BI Norwegian Business School - campus Oslo

GRA 19502

Master Thesis

Component of continuous assessment: Thesis Master of Science

How Does a Fall in Oil Prices Affect Firm Performance Across Industries in an Oil Exporting Country like Norway?

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Start: 02.03.2017 09.00

Finish: 01.09.2017 12.00

Acknowledgements

We would like to express our genuine gratitude to our supervisor, Ignacio Garcia de Olalla Lopez. Our supervisor has been encouraging and very helpful throughout our thesis writing. We are very grateful for his input and constructive criticism.

We also appreciate the support and inspiration from our family and friends during our work with this thesis.

Date of submission: September 1st, 2017

Master of Science in Business with Major in Business Law, Tax and Accounting

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Executive Summary

The purpose of this thesis is to get insight into how the Norwegian economy is affected by changes in oil prices, with emphasis on the 2014 oil bust. We also study if this effect differs between Norwegian industries. We use data from all registered Norwegian firms in the period from 2000 to 2015.

We investigate how oil price changes affect the Norwegian economy, measured through firms' return on assets and return on equity, by using panel data regression analysis. We perform the same regression on all industries in Norway and investigate if industries' exposure to the oil price determines how they are affected by fluctuations in oil prices. We also include an analysis of bankruptcies in Norway during the period from 2000 to 2016 to further explore how changes in oil prices affect different industries. Finally, we investigate if negative shocks have a bigger impact on Norwegian industries than positive shocks, as proposed by the prospect theory.

Testing 41 396 Norwegian companies we find that the Norwegian firm performance, as a whole, will be affected by a fall in oil price. The coefficient for oil price changes is positive, which means that firm performance, collectively, decreases when the oil price decreases. For the Norwegian industries with a statistical significant relationship between percentage change in oil price and return on assets, the oil price coefficient is positive for every industry, except two. We find that for most industries consuming oil, the economic activity plays a determinant role along with the actual price of oil. When it comes to the number of bankruptcies in Norway during our sample period, we find evidence that bankruptcies tend to move in the opposite direction of the oil price. From our last analysis we find asymmetry in response to different oil price shocks. We find that a negative event has a statistically significant effect, and that a positive event is not statistically different than zero.

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1. Introduction and Motivation

The success story of the petroleum industry in Norway started back in mid 1960s, when the first production licenses were awarded. Over 50 years later, the industry is Norway's most important in terms of income to treasury, investments and share of total value creation. In 2015, the petroleum industry accounted for 15 percent of gross domestic product in Norway, approximately 20 percent of government revenues, and 39 percent of all exports (Regjeringen, 2016).

Since the beginning of the Norwegian petroleum industry's journey, there have been both booms and recessions. The spot price for *Nordsjøolje* is Brent Crude Spot, and as one can read from the graph below, the price for Brent Crude has both increased and decreased over the last 18 years.

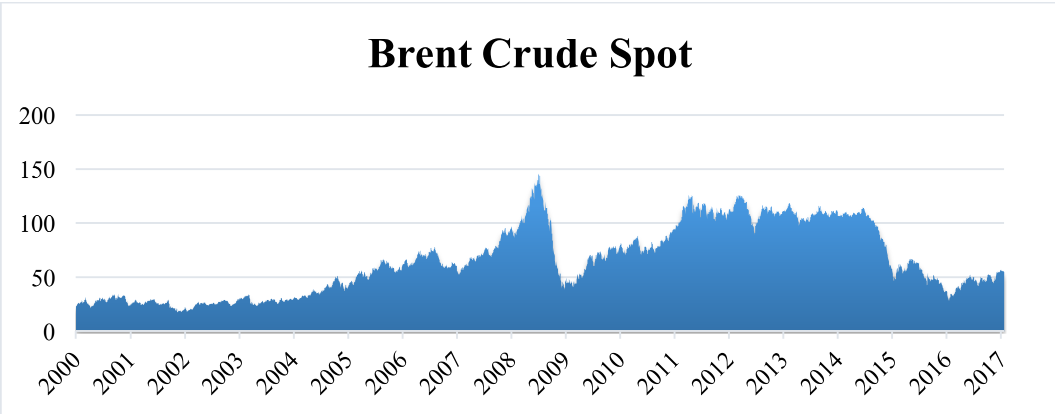

Figure 1- Brent Crude Spot, (source: Bloomberg)

From 2000 to 2008, the world experienced growing demand and stagnant supply. The economic growth at a global level was high during 2004 and 2005, with the real gross world product growing at an annual rate of 4.7 percent (Hamilton, 2011). World oil consumption grew with three percent annually at this time, while production did not grow further after 2005. These factors of demand were the key reason for the steady increase in oil price at the time. 2008 marked a new record for an all time high oil price at $147 per barrel. Then the financial crisis of 2008 hit, and oil prices fell to a low of $33 per barrel. In 2009, oil-producing countries started to reduce their oil production to maintain their revenue, which made the oil price rise gradually back to $80. In 2010, demand for oil began to grow quickly as the economic recovery from the financial crisis commenced. Prices continued to grow until a new peak of $128 in 2012, before stabilizing above $100 in 2013 (Planete Energies, 2015). The summer of 2014 marked the beginning of what we know today; the 2014 oil bust. During this oil bust, the crude oil prices started to decline significantly, and on January 20th, 2016 the crude oil price hit this cycle's bottom at $27.72 per barrel (Bloomberg). This was a decrease of 78 percent from the peak in 2014. In the second half of 2016 the crude oil price started to increase again, and has stabilized around $50-55 per barrel, possibly marking a turn in this oil bust.

Research Question

Oil price fluctuations have had a significant effect on the Norwegian economy, due to its contribution to value creation in gross domestic product. During the recent oil bust, unemployment in Norway has increased, the Norwegian Krone measured against other currencies has depreciated, and the actual growth in gross domestic product is lower than the expected growth. We see this as an opportunity to further explore how Norway is affected by changes in the oil price, with emphasis on the 2014 oil bust.

Previous research on positive and negative oil price shocks have found relationships between oil prices, stock markets and firms' performance. These studies have focused on macroeconomic variables and mostly on oil importing countries. However, the literature is scarce on oil exporting countries such as Norway. There is also considerable evidence of differences between industries, and we wish to see if this is also the case for an oil exporting country. Our contribution to the literature is to explore the effect of oil prices on firms' profitability within different industries, in an oil exporting country. Our main goal is to analyze:

> *How does a fall in oil prices affect firm performance across industries in an oil exporting country like Norway?*

2. Literature Review

Throughout modern history, oil has played a prominent part of economic and political developments of industrialized economies. Previous published literature has, amongst other things, focused on the relationship between oil prices and macroeconomic variables, impacts in different economies, the relationship between oil prices and stock markets, as well as asymmetry between positive and negative oil price shocks.

2.1 Oil Prices and the Macroeconomy

Considerable literature is devoted to the study of oil and its effect on macroeconomic variables. Especially the correlation between oil price movements and fluctuations in gross domestic product has been given a lot of attention. One of the most frequently mentioned studies is Hamilton's (1983) study which concluded that increases in oil prices are responsible for declines in real gross national product growth. Since this, his main findings have been subject for testing using alternative data and estimation processes.

Hamilton (1983) suggests that crude oil prices has had a strong influence on the United States business cycles well before 1973 (The OPEC Embargo[1]). He looked at the results from Sims' (1972) macro model, which found that an increase in oil prices over the period 1948-72, tended to be followed by decrease in real GDP growth. He found that seven out of eight postwar recessions in the United States was preceded by a significant increase in crude oil prices.

Gisser and Goodwin (1986) supported Hamilton's findings and saw that crude oil prices historically have had a significant effect on a broad range of macroeconomic indicators in the United States such as real GDP and real investment, both real and inflationary effects.

[1] In October 1973, the members of OPEC proclaimed an oil embargo and raised the oil prices with 200 percent. This embargo had major impacts on international relations and has later been viewed as the first big oil crisis (Office of the Historian, 2017).

In 1989, Mork challenged Hamilton's (1983) demonstration of a strong correlation between oil price changes and gross national product growth in the United States. His results supported Hamilton's for oil price increases, and he found that this also holds in the longer run.

Sadorsky (1999) found that oil prices and fluctuations in oil price both play important roles in affecting economic activity. Sadorsky also suggested a mutual causality between changes in oil prices and changes in economic activity, but did not find any statistical significant relationship over time.

Lee and Ni (2002) investigated the effects of oil price shocks on demand and supply in various industries and found that oil price shocks reduce supply in industries that have a large cost share of oil, while for other industries, oil price shocks mainly reduce demand. Narayan and Sharma (2011) supported Lee and Ni (2002) with their findings that oil prices affect firms differently according to their sector because of differences in oil consumption. Cappelen et al. (2014) have published an economic analysis of the effects on the Norwegian economy from a drop in oil prices. They propose that the individual sectors of the economy will be exposed to different influences by a decline in oil prices. Industries that have high exposure to the petroleum industry through deliveries, will experience the biggest negative shock in the short run. On the contrary, industries that have oil on the cost side might be expected to profit. A decline in oil prices could also benefit Norwegian exports, except for oil and gas (Cappelen et al., 2014).

2.2 Oil Prices and Stock Markets

If oil plays an important role in an economy, it is reasonable to expect oil price changes to be correlated with stock price changes. It has been shown in previous literature that oil price shocks have a statistically significant impact on real stock returns.

A theoretical link between oil prices and stock prices exists. Stock prices are the value of expected future cash flow discounted at a discount rate. Future oil prices may impact expected future cash flows and also possibly discount rates. Oil is a real resource and an essential input to production of many goods. Expected changes in oil prices cause changes in expected costs and therefore opposite changes in stock prices. According to Kim and Loungani (1992) oil is an input where increases in oil prices would depress collective stock prices for the world economy as a whole.

In 1996, Huang et al. studied the relationship between oil future returns and stock returns. The results showed that oil future returns lead to some individual oil company stock returns but not much on broad-based market indices.

Norway is an oil exporting country, and it is shown that Norway has a positive response to oil price increases on real stock returns (Park and Ratti, 2008). Park and Ratti found that oil price shocks have a significant impact on real stock returns in the same month, or within the next month.

2.2.1 Stock Market and Industry

A question that has been studied a lot is to what extent changes in oil price impact industries differently. Nandha and Brooks (2009) examined the relationship between oil prices and equity returns in the transportation sector. They found that oil price plays a big part in explaining the transportation sector returns for developed countries.

Arouri (2011) studied the European sector stock markets' response to changes in oil price and found that the strength of association between oil and stock prices vary greatly across sectors. In his study he found that there is a significant effect of oil price fluctuations on European sector stock prices, in the short-term. Further, he also found that oil price increases negatively affect sector returns in the following sectors; financials, food and beverage, health care, personal and household goods, technology, and telecommunications, and positively in; oil and gas, basic materials, and consumer service. However, his results suggest that there is no relationship between oil price changes and stock returns in industrials and utilities, and a weak negative relationship in the automobile and parts industry.

In 2011, Narayan and Sharma investigated the relationship between oil price and firm returns for United States listed companies. They found that oil price affects firms differently depending on their industry, and that there is strong evidence of lagged effects of oil price on firm returns. For energy and transportation they found a positive correlation between returns and oil prices. For the other industries; electricity, supply, manufacturing, food, chemical, medical, engineering, computer, banking, financial, real estate, and general services, they found a negative correlation with the biggest impact on banking, real estate, medical, food, and supply sector, respectively.

Efficient Capital Markets

The hypothesis on efficient capital markets is about to what extent the price of an asset at any given time reflects all available information about the fundamental value of that asset. This hypothesis was developed by the economist Eugene Fama who said that securities always trade at real value, which means that it is not possible for investors to make abnormal returns on their trading. There are three conditions behind the efficient capital market hypothesis. The first condition is rationality; if the assumption that all investors are rational holds, new information will cause all investors to adjust their estimates in a rational way and the price of the asset would change accordingly. Second, is independent deviation from rationality; some investors act on their optimism and others on their pessimism, and because of the assumption that there are equal numbers of optimistic and pessimistic investors, this will produce efficiency. The last assumption is that the arbitrage of professionals dominates the speculations of amateurs, leading markets to be efficient.

Jones and Kaul (1996) examined the relationship between stock markets and future real cash flow in reaction to oil price shocks. They found that the United States and Canadian stock markets are efficient in the way that the change in stock prices as a result of oil price shocks, can be completely accounted for by the impact on current and expected future real cash flows.

Profitability and Industry

Wattanatorn and Kanchanapoom (2012) examined the impact of crude oil prices on the profitability performance of different sectors. They used data from Thailand stock exchange in the period from 2001 to 2010, and found that the impact of oil prices on firms' profitability moves in the same direction as the impact of oil prices on stock returns. Thailand is an oil importing country, which in 2012 suffered from high crude oil prices. In this study they found that crude oil prices have a clear positive effect on the energy sector, but in controversy with Arouri (2011) they found a positive correlation with return on assets and oil prices in food and beverage.

2.3 Oil Prices and Asymmetry of Shocks

According to Kahneman and Tversky's (1979) prospect theory, an investor considering a risky investment will separately evaluate gains against losses. This theory assumes the investor's utility for gains exhibits the familiar risk-averse, concave line (Scott, 2015). Prospect theory assumes that an investor's loss aversion will lead to the rate of utility for loss being greater than the rate of utility for gain. This theory can relate to our research question looking at positive and negative oil price shocks. In light of the prospect theory, some conclude that negative shocks have a more pronounced effect than positive shocks because investors' behavior is more sensitive to bad news than good news (Sehgal and Kapur, 2012).

Mork (1989) looked closer at the possibility of asymmetric responses to oil price increases and decreases. He discovered that an asymmetry in responses is quite evident. In line with Hamilton (1983) he found that an increase in oil price will lead to a negative correlation with macroeconomic variables. Significantly different from this was responses to price decreases which had close to zero correlation with macroeconomic variables.

Further, in 1994, Mork and Olsen looked deeper into the asymmetry of response to oil price increases and decreases. They found that for most countries there were an adverse effect on the business cycle from oil price changes, looking at the oil price and GDP correlation. Oil price decreases tended to have positive effects, while oil price increases tended to have negative effects. However, for most countries, price decreases where not significantly different from zero. Mork and Olson concluded that the asymmetry was significant. From the seven OECD countries, Norway stood out as a net exporter of oil, where price changes in Norway had the opposite effect from the other countries. These results showed the same as in Mork 1989.

On the contrary, Huang et al. (1996) did not find evidence of asymmetric effects on the economy from oil price volatility shocks. Findings from Park and Ratti (2008) for the United States and Norway, also showed that there was little evidence of asymmetric effects on real stock returns of positive and negative oil price shocks.

3. Hypotheses

Based on our literature review, we use this section to formulate our hypotheses. Presumably, oil exporting countries will be affected differently than oil importing countries. According to previous research, there is evidence that oil price shocks affect firms differently depending on which industry the firm operates within. The reason for this is that different sectors in an economy have different exposure to influences from oil price changes. Based on what we have learned so far, we expect changes in oil price to affect the Norwegian firm performance collectively as an oil exporting country and have different impact across industries according to their oil exposure.

Our main hypothesis is that profitability in Norwegian firms collectively will move in accordance with oil price changes. Norway is a net oil exporting country, and will be negatively affected by oil price decreases (Mork and Olsen, 1994; Cappelen et al., 2014).

Oil related industries, which have high fixed costs and revenues based on the oil price, suffer from decreases in oil prices (Lee and Ni, 2002). After 2014, revenues shrunk while the fixed cost have remained the same. This lead to lower margins and, even further, unprofitable productions. Oil consuming industries will initially benefit from the decreased oil price. For example, in water transportation almost 40 percent of firms' operating costs consist of bunker costs (Glave et al., 2017), while for transportation by air, fuel expenses account for 30 percent (Hegnar, 2015). With oil being a major part of variable costs, a lower oil price is expected to contribute to higher profits.

We expect our findings to be in line with previous research on the relationship between oil price and stock markets, as found by Jones and Kaul (1996).

As a result of asymmetry in response to different oil price changes, we expect Norwegian oil related firms to have a significant correlation with positive oil price shocks in the oil-price-profitability correlation, and not a significant response to negative oil price shocks. On the contrary, we expected oil consuming firms to have significant correlation with negative oil price shocks in the oil-price-profitability correlation (Mork, 1989; Mork and Olsen, 1994; Huang et at., 1996; and Park and Ratti, 2008).

This leads us to believe that profitability within oil related and oil consuming industries will be affected by oil price changes in accordance to their relative consumption of oil. Based on this we formulate the following hypotheses we wish to test:

1. *There is a positive correlation between changes in oil price and profitability in Norwegian firms collectively, measured through return on assets and return on equity.*
2. *Industries will be affected to a different degree relative to their net revenue's and cost's exposure to oil price.*
3. *According to prospect theory, negative oil price shocks will have a bigger impact on Norwegian companies in total than positive oil price shocks.*

4. Data

In this section we describe how we clean the data, and the final sample population in detail. In order to make the panel data set balanced and remove extreme observations we use the statistical software STATA. We also present our variables, both those we tried and tested, as well as the ones we ended up using in the final models. In the end of this section, we present descriptive statistics of the data in order to give the reader an understanding of the sample.

4.1 Data Sources

The main data source is accounting data and figures gathered from the Center for Corporate Governance Research (CCGR) at BI. Our master thesis highly relies on accounting figures to calculate performance variables in order to assess firms' performance, as this is the core of our study. CCGR focuses on empirical research and studies Norwegian firms, and seeks to give insight into how the governance firms influences welfare of its stakeholders, which is decidedly suitable for our thesis (BI, 2017).

Other data, like a good proxy for oil prices, is gathered from the Bloomberg terminal at BI, and we supplement with data from Statistics Norway where we find it necessary.

4.2 Sample

The initial data set from CCGR consist of 478 249 Norwegian firms observed over 16 years from 2000 to 2015, leading us to have initially 3 461 962 observations. In the initial data set, we have access to the whole population of registered Norwegian firms in our time period, but we find it necessary to exclude various firms due to our use of regression estimation methods.

When using panel data regression models, it is desirable to have as complete data set as possible, leading us to exclude firms with missing data. This also includes eliminating all companies that are not active during the entire period. If we were to include missing data it could make our estimates skewed or even wrong, which in turn could lead to low validity in our conclusions (Bartholomew et al., 2008).

We have adjusted for extreme values by winsorizing at the first and 99th percentile, because most parametric statistics are sensitive to outliers. Since we base most of our analysis on ordinary least square, outliers will give highly skewed or even wrong conclusions, so it is necessary to treat this carefully.

Further, we are careful with holding companies and companies within corporate groups which only offer financing capital to companies within the same group. The reason for this is that such companies have no value-creating operations and, hence, are not exposed to fluctuations in oil prices as companies with proper operations within an industry. We have then excluded companies with neither revenues nor operating revenues. Firms that operate within finance and insurance are also excluded. These firms have different accounting standards than most other firms, and is not comparable with the rest of the sample.

When it comes to group companies, we have used the consolidated financial statement and excluded daughter companies' data in order to avoid double counting. Consolidated financial statements are the aggregated reports of separate legal entities. Each entity reports its own financial statement, but investors and other stakeholders find consolidated financial statements as the best suitable measurement of the company's overall position.

We only include firms with legal forms Limited companies; AS and Public limited companies; ASA. These are among the most common legal forms in Norway. We eliminate all other firms as they do not necessarily exhibit profit maximizing behavior, which is not the types of companies that we are interested in analyzing. Although we include only AS and ASA, there are very few companies excluded.

After removing extreme outliers and removing all firms that are not active throughout our sample period, we have a sample consisting of 39 272 firms.

4.3 Evaluating the Data

Our data set can be classified as secondary data, which has the advantage of being very time efficient, as we do not have to create the data ourselves. This allows us to focus on analyzing the data and interpreting the results. It also allows for longitudinal studies and to compare the analysis to previous research (Saunders et al., 2012).

The data may have been collected for another purpose than ours, leading it to possibly not be sufficient in order to answer our research questions or reach our objectives (Saunders et al., 2012). This is a disadvantage of using secondary data that we have to take into account.

To assess the overall suitability of the data, we evaluate whether the gathered data set from CCGR matches our needs, known as measurement validity, and whether it covers our desired population, time period, and variables required (Saunders et al., 2012). We wish to collect raw data (accounting figures) and process it ourselves in order to ensure that the data is comparable across firms and that there is consistency in how the performance measures are calculated. Using financial statements as raw data rather than pre-calculated ratios will give us more control and insight into the accounting figures determining the performance measures.

Assessing the reliability and validity of the data is crucial in order to evaluate precise suitability (Saunders et al., 2012). CCGR is considered a credible database, but there are some concerns we need to take into account which could lead to biases or imprecisions. One such thing is changes in accounting standards. Norwegian firms use the accounting standard International Financial Reporting Standards (IFRS). This standard involves different valuation principles, flexibility in estimating so called judgment posts and accounting practices, as well as in recognition of one-time items (Fardal, 2007). We need to consider this, as this can make numbers less comparable. IFRS has evolved over time. In 1998, a new accounting act and a comprehensive tax reform was introduced, and after 2005 firms are required to report their financial statements in accordance with IFRS (Berner et al., 2015). Accounting variables in IFRS are the same as the ones introduced after 1998, and therefore there are no issues with financial statements, using financial statements from 1999 and onwards (Berner et at., 2015).

In the data set, there are also cases of incomplete or missing information, due to incomplete reporting of accounting figures and company details. Another weakness in the data set is that figures from income statements and balance sheets are rounded to the nearest thousand. This might lead to somewhat inaccurate findings in our study. Nonetheless, our goal is to gain insight into how the Norwegian economy and Norwegian industries are affected by the petroleum industry, and with the number of observations that we have, we will get this insight.

Because we have eliminated all companies that are not active during the entire analysis period, we have excluded companies that have either gone bankrupt or have started their business during this period. This gives the data set a survivorship bias as we only look at companies that were successful enough to survive the last 16 years. This might lead to overly optimistic conclusions and we keep this in mind when doing the analysis. We control for this by doing an analysis of bankruptcies within each industry.

4.4 Variables

In order to isolate the effects of oil prices on performance, we control for other variables which could possibly impact return on assets and return on equity. As explanatory variables we try different measures for oil price fluctuations. Further, we include macro-specific variables and firm-specific variables, for instance year-specific effects. This is because we want to control for macroeconomic characteristics that directly impact profitability through economic activity, as well as firm characteristics that have an impact on performance. In *table 1* below we present variables we think may impact profitability.

TABLE 1

TESTED REGRESSION VARIABLES

Table 1 shows the dependent variables, the independent variables under study, as well as possible control variables such as macro-specific variables and firm specific variables.

NATURE OF VARIABLE	VARIABLE
Dependent variables	Return on assets Return on equity
Independent variables	Oil price Percentage change in oil price
Macro-specific control variables	Gross domestic product Percentage change in gross domestic product Interest rate
Firm-specific control variables	Total assets Age Revenues Operating income Net income Leverage (debt/equity) Equity ratio (equity/total assets)
Indicator Variables	Binary industry variables

4.4.1 Dependent variables

A way to examine performance of companies is to look at performance ratios and financial ratios. Financial ratios are tools for comparing and analyzing relationships between different parts of financial performance. Ratio analysis avoids problems arising when comparing companies of different size (Hiller et al., 2013). However, there is a problem when using ratios; different people and different sources do not necessary compute them in the exact same way, which can lead to different results. Therefore, it is highly important to carefully specify how you calculate your chosen ratios.

The focus of our profitability ratios is the bottom line; the net income. What these ratios have in common is that they, in one way or another, aim to measure how efficiently the firm uses its assets and how well the firm manages its operations (Hiller et al., 2013).

There are two ways to calculate financial ratios; either using adjusted or non-adjusted accounting figures. The adjusted approach gives a more accurate measure of the underlying economic value created by a firm (Barney, 2014). The reason for this is that by adjusting accounting figures, accounting numbers are normalized and non-recurring items are eliminated. Despite the advantages of the adjusted approach, we use the non-adjusted approach. The reason for this is the availability of data and the scope of data needed to perform our quantitative analysis in order to draw generalized conclusions. In addition, we believe that non-adjusted measures give the level of information needed to get the insight we seek with our thesis because we are studying causal relationships and not performing valuation of the firms.

We run two different models; the first with return on assets as the dependent variable, and the second with return on equity. The reason for doing two regression models is to strengthen our conclusions.

Return on assets measures how well a firm is generating profit by using their assets, ignoring how these assets are financed. This ratio is generally seen as a better measure of firm performance than pure income statement measures, because it allows to determine if the firm is generating adequate return on their assets. Return on assets is also unaffected by the potential distortion of different financing strategies (Hagel III et al., 2010). Return on assets is widely used in previous studies as a measure of firm profitability (Eriksen and Knudsen, 2003; Wattanatorn and Kanchanapoom, 2012; Fareed et al., 2016). Return on assets is calculated as:

$$ROA = \frac{Net\ Income}{\overline{\overline{Total\ Assets}}}$$

When comparing industries, return on equity might be a better measure than return on assets, because companies within different industries differ in their use of assets. Some firms are very asset-heavy while others are asset-light. Since we are analyzing firms in different industries and of different size, arguments could be made for using return on equity instead of return on assets (Loth, 2017). Bear in mind, return on equity is highly influenced by the amount of equity in a firm, hence the capital structure, which can vary both between firms and between industries. Return on equity is calculated as:

$$ROE = \frac{Net\ Income}{Total\ Equity}$$

Since return on assets is generally seen as a better measure of firm performance than measures that focus solely on income statement numbers, this is our main focus when doing the analysis (Palepu et al., 2004). However, since the companies in our sample differ a lot in their use of assets, we use return on equity as well, to strengthen our conclusions. Since these measures have different strengths and weaknesses, we believe that a combination of them gives the best indicator of firm performance of our sample.

4.4.2 Independent Variable

On the exchange for commodities there are different types of petroleum products being traded. Examples of spot prices on crude oil with immediate delivery are West Texas Intermediate (WTI) and Brent Crude (in Norway called: *Nordsjøolje*). Brent Crude is the most common crude oil, and this is also the focus of Norwegian media. Since we look at oil price changes' effect on Norwegian industries, we find it most suitable to use Brent Crude denominated in NOK as our approximation to oil price (Lee and Ni, 2002; Park and Ratti, 2008; Killian and Park, 2009).

Crude oil prices are affected by region for several reasons: the quality of the oil from different extraction regions varies, and there are diverse transportation costs and uncertainty in production and delivery. Brent Crude normally has higher transportation costs than WTI, which gives a higher Brent Crude price (Akram & Holter, 1996). Despite regional differences in oil prices, there are high correlations in price movements. According to Driesprong et al. (2007) there has been conducted studies using different oil prices' effect on stock returns, without finding any significant differences between the different oil prices.

We calculate the change in oil price as percentage change in yearly oil price, using the yearly median of Brent Crude Spot. The percentage change in oil price gives an understanding of which direction the oil price has moved, whether it has increased or decreased relative to the previous observation. As a robustness test to our variable, percentage change in oil price, we test our regression with the actual oil price.

4.4.3 Control Variables

We control for variables that we expect to have an impact on the dependent variables, because we want to avoid spurious regressions and only test the direct effect of oil price on firms' performance. We therefore find it suitable to control for macroeconomic factors that can impact firm performance, like gross domestic product, as this is correlated with oil prices (Hamilton, 1983, Gisser and Goodwin, 1986, Mork, 1989, and Sadorsky, 1999). As another macro-specific control variable we include interest rate. Interest rates influence the market, and its effect its unavoidable (Wattanatorn and Kanchanapoom, 2012). As our interest rate we use NIBOR (Norwegian Interbank Officer Rate), which is a collective term for Norwegian money market rates. We choose to use three months NIBOR as it is the most common nominal interest rate in Norway.

Among firm-specific variables, we control for firm age and size. We use total assets as a measure of size as this is commonly used in previous studies of firm performance (Rogers et al., 2010, and Cudia and Manaligod, 2011). We use the natural logarithm of these variables as both age and total assets are often positively skewed and transforming them to natural logarithms gives them a normal distribution (Joh, 2003; Wattanatorn and Kanchanapoom, 2012).

We also control for firm's leverage, which is calculated as debt divided by equity. Return on equity does not take leverage into account, but it has been shown that leverage impacts firm performance which is why we may want to include it (Qureshi, 2009; Fareed et al., 2016). Both leverage and other firm-specific control variables, such as revenue, net income, and equity, correlate with our dependent variables. We deal with this problem by lagging these variables with one year (Yazdanfar, 2013).

4.5 Descriptive Statistics

The sample consists of 39 272 firms observed over 16 years. We have cleaned the data, giving us a balanced data set required for cross sectional fixed effects panel data regression.

TABLE 2

DESCRIPTIVE STATISTICS

Panel A

Sample distribution

Country	No. of obs.	No. of firms	No. of years	No. of positive shocks	No. of negative shocks
Norway	628 352	39 272	16	3	3

Panel B

Summary Statistics

Variable	No. of obs.	Mean	Median	Standard deviation	Minimum	Maximum
Return on assets	628 352	0,06	0,06	0,22	-2,35	1,77
Return on equity	628 352	0,37	0,19	1,33	-7,81	10,09
Oil price NOK	628 352	422,22	421,65	159,14	196,39	648,46
Percentage change in oil price	628 352	0,11	0,11	0,29	-0,50	0,59
GDP	628 352	362 000m	38 700k	121 000m	171 000m	523 000m
Percentage change in GDP	628 352	0,06	0,12	0,12	-0,22	0,17
3M NIBOR	628 352	3,33	2,42	2,18	0,99	jan.00
Total assets	628 352	21 600k	3 781 000	72 930k	14 000	599 000k
Age	628 352	18,66	16,00	14,52	0,00	163,00
Revenues	628 352	16 900k	3 103 000	40 900k	0,00	226 000k
Operating income	628 352	4 611 337	316 000	22 500 000	-4 674 000	175 000k
Net income	628 352	10 067k	185 000	3 841 562	-7 262 000	27 300 000
Leverage	628 352	3,64	2,02	12,90	-55,62	139,19

TABLE 3
CORRELATION MATRIX

	ROA	ROE	oil price NOK	change-price	GDP	change GDP	3M NIBOR	TA	age	revenue	operating income	net income	leverage
ROA	1,00												
ROE	0,25	1,00											
Oil price NOK	-0,01	-0,06	1,00										
Changeprice	0,03	0,02	0,07	1,00									
GDP	-0,01	-0,06	0,98	0,04	1,00								
Change GDP	0,03	0,04	-0,19	0,89	-0,20	1,00							
3M NIBOR	0,00	0,02	-0,45	0,15	-0,51	0,36	1,00						
TA	-0,01	-0,03	0,05	-0,02	0,05	-0,03	-0,03	1,00					
Age	-0,02	-0,05	0,26	-0,09	0,26	-0,16	-0,20	0,09	1,00				
Revenues	0,02	0,00	0,06	-0,02	0,07	-0,03	-0,04	0,62	0,05	1,00			
Operating income	0,03	0,01	0,02	0,00	0,02	-0,01	-0,01	0,65	0,06	0,63	1,00		
Net income	0,21	0,10	0,05	-0,01	0,05	-0,02	-0,04	0,64	0,07	0,54	0,57	1,00	
Leverage	0,02	-0,10	-0,06	0,02	-0,06	0,03	0,03	0,02	-0,04	0,02	0,00	-0,01	1,00

5. Methodology

This chapter describes our choice of methodology in order to conduct our study. We begin with formulating our research design, which gives an overall plan for how we address our research question. Then, we talk about the statistical methods of choice, and the various techniques for analyzing data.

5.1 Research Design

Research design provides the framework for collection of data and its analysis (Ghauri & Grønhaug, 2010). It is crucial to achieve coherence throughout the whole study when formulating the research design (Saunders et. al, 2012). This means that the choices we make in our research design needs a well-defined connection to our research question and objectives with analyzing the data.

With deeper understanding of the data, our research problem has changed and developed during our study. The access of data played a determinant role in the choice of analysis tools and research techniques. The purpose of our thesis is to get further understanding of how the Norwegian economy is reliant on its most important industry – the petroleum industry, by looking at the Norwegian economy. We also investigate how industries are contingent on oil prices. Because we aim to develop hypotheses based on existing theory, we use a deductive approach.

In order to answer our research question, we conduct our analysis on two levels. First, we analyze the oil price's effect on the Norwegian firms, seeking to get insight into whether fluctuations in the oil price has a significant effect. Then we analyze oil price changes on industry level.

5.1.1 Choice of Research Methodology

There are two main types of methodology to use when conducting a research; qualitative and quantitative. When conducting our study, we use a quantitative research methodology. Quantitative methods are appropriate when testing theories, and it gives an overview of a larger area, but in less detail. The use of quantitative methods allows for generalization of results, which is one of the main advantages of conducting a quantitative research. Quantitative analysis is also used to draw conclusions about causal relationships by attempting to find out if one or more independent variables, or cause variables, affect a dependent variable or output variable.

5.2 Regression Analysis

There are several frameworks, regression models and techniques to use when performing a quantitative study. In the following section, the most relevant regression models and techniques are presented. The relevance of our models is dependent on significance levels, and how well they fit. We run the regressions using panel data techniques.

After testing the average effects oil price have on firm performance in the Norwegian economy, we analyze industry by industry. Doing this, we run our main regression model on industries to investigate the effect of changes in oil price in that particular industry. Here we also use panel data regression models.

5.2.1 Panel Data

The data set includes both time-series and cross-sectional data meaning that we have a panel. Panel data includes observations on the same variables from the same cross sectional sample from two or more different time periods (Studenmund, 2011). When dealing with more than one time-period, panel data regression is a suitable tool for estimating a regression and analyzing how changes in the dependent variable are explained by the independent variables. Panel data refers to data for n different entities observed at T different time periods (Stock and Watson, 2015). When using panel data, it is favorable to have subscription describing which entity and time-period at which the observation is made. It is common to denote this as Y_{it}, where i refers to the i^{th} of n entities, and t refers to the t^{th} of T time periods:

$$(X_{it}, Y_{it}), i = 1, \ldots, n \; and \; t = 1, \ldots, T$$

Fixed Effects Regression Model

Fixed effects regression is a method for controlling for omitted variables in panel data regression when the omitted variables occur across entities and not time. Fixed effects regression models have n-1 binary variables, and thus make it possible to absorb the influence of all omitted variables that differ across entities but are constant over time (Stock and Watson, 2015). We can denote the fixed effects regression model as:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_i + u_{it}$$

Here, Z_i is an unobserved variable that changes from one state to the next, but does not vary over time. When estimating a regression using fixed effects regression we seek to estimate β_1, the effect of a unit change in X on Y holding Z constant. When interpreting such a regression, it can be viewed as having n intercepts, one for each state. If we let $\alpha_I = \beta_0 + \beta_2 Z_i$ the fixed effects regression with multiple independent variables is expressed as:

$$Y_{it} = \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \alpha_i + u_{it}$$

In this fixed effects regression model, α_1, …, α_n are unknown intercepts to be estimated for each state. α_i can be thought of as the effect of being in entity i. The variation in this entity's fixed effects comes from omitted variables that, like Z_i, vary across entities but not time (Stock and Watson, 2015).

When developing the fixed effects regression model it is also possible to use binary variables to denote the individual states. Introducing binary variables into the fixed effects regression models can be done by including n-1 binary variables in order to avoid the dummy variable trap. Binary variables are commonly denoted as Dn_i, where i=1, …, n and n=1, …, n-1. Accordingly, the fixed effects regression model can be written as:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \gamma_2 D2_i + \gamma_3 D3_i + \cdots + \gamma_n Dn_i + u_{it}$$

Where β_0, β_1, γ_2, …, γ_n are unknown coefficients which are to be estimated. Ordinary least square is one way to estimate a fixed effects regression model in an econometric software package like STATA.

The fixed effects regression model assumes correlation between the entities' error term and predictor variables. One assumes that some individual characteristic within the entity may impact or bias the predictor or outcome variables, and this needs to be controlled for. The fixed effects model removes the effect of these time-invariant characteristics, allowing us to measure the net effect of the predictors on the outcome variable (Princeton, 2007).

Time fixed Effects Regression Model

Another way of estimating panel data regression is to use time fixed effects regression. Time fixed effects control for variables evolving over time but that are constant across entities (Stock and Watson, 2015). Time effects are denoted as $\beta_k S_t$, and the goal is to estimate β_1, controlling for S_t. S_t is unobserved, but its influence can be eliminated because it changes over time and not within states. The time fixed effects regression model with more than a single X regressor can be written as:

$$Y_{it} = \beta_1 X_{it} + \lambda_t + u_{it}$$

Where $\lambda_t = \beta_0 + \beta_2 S_t$ where t=1, …, T. This model has a different intercept, λ_t, for each time-period. Time fixed effects regression model can also be developed using n-1 binary variables representing T-1 binary indicators:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \delta_2 B2_t + \cdots + \delta_T DT_t + u_{it}$$

Where δ_2, …, δ_T are unknown coefficients

Both Entity and Time fixed Effects - Random Effects

It is also possible to have variables that are constant over time but varies within states and other variables which are constant within states but varies across time-periods, leading to the development of the combined entity and time fixed effects regression model (Stock and Watson, 2015), which can be written as:

$$Y_{it} = \beta_1 X_{it} + \alpha_i + \lambda_t + u_{it}$$

This model can also be represented using n-1 entity binary indicators and T-1 time binary indicators, and the model can then be written as:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \gamma_2 D2_i + \gamma_3 D3_i + \cdots + \gamma_n Dn_i + \delta_2 B2_t + \cdots + \delta_T DT_t + u_{it}$$

Assumptions Behind Fixed Effects Regression

There are four assumptions behind fixed effects regression, extending the assumptions behind ordinary least squares estimation (Stock and Watson, 2015):

i. u_{it} has conditional mean zero: $E(u_{it} \mid X_{1,it}, X_{2,it}, \ldots, X_{k,it}, \alpha_i) = 0$.
ii. $(X_{1,it}, X_{2,it}, \ldots, X_{k,it}, u_{i1}, u_{i2}, \ldots, u_{iT})$, $i = 1, \ldots, n$ are identically and independently distributed (i.i.d.) draws from their joint distribution.
iii. Large outliers are unlikely: (X_{it}, u_{it}) have nonzero finite fourth moments.
iv. There is no perfect multicollinearity.

5.2.2 Ordinary Least Square

There are several ways to estimate values of the regression coefficients β and one of the most commonly used for linear regression models is ordinary least square (OLS). This approach aims to minimize the sum of squared deviation of the estimated regression and the actual observations. The error term ε captures the difference between estimated values and observed values.

Assumptions Behind Ordinary Least Square

In order to use a linear regression model to perform statistical tests there are several assumptions that need to be met (Stock and Watson, 2015):

i. $E(\varepsilon_t) = 0$. The expected value of the error term is zero.

ii. $Var(\varepsilon_t) = \sigma^2\varepsilon < \infty$. The variance of the error term must be constant and less than infinity. This assumption says that the residuals are homoscedastic, hence no heteroscedasticity.

iii. $Cov(\varepsilon_i, \varepsilon_{j,}) = 0$. No correlation between the error terms, hence no autocorrelation.

iv. $Cov(\varepsilon_t, X_t) = 0$. The explanatory variables are non-stochastic.

v. $U_t \sim N(0, \sigma^2)$. The error terms are Normally distributed.

If the abovementioned assumptions hold, OLS will have the desired attributes. The attributes sought when using OLS is best linear conditionally unbiased estimator (BLUE) (Stock and Watson, 2015):

- **B**est: the β-estimates in OLS has the smallest variance of all linear unbiased estimators.
- **L**inear: the estimates of $\hat{\alpha}$ and $\hat{\beta}$ are linear.
- **U**nbiased: the estimates of $\hat{\alpha}$ and $\hat{\beta}$ will on average be equal to the actual values of α and β.
- **E**stimators: $\hat{\alpha}$ and $\hat{\beta}$ will be the best estimators for the actual values of α and β.

Multicollinearity

An implicit assumption of the regression model is that there is no perfect multicollinearity, which means that the independent variables are not correlated with OLS estimation (Stock and Watson, 2015). There should be an orthogonal relation, and a perfect linear relationship between the independent variables should not exist. Perfect multicollinearity is a problem because you are asking the regression an illogical question. The regression coefficient explains how a change in the effect of that regressor, holding the other regressors constant, affects the dependent variables, leading the estimation to be skewed or even wrong if perfect multicollinearity occurs. In order to make sure our regression estimation does not suffer from multicollinearity we can run tests such as the Variance Inflation Factor-test and look at the correlation coefficients of variables.

5.2.3 Hypothesis Testing

Testing hypotheses about one of the regression coefficients is used to draw conclusions about whether a coefficient is statistically significant or not. When doing hypothesis testing one need a confidence interval in order to know when to reject the null hypothesis. A commonly used confidence interval is the 95 percent, which means that the formulated null hypothesis will hold with at least 95 percent probability. Performing a hypothesis test involves the formulation of a null hypothesis (H_0) and an alternative hypothesis (H_A). The null hypothesis involves testing whether a coefficient is zero, with the alternative hypothesis that it is non-zero.

When testing a hypothesis, we can use a t-test. A t-test is a common test where the aim is to find how many standard deviations the models' estimates is from the null hypothesis. T-values are defined as the relationship between the estimated coefficient and the null hypothesis, divided by the standard error:

$$t = \frac{\hat{\beta} - \beta_{H_0}}{SE_{\beta}}$$

We are testing the t-value against a 95 percent confidence interval, which means that we can reject the null hypothesis with a 95 percent probability. The confidence interval can be calculated as:

$$\hat{\beta} \pm 1.96 * SE(\hat{\beta})$$

F-value is another method that can be used in testing the properties of the regression. F-value can replace t-value when there is more than one independent variable in the regression. F-value can be calculated as:

$$F = \frac{(\frac{RSS_1 - RSS_2}{p_2 - p_1})}{(\frac{RSS_2}{n - p_2})}$$

RSS_i = residual sum of squares of model *i*

P-value is also a common way to test hypotheses as it is the given value of the level of significance where the null hypothesis can not be rejected. A P-value below 0.5 is equivalent to rejecting the null hypothesis at a 95 percent confidence interval. This measurement of fit gives more insight to the significance level of an estimated regression coefficient.

5.2.4 Difference-in-Difference

Difference-in-difference analysis is a statistical technique commonly used in quantitative research. The aim of performing such an analysis is to compare the effect of some treatment on a *treatment group* against a *control group* (Abadie, 2005). The comparison is done by comparing the average effect in the treatment group over time with the average effect in the control group before and after a treatment is given. Consider the model:

$$y_{ist} = \gamma_s + \lambda_t + \delta D_{st} + \varepsilon_{ist}$$

where y_{ist} is the dependent variable for individual i, given s and t. s and t are dimensions indicating entity and time. γ_s and λ_t are the vertical intercept for s and t. D_{st} is the indicator variable indicating treatment status, with δ as the treatment effect. ε_{ist} is the error term. The difference-in-difference estimate is:

$$\widehat{\delta_1} = \left(\overline{y_{B,2}} - \overline{y_{B,1}}\right) - \left(\overline{y_{A,2}} - \overline{y_{A,1}}\right)$$

Assumptions

For difference-in-difference estimation all the assumptions of Ordinary Least Squares apply equally. Further, difference-in-difference requires an assumption called parallel trend assumption. This assumption says the $\lambda_2 - \lambda_1$ are the same in both s=1 and s=2. The treatment effect will be the difference between observed values of y and what the value of y would have been with parallel trends if treatments had not occurred. In order to have an accurate difference-in-difference estimate, the individuals in the two groups are assumed to remain unchanged over time.

5.2.5 Choice of regression

The data set contains both different time periods and different entities, and is a panel data set. Therefore, it is desired to use panel data regression models. When estimating this regression model, we chose to use the ordinary least square estimation method as it is most common to use. We control for all time-invariant differences between firms, because we are interested in analyzing the impact of variables that vary over time, which is why we chose to use fixed effects regression models. This allows us to control for variables that differ between firms, but are constant over time, such as industry.

6. Empirical Results

In this section we have incrementally tested our hypotheses. We use this section to present our results and analyze them.

6.1 Background

The first panel data regression, *model (1),* has return on assets as the dependent variable, and the second, *model (2),* has return on equity as the dependent variable. We use percentage change in oil price, changeprice, as the independent variable because this captures the changes in Brent Crude Spot. This is more interesting than the actual price, as we wish to explain how return on assets responds to changes in the oil price. As a robustness test, we run the same regressions using the actual oil price instead of change in oil price and get very similar results.

When regressing return on assets and return on equity we control for change in gross domestic product, interest rate, size, leverage and age.

$$ROA_{it} = \beta_0 + \beta_1 changeprice_t + \beta_2 l.changeGDP_t + \beta_3 3MNIBOR_t + \beta_4 lnTA_{it} + \beta_5 l.leverage_{it} + \beta_6 lnage_{it} + u_{it}$$

$$ROE_{it} = \beta_0 + \beta_1 changeprice_t + \beta_2 l.changeGDP_t + \beta_3 3MNIBOR_t + \beta_4 lnTA_{it} + \beta_5 l.leverage_{it} + \beta_6 lnage_{it} + u_{it}$$

6.2 The Effects of Oil Price Changes on Firm Performance

The models are presented in table 4 below. We use fixed effects in order to control for all time-invariant differences between the individuals. We study the causes of changes within industries in the Norwegian economy. Using this method, we eliminate unobservable variations between firms that do not vary over time.

Our findings in *model (1)* indicate a statistical significant positive relationship between percentage change in oil price and firm performance within the Norwegian economy. *Model (2)* supports our findings for *model (1)*. In both regression models the coefficients of changeprice are significant at a one percent level. We would have been satisfied at a five percent level.

The results from both models confirms our hypothesis 1, that changes in the oil price and firm performance, measured through return on assets and return on equity, are positively related. This indicates that a decrease in oil price decreases firm performance collectively, in Norway, supporting previously published work.

With a one-year lag for changeprice, the coefficient in our *model (1)* increases. The main reason for this is that a positive change in oil price affects both net income and total assets positively, with the largest effect on total assets. When oil prices are low, or even characterized as a negative shock, in an oil exporting country, businesses tend to postpone their investments (Ferderer, 1996). When businesses do invest in assets, it usually takes some time to implement those assets into their operation in order for the assets to generate increased profits. This leads to return on assets increasing when doing the model with a one-year lag on the oil price.

TABLE 4

EFFECTS OF CHANGES IN OIL PRICE ON FIRM PERFORMANCE

Table 4 presents the average effect each variable has on firms' performance. There are two dependent variables defined as return on assets: net income over total assets, and return on equity: net income over equity. The independent variable percentage change in oil price is controlled for firm-specific and macro-specific variables as defined in Data. *** represents a significance level of 1 % ** represents a significance level of 5 % and * represents a significance level of 10 %

Dependent variable	(1)	*1.lag*	(2)	*1.lag*
	ROA	*ROA*	ROE	*ROE*
Explanatory variable				
changeprice	0.0071***	*0.0262****	0.0389***	*-0.0129**
	(0.0013)	*(0.0015)*	(0.0061)	*(0.0084)*
Control variables				
l.changeGDP	0.0560***	*0.0400****	0.2198***	*0.0445***
	(0.0030)	*(0.0032)*	(0.0134)	*(0.0136)*
3M NIBOR	-0.0005**	*0.0008****	-0.0159***	*-0.0128****
	(0.0002)	*(0.0002)*	(0.0009)	*(0.0011)*
lnTA	0.0619***	*0.0659****	0.0805***	*0.0892****
	(0.0019)	*(0.0020)*	(0.0042)	*(0.0046)*
l.leverage	-0.0001***	*-0.0001****	0.0062***	*0.0027****
	(0.0000)	*(0.0000)*	(0.0003)	*(0.0002)*
lnage	-0.0285***	*-0.0426****	-0.3223***	*-0.4078****
	(0.0019)	*(0.0020)*	(0.0073)	*(0.0077)*
Constant				
	-0.8020***	*-0.8267****	0.0258***	*0.1587***
	(0.0257)	*(0.0277)*	(0.0622)	*(0.0664)*

6.3 Firm Performance within Each Industry

In order to isolate the effect of percentage change in oil price on firms' performance within specific industries, we run our regression *model (1)* on each industry in Norway and examine the significance levels of the changeprice variable. Table 5 presents the change in oil price regression coefficient for different industries, its standard deviation, and the level of statistical significance. Out of the 80 industries in our sample, we find significant results for 30 industries.

TABLE 5

EFFECTS OF CHANGES IN OIL PRICE ON FIRM PERFORMANCE, INDUSTRY

Table 5 presents the average effect of percentage oil price change on firms return on assets within each industry in the Norwegian economy. *** represents a significance level of 1% ** represents a significance level of 5% and * represents a significance level of 10%. The table only include the statistically significant results.

A	AGRICULTURE, FORESTRY AND FISHING	3	Fishing and aquaculture	0.0327** *(0.0149)*
B	MINING AND QUARRYING	6	Extraction of crude petroleum and natural gas	0.0892*** *(0.0248)*
C	MANUFACTURING	11	Manufacture of beverages	-0.0494* *(0.0272)*
		14	Manufacture of wearing apparel	0.0543* *(0.0210)*
		18	Printing and reproduction of recorded media	0.0349* *(0.0193)*
		22	Manufacture of rubber and plastic product	0.0522*** *(0.0200)*
		25	Manufacture of fabricated metal products, except machinery and equipment	0.0496*** *(0.0109)*
		27	Manufacture of electrical equipment	0.0668** *(0.0271)*
		28	Manufacture of machinery and equipment n.e.c.	0.04126*** *(0.0108)*
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT	37	Sewerage	0.0974** *(0.0422)*
F	CONSTRUCTION	41	Construction of buildings	0.0111* *(0.0063)*
		43	Specialized construction activities	0.0161*** *(0.0040)*
G	WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	45	Wholesale and retail trade and repair of motor vehicles and motorcycles	0.0130** *(0.0056)*
		46	Wholesale trade, except of motor vehicles and motorcycles	0.0198*** *(0.0043)*
H	TRANSPORTATION AND STORAGE	49	Land transport and transport via pipelines	0.0227*** *(0.0082)*
		52	Warehousing and support activities for transportation	0.0474*** *(0.0113)*
J	INFORMATION AND COMMUNICATION	58	Publishing activities	0.0563*** *(0.0150)*
		62	Computer programming, consultancy and related activities	0.0527*** *(0.0153)*
		63	Information service activities	0.1072* *(0.0579)*

M	PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	69	Legal and accounting activities	0.0271*** *(0.0067)*
		71	Architectural and engineering activities; technical testing and analysis	0.0457*** *(0.0084)*
		73	Advertising and market research	0.0843*** *(0.0233)*
		74	Other professional, scientific and technical activities	0.0350* *(0.0192)*
N	ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	77	Rental and leasing activities	0.0330** *(0.0143)*
		79	Travel agency, tour operator and other reservation service and related activities	0.0504** *(0.0248)*
		81	Services to buildings and landscape activities	0.0286* *(0.0152)*
P	EDUCATION	85	Education	0.0836*** *(0.0188)*
R	ARTS, ENTERTAINMENT AND RECREATION	93	Sports activities and amusement and recreation activities	0.0417* *(0.0239)*
S	OTHER SERVICE ACTIVITIES	94	Activities of membership organizations	-0.0645* *(0.0380)*
		96	Other personal service activities	0.0214** *(0.0107)*

The main result is, as expected, that oil prices affect firms differently across industries both in terms of magnitude and significance level. Regression alone can not determine causality but it can determine positive or negative relationships between the variables under study. For the majority of industries with statistically significant results, the changeprice coefficients show a positive relationship with firm performance, measured through return on assets. Only for two industries there appear to be a negative relationship. Further, we look into these results to answer hypothesis 2.

Agriculture, forestry and fishing sector

For industry 3; fishing and aquaculture, a decrease in oil price has a negative effect on profitability, at a five percent significance level. This is in line with both theory and expectations from media. When the oil price decreases, it leads to a deflation in fuel prices, which makes more fishing possible and in turn increases supply. However, according to Pauly and Zeller (2016), the global fish harvest is experiencing overfishing. The recent growth in demand for seafood has been one of the major drivers behind this overfishing. Overfishing means oversupply, which is bad for market balance as it can reduce the profitability in the industry. There is a possible explanation for why we are experiencing overfishing; fishing vessels has a break even, and moving beyond this point is not economically sustainable. Thus, a lower oil price leads to an imbalanced fishing and aquaculture industry, which has a negative effect on this industry, and vice versa.

Oil and Gas

For for industry 6; extraction of crude petroleum and natural gas, the coefficient of the oil price variable is positive and statistically significant at a five percent level, showing that an increase in oil price will lead to an increase in profitability. This result is expected, as higher oil prices mean higher profit margins. This is also in line with previous studies on oil price and stock returns: Arouri (2011), Narayan and Sharma (2011), and Wattanatorn and Kanchanapoom (2012). The drop in oil prices in 2014 led to restructuring, downsizing, reduction in oil investments, and requirement for improved efficiency in this industry. When lagging these results, the effect becomes smaller, indicating that such restructuring is working.

Manufacture Sector

For industry 11, we find a negative relationship between profitability and changes in oil price. For other industries within manufacturing; 14, and 18, we find a positive relationship between profitability and oil price changes. With oil being an important input in most manufacturing, the result for industry 11 is as expected, as profitability will increase when the oil price decreases because of lower costs. Our findings for industries 14 and 18 can be explained by a decreased demand for manufacturing products as a result of lower activity in the Norwegian market. As a result of the lower oil price, there has been a reduction of households' income from 2014 to 2015 leading households to have less income to spend (Statistics Norway, 2016). Even though these industries might experience lowered costs, the lower oil price does not seem to compensate for the lower activity.

Further, for industry 22, 25, 27 and 28 there is a statistically significant positive relationship at a five percent and one percent level. These results can also be explained by decreased demand. Numbers from Statistics Norway show that these industries are more dependent on selling their products to businesses within the oil industry than they are of oil as an input in production. When the oil price dropped in 2014, participants in the petroleum industry focused on driving operational efficiencies by reducing costs. One measure taken after the 2014 oil price bust was downsizing. As a result of declining oil price, activity in the oil industry will decline as well, leading to lower demand for manufacturing products. This will be partially offset by lower manufacturing expenses, but will not counteract the effect of lower demand.

Other studies have found negative correlation for these industries for OECD countries (Arouri, 2011; Narayan and Sharma, 2011). As Norway is an OECD country, it would have been reasonable to expect the same results. However, Norway stands out from the other member countries as a net oil exporter, possibly explaining the deviation (Mork and Olsen, 1994).

Sewerage

For industry 37; sewerage, we find a positive and statistically significant relationship between profitability and changes in oil price at a five percent level. Sewerage is a part of public spending through infrastructure. As we have seen from our first analysis, the profitability collectively decreases in Norway with a decrease in oil price. It is then further reasonable to expect sewerage to be positively correlated with the oil price as infrastructure and public spending will follow the economic activity. However, infrastructure is also a subject to politics, which is why we choose not to go further into this industry.

Construction Sector

Industries 41 and 43; construction of buildings; and specialized construction activities respectively, have positive coefficients for changes in oil price. When the oil prices decrease, this industry will experience a decrease in profitability, and vice versa. Several companies report that due to the lower price of oil, growth has declined in recent years. This can be explained by the fact that the recent drop in oil price has affected demand for construction considerably and created uncertainty and a cautious approach with regard to purchasing new construction projects. In addition, downsizing in the oil service industry has led to a decrease in the need for commercial buildings. It is worth mentioning that development of public infrastructure is often used to compensate for lower economic activity, possibly explaining the low coefficients. Even though these industries are dependent on oil as an input, they are more dependent on selling their services to the oil industry, leading to a net negative effect of a lower oil price (Statistics Norway).

Wholesale

There is a conceivable causal relationship between oil price and return on assets within the wholesale industries 45 and 46. The changeprice coefficient is positive and statistically significant at a five percent and one percent level, respectively. These industries are assumable indirectly affected by oil price changes through economic activity in Norway. However, Norway is seeing historically low interest rates, which encourage more spending and less saving. A possible explanation for the low interest rates is that one of the instruments Norges Bank can use in order to reach Norway's target inflation of two and a a half percent[2], is the interest rate. When Norges Bank deflates the interest rate, consumption will increase and savings will decrease according to macroeconomic theory and monetary policy (Steigum, 2014). This may explain why these coefficients are amongst the lowest.

Transportation

For companies operating within transportation, industry 49 and 52, the oil price coefficient shows a positive relationship between profitability and changes in oil price, at a one percent significance level. Lee and Ni (2002) found that industries will be affected relative to their consumption of oil. Looking at the transportation industry we find that they consume oil through fuel. However, their demand is also indirectly affected by fluctuations in oil price as the general activity in the Norwegian economy decreases. First of all, oil prices affect demand. In most segments, demand will fluctuate in accordance with the world economic activity as well as oil prices. Lower oil prices lead to lower or even more volatile demand which has a negative effect on this industry. This may explain why the changeprice

[2] In 2001, the current inflation target regulation for monetary policy in Norway was established. The target is that average inflation is 2½ percent (Finansdepartementet, 2017).

coefficient is small. These results are in line with Narayan and Sharma (2001) who found a positive relationship between oil prices and the transportation industry. Nandha and Mohanty (2011) also found positive correlations within the transportation sector in the United States. In addition, they found that companies within transportation are less exposed to oil price changes than expected, which can explain why the correlation is positive. One can also assume that companies with high exposure to oil price, will use various risk managing strategies, for example hedging against oil price risk, which will make them less sensitive to oil price fluctuations.

Technical Services

Industries 69, 71, 73, 74 and 81 can all be classified as technical services. Our results show a positive relationship between oil price changes and profitability for all these industries at one and ten percent significance levels. Industries within technical services are also dependent on delivering their services to the oil industry, (Statistics Norway). Because of lower activity in the petroleum industry, these industries have reported lower margins the last years like we found for parts of the manufacturing industry and construction industry.

Others

In the case of industries 58, 62 and 63, within information and communication, we find a strong, positive relationship between profitability and oil price changes. This is surprising, as we would not expect these industries to have much significant relationship with the oil price. Industry 58; publishing activities, is highly subsidized by the state, making an analysis of this industry less interesting. This leads us to believe that our results might be due to a spurious relationship. A spurious relationship is where two variables appears to have a cause-effect relationship, but are in fact not causally related to each other. This might be due to a third underlying variable, or merely because of coincidence.

Firms are facing challenges because of digitalization, which increases activity within industries 62 and 63; computer consultancy and information service activities. It is reasonable to assume that this digitalization is mainly impacted by technological innovation, rather than oil price fluctuations. We assume this because demand for digital solutions is increasing, and has been over the past years. However, it is also possible that firms invest more in computer systems when the profitability is higher, possibly explaining some of our results.

For industry 77; rental and leasing activities, there is a positive relationship between oil price and profitability, which is statistically significant at a ten percent level. This was somewhat surprising when looking at car leasing for instance, because when oil prices decrease, fuel prices also decrease as crude oil make up approximately 71 percent of the price of gasoline (McMahon, 2015). When fuel prices decrease, it becomes less expensive to own a car, and therefore car leasing would decrease as people seek to own their car. Further, car taxes and fees are determined by the government, so this industry may be subject to politics, and hence we might be having a spurious relationship possibly explaining the significant correlation. This industry also consists of firms renting out machines and equipment, and will assumable be adversely affected by lower demand from industries like construction and manufacturing. This two-sided effect may explain the low coefficient.

For travel agency, tour operator and other reservation services; industry 79, the relationship between oil price changes and profitability is positive. When the crude oil prices started to drop steeply in 2014, the Norwegian Krone began to depreciate. A depreciated NOK makes it more expensive for Norwegians to travel abroad. Further, there will be decrease in domestic demand. The decreased domestic demand for accommodation has been especially visible in Rogaland the past three years where employees within petroleum industries frequently visited prior to the 2014 oil price drop (Lorch-Fach and Svanemyr, 2015). These results are in line with both expectations and theory.

When it comes to education, industry 85, we see that the result indicates a positive relationship which is significant at a one percent level. Within this industry we find private schools, traffic schools, etc. These schools are subject to different politics in Norway, and are also regulated by the government. Based on this, we do not find this industry particularly interesting to comment further upon.

For industry 93; sports activities and amusement and recreation activities, we find a positive relationship between oil price changes and profitability, significant at a ten percent level. This industry is highly subsidized by the government and does not exhibit competitive and profit-maximizing behavior. Therefore, we choose to not look further into this industry as it is not relevant. Industry 94; activities of membership organizations is also to some extent regulated by the government and is also influenced by volunteer work, which is not relevant for our study. Also, there may be spurious relationships explained by other freestanding factors.

For industry 96; other personal service activities, we find a positive relationship which is statistically significant at a five percent level. This industry will likely be affected by the lower purchasing power that will follow an oil price decrease. This industry mainly consists of hairdressers and beauty salons, which can be classified as dispensable goods, and will normally be given less priority when the purchasing power declines.

In hypothesis 2, we expected industries to be affected according to their costs' and revenues' exposure to the oil price. Throughout this industry analysis we have seen that industries are exposed to the oil price through different factors, and not merely through oil as direct input or output. Because of the lower oil price since 2014, growth in the Norwegian economy has declined compared to previous years, there has been a reduction of households' income from 2014 to 2015 and the activity in the petroleum industry has declined. We expected industries with oil on the cost side to benefit from lower oil price. However, we have seen that this is not necessarily the case. In several of these industries, other external factors in the industry impact the pure effect.

As we have seen for fishing and aquaculture there is a positive correlation with oil price changes and profitability, caused by market dynamics. The results for the energy sector is in line with both theory and expectation. For manufacturing industries, we find that a decreasing cost of oil does not compensate for low demand as a result of lower activity in both the Norwegian economy and the petroleum industry. We find that wholesale has a positive but weak relationship between oil price changes and profitability, and we believe that this industry is both influenced by lower economic activity and Norway's monetary policy. The transportation industries are assumable affected both by lower cost of fuel and lower demand, with demand having the largest effect, leading to a positive coefficient for oil price changes. This is in line with what previous studies have found. Sewerage is likely to follow the economic activity because it is a part of public spending. For construction and technical services, we find that they are dependent on demand from the petroleum industry and will experience decreased demand when oil prices decrease. Other industries, which we expected to be more independent of oil prices surprised us. However, there might be spurious relationships influencing our results which give a wrong picture of the results.

This partially confirms our hypothesis 2 and shows that external factors, such as economic activity in Norway and activity in the petroleum industry, play a more significant role than oil as an input or output.

6.4 Correlation Analysis

In our sample we have included only firms that exist throughout our time period. As mentioned, our sample has a survivorship bias because bankruptcies and start-ups are not included. In order to deal with this bias, we have analyzed the number of bankruptcies in Norway over the last 17 years, categorized them into industries, and done a correlation analysis for industry bankruptcies and crude oil price.

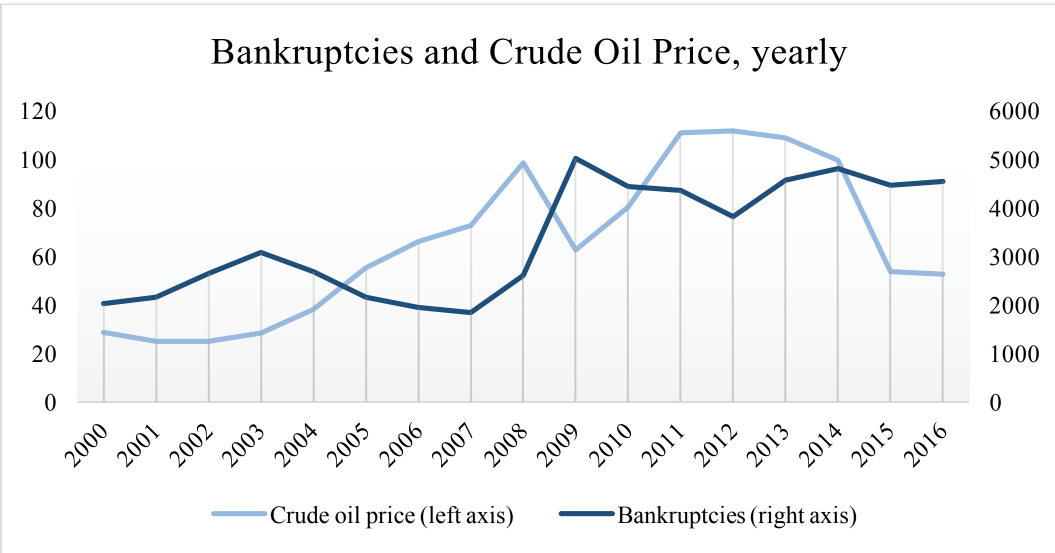

Figure 2 - Yearly bankruptcies and crude oil prices (Source: Statistics Norway)

The graph shows the total number of bankruptcies in Norway compared to the oil price. The number of bankruptcies moves, in almost all years, in the opposite direction of the oil price, except for 2002, 2007, and 2014. 2007 and 2014 are both years in advance of oil price shocks. It would be interesting to study further why that is so. The fact that the number of bankruptcies moves in the opposite direction as the oil price for the majority of years, is in line with expectations for an oil exporting country like Norway. As the oil price drops, the number of bankruptcies increases, and vice versa. This supports our findings from the regression analysis.

TABLE 6

CORRELATION BETWEEN OIL PRICE AND INDUSTRY BANKRUPTCY

Table 6 presents the correlation between oil price and industry bankruptcies at a broad structure. Industries with 0 correlation has been excluded. 0.10-0.29 represents a weak correlation, 0.30-0.49 represents a moderate correlation while 0.50-1.00 represents a strong correlation.

		Oil price
A	Agriculture, forestry and fishing	-0.0782
B	Mining and quarrying	-0.1867
C	Manufacturing	**-0.3046**
D	Electricity, gas, steam and air conditioning supply	-0.1496
E	Water supply	-0.0121
F	Construction	**-0.3672**
G	Wholesale and retail trade	**-0.4291**
H	Transportation and storage	-0.2872
I	Accommodation and food service activities	0.0101
J	Information and communication	**-0.4247**
K	Financial and insurance activities	0.0225
L	Real estate activities	-0.1029
M	Professional, scientific and technical activities	**-0.3128**
N	Administrative and support service activities	**-0.3624**
P	Education	-0.2228
Q	Human health and social work activities	**-0.5442**
R	Arts, entertainment and recreation	-0.1005
S	Other service activities	0.2388

The results presented in table 6 shows that all industries except three have a negative correlation between changes in oil price and bankruptcies. The three industries with positive results; accommodation and food service activities, financial and insurance activities, and other service activities have only a weak correlation. This indicates that, for the majority of industries, an increasing oil price leads to a lower number of bankruptcies. This supports our previous findings, that an increasing oil price is positive for most industries in Norway.

The industries with a moderate to strong negative correlation are highlighted in the table above. The results for manufacturing, construction, wholesale and retail trade, professional, scientific and technical activities, and administrative and support service activities are all in line with our regression analysis results.

For information and communication, we find a strong negative correlation. This result is also in line with the regression, but is somewhat surprising, as we would not expect this industry to be particularly related to the oil price. We also find a strong negative correlation in human health and social work activities. This is in contrast to the regression analysis, where we did not find any significant results for this industry group. Both these industry groups include several industries that are both subsidized and regulated by the government, making a further analysis of these of less relevant in this study.

Overall, the results in this analysis supports the regression results, that Norwegian industries are positively affected by an increasing oil price. This indicates that the survivorship bias in our sample does not have a considerable effect on the regression results, at least not for the direction of impact of changes in the oil price on profitability.

6.5 Difference in Difference, Oil Price Shock Events

In order to test our third hypothesis, that negative oil price shocks will have a bigger impact on Norwegian industries as proposed by the prospect theory and previous findings, we want to isolate the effect of a positive and negative price shock. In order to do so, we recognize two different shocks – one positive, and one negative. Then we run difference-in-difference tests.

We have used Statistics Norway’s classification of industries’ oil input and/or output in their value chain. As the table below presents, we are looking at the three industries selling the highest amount to the petroleum industry as one treatment group, and the three industries consuming the highest amount of oil as another treatment group. In order to isolate how the events impact return on assets in the treatment groups, we have generated a control group consisting of the industries least dependent on the crude petroleum industry.

TABLE 7

Table 7 shows the two treatment groups. The treatment groups are categorized into the industries selling the highest amount to the petroleum industry and the industries consuming the highest amount of oil.

	Crude petroleum and natural gas	
Industry	Industries selling to petroleum industry	Industries consuming oil
6: Extraction of crude oil	27.25%	
9: Mining and support service activities	14.69-27.25%	
30: Manufacture of other transportation equipment	15.31-18.94%	
21: Manufacture of basic pharmaceutical products and pharmaceutical preparations		31.86-44.35%
20: Manufacture of chemicals and chemical products		39.07-44.35%
23: Manufacture of other non-metallic mineral products		3.18-3.37%

The negative oil price shock event is defined as the largest percentage reduction in crude oil prices, which was in 2014. The positive oil price shock is defined as the second largest increase in crude oil prices, which was in 2004. The reason for not taking the largest increase in oil price in 2008 is that this was the build up of a financial bubble, and when this bubble busted it affected the whole world economy, and the positive oil price shock was one year later replaced by a negative oil price shock. Using 2004 as the event for the oil price shock strengthens our difference-in-difference analysis because crude oil price continued to increase in the following years.

TABLE 8

DIFFERENCE IN DIFFERENCE, INDUSTRY OIL DEPENDENCY

Table 8 presents two columns. Column 1: industries selling to petroleum industry, shows how these selling industries in Norway affect return on assets compared to the most oil-neutral industries in Norway. We have chosen the biggest negative oil price shock which was in 2014. Column 2: oil-consuming industries, shows how oil-consuming industries in Norway affect return on assets compared to the most oil-neutral industries in Norway. We have chosen the biggest positive oil price shock which was 2004. *** represents a significance level of 1%, ** represents a significance level of 5% and * represents a significance level of 10%

Explanatory variable	Industries selling to petroleum industry	Industries consuming oil
Negative-shock	0.0223** (0.00995)	0.0072 (0.0054)
Selling-to-petroleum	0.00133* (0.00856)	-0.0620*** (0..0039)
Negative-shock and selling-to-petroleum	-0.0627*** (0.0197)	-0.0072 (0.0122)
Positive-shock	0.0053*** (0.0015)	0.0261*** (0.0039)
Oil-consuming	-0.0450*** (0.0120)	-0.0471*** (0.0064)
Positive-shock and oil-consuming	0.0141 (0.0132)	-0.0210*** (0.0079)

In table 8, the coefficients of interest are highlighted. For both treatment groups, the corresponding events do impact the return on assets compared to oil-independency. We interpret the coefficients as the excess reduction due to the oil price shock event compared with the control group. For industries selling to the petroleum industry, the difference of being in the treatment group compared with the control group is – 0.063, which is statistically significant at a five percent level. For industries consuming oil, this excess reduction is -0.023, which is statistically significant at a ten percent level.

We also tested oil-consuming industries in the event of the negative oil-price shock but did not find any significant results, in line with Mork (1989), and Mork and Olson (1994). Also, we ran the test with industries selling to the petroleum industry in the event of the positive oil-price shock but did not find any significant results, also in line with Mork (1983), and and Mork and Olson (1994).

Our findings are in line with our predictions, as well as supporting the prospect theory (Kahneman and Tversky, 1979) and asymmetric response to oil price shocks. A negative oil price shock will have a negative effect on industries selling to the petroleum industry because it will lower their earnings. In the same way this will happen when a positive oil price shock occurs for oil-consuming industries as it will increase their expenses. The opposite effect will occur for positive oil price shock in industries selling to the petroleum industry, and negative oil price shock in oil-consuming industries. The fact that a negative event has a statistically significant effect, and the positive event is not statistically different than zero, supports Kahneman and Tverky's theory, Mork (1983), and Mork and Olson (1994). As well as Sehgal and Kapur's findings in 2012 that negative shocks have more pronounced effect than positive shock because of firms' behavior are more sensitive to bad news than good news. Hence, this analysis confirms our hypothesis 3.

7. Concluding Remarks

The overall purpose of this thesis is to gain insight into how fluctuations in the oil price affect firm performance across industries in Norway. We look further into how Norwegian industries react differently to oil price fluctuations. The motive behind our thesis is to contribute to previous studies and literature on how an oil exporting country reacts to a fall in oil price. Below we go through our main findings from our analyses, as well as the limitations of our study.

Findings

Testing 41 396 Norwegian companies in the time period from 2000 to 2015, we find that Norwegian firms performance will be affected by a fall in oil price in line with expectations of being an oil exporting country. On average, the Norwegian economy, measured through both return on assets and return on equity, is positively related with changes in oil price.

In our industry analysis, we find that for the industries with a statistical significant relationship between changes in oil price and return on assets, the oil price coefficient is positive for every industry, except two. During this analysis we find that for the majority of industries consuming oil, economic activity and external factors play a determinant role. We learn that oil price as a component in the value chain for different industries does affect return on assets to some extent, but external factors, such as economic activity and activity in the petroleum industry, also play a significant role.

Investigating the survivorship bias further by analyzing the correlation between bankruptcies and crude oil price, we find that this overall supports our previous findings. We see that for the economy as a whole, bankruptcies tend to move opposite of the oil price, as expected. When doing the same analysis on industry level we find a negative correlation between oil price and bankruptcies for most industries.

Performing a difference in difference analysis testing the asymmetry of response to different oil price shocks, we find that negative event has a statistically significant effect, and the positive event is not statistically different than zero.

To answer the question we asked at the beginning of our thesis how a fall in oil prices affect firm performance across industries in Norway, we can answer this in two parts. The first part is answered through our main regression analysis that Norwegian firms' performance collectively have a positive relationship with changes in oil price. This means that a decrease in oil price will decrease the firm performance in Norway, collectively. Secondly, industries will be affected through their value chain, in terms of whether oil price is an input or an output, but this effect will be influenced by external factors. We find that the decisive factor in many cases is whether the industry is dependent on delivering to the oil industry and not whether oil is an input or output.

Limitations and Suggestions for Further Studies

A limitation to our study is that we only have access to yearly accounting data. This creates a problem regarding the oil price, as a yearly oil price is less accurate than an oil price calculated for a shorter time period. This has also given constraints to our analyses when adding lagged values. With, for example monthly data, we could have lagged the oil price by shorter time periods.

For further study it would have been interesting to develop a prediction model for how the oil price impacts bankruptcies. We would have done this if we had the data needed available. It would also have been interesting to include accounting numbers for 2016, but these will not be available in the CCGR database until January 2018.

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BI Norwegian Business School - campus Oslo

GRA 19502

Master Thesis

Component of continuous assessment: Forprosjekt, Thesis MSc

How a fall in oil prices affect firm performance across industries in an oil exporting country like Norway

ID number:	0929547, 0991395
Start:	01.12.2016 09.00
Finish:	16.01.2017 12.00

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1. Introduction

Norway is a small, open economy. One of the most important industries in Norway is the petroleum industry. In 2015, the petroleum sector accounted for 15 percent of GDP, approximately 20 percent of governments revenues, and 39 percent of all export (Regjeringen 2016). The summer of 2014 marked the beginning of what we know today; the 2014 oil bust. During this oil bust the crude oil prices started to decline significantly, and on January 20th 2016 the crude oil price hit this cycle's bottom at $27.72 per barrel (Bloomberg). This was a decrease of 78 percent from the peak in 2014.

We see this as an opportunity to explore how Norwegian industries are affected by an oil bust such as this. Previous research on positive and negative oil price shocks have found relationship between oil prices, stock markets and firms' performance. These researches have focused on macroeconomic variables and mostly on oil importing countries. However, the literature is scarce on oil exporting countries such as Norway. Further, this negative oil price shock differs from previous shocks, as it is supply driven and not demand driven. As a result, oil investments in Norway has decreased and plays a significant role in slowing down the economy. In the second half of 2016 the crude oil price started to increase again, and has stabilized around $50-55 per barrel. Making this an interesting time to analyze the effects of the recent oil bust.

1.1 Norwegian Economy in the Light of the 2014 Oil Bust

In comparison to the previous oil price busts in 1991 and 2008, it is particularly interesting to note that the bust of 2014 was completely unexpected (Tokic, 2015). Crude oil price simply collapsed after a gradually increasing uptrend (see figure 1). According to Tokic, financial media saw this collapse as a surplus in oil supplies, noting the possible demand slowdown in China and insistent energy consumption from US shale oil. In his study of the unexpected 2014 crash, Tokic suggests that the price collapse possibly was triggered by the falling EUR/USD relationship.

The drop in oil prices led to restructuring, downsizing, reduced oil investment and requirement for improved efficiency, particularly in the energy industry. The result of this became visible in the first half of 2016, where we saw a decrease from the supply side. Analysts are expecting this reduction in oil investments and restructuring to restore the market balance, which will increase future oil prices.

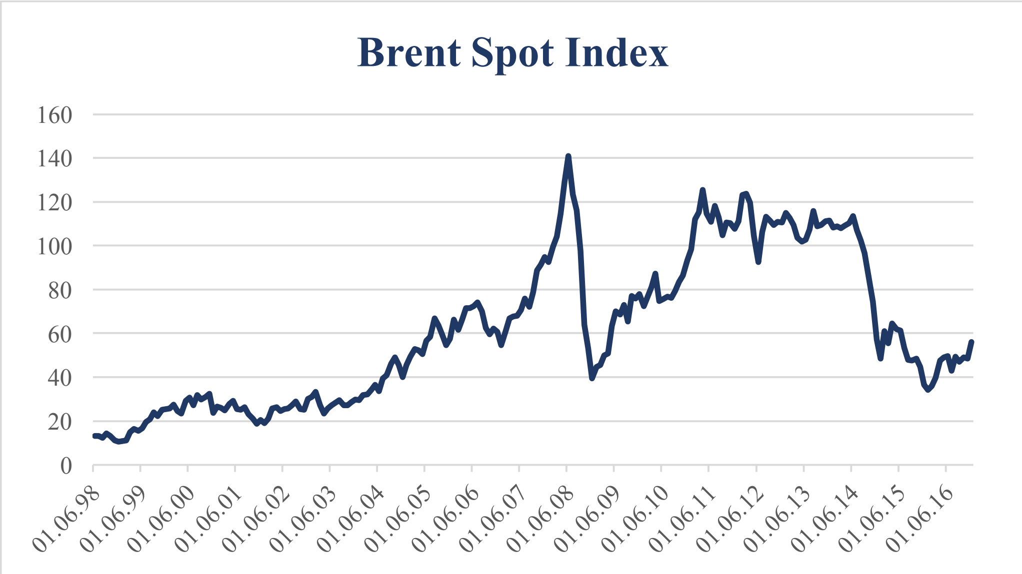

Figure 1 - Brent Spot Index, source: Bloomberg

The Norwegian economy started to contract as a result of the drop in oil prices. The expected growth in GDP versus the actual growth in GDP differs with a lower actual GDP in 2015 (Statistics Norway, 2016). This has forced Statistics Norway to lower their forecasts of growth in GDP, but with the expected increase in oil prices, Statistics Norway expects the growth to stabilize back to somewhere between 2.1 – 2.4 percent after 2017. Because of the reduced oil investments and downsizing, Norway has seen an increase in real estate development, public manufacturing and increased activity in competitive exposed industries. All this together will, according to Statistics Norway, contribute to increased growth in Norway's GDP in the upcoming years.

2. Literature Review

Existing theory has explored the relationship between effects of oil price and different industries in an economy, and there is evidence that oil price shocks affect firms differently depending on what industry or sector they belong to. McGahan and Porter (1997) wrote an article on *"How Much Does Industry Matter, Really?"*.

They found that year, industry, corporate-parent, and business-specific effects all impact the variance in business-segment profits, with business-specific effects and industry having the biggest impact. Further, the effects of the abovementioned factors vary broadly across economic sectors. Looking at manufacturing companies, industry effects account for a smaller amount of the variance in profit than in, for example, transportation and wholesale. In 1999, McGahan and Porter studied industry effects further, and found that there are incremental differences in industry effects on profitability.

Previous research has also looked at the macroeconomic impacts of oil price shocks. Hamilton (1983) suggests that crude oil prices has had a strong influence on the US business cycles well before 1973 (The OPEC Embargo[1]). He looked at the results from Sims' (1972) macro model that suggests increase in oil prices over the period 1948-72, tended to be followed by decrease in real GDP growth. Hamilton found that seven out of eight post World War II recessions in the US was not spurious. Gisser and Goodwin (1986) supported this finding and saw that crude oil prices historically have had a significant effect on a broad range of macroeconomic indicators, both real effects and inflationary effects.

Lee and Ni (2002) investigated the effects of oil price shocks on demand and supply in various industries and found that oil price shocks reduce supply in industries that have a large cost share of oil, while for other industries, oil price shocks mainly reduce demand. Moreover, other studies have investigated the relationship between oil prices and stock prices in different sectors. Narayan and Sharma (2011) supported this with their findings that oil prices affect firms differently according to their sector because of differences in oil consumption. Arouri (2011) studied the European sector stock markets' response to changes in oil price and found that the strength of association between oil and stock prices vary greatly across sectors.

Wattanatorn and Kanchanapoom (2012) examined the impact of crude oil prices on the profitability performance of sectors in their paper "*Oil Prices and Profitability*

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[1] In October 1973, the members of OPEC proclaimed an oil embargo and raised the oil prices with 200 percent. This embargo had major impacts on international relations and has later been viewed as the first big oil crisis (Office of the Historian, 2017).

Performance: Sector Analysis". They used data from Thailand stock exchange in the period from 2001 to 2010 and found that the impact of oil prices on firms' profitability moves in the same direction as the impact of oil prices on stock returns. Thailand is an oil importing country, which in 2012 suffered from the high crude oil price.

2.1 Gap in Literature and Our Motivation

"Higher oil prices have a stimulating effect on the Norwegian economy that is consistent with what one would expect for an oil exporting country. In particular, a higher stock price increases stock returns" (Bjørnland, 2008, p. 26). There is no equivalent study of what happens in an oil exporting country when there is an oil price shock. Previous studies have focused on the impact of oil prices on stock returns. There is also scarce work on to what extent the effects depend on the different causes behind the oil price change. Our contribution to the literature is to explore the effect of oil prices on firms' profitability within different industries in the short-term, in an oil exporting country. We will analyze Norwegian industries based on the 2014 oil bust and investigate how it impacts different industries. Industries have different oil consumption, for instance, oil selling industries have different revenue shares generated from oil. We also wish to fill the gap on to what extent the effects depend on different causes behind the oil price change. We also want to investigate why some industries may be affected differently from others.
Our main goal is to analyze:

> *How does a fall in oil prices affect firm performance across industries in an oil exporting country like Norway?*

3. Theoretical Framework

To gain a further understanding of oil price shocks and their effect on industries and capital markets, reviewing applicable theory is advantageous. To gain further insight of mechanisms and theories helping us studying our research area, we will look into theories on business cycles; how they work and how economic activity is affected by macroeconomic aspects, and effects of oil price shocks. We will also look at the efficient capital markets hypothesis (EMH) because this causally links profitability to stock prices.

3.1 Business Cycles

The economy is not always in a steady state, it fluctuates between different phases of economic activity (Steigum, 2014). A characteristic of cyclical fluctuations in an economy is that changes in economic activity moves in the same direction in several parts of the economy and goes along with significant variations in employment, unemployment, gross investments and other macroeconomic variables. Cyclical and permanent changes in environment impact firms' positioning and performance within industries and among competitors. The business cycle represents fluctuations of economic growth over a historical trend (Hamilton, 1989). Periods of high economic growth where the economy expands is repeatedly disrupted by phases characterized by slow growth, so called recession, where the economy tightens. The American economists Burns and Mitchell gave the following definition of business cycles (Sørensen and Whitta-Jacobsen, 2010, p. 358):

> Business cycles are a type of fluctuations found in the aggregated economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

If we look at the figure below we see the development of Norway's GDP growth and the OBX index over the past years. The financial crisis of 2008, where oil prices also dropped significantly, affected the OBX Index the same year, while the decrease in Norway's GDP growth became negative the year after, in 2009. In 2012, the oil price reached an all time high and the growth in Norway's GDP increased from 1.9 percent in 2011 to 3.8 percent in 2012. Hence, the fluctuations in oil prices affect the Norwegian economy's business cycle.

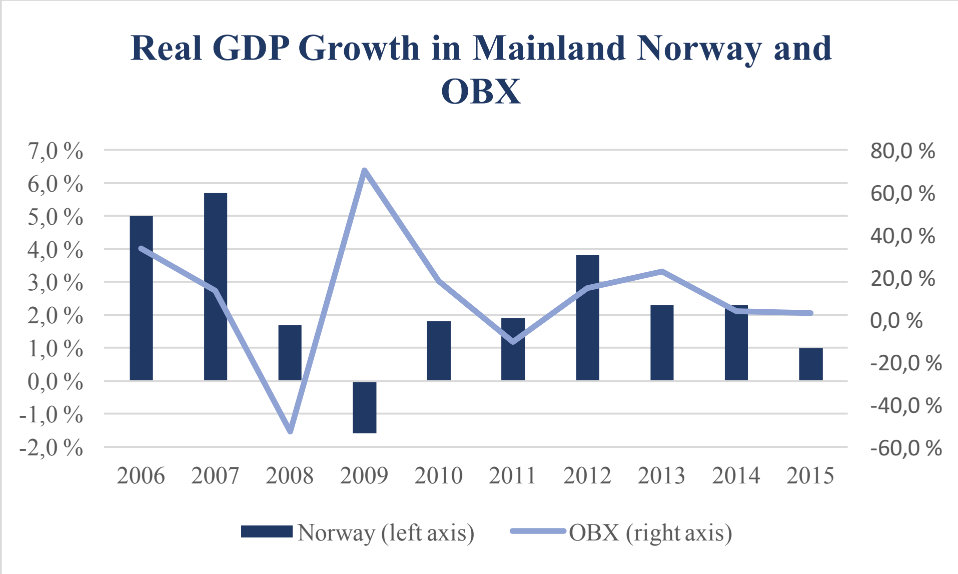

Figure 2 - Real GDP Growth in Mainland Norway and OBX Index, sources: Statistics Norway and Bloomberg

An economic downturn does not impact all industries equally. Lien (2010) found that demand in industries are to a varying degree affected by recessions. The strongest finding of Lien is that demand for durable goods are far more cyclical than demand for nondurable goods based on three main reasons. The first reason is based on stocks and flows. A buyer can have a stock of durable goods, and when the economy changes to a downturn, the buyer may want to reduce their stock by a small percentage, which can lead to large reduction in aggregated demand in that business segment. Another reason is the fact that on average, it is easier to buy durable goods than nondurable goods. The final reason presented by Lien is that demand for durable goods are strongly linked to the circumstances in financial markets.

3.2 Effects of Negative Oil Price Shocks in Exporting Countries

Kilian (2009) argues that the effects of an oil price shock is dependent on the underlying causes of the shock, supporting Lee and Ni (2002). If a change in oil price is a result of low economic activity; demand driven, the effects will be different than if the change is a result of surplus in supply; supply driven. It is therefore essential to distinguish between changes in oil prices as a result of changes in demand and as a result of changes in supply. A drop in oil price as a result of decline in demand could have large effects on the Norwegian economy, because it would also be indirectly affected by declining activity in the world economy (Cappelen et al., 2014).

A drop in oil prices as a result of excess supply is expected to have smaller effects, and will mainly affect the oil sector in exporting countries. In the Norwegian economy, this will lead to lower activity levels, as we have seen since the oil bust; Norwegian economic activity has fallen; and unemployment in Norway has risen to its highest level since 1996. Cappelen et al. (2014) have published an economic analysis of the effects on the Norwegian economy from a drop in oil prices. They propose that the individual sectors of the economy will be exposed to different influences by decline in oil prices. Industries that have high exposure to the petroleum industry through deliveries, will experience the biggest negative shock in the short run. Supply companies, such as Havila Shipping and Farstad Shipping, struggled and barely managed after several rounds of negotiations to refinance their loans and avoid financial distress. On the contrary, industries that have oil on the cost side, might be expected to profit. A supply driven decline in oil prices will also benefit Norwegian exports, except for oil and gas (Cappelen et al., 2014).

The 2014 oil bust was caused by a supply shock. Oil price shocks in the past have mainly been caused by demand shocks:

Year	Direction of price shock	Cause	Driven by
1973	Positive	OPEC Embargo	Politics
1980	Negative	Decreased demand	Demand
1990	Positive	Political instability	Politics
2000	Positive	Production cut by OPEC	Politics/demand
2008	Negative	Financial Crisis of 2008	Demand
2014	Negative	Supply surplus	Supply

Table 1 - Historical oil price shocks, causes behind and the main driver, source: Kilian (2009)

3.3 Efficient Capital Markets

The hypothesis on efficient capital markets is about to what extend the price of an asset at any given time reflects all available information about the fundamental value of that asset. This hypothesis was developed by the economist Eugene Fama who said that securities always trade at real value, which means that it is not possible for investors to make abnormal returns on their trading. There are three conditions behind EMH. The first condition is rationality; if the assumption that all investors are rational holds, new information will cause all investors to adjust their estimates in a rational way and the price of the asset would change accordingly. Second, is independent deviation from rationality; some investors act on their optimism and other on their pessimism and there is an assumption that this will produce efficiency, because the expectation is that there are equal numbers of optimistic and pessimistic investors. The last assumption is that the arbitrage of professionals dominates the speculations of amateurs, leading markets to be efficient.

Fama (1970) divided market efficiency into three subcategories:
Strong-form – prices reflect all available information, publically available or not.
Semi-strong-form – prices reflect all publicly available information.
Weak-form – prices reflect information on all historical prices and returns.

If the EMH holds, it has implications for both firms and investors for two main reasons (Hiller et at., 2013). Because information will be reflected in prices immediately, investors should only expect to obtain a normal rate of return. New information available would not make a change for the investor as the price will reflect it before the investor traded on it. Next, firm should expect to receive fair value for securities they sell. By *fair* it is meant that the price received by the firm when issuing shares, is at present value.

There has been a lot of discussion after Fama published his work on market efficiency. Collectively, behavioral financial theory and evidence discussed on efficient capital markets raises questions about the extent of security markets' efficiency (Scott, 2015). An important assumption behind the efficient capital market hypothesis is that all investors are rational. This is, however, shown to not be true. According to supporters of behavioral finance, investors are not rational, deviations from rationality are similar across investors, and arbitrage, being costly, will not eliminate inefficiencies (Hiller et al., 2013).

According to Barberid, Shleifer, and Vishny (1998), underreaction occurs when an increase in earnings come along on a one-time basis, and overreaction strikes when longer term sequence of improved earnings leads investors to assume that earnings will increase steadily over time.

A question still remaining is why efficient markets deviate persistent over time. Behavioral finance also suggests that there are limits to arbitrage causing shares to repeatedly being mispriced. Studies like, Ke and Ramalignegowda (2005), Mashruwla et al. (2006), and Mendenhall (2004) show that transaction costs and idiosyncratic risk are major barriers to arbitraging away mispricing (Scott, 2015).

Implication of the efficient market hypothesis became visible in Statoil ASA's share in 2014. Until the first half of 2014, Statoil has enjoyed the uptrend in oil prices. However, from the first quarter to the second quarter, the firm reported lower results. The stock market reacted in accordance with the efficient market hypothesis and the stock price fell. In the third interim of 2014, Statoil reported a negative result, and according to Fama's theory the stock price should have decreased. However, this did not happen. Statoil's stock price increased to even higher levels than in the beginning of 2014 - which may be an example of market inefficiency.

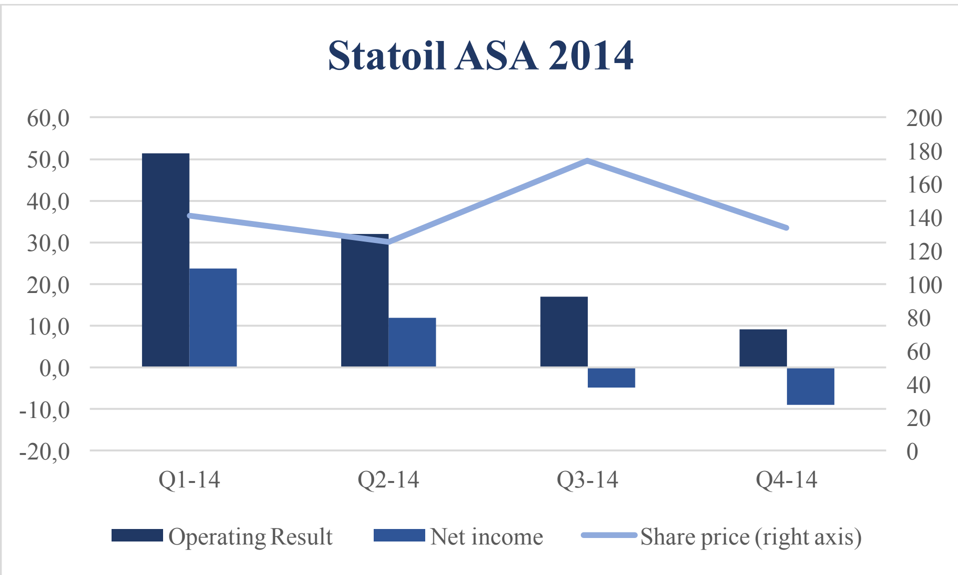

Figure 3 - Statoil ASA performance in 2014, sources: Statoil and Bloomberg

3.4 Performance Measures

A way to examine performance of companies is to look at ratios. Financial ratios are a way of comparing and analyzing the relationship between different parts of financial information. Ratio analysis is a way of avoiding problems arising when comparing companies of different sizes (Hiller et al, 2013). However, there is a problem when using ratios, and that is; different people and different sources frequently do not compute them in exactly the same way, which lead to different answers and confusion. Therefore, it is very important to carefully specify how you choose to calculate your chosen ratios. This is something we will take into account in our methodology design.

4. Methodology and Data Collection

4.1 Research approach

Our research question requires us to analyze a large amount of data making this a quantitative analysis. We will need data from numerous firms to have a representative sample. This is essential in order to generalize our results. We will use secondary data and conduct our analysis using statistical methods. Based on available data we collect; we will define the most suited statistical methods to use.

4.2 Industry Classification

We will choose industries based on the Norwegian Standard Industrial Classification (SIC2007). These codes are made to give rules and guidelines for classification of firms into industries. The classification is based on firm's primary economic activity, making this a good base for choosing industries (Statistics Norway, 2008). Our aim is to analyze industries that have different exposure to oil prices. We will use SIC codes on a three-digit level, as we believe this is a sufficient level of specification.

4.3 Performance Measures

4.3.1 Profitability Measures

The focus of our profitability ratios is the bottom line; the net income. What these ratios have in common is that they, in one way or another, aim to measure how efficiently the firm uses its assets and how well the firm manages its operations

(Hiller et al., 2013). We will first discuss three measures, which are probably the most commonly used financial ratios: profit margin, return on assets (ROA), and return on equity (ROE). We will also include return on invested capital (ROIC) and operating margin.

There are two ways to calculate these ratios, either using adjusted or non-adjusted accounting figures. The adjusted approach gives a more accurate measure of the underlying economic value created by a firm (Barney, 2014). The reason for this is that by adjusting accounting figures, accounting numbers are normalized and non-recurring items are eliminated. Despite the advantages of the adjusted approach, we will use the non-adjusted approach. The reason for this is the availability of data and the scope of data needed to perform our quantitative analysis in order to draw generalized conclusions. In addition, we believe that non-adjusted measures will give the level of information needed to get the insight we seek in the industries.

The first ratio we will discuss is profit margin. It measures how much profit it is left from sales after all expenses are subtracted. This corresponds to expense ratios, and of course it is desirable to reach a high profit margin and low expense ratios, as this means the firm is cost efficient. A weakness with profit margin is that it varies between industries as a result of different asset management and capital structure (Hiller et al., 2013). Profit margin can be calculated as:

$$Profit\ Margin = \frac{Net\ Income}{Sales}$$

The second ratio is ROA. ROA measures how well a firm is generating profit by using their assets, ignoring how these assets are financed. ROA is generally seen as a better measure of firm performance than pure income statement measures, because it allows us to determine if the firm is generating adequate return on their assets. ROA is also unaffected by the potential distortion of different financing strategies (Hagel III et al., 2010). ROA can be calculated as:

$$ROA = \frac{Net\ Income}{Total\ Assets}$$

When comparing industries, ROE might be a better measure than ROA, because companies differ in their use of assets. Some firms are very asset-heavy while others are asset-light. Since we are analyzing firms in different industries and of different size, arguments could be made for using ROE instead of ROA (Loth, 2017). Bear in mind, ROE is highly influenced by the amount of equity in a firm, hence the capital structure, which can vary both between firms and between industries. ROE can be calculated as:

$$ROE = \frac{Net\ Income}{Total\ Equity}$$

Another ratio to include is ROIC. It measures profitability of operations on invested capital (Damodaran, 2007). The benefit of this ratio is that it is comparable across firms and industries because it does not take into account how the firm is financed. ROIC can be calculated as:

$$ROIC = \frac{Net\ Income - Dividends}{Total\ Capital}$$

Another accounting ratio is operating margin. Using this ratio enables us to observe how much a firm has earned from cash generated by sales, before both interest and taxes (Berk and DeMarzo, 2013). This ratio incorporates cost of goods sold and additional operating expenses. Operating margin can be calculated as:

$$Operating\ Margin = \frac{Operating\ Result}{Operating\ Revenue}$$

4.3.2 Growth Measures

Another way to capture performance within industries is to include growth measures. We will use two growth measures; growth in EBITDA, and sales growth versus sales compounded annual growth rate. Analyzing growth in EBITDA will make us able to look at how volatile this is within given industries, and compare it to changes in oil prices. Compounded annual growth rate is the mean annual growth rate of an investment; as if the investment grows at a steady rate. Using sales compounded annual growth rate enables us to analyze how actual growth in sales have fluctuated compared to the industries' mean average growth rate. Compounded annual growth rate can be calculated as:

$$CAGR = \left(\frac{Ending\ Value}{Beginning\ Value}\right)^{\left(\frac{1}{No.of\ Years}\right)} - 1$$

4.4 Data Collection

In order to conduct our analysis, we will need industry data, industry indexes and stock prices within each industry in order to get an overall understanding of the different industries, market perceptions, and expectations. Further, we will need accounting data for numerous firms within each industry. Vital is also information on how industries'– and firms' financials are affected by oil prices, whether it buys oil to use in production or sells oil, as well as the share of costs and revenues relying on oil investments. We will also need a good indicator for the real oil price.

We expect to find most of the data needed from the Bloomberg-terminal at BI, Datastream, Statistics Norway (SSB) and Oslo Børs.

4.5 Hypotheses

1. The 2014 oil bust will affect industries with oil on the revenue side negatively with the largest effect on the energy industry.
2. The 2014 oil bust will affect industries with oil on the cost side positively with the largest effect on the transportation industry.
3. Differences between profitability of firms increases within industries during this oil crisis.
4. According to efficient market hypothesis the impact of oil price on firms' performance will be in the same direction as the oil prices' impact on stock returns.
5. Industries with high growth rate late in the boom will have large contraction early in recession due to exposure to oil prices.

5. Thesis Progression Plan

From	To	Work	Goal
01.des	**16.jan**	Preliminary Thesis	Get an overall understanding of our research topic, previous literature, data needed and research methodology. Formulation of our working hypothesizes
16.jan	**31.jan**	Collection of data	Find the data we need to address our research topic
01.feb	**20.feb**	Theory and model specification	Formulate relevant theories and specify the models we will use
21.feb	**15.apr**	Testing and results	Testing our hypothesizes and interpret our results using the specified model
16.apr	**30.apr**	Finish the first draft of our thesis	All of the above. Make conclusions and evaluation of our work
01.mai		Hand in our first draft to supervisor	
22.mai	**01.sep**	Finish final version	Revise thesis based on feedback on our first draft

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