value of U.S. multinationals and the exchange rate. Further Jorion (1991) examined the pricing of exchange rate risk in the U.S. stock market, using a two factor and a multi-factor arbitrage pricing model. The evidence proves that stock returns and dollar value differ systematically across the industry. Jorion concludes that currency risk is not priced in the stock market, and risk premium associated with foreign exchange, is never significant. On the other hand, Næs, Skjeltorp, and Ødegaard (2009) find that important currency pairs are highly correlated with the Norwegian stock market.

More recently Du, Ng, and Zhao (2013) expressed the importance of exposure in a research where they use quantile regression to test if currency exposure is significant. Using this technique, and controlling for time variation in exposure and missing variable bias, 26 out of

30 U.S. industry portfolios exhibit significant currency exposure towards the major currencies. Before controlling for these factors, only 5 out of 30 were significant. They suggest that these findings explain why prior research often finds currency exposure insignificant, and suggest that the quantile regression is an efficient way for a firm to locate currency exposure.

We find location of currency exposure highly relevant in order to research the effect of currency hedging. Research by Du et al. (2013) reveals the importance of approached methodology, where significance of exposure can highly increase by a change in technique and control variables. Not only methodology and understanding affect the research. In addition, the International Financial Reporting Standards (IFRS) had an effect on research quality. Before January 1, 1990, firms were not required to report information about derivatives use in their annual reports. Any prior researches that required detailed financial reporting of derivatives were based upon surveys. IFRS rules also regulate the possible extent of future research, as the availability of financial data seems only to grow.

3.2 Hedging incentives

Hedging behavior has been an important topic of discussion in modern finance. Research on hedging behavior enlightens why companies participate in risk management in the first place. Knowledge of such helps to clarify the rationale and functionality of a firm. Without the knowledge, it will be hard to conclude why a firm would participate in hedging activities in the first place.

Smith and Stulz (1985) analyzed hedging behavior of firms. They assume that firms are not risk averse. They conclude that firm's hedge for three reasons: (1) taxes (2) cost of financial distress, and (3) managerial risk aversion. Further, Perold and Schulman (1988) argue that exposure to currency risk should be viewed as an active decision, as it gains a lot of risk reduction. They state that it is hard to prove that currency hedging reduces long run expected return, as the costs for hedging appear to be minimal. Jorion (1988) also investigates the relation of risk management, by comparing the empirical distribution of returns in the stock market and the foreign exchange market, and provides evidence that exchange risk is diversifiable.

Géczy, Minton, and Schrand (1997) use a sample of 372 of Fortune's non-financial firms from 1990. They research the reasoning behind corporate participation in hedging behavior. They find a direct link between firms with high growth opportunities, and with tight financial constraints tend to hedge more with currency derivatives. They suggest that firms might use derivatives to reduce cash flow variation that might otherwise preclude firms from investing in valuable growth opportunities. While Børsum and Ødegaard (2005) research derivative usage in the Norwegian economy, and find that small firms use fewer derivatives than large ones do. The usage and strategies vary a lot in each firm, where companies that have exposed revenue tend to use more hedging strategies than those with exposed costs do.

Guay and Kothari (2003) research if financial derivatives are economically important component of corporate risk, where they use a sample of 234 large non-financial companies. The result suggests that the magnitude of derivative positions held by firms is economically small in the relation to their entity-level risk exposures. They assume firms perceive the benefits of their derivatives programs exceed the costs. A typical firm benefit from derivative is the underinvestment problem, Gay and Nam (1998) analyze this problem as a determinant of corporate hedging policy. Their findings support the argument "derivate usage may be used to avoid underinvestment problem." Arnold, Rathgeber, and Stöckl (2014) do not fully support Gay and Nam (1998) in this finding. They find weak evidence that both underinvestment and narrow financial constraints induces firms to hedge. On the other hand, they find evidence of financial distress to induce firms to hedge. They conduct a meta-statistical analysis on previous studies regarding corporate hedging behavior, by utilizing prior research on the subject.

Prior research reveals hedging incentives: financial distress, growth opportunities, avoiding underinvestment problems, etc. Most incentives are to advance a company's current market position. We find these incentives of interest, and a good understanding is important in order to investigate the area further.

3.3 Value of hedging

In the financial market, financial instruments enable a firm to hedge risky variables to remain in a more predictable market position. A company can select financial instruments that fit their view of the market or preferred risk aversion. Hedging has been widely discussed, whether it is value-increasing or not. Regarding all the hedging incentives (3.2), we find it interesting to explore if hedging actually is value increasing for a firm.

Allayannis and Weston (2001), Pramborg (2003), Hagelin (2003), Carter, Rogers, and Simkins (2006), and Bartram, Brown, and Conrad (2011) find support in their research that hedging adds value, while Jin and Jorion (2006) disagree and find that hedging has no effect on firm value. Jin and Jorion (2006) research the hedging activities of 119 U.S. oil and gas producers from 1998 to 2001. They test the difference in firm value of companies that hedge or not. They use Q ratios as a proxy for the market value, and research the hedging effect in one industry in order to get a clean test. Both Pramborg (2003) and Hagelin (2003) find support that hedging the transaction exposure is value-increasing, while hedging translation exposure is not. Allayannis and Weston (2001) examine the usage of FCDs in a sample of 720 large U.S. nonfinancial firms between 1990 and 1995. Their research reveals that firms who use derivatives to cover currency exposure have a 4.87% higher value than firms who do not. In other words, they find evidence that derivative use actually increases firm value. While Griffin and Stulz (2001) research does not support Allayannis and Weston (2001), when they research the effect of exchange rates in U.S. industry. They find that the exchange rate changes explain 1.5% of the variation in the average industry's excess return and 3.8% of the variation in the common industry's excess return. In addition, they conclude that the exchange rate nearly has a negligible effect on the value of industries worldwide.

Carter et al. (2006) find that hedging increases firm value and they researched fuel hedging in the airline industry for the period 1992–2003 in the United States. They find that hedging fuel firms trades at a premium of about 14%, after controlling for other factors that affect the value. Reduction of fuel prices' risk is statistically significant, which implies evidence in favor of hedging. Further, Bartram et al. (2011) examine the effect of derivative use on firm risk and value, where they use a sample of nonfinancial firms from 47 countries. The result of the analysis proves that both systematic and unsystematic risk are reduced by the usage of derivatives, and derivatives increase firm value, but the firm value effect is not significant, because the analysis includes omitted variable bias, and endogeneity problems.

3.4 Literature summary and implications to our thesis

The literature review represents the foundation of which this thesis is built upon. Section 3.1 consists of research of general currency theory, which has enabled us to create an understanding of the nuances that are involved when working with currency. This section also presents Jorion (1990), which is the basis of our research when exploring the effects of currency risk and hedging on stock prices.

Section 3.2 presents research concerning corporate hedging incentives and determinants. This research has helped us create an understanding of hedging polices and activities within firms. As we study the value effects of hedging, it is essential to have an understanding of why firms participate in hedging activities. This research creates a framework, of which we can discuss the results and hedging coefficients of our regression analysis.

Section 3.3 refers to research concerning hedging and firm value, and represents the basis of what our thesis builds upon. Our main sources of inspiration stems the research of Allayannis and Weston (2001) who examine the effect of currency hedging on firm value, and Jin and Jorion (2006) whom focuses on firm value and hedging within one industry. We have used Allayannis and Weston's approach to measuring hedging effects on Tobin's Q as a proxy for firm value, using panel data regression techniques. The usage of hedging effects on stock prices and some control variables are built on the work of Jin and Jorion (2006).

From the research findings of section 3.3 it seems that there exists industry specific effects concerning value of hedging activities, which the more "broad" papers seems not to catch. A consequence of this, is that in order to find the true effect of hedging one must look at industry specific studies. Such an industry specific study of the seafood industry would be very interesting and valuable for any operators within this industry and to our knowledge; there exists little research concerning the effects of currency hedging on seafood companies.

To conclude; our contribution to the field of hedging and firm value is an industry specific study of the Norwegian seafood industry, where we explore the effects of currency hedging on the financial result, stock price and firm value.

4 Theory section

The purpose of this chapter is to present the theory the thesis builds upon. Here we will present definitions and important implications of theory that represent the foundation for our approach to explore our research problem. The following theory is presented: Currency exposure, risk, general hedging theory, hedging strategies, Black and Scholes, and Tobin's Q.

4.1 Currency

The purpose of the following section is to present the background of currency risk, currency exposure and firm value. We find it necessary to present the risk theorem in order to develop an understanding of risk management. To hedge in the first place, one simply needs to know what risk is.

4.1.1 Currency exposure

According to Adler and Dumas (1984), exposure for a firm should be defined in terms of what the firm has at risk. Exposure exists within all operations of the firm that is sensitive to changes in foreign currency. Jorion (1990) argues that foreign currency can be divided into two parts: the value of net monetary assets with fixed nominal payoffs and the total value of assets held by the firm. These assets contain full exposure in currency, unlike monetary assets. Jorion (1990) expresses this term of exposure as translation exposure. Second, there is "transaction exposure," which is currency exposure against foreign financial contractual obligations.

4.1.2 Currency risk

Adler and Dumas (1984) express in the paper that currency risk is not the same as exposure. They define it as: "Currency risk is to be identified with statistical quantities which summarize the probability that the actual domestic purchasing power of home or foreign currency on a given future date, will differ from its originally anticipated value." In light of this definition, one could express currency risk with a sensitivity analysis towards a company's currency exposure in revenue. To create link between currency exposure and currency risk, currency exposure is how much the firm value will change, as a factor of the currency risk, which is the risk that currency rates might change.

4.1.3 Currency and firm value

Currency risk is a complex concept as it contributes to systematic risk and idiosyncratic risk to the firm. Systematic risk in the form of varying with macroeconomics of its country, and fluctuations has a broad “striking” effect. It is idiosyncratic in the form that it can diversified by investors. If currency risk is idiosyncratic, the use of forward contracts will not add value to shareholders of the firm. However according to CAPM the only risk that is important for the valuation of the company is the covariance between the company’s cash flow and the market. So if the currency risk affects this covariance, it will affect the Beta of the firm and thereby have a direct influence on the valuation of the firm (Børsum & Ødegaard, 2005).

The connection between firm value, currency risk and exposure can be written as:

$$Change\ in\ Firm\ Value = Exposure * Change\ in\ Currency \tag{1}$$

This relationship between firm value, exposure and currency risk enables us to estimate currency exposure as the beta coefficient of change in currency.

4.2 Hedging

Generally, hedging is designed to cover against potential losses. For a regular person, hedging can be associated with insurance coverage. If a person lives in an area that is highly exposed towards tornados, he could cover the risks by insuring his house and belongings, then be priced after the outcome of the tornado. However, in the financial world, hedging risk is much more complicated, and one can cover risk by using financial instruments. To mention some, a company can use options, forward contracts, and futures. To locate the risk exposure is also challenging, as nearly every single operation within the company contains some kind of risk. There can even be a third party, like the investors that wants a say in the selected strategy, as many investors may already be diversified in several projects.

4.2.1 Motives of hedging

The motivation for firms to participate in hedging activities has been discussed in several research papers, especially in the subject of "hedging behavior." In this section, we will enlighten some past scientific findings around the subject, in order to generate an understanding of the hedging incentives. We find it necessary to understand the incentives in order to research the effect of hedging.

Most hedging approaches come with a premium cost, where one pays a certain price to develop a more predictable position. Companies have many different incentives to hedge exposure. Our understanding is that hedging can reduce eventual risk factors of a firm. Following is motives that can be included in the decision of engaging in risk management with derivatives.

4.2.1.1 Taxes

Smith and Stulz (1985) discuss tax as a hedging incentive; they state that participating in risk management can be advantageous in terms of tax reduction. This will only be beneficial if the tax function is convex, suggesting that tax rate rises if income increase, and the cost of hedging must not exceed the tax cost. Hedging the variability of the taxable income, the firm can also take advantage of tax preference items (i.e. tax loss carryforwards) and lower the probability that firms pay higher tax rates due to the convex tax function.

4.2.1.2 Transaction cost, financial distress and costly external financing

Nance, Smith, and Smithson (1993) argues that hedging can reduce the firm's probability of financial distress. One can argue that large losses can cause bankruptcy for some firms, as it can lead to costly external financing. If that is the case, a potential loss of 10 million, can be more costly than a profit of 10 million. The loss of 10 million can require more debt, which contains the cost of interest, or it can require external financing, like cash and equivalent, that makes the company less liquid.

4.2.1.3 Debt capacity

According to Perold and Schulman (1988), hedging is risk reducing. If so, hedging can also attract investors and bondholders to the firm. By reduction of default risk, it may increase the willingness of bondholders to lend money to the firm.

4.2.1.4 Underinvestment problem

Gay and Nam (1998) defines the underinvestment problem as, "underinvestment problem results when firms find that external financing is sufficiently expensive that they must reduce investment spending during times when internally generated cash flows are not sufficient to finance growth opportunities." Hedging cash flow variation might reduce probability that internal cash flows are not sufficient to cover investment. Gay and Nam (1998) find that firms with many positive high growth NPV projects and tight financial constraints tend to hedge more.

4.2.1.5 Agency problems and information asymmetry

Arnold et al. (2014) discuss the agency problems. These problems stem from the conflict of interest between shareholders and managers of the company. The shareholder expects the manager to work according to shareholder maximization principles, while in reality the manager might work in self-interest. This is because the manager has other sources of risk within the company. The manager is risk-averse and, if not compensated for this risk, he might participate in hedging activities to reduce this risk. There are two sides of this argument; the hedging activities might reduce the exposure to a specified industry the shareholder is looking for i.e. decrease value for shareholders, or it can increase value of the firm, as the added security acts as compensation for the managers. A consequence of the information asymmetry in the market is that shareholders cannot replicate the hedging activities of the managers. Managers have better information about firm operations than the shareholders have, and can hedge risk more efficiently than the shareholders can.

We observe that there are many incentives to hedge. The companies hedge for several reasons and we believe that most incentives are in order to obtain a better market position, or even a necessity for some of the companies' survival.

4.3 Financial instruments

In the financial market, there are several financial instruments usable to manage risk. Our focus of the available instruments are forward contracts and options. The reasoning behind this selection comes from the Norwegian seafood industry, where usage of forwards is common, while options are uncommon. We will represent these two derivatives in the following section, to generate a better understanding of the functionality, in order to precede further investigation of the usage and potential benefit gained from derivatives.

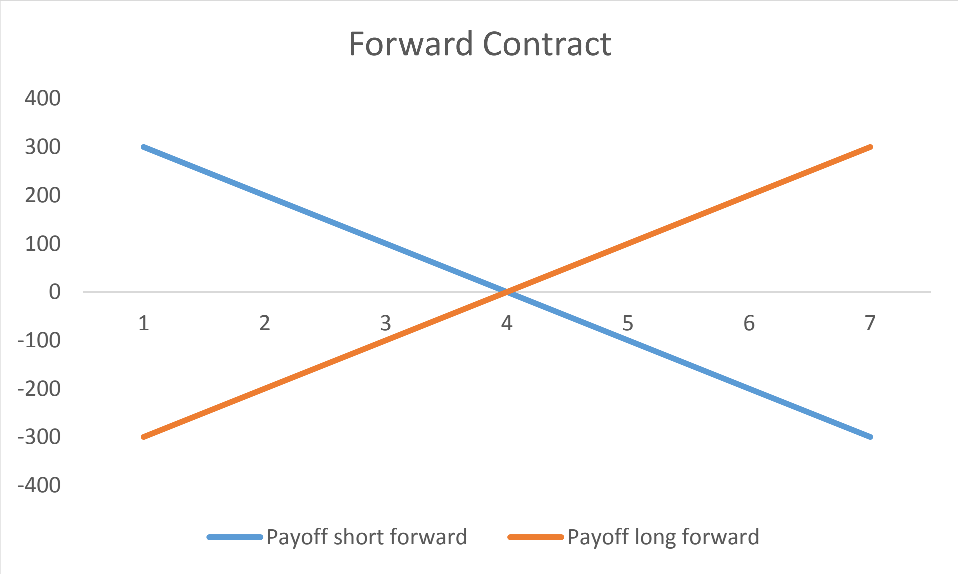
4.3.1 Forward contract

Hull (2012) define forward contract: "an agreement to buy or sell an asset at a certain future time for a certain price." There are two types of forward contracts, short and long. These contracts differ in terms of the selected hedge rate, where one has the choice to hedge after the spot, or future rate. The purposes of forward contracts are normally to reduce risk. It is important to establish its exposure in the market, in order to reduce risk. If the company is naturally long, that is incoming payments; short forward contracts would reduce the risk. If the company is naturally short, that is incoming expenses; a long forward would be fitting (Figure 4.1). Forward contracts offer the opportunity to hedge risky variables. Investors can use these contracts to lock down unsecure investments to get a predictable outcome. It can also backfire if an investor uses a short forward, the spot rate exceeds the future rate, and the payoff function will become negative (2) and (3) express this relation.

$$\textit{Payoff long forward} = \textit{Spot price} - \textit{Forward price} \tag{2}$$

$$\textit{Payoff short forward} = \textit{Forward price} - \textit{Spot price} \tag{3}$$

Figure 4.1 Forward contract



4.3.2 Options

There are many different types of options available in the market. Two common types are European and American options. They differ in terms of maturity; European options will only be exercised at maturity, while the American options can be exercised any time between purchase and maturity. The purpose of options is to hedge against market movements. Investors can protect themselves by using either put or call options. Options are defined as: "An option gives the holder the right, but not the obligation to buy or sell the underlying asset at a certain date for a certain price." Options are priced after how volatile the market is, if the market increases in volatility, it is likely that an option strategy will trade at a premium.

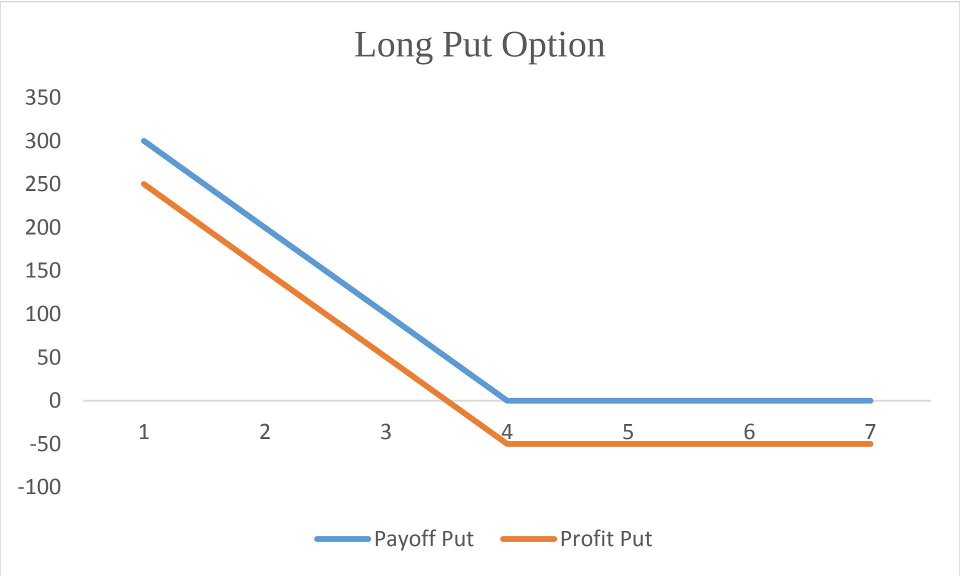
4.3.2.1 Put Options

Put options are appropriate when selling assets, it protects investor from potential decline in prices. Put options will trade at a premium if the price of an asset declines and is defined as “A put option owner has the right to sell an asset at a certain price, and receive a limited downside, which is decided by the cost of premium. “ There are two types of put options, short and long. The short put option is an opposition of the long put option, expressed in (4) and (5). The functionality of long put option is illustrated in Figure 4.2, where the option differ in terms of profit and payoff.

$$\textit{Payoff long put option} = \textit{Max(Forward price} - \textit{Spot price;0)} \tag{4}$$

$$\textit{Payoff short put option} = -\textit{Max(Forward price} - \textit{Spot price;0)} \tag{5}$$

Figure 4.2 Long put option, potential profit and payoff



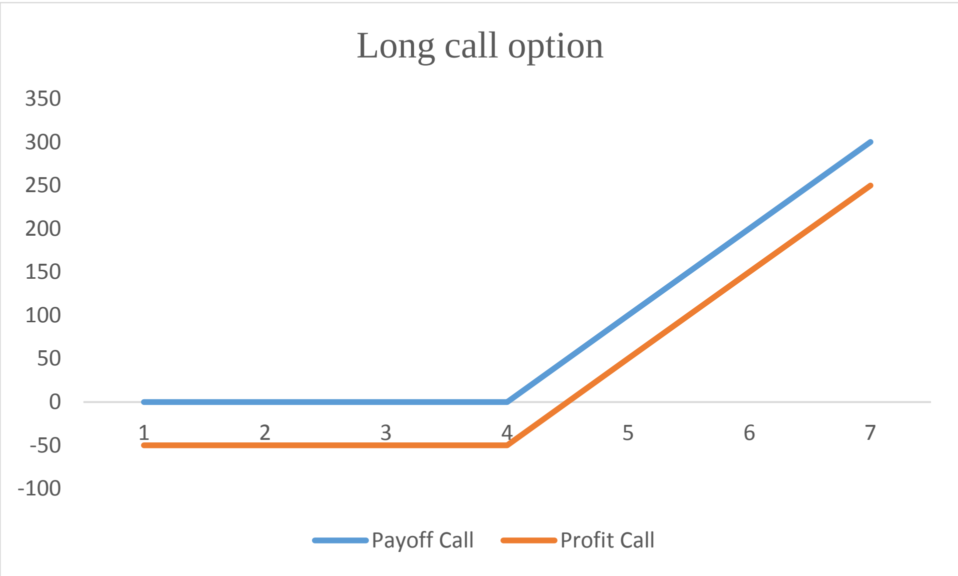
4.3.2.2 Call Options

Call options are appropriate when purchasing an asset; it protects investors from potential increases in prices. Call options will trade at a premium if the price of an asset increase and is defined as “A call option owner has the right to by an asset at a certain price, and receive an unlimited upside.” There are two types of call options, short and long (6) (7). Where the long call option is an opposition of the short. The functionality of long call option is illustrated in Figure 4.3, where the option differ in terms of profit and payoff.

$$\textit{Payoff long call option} = \textit{Max(Spot price} - \textit{Forward price;0)} \qquad (6)$$

$$\textit{Payoff short call option} = -\textit{Max(Spot price} - \textit{Forward price;0)} \qquad (7)$$

Figure 4.3 Long call option, potential profit, and payoff



4.3.3 Difference between forwards and options

A forward contract is designed to neutralize the risk by fixing the price, while options are designed to protect investors of adverse price movements, where one can either protect the investment for an increase in price or decrease.

4.4 Black and Scholes

Garman and Kohlhagen (1983) developed an extended version of the Black and Scholes model that is used to value currency options. We present the formulas and assumptions of this model in order to understand its functionality.

The assumptions for the option-pricing model:

- Geometric Brownian motion governs the currency spot price: i.e., the differential representation of spot price movements is $dS_t = \mu S_t dt + \sigma dW_t$, where W_t is the standard wiener process.
- Option prices are a function of only one stochastic variable, namely S_t.
- Markets are frictionless.
- Interest rates, both in domestic and foreign markets, are constant.

The extended formula:

$$P = Ke^{-rT}N(-d_2) - S_0 e^{-rfT}N(-d1) \tag{8}$$

$$d_1 = \frac{ln\left(\frac{S_0}{K}\right) + \left(r - r_f + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} \tag{9}$$

$$d_2 = d_1 - \sigma\sqrt{T} \tag{10}$$

Where P is the price of a call option, Kstrike price, S_0spot price, r domestic interest rate, r_f foreign, where both have T time to maturity. The option premiums are sensitive to volatility, interest rate and spot/strike prices.

Usage of formula (8), (9), and (10) enables us to price currency options in the seafood sector, in order to investigate if currency options trades at a premium.

4.5 Tobin's Q and replacement costs of capital

Tobin's Q is a measure of value of firm company that James Tobin developed in 1969. It is an attempt to make a measurement of value, free from financial measurement errors and account manipulations. The ratio is defined as the relationship between the market value of the company, and the replacement value of its assets. It is presented as the following equation:

$$Tobin's\ Q = \frac{Equity\ market\ value + Liabilities\ book\ value}{Equity\ book\ value + Liabilites\ book\ value} \tag{11}$$

The calculation for this equation is complex, but one can get a good approximation by doing some simplifying assumptions. Assuming the market value of liabilities equals book value, the Q ratio would be Enterprise value over book value of assets:

$$Tobin's\ Q \approx \frac{Enterprise\ value}{Book\ value\ of\ assets} \tag{12}$$

The Q ratio is unit-less and comparable across firms. A higher Q ratio indicates higher value of a firm. A Q over one indicates the firm is overvalued, as the firm is priced higher than its replacement cost of capital. Tobin's Q allows us to compare firms across the industry. The functionality of this measure enables us to use Tobin's Q as a pooled dependent variable in the regression analysis.

5 Monte Carlo simulation

The purpose of the simulation is to research the effect that short forwards and put options have on a company's results. During our research of the seafood industry, we discovered that company's hedge exposure differently. The usage of forward contracts varies and options are barely used in the seafood industry. These findings were made in the annual reports and it made us question the reasoning and rationale behind the firm's policy of hedging currency risk. Therefore, we decided to simulate Lerøy's actual exposure attached to revenue, to try to answer this question. In the simulation, we control for short forwards and put options, to cover the naturally long position in revenue.

The simulation is executed in excel, using the program @risk. Exposure, cost and revenue are collected from Lerøy (2015) annual report. We use 5000 iterations, which result in 5000 random outcomes.

5.1 Part 1. Descriptive data for the calculation divided into tables

Table 5.1 Descriptive data of Lerøy's result

	Revenue (NOK)	Exchange rate	Revenue Currency	Standard Deviation	Mean of distribution
NOK	2 115 685	1	2 115 685		
SEK	1 457 179	0,9571	1 522 494	0,0398	0,957
GBP	431 757	12,3415	34 984	1,2370	12,342
EUR	4 413 122	8,953	492 921	0,4440	8,953
USD	934 190	8,074	115 703	0,7175	8,074
JPY	451 490	0,0667	6 768 966	0,0078	0,067
Other currency	2 776 042	1	2 776 042		
Revenue Total	12 579 465				
Cost (-)	10 790 789				
Result	1 788 676				

Table 5.1 illustrates the actual revenue and exposure of Lerøy. Their main currency exposure is traded in SEK, GBP, EUR, USD, and JPY, these exchange rates are set as input variables, and varies throughout the simulation. NOK is constant and "other currency" is held fixed because of inaccuracy. Cost is also held fixed, as we are interested in the exposure attached to revenue. The standard deviations are calculated based on historical data, for a 1-year average

exchange rate for the past 10 years. The input variables are lognormal distributed, as we find it the best fit for exchange rates.

Table 5.2 Correlation matrix for exchange rates

@RISK Correlati	SEK / Exchange	GBP / Exchange	EUR / Exchange	USD / Exchange	JPY / Exchange
SEK / Exchange	1				
GBP / Exchange	0,48	1			
EUR / Exchange	0,35	0,55	1		
USD / Exchange	0,69	0,67	0,75	1	
JPY / Exchange	-0,10	-0,57	-0,09	0,12	1

Table 5.2 illustrates the correlation for the different exchange rates. The correlation matrix control for correlation effects, and are implemented in the simulation of the exchange rates (Table 5.1). The matrix reveals that the exchange rates are highly correlated towards the Norwegian Krona.

Table 5.3 Descriptive data of short forward contract and put option

Forward contract	SEK	GBP	EUR	USD	JPY
Forward price	0,957	12,342	8,953	8,074	0,067
Spot Price	0,957	12,342	8,953	8,074	0,067
Forward -Spot	0	0	0	0	0
Foreign revenue	1 522 494	34 984	492 921	115 703	6 768 966
Payoff Short Forward	0	0	0	0	0
Total payoff	0				
Put payoff	0	0	0	0	0
Total payoff	0				
Put Cost	36 058	17 671	131 847	45 202	27 404
Put Profit	-258 182				
Put Result	1 530 494				

Table 5.3 illustrates that the same forward rates are used for short forwards and put options. The forward rate is set equal to the spot rate. The reasoning behind it is to get a fair variety for the exchange rate. Otherwise, the exchange rate could have been affected by the much depreciated NOK the past years. The costs of forward contract are assumed to be 0.

Table 5.4 Descriptive data of Black and Scholes variables

Input data		SEK		GBP		EURO		USD		JPY
St	NOK	0,96	NOK	12,34	NOK	8,95	NOK	8,07	NOK	0,07
Xt	NOK	0,96	NOK	12,34	NOK	8,95	NOK	8,07	NOK	0,07
Duration		1		1		1		1		1
Interest rate		0,75 %		0,75 %		0,75 %		0,75 %		0,75 %
Foreign interest rate		-0,50 %		0,50 %		0,00 %		-0,10 %		0,00 %
Implied volatility (stdev)		7,68 %		10,64 %		8,43 %		13,22 %		16,21 %
Put price	NOK	0,02	NOK	0,51	NOK	0,27	NOK	0,39	NOK	0,004

Quantities used in Black-Scholes formula					
d1	0,2012	0,0767	0,1311	0,1304	0,1273
d2	0,1244	-0,0297	0,0469	-0,0018	-0,0348
N(d1)	0,5797	0,5306	0,5522	0,5519	0,5507
N(d2)	0,5495	0,4882	0,5187	0,4993	0,4861
N(-d1)	0,4203	0,4694	0,4478	0,4481	0,4493
N(-d2)	0,4505	0,5118	0,4813	0,5007	0,5139

Table 5.4 illustrates the variables used in pricing the put options for each currency. The calculation is executed using Garman and Kohlhagen (1983) Black and Scholes. All the variables are held fixed, and the interest rates are collected form GlobalRates (2016). The standard deviation are calculated using log-transformed daily data on historical exchange rate the past 8 years, collected from NorgesBank (2016). The duration of the put options is set to one year, and the prices are given in NOK. For example, the price for a put option for USD with maturity in one year is 0.39 NOK.

Part 2. Result and discussion of the simulation.

Figure 5.1 Potential exposure of Lerøy's result

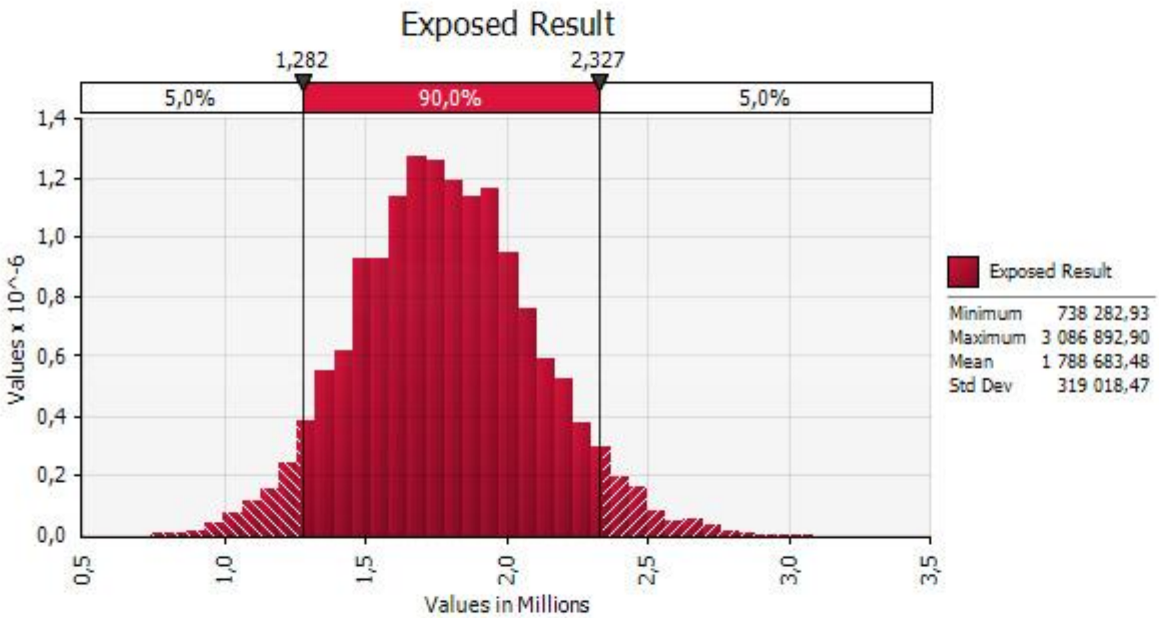


Figure 5.1 illustrates the possible outcomes of Lerøy's result if not controlled for with derivatives. A result in the range of 1.282 to 2.327 million, have a 90% probability to occur. The result can even range from 0.7 to 3 million. The normal distribution for potential exposure reveals that the result actually is very volatile, and can vary from 0.738 to 1.788 million.

Figure 5.2 Tornado graph

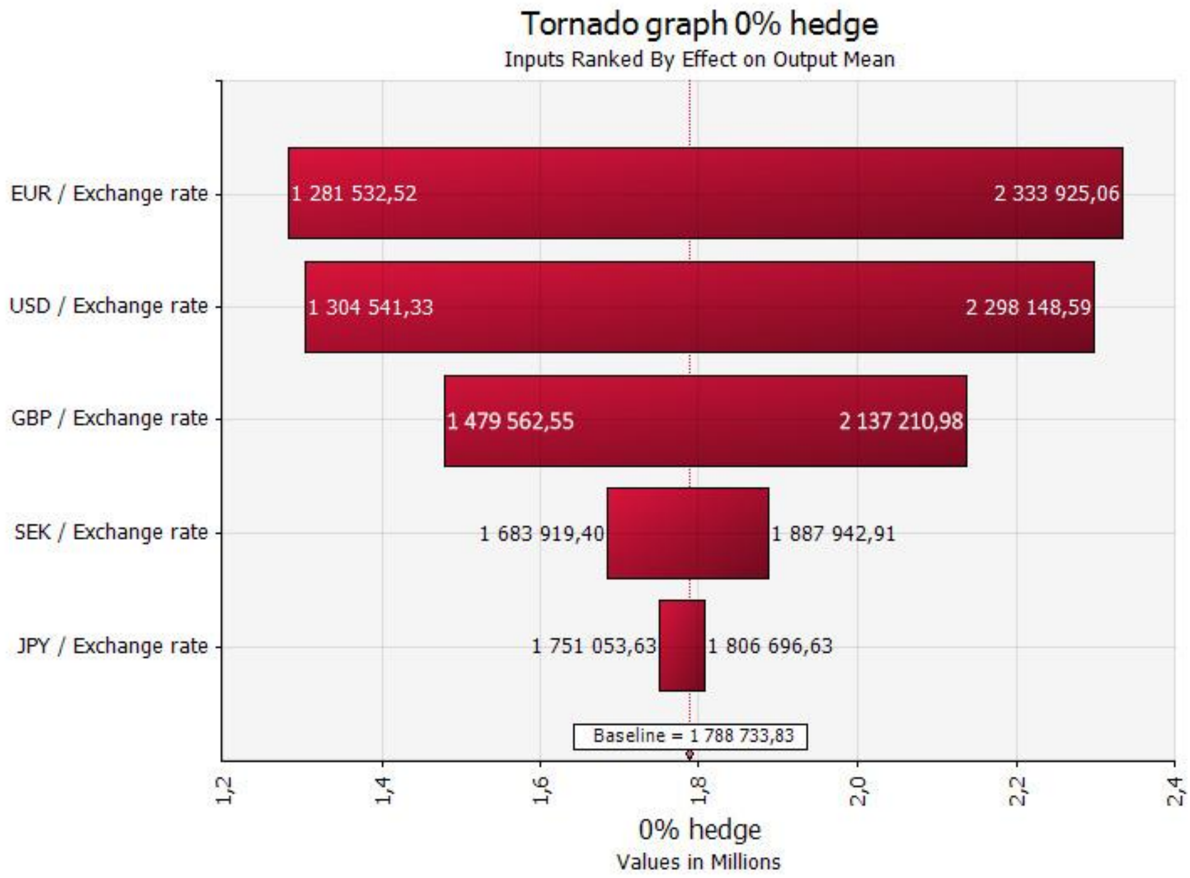


Figure 5.2 illustrates a tornado graph that functions as a sensitive analysis. It shows what effect each exchange rate could have on Lerøy's result, where only the EUR itself can vary the result from 1.28 to 2.33 million. We observe that the largest currency risk in Lerøy's revenue consists of three main exchange rates: EUR, USD, and GBP. To develop a predictable result these exchange rates must be controlled for. The baseline is the output mean of 1.788million, that is Lerøy's revenue of 2015.

Figure 5.3 Hedging overview

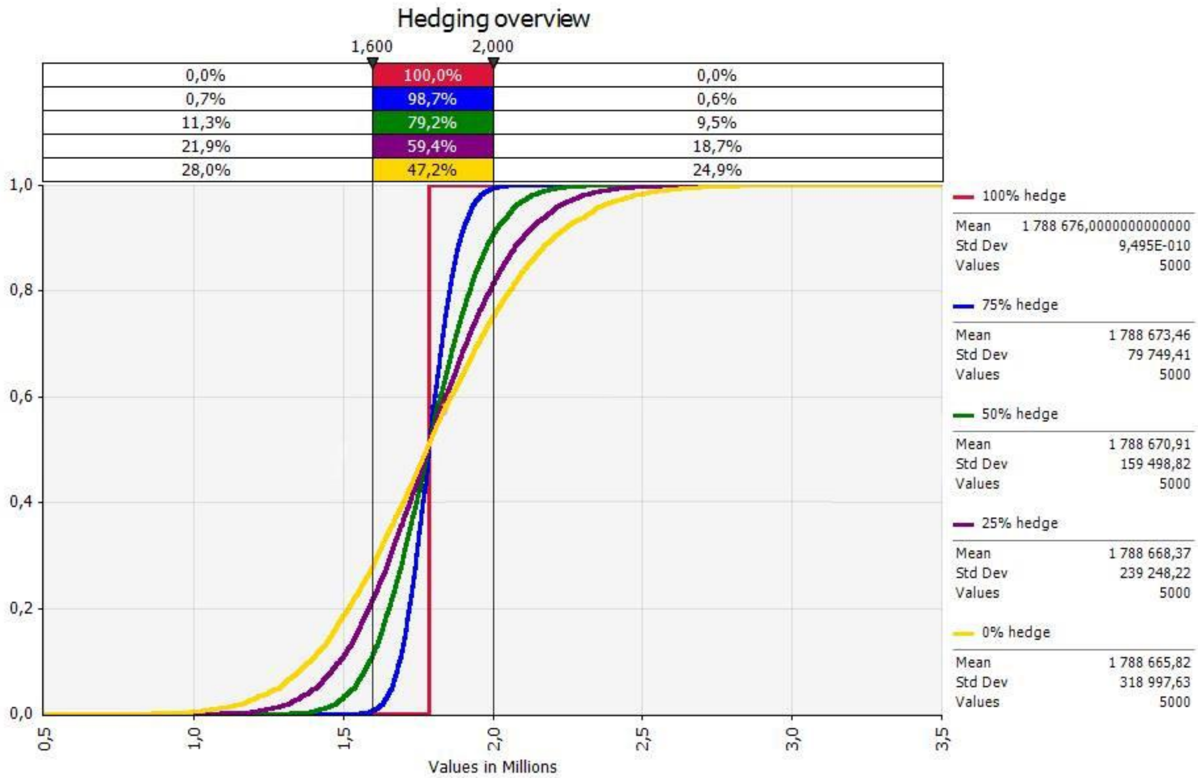


Figure 5.3 illustrates a hedging overview of Lerøy's result. Where the hedged amount is controlled for with short forwards with one year to maturity. Means, standard deviation, and hedge ratios of revenue are listed in the table. This table reveals the purpose of hedging concerning uncertainty. From the table we can observe that more hedging result in lower standard deviations. When more hedging is implemented the outcome narrows, and the result of Lerøy becomes more predictable. There is no value found in monetary terms, but it can be a great value in the lowered standard deviation.

Figure 5.4 Put hedging vs. no hedging

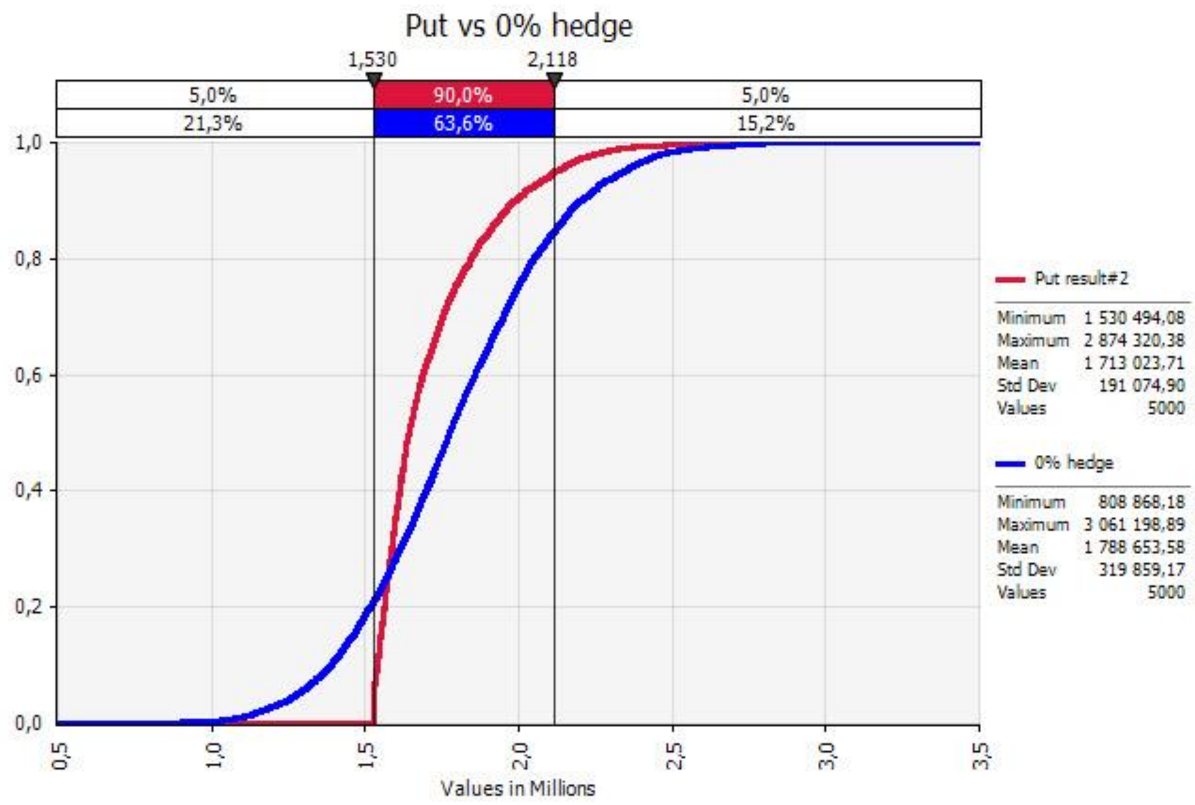


Figure 5.4 illustrates the outcomes of using put options to cover all of Lerøy's exposure vs. no hedging. The advantage of using put options, is a limited downside of 1.5 million vs. a possible downside of 0.8 million. The mean of both distributions varies, where puts equals 1.7 million and the mean for "no heding" equals 1.79 million, which raises quistions if the lowered standard deviation can account for the higher potential value. Put options will have a lower mean because of premium cost on options.

5.2 Findings

By executing the Monte Carlo simulation, with both short forwards and put options, we find that it brings no financial gain for the company. We also find that the simulated hedging approaches are awarded with lowered volatility. These findings in our simulation support Perold and Schulman (1988) research, they argue that hedging result in lowered volatility. In the simulation short forwards have no associated cost. It will not be 100% accurate, because in the real world forwards should entail an added costs. The put options are simulated with a cost, and resulted in lowered volatility of the revenue. This is reflected in the lowered mean for the distribution (Figure 5.4). The result of this simulation might answer why seafood companies remain sceptical towards usage of put options, as the options in general are mostly beneficial when the markets are volatile. If there are no market frictions, options wont trade at a premium. By the findings of no financial gains and lowered volatility, it opens the discussion of wether hedging increase firm value. Does the benefit of a smoother revenue stream, outweigh the cost of and risk associated with hedging? This analysis does not answer that question, so we investigate the question further by utilizing regression analysisis to explore the problem, where we use our sample of 10 seafood companies to reasearch if currency hedging actually increases the firm value.

6 Descriptive data and statistics

The purpose of this chapter is to provide an overview concerning the data used in our analysis. The nature and characteristics of the sample data explain some of the rationale behind our approach to the research problem.

6.1 Calculating hedge ratio of the companies

The "hedge ratio" is a concept we developed to help us explain the connection between hedging and firm value. "Hedge ratio" is the value of forward currency contracts divided by foreign revenue (Table 6.1). By utilizing this value, we hope to find a connection between the rate of hedging and firm value.

We calculated the "hedge ratio" through extensive work with the sample firm's annual reports. In the annual report calculations, we had to do several assumptions to locate currency exposure and the amount of forwards contracts the firms used to hedge. The annual reports we base our sample on, reported the usage of derivatives. Even though it wasn`t always clear how much of the revenue were exposed to currency risk, and what the derivate usage was intended for. The foreign operations in the companies were protected using subsidiary companies and through internal diversification mechanisms. To calculate the necessary currency exposure one has to consider foreign costs. This is impossible with the available information in the annual reports. To create a usable dataset to cover currency exposure, and the amount hedged we did following assumptions:

Forward contracts yield to maturity varies a lot, in order to specify which proportion that belongs to each year, we assumed that the expiration date of the contracts are determinative. E.g. If a forward contract are made in 2008 and expires in 2009, the hedge amount for the forward contract is implied in the 2009 calculation.

Geographical divisions of revenue do not always contain the required information, sometimes we use the past year data on geographical divisions in order to calculate exposure. For example, the revenue for EUR in 2009 equals 25% of total revenue, and revenue amount of 2008 is not reported, we use 25% from 2009 as target for EUR revenue in 2008.

We assume all foreign revenue is exposure to currency risk, and we ignore the fact that subsidiary companies placed abroad, accounts for some of the foreign revenue. We assume foreign currency settles at home currency at the end of the year.

The expenditures listed in the annual reports do not contain enough information about the geographical divisions or costs associated with international business. Cost-analysis was excluded, and the hedge amount of exposure is calculated from revenue.

After these assumptions, we calculated a value that we call the hedge ratio (Table 6.1)

Table 6.1 Hedge ratio of companies

Year	Akva Group	Austevoll Seafood	Bakkafrost	Grieg Seafood	Lerøy Seafood	Marine Harvest	Norway Royal Salmon	Salmar	Scottish salmon company	Hofseth biocare
2014	6 %	14 %	54 %	8 %	16 %	13 %	16 %	29 %	0.50%	0 %
2013	25 %	15 %	0 %	3 %	20 %	9 %	4 %	10 %	0 %	0 %
2012	0 %	7 %	0 %	2 %	9 %	26 %	8 %	2 %	0 %	0 %
2011	18 %	9 %	0 %	11 %	12 %	25 %	9 %	19 %	0 %	0 %
2010	23 %	11 %	0 %	0 %	15 %	39 %	0 %	7 %		0 %
2009	4 %	14 %	0 %		17 %	88 %	4 %	8 %		
2008	0 %	36 %	0 %		19 %	29 %	0 %	1 %		

Note: The table represents the percentage of foreign revenue hedged with forward currency contracts.

From Table 6.1 we made a variable to define the hedging ratio of companies, we called this variable “Hedge.Ratio”. This variable is used in Regression series 1 and 2, and we assumed that hedging ratio is constant across the year, in order to use monthly data.

6.2 Descriptive data of companies

Table 6.2 Descriptive firm data

Company	Market Value	Total Assets	Volatility (σ)	Mean Hedge Ratio
Marine Harvest	21 242	27 831 087	13.82%	33 %
Lerøy Seafood	8 160	11 916 667	11.41%	15 %
Salmar	6 825	7 174 285	9.27%	11 %
Austevoll	6 775	19 865 879	11.79%	15 %
Bakkafrost	4 455	2 214 100	9.28%	8 %
Grieg Seafood	1 707	4 319 916	17.70%	5 %
Norway Royal salmon	1 444	1 758 290	11.02%	6 %
Scottish Salmon	655	133 788	9.45%	0 %
Akva Group	408	735 536	12.03%	11 %
Hofseth Biocare	290	151 279	13.73%	0 %
Mean	5 196	7 610 083	11.95%	10 %

Note: Market value is notated in millions of NOK, and the table represents descriptive data of our sample companies. The values are calculated from monthly data since 2008 (or when they listed on the exchange) and are the mean values for this timeframe. Volatility is estimated from monthly stock returns over the same timeframe. The companies in the table are ordered by the market value of equity. Mean hedge ratio is calculated from Table 6.1.

From Table 6.1 we can observe that the larger companies tend to hedge more of their revenue stream than those of the smaller firms. This corresponds well to the findings of Jin and Jorion (2006) and Allayannis and Weston (2001) regarding size and hedging. The volatility of the stock returns is within a small range across the sample, which makes sense as the companies operates within the same industry.

To test for currency effect on an industry level we created an industry index of the seafood firms in our sample. It consists simply of the average return of all the companies in the sample.

6.3 Regression variables

The regression data are all gathered through the database “Datastream” except for the location of exposure, and calculation of hedge ratio. Which is collected from the annual reports in the timeframe 2008-2014.

Table 6.3 Number of observations

	Number of companies	Total monthly observations	Average monthly observations per firm
Regression series 1	10	811	81.1
Balanced data set	10	350	35
Unbalanced data set	10	687	68.7

Table 6.3 displays the number of observations utilized in the different regression series. The first series of regression was run individually for each company with data from 2008–2014 or from when the firm was listed on the Oslo Stock Exchange. The balanced and unbalanced data set represents Regression series 2, which is run with two different time frames. A balanced data set for the time frame 2012(February) to 2014 (December), and an unbalanced data set with varying observations dating back to 2008.

Table 6.4 Descriptive data regression series 2

		Q-ratio	Total Assets	ROA	Investment growth	Leverage	Hedge ratio
Balanced data	Mean	1.09	8 624 433	0.03	0.12	364.54	0.1
	Median	1.03	3 766 606	0.04	0.06	289.92	0.08
	SD	0.40	10 191 095	0.14	0.22	288.79	0.12
Unbalanced data	Mean	0.97	8 653 717	0.03	0.1	446.87	0.12
	Median	0.84	4 172 197	0.04	0.06	343.48	0.09
	SD	0.39	9 117 536	0.11	0.16	426.63	0.15

Note: The calculation and definitions of these variables can be seen in the method chapter 6.2. Descriptive data for all the calculation data can be seen in appendix 1.

6.4 Currency data

To test for currency effects we have used the percentage change of the relevant currencies for the companies in our sample. Descriptive data are presented in Table 6.5.

For most of our analysis, we have used the Norwegian TWI to calculate currency exposure. NorgesBank (2006) defines the Norwegian TWI as a “nominal effective krone exchange rate weighted by the 25 main trading partners of Norway.”

Table 6.5 Descriptive data of currency pairs and TWI

	TWI	*NOK/USD*	*NOK/EURO*	*JPY/NOK*	*DKK/NOK*	*NOK/GBP*	*NOK/CHF*
Mean	0.22	0.54	0.16	-0.25	0.39	0.18	0.62
Median	0.15	0.46	-0.04	0.35	0.01	0.19	0.01
SD	1.53	3.7	2.24	4.46	3.37	2.78	3.31

Table 6.5 illustrates that TWI has a lower volatility than the other currency pairs represented, which makes sense, as it is a weighted diversified representation of the NOK. This creates some implications to our analysis. Use of TWI might not capture the proper volatility associated with currency fluctuations. However, it captures a “broader” effect of currency exposure. Using relevant currency pairs might represent a more proper effect of currency risk, but it raises some more issues to our analysis.

6.4.1 Correlation studies

Working with multiple assets that intuitively affect each other, we did some research on the correlation between the different variables in our studies.

Table 6.6 Correlation matrix of currency pairs and TWI

	NOK/USD	*NOK/EUR*	*DKK/NOK*	*NOK/GBP*	*JPY/NOK*	*NOK/CHF*
NOK/USD	1.000					
NOK/EUR	0.434	1.000				
DKK/NOK	0.801	-0.189	1.000			
NOK/GBP	0.593	0.467	0.338	1.000		
JPY/NOK	-0.752	-0.421	-0.540	-0.429	1.000	
NOK/CHF	0.431	0.579	0.089	0.341	-0.521	1.000

Table 6.6 illustrates significant correlation between the currency pairs (as one would expect), which might lead to some issues when regressing later in the analysis. We utilize a rule of thumb; if the correlation is over 0.6 there might be some correlation issues in the regressions. If this turns out to become a problem, we might consider using the trade-weighted index of the Norwegian Krone as a replacement.

Table 6.7 Correlation of important variables

	OSEBX	TWI	Salmon Price
OSEBX	1		
TWI	-0.333	1	
Salmon Price	0.064	0.105	1

Note: OSEBX is the Oslo Stock Exchange index, TWI is the Norwegian trade weighted Index

From Table 6.7 we observe some correlation, but not critical correlation between OSEBX and TWI. We will test for this later and see if this affects our analysis.

6.5 Time series data

Our analysis is composed of multiple time varying variables. We have conducted “unit-root” tests to test if we have stationary data, and if this will influence our data and future regressions. To test for the effect we have run Augmented Dickey-Fuller tests on the variables used in the regression. We have run tests with “drift” (trend) and without. The test values for all the variables are reported in the appendix. The tests indicates unit-root issues with the control variable “Total Assets.” This will have some implications on what inferences we can make from the regressions in our analysis.

7 Method

The purpose of this chapter is to highlight and explain our method and procedure for exploring the research problem. The data analysis presented in this chapter was all conducted using the statistical software R. The analysis expands on the research of Jin and Jorion (2006) whom focused on the oil industry and Allayannis and Weston (2001) whom focused on how currency hedging affects value on a larger range of industries. The following series of regressions follows an explorative design, in the search for the best fitting model for our selection of industry and companies. Our analysis is divided into two parts; (1) to find if currency hedging is recognized in stock price returns, (2) to see if currency hedging increases the value of the companies. The regressions are run with robust White-standard errors if necessary to best avoid any heteroscedasticity issues in our models.

7.1 Regression series 1: The sensitivity of stock returns to hedging

The purpose of this series of regressions is to explore the effect of currency hedging on stock returns. To explore this relationship we built a model to establish currency exposure on stock returns and the following effects of hedging on stock returns.

7.1.1 The sensitivity of market returns (OSEBX) to TWI

Regression 1 is to explore the relationship between market return and foreign exchange rates, in order to address any possible correlation issues between the variables. The regression works under the assumption that exchange rate affects market return, and not the other way around.

$$Market\ Return_t = TWI_t \tag{13}$$

$Market\ Return_t$ is the Oslo Stock Exchange index at time t, TWI_t is the return of the nominal trade weighted index of the NOK

7.1.2 Estimating sensitivity of industry returns to relevant variables

To observe the effect currency has on the index, we run regression (14). The index is the average stock returns of our sample firms, which we see as a good approximation of the Seafood Industry. Return on salmon prices is included in the regression to get a more precise model.

The model is based upon the work of Adler and Dumas (1984) regarding measuring currency exposure with sensitivity of firm value to exchange rate. Jorion (1990) later expanded on this incorporating market return and foreign exchange rate.

$$Industry\ Index_t = \alpha_i + \beta_{mkt} * R_{mkt,t} + \beta_{TWI} * R_{TWI,t} + \beta_{Salmon\ Price} * R_{Salmon\ Price,t} + \varepsilon_{i,t} \quad (14)$$

$Industry\ Index_t$ is the average return of all our sample companies at time t, α_i is the constant, β_{mkt} is the beta of market return, $R_{mkt,t}$ is the return of the Oslo Stock Exchange index at time t, $\beta_{TWI,t}$ is the beta of the TWI, $R_{TWI,t}$ is the return of TWI at time t, $\beta_{Salmon\ Price,t}$ is the beta of the salmon price and $R_{Salmon\ Price,t}$ is return of salmon prices at time t.

7.1.3 Sensitivity of stock returns to currency fluctuations on firm level

Regression (15) and (16), of our analysis, is to find the sensitivity of stock returns to variations foreign exchange rates. The regressions are run in two steps: First with TWI and salmon prices, then with individual relevant foreign exchange rates which might get more precise estimated coefficients for the firms.

$$R_{i,t} = \alpha_i + \beta_m * R_{mkt,t} + \beta_{TWI,t} * R_{TWI,t} + \beta_{Salmon\ Price,t} * R_{Salmon\ price,t} + \varepsilon_{i,t} \quad (15)$$

$$R_{i,t} = \alpha_i + \beta_m * R_{mkt,t} + \beta_{exchange\ rate,i} * R_{exchange\ rate,i,t} + \varepsilon_{i,t} \quad (16)$$

$R_{i,t}$ is the return on stock i at time t, $\beta_{exchange\ rate,i}$ is the beta of exchange rate i at time t, $R_{exchange\ rate,i,t}$ is the return of exchange rate i at time t.

Regressions are run for each of the companies to find the necessary Betas for our research and explore these relationships. Due to the result of the correlation studies, we suspect the models will have a degree of multi-collinearity, so we conduct tests for Variance inflation Factors (VIF).

7.1.4 Relation between stock returns, exchange rates and Hedge ratios

The purpose of regression (17) is to test if an addition of the hedging variable will have an effect on stock returns. We simply added a hedge ratio variable to the regression to see if this affects stock return.

$$\mathrm{R}_{\mathrm{i,t}} = \alpha_i + \beta_m * R_{mkt,t} + \beta_{TWI,t} * R_{TWI,t} + Hedge.Ratio_{i,t} + \varepsilon_{i,t} \qquad (17)$$

The $Hedge.Ratio_{i,t}$ is the hedge ratio of firm i at time t

7.2 Regression series 2: The effect of hedging on firm value

The purpose of the following series of regression is to test whether hedging increases the value of the company. Continuing with the method of Jin and Jorion (2006) and Allayannis and Weston (2001) with the use of Tobin's Q as a proxy for firm value. This analysis is conducted through two steps: First with a balanced panel data and secondly with an unbalanced data set. They both are regressed with three regression estimators: pooled OLS, panel data methods with "random" and "between" effects. Descriptive data of the balanced and unbalanced data sets are presented in Table 6.4.

In this series of multivariate regressions, we have added control variables we believe affect the Q-ratio. This is to attempt to isolate the effect of hedging ratio on the Q-ratio. The control variables we decided to a fairly similar to that of Allayannis and Weston (2001) and Jorion (2006). These control variables seem to fit our sample group as it is a general homogenic type of industry, and we believe the variables have a consistent effect over our sample of firms. The data for the control variables were extracted from the database *"Datastream"* and described as:

Firm size: Allayannis and Weston (2001)'s research state that Tobin's Q vary with size of the firms. We control for size by utilizing log of total assets of the firm.

Profitability: Profitable firms are likely to have a higher value than less profitable firms. We control for this using return on assets.

Investment Growth: we control for investment growth using capex over revenues. Firm value is associated with future investment projects. Hedging might also cause more investment opportunities, due to better financial planning capabilities.

Leverage: Allayannis and Weston (2001) found evidence of leverage having a negative relation to Q-ratio. We control for “leverage” using book value of debt over market value of equity.

Dividends: Allayannis and Weston (2001) uses Fama & French’s research that dividends convey information about future profitability . We use a dividend dummy, which is defined as “1” if it paid dividends the relevant year and “0” if not. This is to control if firms have limited financing. They are then forced to neglect projects and only take on projects with positive net present value. This can affect the Q-ratios of the firms.

$$Log(Q) = \alpha + \beta * Hedge.Ratio + \sum \beta_i * controll\ variables_i + \varepsilon_i \quad (18)$$

$Log(Q)$ is the Q-ratio of the companies, the control variables are defined above

The purpose of this method is to find a long run relationship between hedging activities and firm value with the different data sets to support each other. The panel data techniques are used to add robustness, as we work with multidimensional data and these techniques are better to explore the dynamics of change over time. With panel data techniques, we account for the heterogeneity and independent time effects, which might affect the regressions.

8 Results and discussion

8.1 Regression series 1: Sensitivity of stock returns to currency hedging

The purpose of this chapter is to present and analyze the regressions we have conducted. We will draw some inferences from the results and explain the rationale behind the progression of our research.

8.1.1 Relationship between market returns and currency fluctuations

When running regression (13) we get a significant coefficient of -1.5 and an adjusted R^2 of 0.102 (appendix 2). This implies that currency fluctuations stand for some of the variability in the Market return. It also raises some multicollinearity issues that might affect future regressions, which we must account for. Therefore, a variance inflation factor (VIF) is run for the models.

The results also indicate that when we add the Market return variable in the next regressions, the stock returns might be affected by currency through the Market return variable. So if we get an insignificant currency coefficient, the stock returns might still be affected by currency effect through the market variable.

8.1.2 Sensitivity of industry returns to currency fluctuations and salmon price

To observe the effect currency has on the index we run regression (14). The index is the average return of the companies of our sample, which we believe is a good representative approximation of the seafood industry. The return on salmon prices is added to the regression to get a more precise model. The model is based upon the work of Adler and Dumas (1984) regarding measuring currency exposure with sensitivity of firm value to exchange rate. Jorion (1990) later expanded on this incorporating market return and foreign exchange rate.

Table 8.1 Sensitivity of industry returns to currency fluctuations

Variables	*IndexStocks*
OSEBX	0.844^{***}
	(-0.111)
SalmonP	0.146^{**}
	(-0.061)
TWI	0.644
	(-0.501)
Constant	0.876
	(-0.728)
Observations	96
R^2	0.429
Adjusted R^2	0.41
Residual Std. Error	6.970 (df = 92)
F Statistic	23.035^{***} (df = 3; 92)
Note:	*p<0.1, **p<,0.05, ***p<0.01

Note: Represents Index of seafood stock as dependent variable. The Norwegian stock index (OSEBX), Salmon price (SalmonP) and the Norwegian trade Index (TWI) as explanatory variables. Standard errors are reported in parenthesis.

The results from Table 8.1 indicate that currency fluctuations have little or no significant effect on the index. This is similar to that of the studies of Griffin and Stulz (2001) who studies the effect of currency shocks on stock return (here industry level). The paper argues that the low explanatory power of the currency coefficients is a consequence of high exposure coefficients in absolute values on an individual level, but some are negative and positive so they offset each other. To see if we get estimates that are more precise we continue to test with individual firm regressions.

8.1.3 Sensitivity of stock returns to currency fluctuations on firm level

To explore the relationship between stock return on individual firms, we did a regression of the stock return for each individual company.

Table 8.2 Sensitivity of stock returns to currency fluctuations

	Beta Market	Beta TWI	Beta Salmon	Adjusted R-squared
Mean	0.768	0.881	0.130	0.186
Median	0.767	0.935	0.123	0.208
SD	0.409	0.678	0.085	0.117
Significance at p < 0.10	7/10	3/10	3/10	

Note: Summary table of regressions with individual Stock returns as dependent variable. The Norwegian stock index (OSEBX), Salmon price and the Norwegian trade Index (TWI) as explanatory variables. Complete regression results in appendix 3.

The results show that TWI is only significant in 3 out of 10 firms. This implies that currency fluctuations have little effect on stock returns. As firms are complex, the reasons for this may be a sum of many factors as natural hedging, financial hedging and native diversification effects (as NOK depreciates the foreign sales rise, but the price of fish feed rises so the currency effect would be close to zero). The Salmon price variable seems not to be significant to many of the companies and does little to increase the R-square, so we decided to exclude this variable from the rest of the analysis.

Table 8.3 Sensitivity of stock returns to specific currency fluctuations

	OSEBX	NOK/USD	NOK/EURO	JPY/NOK	NOK/GBP	Adjusted R-squared
Mean	0.862	0.117	0.310	0.310	0.694	0.188
Median	0.899	0.068	0.090	0.414	0.437	0.195
SD	0.303	0.443	0.519	0.430	0.496	0.122
Significance at p < 0.1		2/10	2/10	2/10	1/10	

Note: Summary table with individual stock returns as dependent variable. The Norwegian stock index (OSEBX) and specific currency pairs are explanatory variables. Complete individual regression in appendix 4.

The results using specific currency rates seem to give the same or slightly better (more significant) variables. The next regression will then be with TWI and not specific currency pairs.

If the low importance of foreign exchange rate is true, there seems to be a contradiction that firms choose to hedge their foreign exchange rate risk with forward contracts. We assume this effect is not by design, as the companies noted in annual reports; that a lot of variability (risk) in the cash flow of the firm, is attributed to foreign exchange rate fluctuations. This raises some questions on why firms decide to hedge in the place, if investors in the market do not recognize the currency risk. We continue our research by exploring if hedging has an effect on stock return.

8.1.4 Relationship between stock returns, currency fluctuations and hedging ratio

Regression (17) is run to explore the relationship between hedging activities and stock return. The approach of utilizing a ratio, to explore this relationship, makes our method differ to that of the previous studies that we have built upon. Most previous research uses a dummy variable to control for derivative usage. We investigate the relationships by the degree of hedged foreign revenue against stock returns. The results are presented in the Table 8.4:

Table 8.4 Sensitivity of stock returns to currency and hedge ratio

	OSEBX	TWI	Hedge Ratio	Adjusted R-squared
Mean	0.898	0.899	-11.018	0.174
Median	0.810	0.583	-22.360	0.188
SD	0.275	0.885	30.945	0.145
Significance at $p < 0.1$	7/10	1/10	2/10	

Note: Summary table with individual stock returns as dependent variable. The Norwegian stock index (OSEBX), the Norwegian trade weighted index (TWI) and hedge ratio are the explanatory variables.

The results display that the “Hedge.Ratio” variable has minor effects on the stock returns. The mean coefficient presented here of the “Hedge.Ratio” variable is skewed due to some outliers, but it is mostly the level of significance we are interested in. The “Hedge.Ratio” is only significant in 2/10 cases, and by these findings we conclude the analysis find little evidence of any significant relationships between stock returns and hedging activities. This result builds upon the findings from the previous regression; if the currency fluctuations do not affect stock returns why should hedging of the exchange rates make a difference?

8.1.5 Discussion regression series 1

Our findings of the general low significance of TWI is a good representation of how difficult it has been to work with, and map true exposure to foreign exchange rates of a firm. We used the model of Jorion (1990) to create a model for currency exposure, but the result we have might be the causal relationship between to endogenous variables. We tried to avoid this by focusing on one industry, but we cannot dismiss this possibility. Jorion (1991) states that currency risk is almost never recognized by the stock market, and that currency hedging will only be valuable for investors if currency risk is priced in the stock market and some kind of segmentation occurs. He also states that there is evidence that currency risk is easy diversifiable for investors, which reinforces the argument that the degree of hedging is not reflected in stock returns. Moreover, if exposure is the "simultaneous impact of shocks on currency and stock returns," the reason we get zero effect of currency is due to this reflexive relationship. There is also the possibility that currency follow the theory of random walk. If so, is the result we have found simply the case of expected currency returns over time is zero and investors do not care about currency fluctuations? However, the results raises some questions about the reasons firms decide to hedge in the first place.

The low significance of exposure on stock return is in line with most other research on the topic, however there exists some evidence that the more foreign operations the firm has, the higher probability of a significant currency coefficient (Priestley & Ødegaard, 2007). As the seafood industry is a highly globalized industry, we find it curious that there is such a low significance of the currency coefficients. We recognize that our approach and model might be too simple for estimating hedging effect on stock returns, due to dangers of misspecification of model, the complex nature of currency exposure, or due to the weakness of our "Hedge.Ratio" variable. We conclude that this approach has failed to find any meaningful relationship between stock returns and hedging activities.

8.2 Regression series 2: Firm value and hedging

This series of regressions is to test if the “Hedge.Ratio” variable has any effect on the Q-ratio of the companies. We conducted a Hausman test to decide that the “random” estimator was the best estimator for our data sets. Then we ran regressions with the standard pooled OLS, “random,” and “between” estimators. The random effects estimator adjusts for unobservable firm specific factors that might influence our data. The “between” estimator adjusts for risk, so those observations drawn from the same sample may not be independent. The results of these regressions are presented in Table 8.5.

8.2.1 Balanced panel data regression

From Table 8.5 we see a highly significant “Hedge.Ratio” with a positive coefficient of 0.458. This indicates that the Q-ratio increase 0.458% for every 1% increase of the “Hedge.Ratio” variable. This is evidence that hedging of currency is associated with a higher Q –ratio within our sample of firms. Total assets, dividends, and investment growth seem to have a high positive effect on the Q-ratio. Investment growth has a positive coefficient, which is logical as this indicates companies have more positive NPV projects to invest in. The positive coefficient of dividends is a little surprising as one would assume companies that did not pay dividends had more profitable investment projects and thereby a higher Q. This implies that investors interpret dividends as a positive signal of the future. ROA is not significant and Debt (leverage) is associated with slightly lower Q-ratio. This is consistent with most other research. The negative coefficient of leverage seems to correspond with the negative relationship Allayannis and Weston (2001) found between the Tobin’s Q and leverage.

The “between” estimated model turned out insignificant due to the F-statistic, and will not be used to make any inferences. With the “random” estimator, the sign of the coefficients change in almost all the variables. Only Leverage and ROA stays significant. The “Hedge.Ratio” variable has a negative coefficient. This implies that hedging of currency, is on average per firm associated with a lower Q-ratio. This is most likely a factor of our short timespan (2012-2014) as the NOK depreciated a lot from 2013 and throughout 2014. However, the hedging variable is still insignificant.

Table 8.5 Regression series 2: relationship between firm value and hedging activities

Dependent variable: Log(Qratio)	*OLS* Pooled	*Linear panel models* Random effects	Between effects	*OLS* Pooled	*Liner panel models* Random effects	Between effects
	Balanced data			*Unbalanced data*		
Log(Total.Assets)	0.018	0.054	0.08	-0.037***	0.045	0.081
	(-0.014)	(-0.051)	(-0.114)	(-0.01)	(-0.028)	(-0.08)
ROA	0.257	0.574***	0.777	0.595***	1.276***	0.348
	(-0.203)	(-0.184)	(-2.047)	(-0.158)	(-0.199)	(-1.132)
Log(Investment.Growth)	0.255***	-0.007	0.195	0.223***	0.177***	0.163
	(-0.03)	(-0.026)	(-0.35)	(-0.022)	(-0.028)	(-0.197)
Leverage	-0.0005***	-0.0004***	-0.001	-0.0003***	-0.0002***	-0.0002
	(-0.0001)	(-0.00004)	(-0.001)	(-0.00003)	(-0.00003)	(-0.0003)
Dividends	0.223***	-0.019	-0.421	0.350***	0.007	-0.287
	(-0.041)	(-0.025)	(-0.824)	(-0.032)	(-0.031)	(-0.274)
Hedge.Ratio	0.458***	-0.026	2.772	0.240***	0.050	0.705
	(-0.14)	(-0.069)	(-4.513)	(-0.084)	(-0.089)	(-1.188)
Constant	0.426**	-0.656	-0.481	0.937***	-0.240	-0.703
	(-0.191)	(-0.763)	(-1.911)	(-0.142)	(-0.423)	(-1.191)
Observations	350	350	10	687	687	10
R^2	0.459	0.311	0.612	0.37	0.16	0.781
Adjusted R^2	0.45	0.305	0.183	0.364	0.159	0.234
Residual Std. Error	0.256 (df = 343)			0.295 (df = 680)		
F Statistic	48.580*** (df = 6; 343)	25.801*** (df = 6; 343)	0.787 (df = 6; 3)	66.502*** (df = 6; 680)	21.641*** (df = 6; 680)	1.784 (df = 6; 3)
Note:	*p<0.1, **p<0.05, ***p<0.01					

Note: Table 1 represents regression estimated with OLS, "random," "between" estimators with the log of Tobin's Q as the dependent variable. The explanatory variables are: ROA is the return on assets for the companies, Dividends is a dummy variable if the firm pays dividends or not, "Hedge.Ratio" is the ratio of how firm hedges foreign revenue with derivatives, Log(Total. Assets), Log(Investment.Growth), Leverage are self-explanatory. The balanced regressions represent data from 2012 to 2014, the unbalanced data represents data dating from 2008 or from when available to 2014. Standard errors are reported in parenthesis.

8.2.2 Unbalanced panel data regression

This series of regressions is run to get more observations. The effect of more observations is that we can make inferences on a broader scale, and hopefully this population mean is closely to that of a "regime" independent unbiased sample. The Hausman test was conducted and showed that "random" was a better estimator than "within."

In the pooled regression all, the variables are significant. The variable coefficients seem to be relatively consistent although the values have changed a little. ROA has now a significant positive effect on the Q-ratio. This might be an effect of the skewness of the unbalanced data. The "Hedge.Ratio" coefficient is positive. As the regression is an elasticity, we interpret this as 0.24% increase in Q-ratio for every 1% increase in "Hedge.Ratio."

The "between" estimated model turned out insignificant due to the F-statistic, and will not be used to make any inferences. The "random" estimator models seem to confirm the significance and sign of the variables ROA, Investment growth, and Leverage. However, the "Hedge.Ratio" variable is no longer significant. This makes us question the validity of the pooled regression coefficient of the "Hedge.Ratio" variable.

There are some consequences of the usage of an unbalanced data set. The random effect estimator creates an independent mean for each firm, but constrains the firms to a normal distribution of the firms. This entails that firms with small means will be represented by the overall mean, and the effect is even larger for firms with high deviations from the mean. As the firms with more observations tend to be larger than the firms with fewer observations, the results will probably be skewed towards the larger firms.

8.2.3 Summary discussion regression series 2

The balanced and unbalanced data sets seem to yield relatively the same estimation results. Since this is the case, it might indicate that the balanced panel regression represents as the mean coefficients of that of a larger population, which is the goal of regressions in the first place. The only consistent variable throughout this series of regressions is the negative small coefficient of the Leverage variable. This indicates evidence that debt has a negative small effect on firm value. Regarding the “Hedge.Ratio” variable there are some differences regarding the “random” estimated regressions. The sign of the “Hedge.Ratio” coefficient changes in the balanced panel while in the unbalanced it stays the same. This can indicate that the variable suffers from timeframe/sample constraints in the balanced panel, however, it is never significant in any of the random estimated regressions.

8.2.4 Consequences of the Augmented Dickey-Fuller tests

Both the balanced and unbalanced data sets had some issues with unit-roots. The augmented dickey-fuller tests could not reject the possibility that there is a unit-root issue with the variable Total Assets. An implication of this, is that the regression results might not be relevant for a larger population mean (in this case other timeframes) or simply “spurious.” However to reject the whole series of regressions as “spurious” based on this variable seems to be an overreaction. Still Total Assets is a part of the calculation of multiple of our variables (Q-ratio, ROA) which might imply that a unit-root problem affects our regression on a larger scale. Another factor that raises our suspicion of a “spurious” regression is the number of significant variables, as most comparable research has not that many significant control variables. With this uncertainty regarding the analysis, we will interpret the results from the pooled OLS with caution and put an emphasis on the “random” regression results, which we believe represents the true long run relationship.

9 Summary and conclusions

9.1 Stock returns and currency hedging

The purpose of this series of analysis was to establish a model, which could best explain the relationship between stock returns, currency fluctuations, and the hedging activities of the firm. To find the best model we added the variables OSEBX and Salmon prices together with currency to minimize the risk of misspecification of the models. OSEBX usually had significant effect on stock returns, while salmon prices only was significant on average in 3/10 cases. For the remaining regressions, we decided to exclude the salmon variable. Testing with both specific currency pairs and TWI, we concluded that the TWI was best fitted to explain foreign exchange exposure. It was also just significant on average in 3/10 cases. A logical implication from this result is that hedging of currency will never be significant for stock returns if currency fluctuations don`t affect stock returns. The results from our regressions also supported this logic, as the hedge ratio only was significant in 2/10 cases.

The results from this series of regressions imply that investors do not require compensation for undertaking exchange rate risk, no premium is given to companies that participate in currency hedging activities.

9.2 Firm value and hedging

The purpose of this series of analysis was to explore the relationship between firm value and hedging. As prior research within the same theme, we used Tobin’s Q as a proxy for value as it is a unit less measure comparable across firms. Regressions where run on a balanced data set to represent all the firms. We cut the sample a timeframe of 2012-2014 and an unbalanced data dating from 2008-2014.

The first regression of Q value and hedging resulted in a positive significant coefficient on the hedging variable. All variables where significant, except return on assets. This is more significant variables than most other similar research. We found no specific reason for this, but we believe this might be attributed to the homogeneity of the industry or an underlying issue regarding the calculation of the Q-ratio and the control variables. The two data sets seemed to give approximately the same “pooled OLS” results. Regressing using panel data estimators the coefficients changed drastically. This makes us questions the validity of the pooled OLS estimator. The two different results suggests with the pooled regression that firm value increase with hedging, while the “random” regression suggests that, on average, the hedging ratio is not significant.

The implications of these analysis is that we a find that hedging has positive effect on firm value, using standard pooled OLS methods. However, these results must be interpreted with caution. Using the random estimators we never found any significant effect of hedging activities. We then concluded that we have failed to find sufficient evidence that hedging increases firm value.

9.3 Summary discussion

The analysis has suffered of sample size issues throughout the whole analysis, even though we have had complete representation of the population we wanted to test, it would have been preferable to have a larger sample of firms. Still, we believe we have a viable representative analysis within the data constraints that was set by the research topic.

With small sample issues, the results from the different analysis can refer to a common thread towards hedging of currency risk. The Monte Carlo simulation showed some evidence that the financial outcome is the same whether you hedge or not. Hedging seemed to have no effect on stock returns, however, it had a positive, but highly debatable association with the Q-ratio. The positive, but highly debatable hedging coefficient might comply with the results of the Monte Carlo simulations. That hedging lowers volatility of revenue and increases the investment capabilities of the firms. As the timeframe of the analysis has been a period of high growth for seafood firms, added investment capabilities might have been extra important during this period. This is because a premium associated with hedging activities, raises the question: Had hedging paid a premium, why would not all companies hedge at the optimum? If so, why would not all companies hedge their cash flows against currency risk? Is this then a question of efficient markets? This is speculation under the assumption that the pooled OLS regressions represent the true relationship between hedging and firm value, which makes us highly skeptical. It is also speculation in why we find the effects of the regression, which is beyond the scope of this thesis.

The results of the research done throughout the thesis are inconclusive, and we are left with the belief that there exists a relationship between hedging and firm value that we have failed to quantify and should be the topic of future research.

10 Limitations

The purpose of the chapter is to discuss the weaknesses and limitations of the research done throughout this thesis. First, we will discuss the general weaknesses of this thesis, second we will go into specifics of the individually conducted series of analysis.

10.1 General limitations

The major issue throughout our research, has been the number of firms in our sample. We limited ourselves to Norwegian seafood companies listed on the Norwegian stock exchange, with foreign operations. We expected to find significant currency effects on this narrow sample of firms, and it might have been presumptuous from our side, as most comparable research has samples with hundreds of firms.

Utilizing this sample of firms, we also ran into some timeframe issues. The balanced data set we used to run pooled regressions cut the timeframe to 2012-2014. The unbalanced data panel has some data dating back to 2008. We assume the hedging ratio only changes once per year so this is still not too many observations of different hedging policies.

There lies a lot of weakness in the calculation of the hedge ratio. The necessary simplifying assumptions we had to do to calculate the ratio, results in a very imprecise value. The fact that we have ignored the cost side of foreign exchange risk, implies we will never get a correct value for exchange risk. Ignoring the cost side of exposure risk, the net exposure will never be correct. If the cost side were equal to the revenue in a foreign currency the net exposure of the firm would be zero. We have also ignored any foreign debt that contributes to foreign exchange exposure.

There might also exist some issues with the creation of the “Hedge.Ratio” variable. The variable ignores the reason why companies hedge foreign exchange risk. It pools all types of currency exposure into one value. By doing this, the variable might give a wrong representation of why company’s hedge and what type of hedging adds value.

One potential weakness through the analysis is the interpretation of the concept “exposure.” Running regressions to establish the exposure of a company to exchange rates, we created a statistical measure of exposure. Combining this with the “Hedge.Ratio” variable, which is derived from an accounting point of view, might create some issues, which we have not been able to grasp.

10.2 Monte Carlo analysis

Monte Carlo simulations does not take into account the currency exposure in cost, only the currency exposure in revenue, as the annual report involve limited information about costs.

The analysis was only simulated on one particular firm. We do not assume that this firm is fully representative for all the firms in our sample, as other firms entails different currency risk.

Forward contracts does not entail cost in the simulation, even though the cost should be minimal in the real world.

10.3 Regression series 1

The Adjusted R-squared of these models are on average low. This means that our models explain very little of the variation of the response variable. This could imply that our models are misspecified or simply bad. We were mostly interested in the casual relationship between the response and the predictor variable. However, this will not hinder us to draw inferences from the models.

To present the results of our analysis we presented the means of the different Market beta values (OSEBX coefficient). The values are probably not comparable like this, as these values are likely affected by different levels of debt. However, we do not believe this affects our inferences, as we are only interested in the significance of these variables in this analysis.

There is also some risk associated with the currencies we have used to estimate foreign currency risk. The TWI might be imprecise measure of currency risk for seafood companies, and individual currency risks might lie with other currency when we tested with specific currency pairs.

10.4 Regression series 2

This series of regression relies on different control variables that we believe effect the value of a company. It could be that we lack some important variables that might affect the Q-ratio of the companies which should have been included in the model.

We have not done a reverse causality test. I.e. if value affects hedging, and not the other way around.

This series of regressions suffers from small sample size and narrow timeframe. This makes us suspect the findings of this analysis is not significant outside of this narrow timeframe.

A serious weakness of this analysis is the different results from running the pooled regression vs. the random effects regression estimator. The differing results from the regressions makes us highly suspicious of drawing any definitive conclusions from the analysis.

There is some evidence of unit-root issues in our analysis. This makes us conclude that the regression results must be interpreted with caution.

11 References

Adler, M., & Dumas, B. (1984). Exposure to Currency Risk: Definition and Measurement. *Financial Management, 13*(2), 41-50.

Allayannis, G., & Weston, J. P. (2001). The Use of Foreign Currency Derivatives and Firm Market Value. *The review of financial studies, 14*(1), 243-276.

Arnold, M. M., Rathgeber, A. W., & Stöckl, S. (2014). Determinants of corporate hedging: A (statistical) meta-analysis. *Quarterly Review of Economics and Finance, 54*(4), 443-458. doi:10.1016/j.qref.2014.05.002

Asche, F., & Misund, B. (2015). Hedging Efficiency of Atlantic Salmon Futures. *2015/12*.

Bartram, S. M., Brown, G. W., & Conrad, J. (2011). The Effects of Derivatives on Firm Risk and Value. *J. Financ. Quant. Anal., 46*(4), 967-999. doi:10.1017/S0022109011000275

Børsum, G. Ø., & Ødegaard, B. A. (2005). Valutasikring i norske selskaper. *Praktisk økonomi & finans, 22*(01), 83-99.

Carter, D. A., Rogers, D. A., & Simkins, B. J. (2006). Does Hedging Affect Firm Value? Evidence from the US Airline Industry. *Financial Management, 35*(1), 53-86. doi:10.1111/j.1755-053X.2006.tb00131.x

Du, D., Ng, P., & Zhao, X. (2013). Measuring currency exposure with quantile regression. *Review of Quantitative Finance and Accounting, 41*(3), 549-566. doi:10.1007/s11156-012-0322-z

Garman, M. B., & Kohlhagen, S. W. (1983). Foreign currency option values. *Journal of International Money and Finance, 2*(3), 231-237. doi:10.1016/S0261-5606(83)80001-1

Gay, G. D., & Nam, J. (1998). The underinvestment problem and corporate derivatives use. *Financial Management, 27*(4), 53-69.

Géczy, C., Minton, B. A., & Schrand, C. (1997). Why Firms Use Currency Derivatives. *Journal of Finance, 52*(4), 1323-1354. doi:10.1111/j.1540-6261.1997.tb01112.x

GlobalRates. (2016). Interest rate. Retrieved from http://www.global-rates.com/

Griffin, J. M., & Stulz, R. M. (2001). International Competition and Exchange Rate Shocks: A Cross-Country Industry Analysis of Stock Returns. *The review of financial studies, 14*(1), 215-241.

Guay, W., & Kothari, S. P. (2003). How much do firms hedge with derivatives? *Journal of Financial Economics, 70*(3), 423-461. doi:10.1016/S0304-405X(03)00179-X

Hagelin, N. (2003). Why firms hedge with currency derivatives: an examination of transaction and translation exposure. *Applied Financial Economics, 13*(1), 55-69. doi:10.1080/09603100110094501

Hull, J. (2012). *Options, Futures and other derivatives* (Vol. 8): Pearson.

Jin, Y., & Jorion, P. (2006). Firm Value of hedging: Evidence from U.S Oil and Gas Producers. *The Journal of Science, VOL.LXI,NO.2*(April).

Jorion, P. (1988). On Jump Processes in the Foreign Exchange and Stock Markets. *The review of financial studies, 1*(4), 427-445.

Jorion, P. (1990). The Exchange-Rate Exposure of U.S. Multinationals. *Journal of Business, 63*(3), 331. doi:10.1086/296510

Jorion, P. (1991). The Pricing of Exchange Rate Risk in the Stock Market. *J. Financ. Quant. Anal., 26*(3), 363-376. doi:10.2307/2331212

Lerøy. (2015). *Annual Report*. Retrieved from http://hugin.info/131537/R/2007870/742440.pdf

Modigliani, F., & Miller, M. H. (1958). The Cost of Capital, Corporation Finance and the Theory of Investment. *The American Economic Review, 48*(3), 261-297.

Nance, D. R., Smith, C. W., & Smithson, C. W. (1993). On the Determinants of Corporate Hedging. *Journal of Finance, 48*(1), 267-284. doi:10.1111/j.1540-6261.1993.tb04709.x

NorgesBank. (2006, 03.02.2016). Effectiive Krone Exchange Rate. Retrieved from http://www.norges-bank.no/en/Statistics/exchange_rates/Calculated-rates---explanation/

NorgesBank. (2013). *Aktiviteten i det norske valuta- og derivatmarkedet i april 2013*. Retrieved from http://www.norges-bank.no/pages/81135/valuta_og_derivatmarkedet_april_2013.pdf

NorgesBank. (2016). Exchange Rates. Retrieved from http://www.norges-bank.no/Statistikk/Valutakurser/

Næs, R., Skjeltorp, J. A., & Ødegaard, B. A. (2009). *What factors affect the Oslo Stock Exchange?* Retrieved from

Oslobors. (2016). Retrieved from http://www.oslobors.no/markedsaktivitet/#/details/OSLSFX.OSE/overview

Perold, A. F., & Schulman, E. C. (1988). The free lunch in currency hedging: implications for investment policy and performance standards. *Financial Analysts Journal, 44*(3), 45.

Pramborg, B. (2003). Derivatives hedging, geographical diversification, and firm market value. *Journal of Multinational Financial Management, 14*(2), 117-133. doi:10.1016/j.mulfin.2003.07.002

Priestley, R., & Ødegaard, B. A. (2007). Linear and nonlinear exchange rate exposure. *Journal of International Money and Finance, 26*(6), 1016-1037. doi:10.1016/j.jimonfin.2007.05.001

Smith, C. W., & Stulz, R. M. (1985). The Determinants of Firms' Hedging Policies. *J. Financ. Quant. Anal., 20*(4), 391-405. doi:10.2307/2330757

SSB. (2015). Export Seafood. Retrieved from https://www.ssb.no/statistikkbanken/SelectVarVal/Define.asp?MainTable=UhArFiskLand&KortNavnWeb=muh&PLanguage=0&checked=true

Ødegaard, B. A. (2009). What factors affect the Oslo Stock Exchange? (Vol. 2009/33): University of Stavanger.

12 Appendices

Appendix 1: *Descriptive data all regression variables*

Note: Abriviations: TA is total asstets, C is CAPEX, BVD is book value of debt, MC is market value, h is hedge ratio, REV is revenue, NI is net income, EV is enterprise value

Statistic	N	Mean	St. Dev.	Min	Max
OSEBX	96	0.518	6.866	-26.060	16.280
IndexStocks	96	1.662	9.077	-26.127	31.375
MHG	96	2.348	13.823	-59.930	38.810
BAKKA	68	3.230	9.281	-19.460	21.410
GSF	96	2.299	17.695	-48.890	90.070
AUSS	96	1.083	11.786	-32.110	50.000
LSG	96	1.851	11.407	-37.500	35.630
NRS	56	2.934	11.021	-32.090	25.450
SALM	96	1.809	9.271	-23.750	22.220
SSC	64	0.647	9.455	-24.790	26.670
HBC	47	0.054	13.730	-28.120	41.030
AKVA	96	0.961	12.029	-31.580	45.450
NOKUSD	96	0.536	3.704	-8.134	12.647
NOKEURO	96	0.156	2.243	-7.214	8.718
JPYNOK	96	-0.249	4.658	-19.076	11.864
EURODOLLAR	96	0.394	3.380	-9.388	9.742
JPYEURO	96	-0.132	4.309	-14.596	11.266
DKKNOK	96	0.394	3.368	-9.457	9.502
NOKGBP	96	0.176	2.781	-6.526	6.955
NOKCHF	96	0.619	3.309	-7.927	12.028
SalmonP	96	1.409	11.798	-26.590	32.490
TWI	96	0.224	1.528	-4.730	5.710
TA.MHG	96	27,831,088.000	7,262,696.000	20,334,800	40,149,800
TA.BAKKA	96	2,214,101.000	1,221,729.000	538,886	3,920,386
TA.GSF	96	4,319,916.000	834,546.500	3,094,731	5,963,160
TA.AUSS	96	19,865,880.000	3,178,112.000	15,964,156	25,840,314
TA.LSG	96	11,916,668.000	2,743,012.000	7,782,196	15,983,703
TA.NRS	96	1,758,291.000	663,086.900	854,321	2,870,245
TA.SALM	96	7,174,286.000	2,826,442.000	3,068,359	10,943,500
TA.SSC	72	133,788.300	16,700.630	112,004	158,751
TA.HBC	84	151,279.600	65,419.110	29,778	217,868
TA.AKVA	96	735,536.900	150,904.700	586,507	1,070,468

C.MHG	96	1,155,141.000	477,472.400	643,400	2,058,400
C.BAKKA	96	121,720.300	106,950.700	21,194	486,806
C.GSF	96	241,690.300	78,409.020	132,718	404,715
C.AUSS	96	631,145.400	259,322.600	297,631	1,019,605
C.LSG	96	441,728.700	165,278.200	151,960	753,542
C.NRS	72	85,311.670	71,727.350	13,068	263,139
C.SALM	96	352,618.800	276,805.000	102,118	1,040,058
C.SSC	60	9,547.750	2,236.016	5,980	12,876
C.HBC	60	18,250.750	8,802.943	1,533	33,007
C.AKVA	96	33,608.000	7,808.884	24,206	49,765
BVD.MHG	96	7,197,600.000	2,091,434.000	5,107,300	10,680,400
BVD.BAKKA	96	410,315.900	290,129.000	34,350	733,693
BVD.GSF	96	992,425.100	417,544.000	234,699	1,812,654
BVD.AUSS	96	4,894,641.000	478,469.600	4,317,616	5,870,838
BVD.LSG	96	2,216,544.000	394,328.400	1,504,707	2,767,118
BVD.NRS	96	350,118.600	150,898.600	183,329	653,361
BVD.SALM	96	1,916,484.000	679,657.800	814,141	2,761,400
BVD.SSC	72	36,932.330	4,855.610	31,193	44,479
BVD.HBC	84	32,426.430	27,222.710	0	86,067
BVD.AKVA	96	119,460.600	40,483.910	55,048	188,375
MC.MHG	96	21,242.290	11,803.050	3,444.110	53,650.180
MC.BAKKA	69	4,455.075	3,218.846	1,529.260	13,289.390
MC.GSF	96	1,707.070	930.183	230.300	3,662.520
MC.AUSS	96	6,775.278	2,114.389	1,972.190	10,896.050
MC.LSG	96	8,160.260	3,716.151	2,330.610	17,519.330
MC.NRS	57	1,444.824	938.136	281.240	3,398.630
MC.SALM	96	6,825.881	3,901.446	2,678.000	16,655.090
MC.SSC	65	655.480	181.495	367.060	977.090
MC.HBC	48	290.394	86.580	169.780	458.430
MC.AKVA	96	408.213	165.134	224.760	1,085.040
h.AKVA	84	0.109	0.101	0.000	0.250
h.AUSS	84	0.151	0.090	0.070	0.360
h.BAKKA	84	0.077	0.190	0.000	0.540
h.GSF	84	0.036	0.042	0.000	0.110
h.LSG	84	0.154	0.036	0.090	0.200
h.MHG	84	0.327	0.245	0.090	0.880
h.NRS	84	0.059	0.053	0.000	0.160
h.SALM	84	0.109	0.093	0.010	0.290
h.SSC	84	0.000	0.000	0	0
h.HBC	84	0.000	0.000	0	0
REV.MHG	96	18,409,613.000	5,092,289.000	13,486,900	27,880,700

REV.BAKKA	96	1,622,976.000	927,372.700	365,634	2,850,363
REV.GSF	96	2,408,743.000	905,271.800	1,477,029	4,567,253
REV.AUSS	96	11,638,528.000	3,165,538.000	4,019,190	15,273,494
REV.LSG	96	9,686,656.000	2,330,804.000	6,057,053	13,450,725
REV.NRS	96	2,104,822.000	597,821.400	1,341,642	3,210,548
REV.SALM	96	4,529,857.000	2,021,846.000	1,704,242	7,326,200
REV.SSC	72	95,123.670	15,460.400	79,491	125,923
REV.HBC	72	27,535.170	24,394.430	171	62,936
REV.AKVA	96	940,442.500	252,326.600	599,345	1,425,338
NI.MHG	96	989,225.000	1,670,207.000	-2,852,600	3,078,000
NI.BAKKA	96	385,665.000	251,560.600	37,120	810,175
NI.GSF	96	101,830.000	303,416.900	-344,404	631,039
NI.AUSS	96	605,631.400	305,927.200	122,491	1,221,533
NI.LSG	96	888,276.600	519,829.000	124,730	1,733,352
NI.NRS	96	127,315.800	112,606.800	2,140	302,434
NI.SALM	96	785,541.500	538,182.800	144,855	1,790,041
NI.SSC	72	5,111.833	7,426.610	-2,895	18,590
NI.HBC	72	-49,648.170	26,555.920	-76,552	-9,387
NI.AKVA	96	8,161.750	33,630.850	-39,128	56,828
EV.MHG	96	31,535,215.000	16,995,890.000	11,438,545	63,157,944
EV.BAKKA	72	5,091,426.000	2,760,777.000	2,374,887	10,212,877
EV.GSF	96	3,317,962.000	1,236,134.000	1,753,405	5,374,916
EV.AUSS	96	14,279,898.000	3,438,273.000	9,698,274	20,329,982
EV.LSG	96	11,534,596.000	5,386,613.000	4,547,496	21,374,715
EV.NRS	60	2,365,522.000	1,254,540.000	854,276	4,057,046
EV.SALM	96	9,768,606.000	5,409,313.000	3,647,691	20,086,387
EV.SSC	60	98,237.800	21,022.980	66,114	118,624
EV.HBC	48	331,207.000	69,878.290	249,406	438,873
EV.AKVA	96	616,376.900	364,145.100	358,819	1,534,612

Appendix 2: *Sensitivity of Oslo Stock Exchange to currency fluctuations*

```
lm(formula = OSEBX ~ TWI)

Residuals:
     Min       1Q   Median       3Q      Max 
-18.4735 -2.3585   0.5012   3.5269 16.3867 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)   0.8535     0.6712   1.271 0.206694    
TWI          -1.5002     0.4369  -3.434 0.000888 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 6.507 on 94 degrees of freedom
Multiple R-squared:  0.1114,	Adjusted R-squared:  0.102 
F-statistic: 11.79 on 1 and 94 DF,  p-value: 0.0008
```

Appendix 3: *Sensitivity of stock returns to currency and Salmon*

	MHG	NRS	LSG	AKVA	AUSS	HBC	SSC	SALM	GSF	BAKKA
OSEBX	1.037***	0.750	0.784***	0.333	1.021***	-0.061	1.313***	0.607***	1.316***	0.581*
	(0.190)	(0.331)	(0.162)	(0.190)	(0.153)	(0.586)	(0.238)	(0.132)	(0.240)	(0.223)
TWI	-0.078	1.357	0.189	0.964	-0.016	0.906	1.359*	0.482	1.863 .	1.782**
	(0.857)	(1.061)	(0.730)	(0.859)	(0.689)	(1.496)	(0.767)	(0.594)	(1.083)	(0.844)
SalmonP	0.092	0.218	0.101*	0.078	0.042	0.152	0.012	0.144*	0.321*	0.144
	(0.105)	(0.105)	(0.089)	(0.105)	(0.084)	(0.172)	(0.078)	(0.073)	(0.132)	(0.085)
Constant	1.699	1.037 .	-0.078	0.092	1.408	0.259	1.237	0.086	1.206	4.011*
	(1.245)	(1.460)	(1.060)	(1.248)	(1.001)	(2.316)	(1.039)	(0.863)	(1.573)	(1.110)
Observations	96	56	96	96	96	47	64	96	96	68
R^2	0.280	0.189	0.233	0.045	0.360	0.031	0.349	0.232	0.299	0.176
Adjusted R^2	0.256	0.142	0.208	0.014	0.339	-0.037	0.316	0.207	0.276	0.137
Residual Std. Error	11.920 (df = 92)	10.209 (df = 52)	10.149 (df = 92)	11.944 (df = 92)	9.584 (df = 92)	13.979 (df = 43)	7.818 (df = 60)	8.257 (df = 92)	15.057 (df = 92)	8.622 (df = 64)
F Statistic	11.914*** (df = 3; 92)	4.033** (df = 3; 52)	9.337*** (df = 3; 92)	1.457 (df = 3; 92)	17.226*** (df = 3; 92)	0.458 (df = 3; 43)	10.716*** (df = 3; 60)	9.257*** (df = 3; 92)	13.068*** (df = 3; 92)	4.542*** (df = 3; 64)

*p<0.1; **p<0.05; ***p<0.01

Appendix 4: *Sensitivity of stock returns to specific currencies*

	MHG	NRS	LSG	BAKKA	GSF	AUSS	SALM	SSC	HBC	AKVA
OSEBX	0.899*** (0.234)	1.000** (0.408)	0.829*** (0.203)	0.7121** (0.2492)	1.018** (0.312)	0.990*** (0.190)	0.422** (0.163)	1.480*** (0.271)	-0.292 (0.683)	0.609*** (0.219)
NOKUSD	0.068 (0.602)	1.239** (0.794)	0.157** (0.474)		0.057 (0.730)	0.188 (0.444)	0.202 (0.418)	-0.295 (0.456)	-0.294 (0.875)	-0.267 (0.562)
NOKEURO	-0.159 (0.638)	0.919 (1.028)	-0.045 (0.529)	1.2733* (0.6296)	0.090 (0.814)	-0.063 (0.495)	0.243 (0.443)	1.462** (0.666)	-0.102 (1.306)	0.447 (0.596)
JPYNOK	0.654 (0.406)	0.826* (0.525)	0.003 (0.352)		0.581 (0.542)	0.246 (0.330)	0.759** (0.281)			-0.435 (0.379)
NOKGBP	0.708 (0.570)	0.437 (0.892)					0.250 (0.395)	0.433 (0.593)		1.643** (0.532)
Constant	1.909 (1.250)	0.899 (1.511)	0.068 (1.086)	2.32641 (1.04563)	0.654 (1.671)	0.708 (1.016)	1.251 (0.867)	0.172 (1.026)	0.487 (2.414)	0.911 (1.166)
Observations	96	56	96	68	96	96	96	64	47	96
R^2	0.309	0.231	0.223	0.1228	0.235	0.362	0.261	0.409	0.006	0.205
Adjusted R^2	0.270	0.154	0.188	0.09585	0.202	0.334	0.220	0.369	-0.064	0.161
Residual Std. Error	11.807 (df = 90)	10.136 (df = 50)	10.276 (df = 91)	9.067 (df = 64)	15.809 (df = 91)	9.616 (df = 91)	8.189 (df = 90)	7.510 (df = 59)	14.161 (df = 43)	11.017 (df = 90)
F Statistic	8.040*** (df = 5; 90)	3.007** (df = 5; 50)	6.514*** (df = 4; 91)	2.063 (df = 3; 64)	7.005*** (df = 4; 91)	12.925*** (df = 4; 91)	6.352*** (df = 5; 90)	10.216*** (df = 4; 59)	0.080 (df = 3; 43)	4.653*** (df = 5; 90)

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Appendix 5: *Sensitivity of stock returns to currency and hedge ratio*

	MHG	NRS	LSG	BAKKA	GSF	AUSS	SALM	SSC	HBC	AKVA
OSEBX	1.024***	0.701*	0.810***	0.624**	1.436***	1.065***	0.626***	1.342	0.113	0.324
	(0.269)	(0.600)	(0.208)	(0.243)	(0.376)	(0.174)	(0.155)	(1.864)	(0.673)	(0.209)
TWI	0.480	1.483	0.145	1.649	2.815**	0.002	0.542	1.448	-0.198	0.624
	(1.293)	(1.08)	(0.773)	(0.818)	(1.241)	(0.741)	(0.653)	(0.741)	(1.902)	(1.040)
Hedge ratio company i	11.139*	-16.961	11.385	6.096	-89.432**	-5.897	0.027	NA	NA	-4.499
	(6.32)	(26.953)	(31.490)	(4.970)	(41.378)	(9.600)	(10.058)			(12.671)
Constant	-1.729	3.553	-0.365	1.642	4.484*	1.357	1.445	-0.659	-0.723	0.609
	(2.000)	(3.11)	(4.864)	(1.360)	(40.276)	(1.864)	(1.464)	(1.151)	(2.443)	(1.981)
Observations	84	44	84	56	84	84	84	52	35	84
R^2	0.310	0.093	0.233	0.159	0.318	0.405	0.201	0.366	0.002	0.031
Adjusted R^2	0.284	0.025	0.205	0.111	0.292	0.382	0.171	0.340	-0.061	-0.005
Residual Std. Error	12.350 (df = 80)	11.518 (df = 40)	10.637 (df = 80)	8.780 (df = 52)	15.653 (df = 80)	9.741 (df = 80)	8.727 (df = 80)	7.925 (df = 49)	13.006 (df = 32)	12.313 (df = 80)
F Statistic	11.974*** (df = 3; 80)	1.372 (df = 3; 40)	8.118*** (df = 3; 80)	3.283** (df = 3; 52)	12.431*** (df = 3; 80)	18.125*** (df = 3; 80)	6.702*** (df = 3; 80)	14.116*** (df = 2; 49)	0.028 (df = 2; 32)	0.857 (df = 3; 80)

Note: *p < 0.1; **p < 0.05; ***p < 0.01

Appendix 6: *Augmented Dickey-Fuller tests*

Balanced data set

Variables	ADF without trend	ADF with trend
log(Q-ratio)	-3.1389***	-3.1817*
log(Total assets)	-0.753	-2.3566
Leverage	-2.589**	-4.5368***
Investment Growth	-3.7504***	-4.5989***
ROA	-2.8416***	-3.1613*
Hedge.Ratio	-3.3722***	-4.3983***

Unbalanced data set

Variables	ADF without trend	ADF with trend
log(Q-ratio)	-4.2078***	-4.3302***
log(Total assets)	-0.753	-2.7292
Leverage	-4.7358***	-7.298***
Investment Growth	-5.0521***	-6.0686***
ROA	-4.0931***	-4.6442***
Hedge.Ratio	-3.6344***	-4.8312***

Variables	ADF without trend	ADF with trend
OSEBX	-5.766***	-5.781***
INDEX	-4.222***	-4.338***
MHG	-4.7778***	-4.9024***
LSG	-5.0835 ***	-5.2228***
SALM	-5.7181***	-6.0745***
AUSS	-4.7998***	-4.8011***
BAKKA	-1.7808*	-3.575**
GSF	-4.8781***	-4.923***
NRS	-3.0396***	-4.8818***
SSC	-4.4404***	-5.0079***
AKVA	-7.3322***	-8.1958***
HBC	-3.587***	-3.638**

Variables	ADF without trend	ADF with trend
TWI	-6.260***	-6.609***
NOKUSD	-5.1807***	-5.3485***
NOKEURO	-6.5106***	-6.5614***
DKKNOK	-6.8719***	-6.9927***
NOKGBP	-6.7958***	-7.614***
JPYNOK	-5.9316***	-5.9018***
Salmon Price	-6.7926***	-6.8862***

Note: $^{*}p < 0.1$, $^{**}p < 0.05$; $^{***}p < 0.01$