The Impact of Oil Price Volatility on Statoil

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The Impact of Oil Price Volatility on Statoil

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EXECUTIVE SUMMARY

PROBLEM STATEMENT

How do oil price movements impact Statoil ASA?

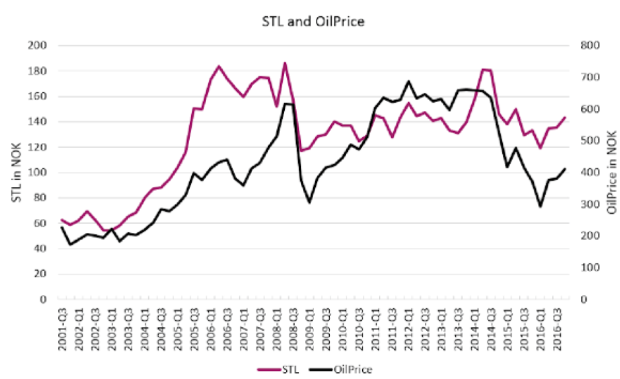
RESEARCH QUESTIONS

- Do oil price fluctuations have an explainable effect on Statoil's capital expenditures and operating expenditures?
- Do oil price fluctuations have an explainable effect on Statoil's share price?

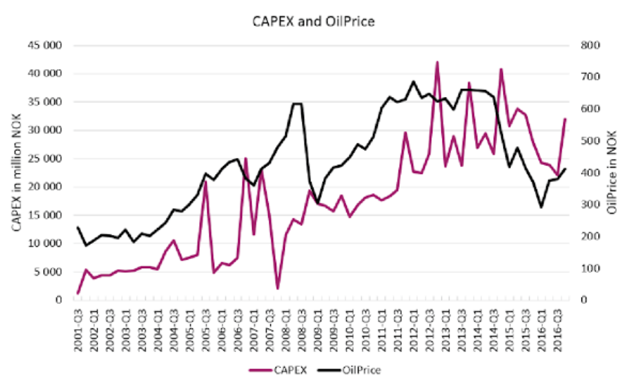
ANALYSIS

To analyse the impact of oil price shocks, Ordinary Least Squares regression has been employed for two separate time periods. First, the period from Q4 2001 - Q3 2008 has been studied to examine how Statoil reacted to a positive movement in the oil price. Second, the period from Q3 2014 - Q4 2016 has been studied to examine if Statoil reacted in a different manner to a drop in the oil price.

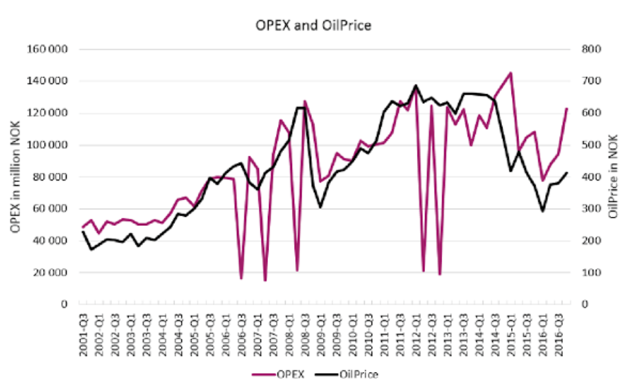
RESULTS



Firstly, the thesis concludes that the oil price has a large effect on Statoil's share price. The effect was larger in the period 2001 - 2008, when the future risk of the oil price was perceived to be low, than in 2014 - 2016, when the future was highly uncertain and the oil price volatility was high.



Secondly, a significant relationship between the oil price and the investment level was only found in the upturn period from 2001 - 2008. In the period 2014 - 2016 no such relationship was found, however, the reason may be due to the large movement in the NOK/USD exchange rate in this period. If the analysis had been conducted in USD instead of NOK, it is possible that a relationship between the oil price and Statoil's share price would have been found also in the period 2014 - 2016.



Lastly, no relationship was found between the oil price and Statoil's operating expenses in any of the time periods. This came as a surprise considering the massive headcount reductions and dramatic cuts in vendor contract prices the media has reported.

Preface

This thesis has been written as the final part of our master's degree in Business Administration, with a specialisation in applied finance, at the University of Stavanger.

In recent years there have been huge changes in the oil and gas industry. After the oil price drop in 2014, the future of the industry has been highly uncertain. Living in Stavanger, The Oil Capital of Norway, we have seen the dramatic effects of the oil price drop up close. This has motivated us to take a closer look at how the oil price impacts Norway's largest company, Statoil ASA.

The six months we have spent working on this thesis have been challenging, but most of all exciting and educational. The cooperation has worked well and we have aquired a lot of new knowledge.

We would like to thank our supervisor, Mads Rømer Holm, for his help and support throughout the whole process.

Stavanger, 12.06.2017

Frida Johannessen   Karina Skjelvik

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1. Introduction

1. Introduction

In the autumn of 2014 the oil price dropped sharply. Nobody had predicted such a massive drop, from a peak of USD 115 per barrel in June 2014 to under USD 35 in the end of February 2016 (Rogoff, 2016, 02.03). This marked the end of a 15-year period with exceptionally strong oil prices.

Oil exporting countries, like Norway, were particularly hard hit by the oil price drop. The petroleum industry is Norway's largest and most important industry, and it plays a major role in financing the Norwegian welfare state. Since 1970, the Norwegian oil and gas industry has created values of roughly NOK 12 200 billion (Hovland, 2016, 03.11). In 2012 the petroleum sector accounted for 23% of Norway's GDP, 30% of the total income to the state and 52% of Norwegian export revenues (Oljedirektoratet, 2013). In 2016, these figures were dramatically reduced, the petroleum sector accounted for 12% of Norway's GDP, 13% of the total income to the state and 37% of Norwegian export revenues (Norsk Petroleum, 2017, 04.04). Further, the oil price drop has led to massive cutbacks in the industry, in the period 2014 - 2016 investments fell with around 27% in Norway (Hovland, 2017, 23.02). This illustrates the serious impact the drop in the oil price has had on the Norwegian economy.

The purpose of this thesis is to analyse how the oil price impacts Statoil's share price, investment levels and operating costs. How Statoil reacts to changes in the oil price, in terms of adjusting investment levels and operational costs, and to what degree the oil price affects Statoil's share price, are questioned. The main tool for evaluating the empirical data and arriving at results and conclusions is regression analysis. This study is expected to address the effects of oil price movements and provide insights into how Statoil ASA is affected by such oil price fluctuations.

How oil price shocks impact economies and companies has been a frequently debated issue and has created significant research interest around the world. Due to the widespread effects of such shocks, both in the short run and in the long run, oil price volatility has been a heated topic.

The patterns of investment sensitivity in Statoil ASA, due to uncertainty in the oil price, call for further investigation. Higher oil price uncertainty could put investments on hold, hence have a significant impact on economic growth in Norway (Norsk Petroleum, 2017, 04.04). There are a number of studies focusing on the effect of oil price volatility on specific industries or countries. This thesis, on the other hand, focuses solely on one specific oil company, Statoil ASA. Compared to existing studies that consider Statoil's response to oil price volatility, this study makes a leap forward by looking at three different measures; CAPEX, OPEX and the share price.

1.1 Problem Statement

The main objective of this thesis is to examine how oil price movements impact the Norwegian-based energy company, Statoil ASA. Specifically, Statoil's investment levels, operating costs and share price will be studied. Capital expenditures are used to measure Statoil's investment levels, while operating expenses are used to measure costs.

The following research questions will be studied to be able to answer the thesis' problem statement:

- Do oil price fluctuations have an explainable effect on Statoil's capital expenditures and operating expenditures?
- Do oil price fluctuations have an explainable effect on Statoil's share price?

1.2 Structure

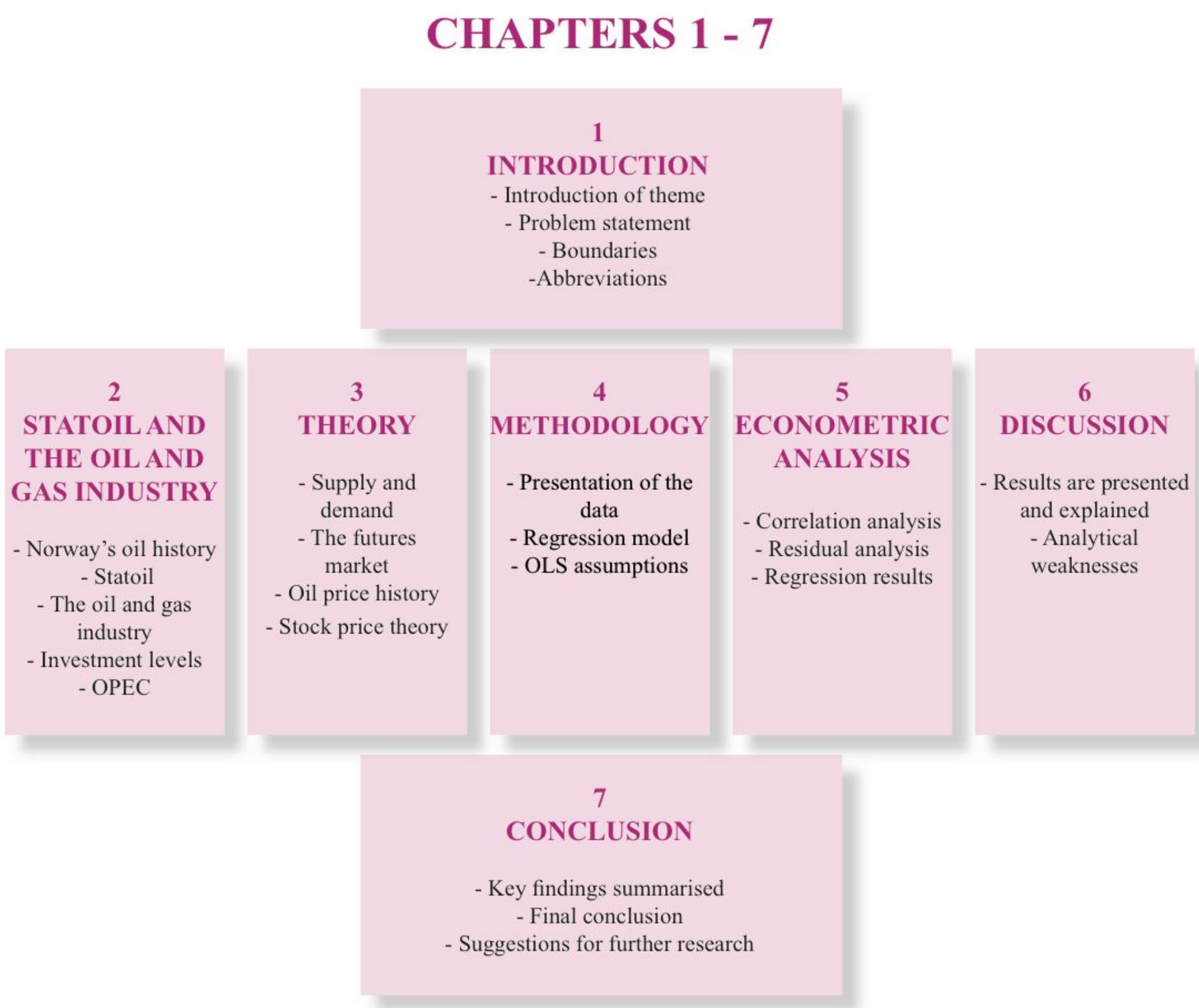

Figure 1: Structure.

This thesis consists of seven chapters; introduction, background, theory, methodology, econometric analysis, discussion and conclusion. Figure 1 gives a graphical representation of the thesis.

In chapter two, a presentation of the oil and gas industry, Statoil ASA and OPEC will be given, and Norway’s oil history will be summarised.

In chapter three, general theory that the thesis is based on will be presented. The factors that determine the oil price and the factors that affect the share price will be examined. An overview of the development of the crude oil price will also be given, with a focus on the time period 2000 - 2016.

In chapter four, the data used in the study and the methods used to answer the research questions will be presented. The main tool used is OLS regression.

In chapter five, the assumptions behind OLS regression will be tested, and the results from the regression analysis will be presented and explained.

In chapter six, the regression results will be discussed and interpreted. Analytical weaknesses in the study will also be pointed out.

In the final chapter, the key findings will be summarised and final conclusion drawn before some suggestions for further research will be presented.

1.3 Boundaries

Statoil ASA was publicly listed on the 18th of June 2001 (Ryggvik, 2015). As Statoil is the main focus of this thesis, the time period studied is from the third quarter of 2001 to the fourth quarter of 2016. More specifically, most attention is focused on two shorter periods within this time period. The first time period is Q4 2001 - Q3 2008, a period with increasing oil prices and the second period is Q3 2014 - Q4 2016, a period with falling oil prices.

There are several reference prices for crude oil. The oil price that is used in this study is Europe Brent Spot Price, which is most commonly used for North Sea oil.

This study uses NOK as the main currency. Thus, all data is in NOK, unless otherwise stated.

1.3.1 Abbreviations

The following abbreviations are used for simplification:

Statoil's share price - STL
Capital expenditure - CAPEX
Operating expense - OPEX
Europe Brent Spot Price - OilPrice
Standard and Poor's 500, an American stock market index - S&P500
Three-month nominal Norwegian InterBank Offered Rate - NIBOR
Oslo Stock Exchange Energy index - OSLEX

2. Statoil and the Oil and Gas Industry

2. Statoil and the Oil and Gas Industry

2.1 Norway’s Oil History

In the 1950s there were not many people who believed there was oil and gas in the Norwegian sector of the North Sea. Nevertheless, 50 years later, the Oil and Gas Industry had become Norway's most important industry in terms of investments, income to the state and contribution to GDP (Regjeringen, 2016, 29.02). In 2012 the petroleum sector accounted for 23% of Norway’s GDP, 30% of the total income to the state and 52% of Norwegian export revenues (Oljedirektoratet, 2013).

The Norwegian oil and gas adventure really began in 1969, when Phillips Petroleum Company discovered the Ekofisk field, one of the largest offshore oil fields ever discovered (Ryggvik, 2017). The production from the Norwegian continental shelf peaked in year 2001, with a production of 3.4 million barrels of oil equivalents per day (natural gas liquids and condensate included), which placed Norway as the world’s third largest exporter of both oil and gas (Norsk Petroleum, 2017, 21.02).

Today the Norwegian oil production covers approximately 2% of the global oil consumption. Norway has a low domestic oil consumption and most of the production is exported, making Norway among the world's largest exporters of oil and gas. In 2016 the total export value of crude oil was NOK 186 billion (Norsk Petroleum, 2017, 21.02). The petroleum industry has given Norway substantial revenues. This has made Norway an affluent country, which consistently is ranked among the best countries to live in (Nebben, 2009, p. 8-9).

2.2 Statoil ASA

Statoil ASA is a Norwegian-based energy company which has explored and produced oil and gas since 1972. Statoil is among the world's largest net sellers of crude oil and condensate. They are the largest operator on the Norwegian continental shelf, responsible for two thirds of total production. Further, the company has operations in over 30 countries (Statoil, 2017). In June 2001 Statoil was privatised and became a public limited company listed on the Oslo and New York stock exchanges. Statoil's largest shareholder is the Norwegian state, which currently owns 67% of the shares (Statoil, 2017). Thus, Statoil's investment decisions are not only important for the immediate investors, but also for the Norwegian economy.

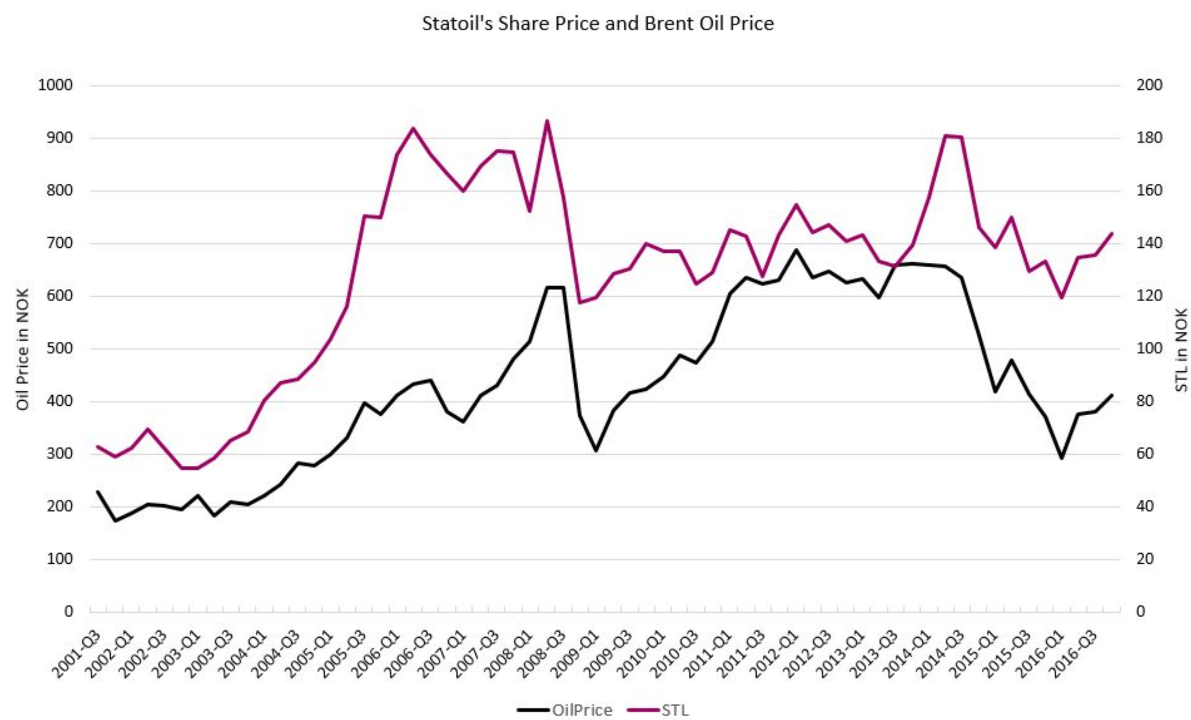

Figure 2: Statoil's share price and Brent oil price based on average quarterly data.

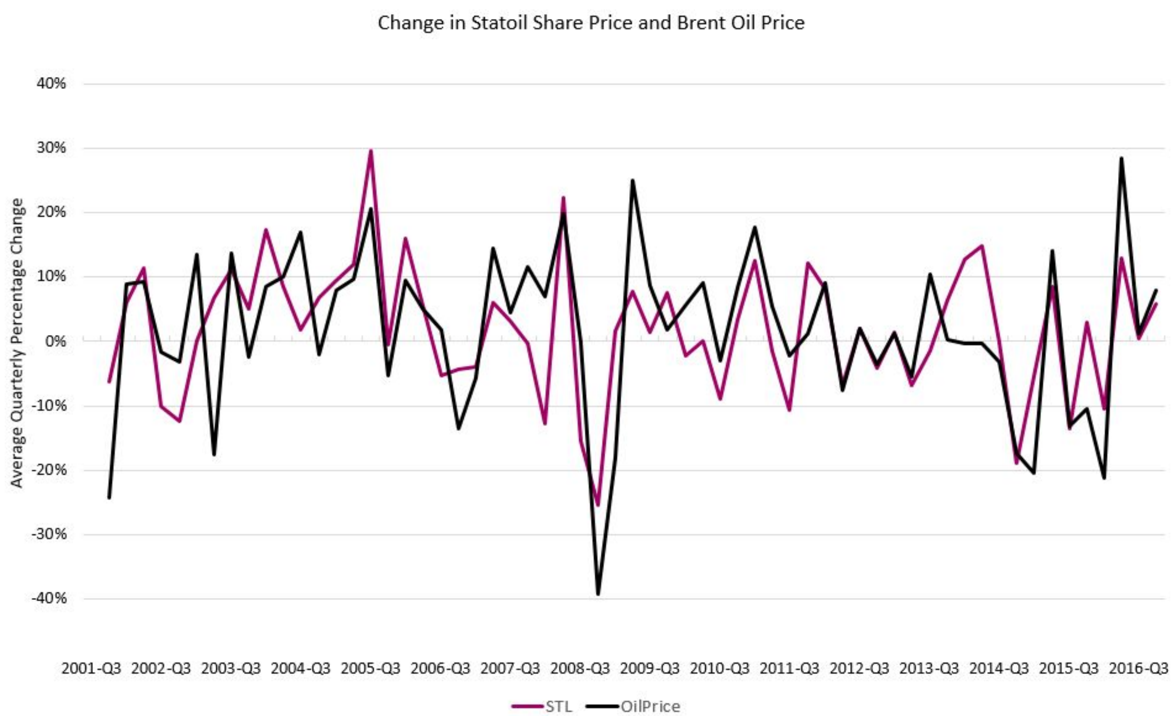

Figure 3: Quarterly percentage change in Statoil's share price and Brent oil price.

Figure 2 shows Statoil's share price and Brent oil price, both based on quarterly average data, from Q3 2001 - Q4 2016. It can be observed that Statoil's share price follows the oil price quite closely. Figure 3 shows the quarterly percentage change in Statoil's share price and the oil price. Again it can be observed that STL and the oil price tend to shift together.

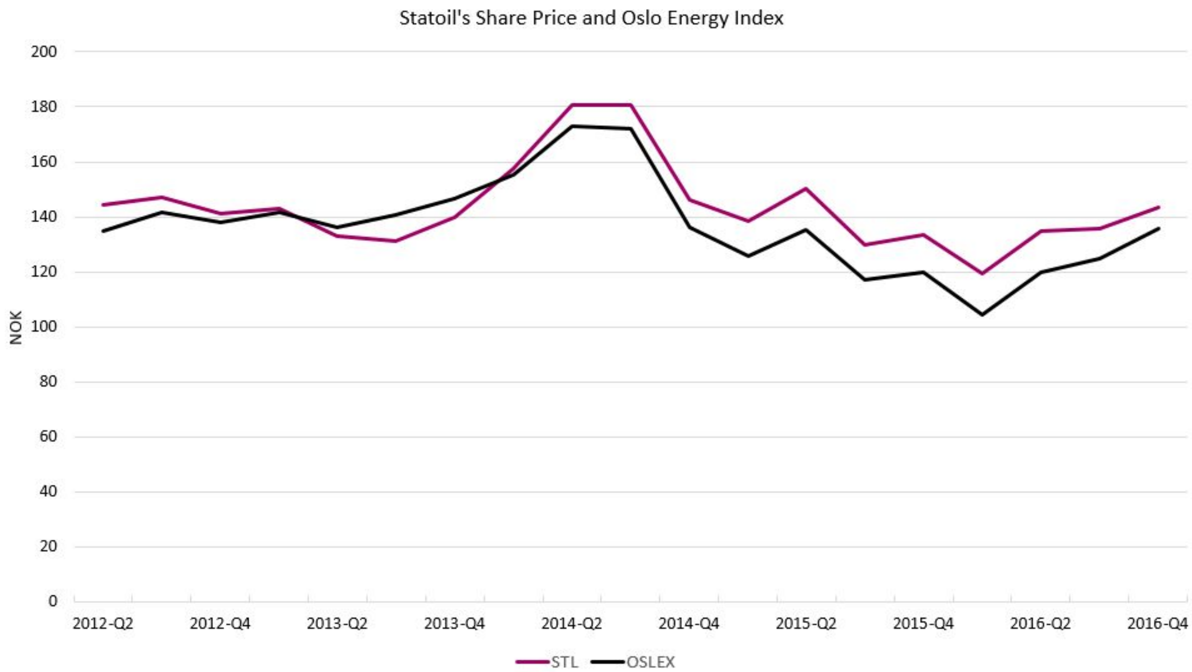

Figure 4: Quarterly averages of Statoil's share price and the Oslo Energy Index.

Figure 4 shows Statoil's share price against the Oslo Stock Exchange Energy Index, OSLEX, from 2012 - 2016. OSLEX consists of 58 companies that operate in the energy sector, including Statoil. The index is weighted based on market value, therefore Statoil is a very large part of the index. Statoil accounts for approximately 68% of the index, while the second largest company, Aker BP, only accounts for approximately 7% (per 22.03.17) (Oslo Børs, 2017). From the figure it can be seen that Statoil and OSLEX move almost in sync. This is not surprising, considering both that Statoil is such a large part of the index and that all the companies in the index are in the same sector and therefore affected by many of the same factors.

2.2.1 Statoil's Investment History

The privatisation and public listing of Statoil in 2001 expanded Statoil's maneuverability. The company got the opportunity to grow outside of Norway. That year Statoil invested twice as much in exploration and extraction on the Norwegian continental shelf compared to abroad, NOK 10.8 billion and NOK 5 billion, respectively. Already by 2004 this had changed. Since then, investments have been higher abroad than in Norway every year except 2006 and 2013 (Noreng, 2017, 23.03).

In the 1980s and 1990s the oil price was relatively low, therefore the number of fields in Norway ready for development was small at the start of the new millennium. At this time Statoil had a lot of capital available for investments and large freedom of action, which made acquisitions abroad a tempting opportunity (Noreng, 2017, 23.03).

After 2003, rising oil prices initiated increasing investments in exploration and extraction. From 2001 to 2015 Statoil's total investments in exploration and extraction increased from NOK 16 billion to NOK 116 billion, measured in nominal kroner (Noreng, 2017, 23.03).

Measured in value creation for shareholders, based on dividends and share price, Statoil has been in front of other major oil companies like BP, ConocoPhillips, Eni, Shell and Total since the privatisation in 2001. This has strengthened Statoil's share price. Statoil has performed above average when it comes to return on invested capital, but weaker than the best, ExxonMobil and Chevron (Noreng, 2017, 23.03).

When it comes to cost management, Statoil has not performed very well. All major oil companies experience a cost increase when oil prices rise, but for Statoil, the cost increase has been significantly higher than the average. Since 2001, Statoil has spent more money than the company has earned. As a consequence, since privatisation, Statoil has had a higher debt burden than most other major oil companies. Even with deficits, Statoil has paid large dividends to the shareholders. In the long run, it is not sustainable to give priority to dividends at the expense of investments (Noreng, 2017, 23.03).

Since 2001, Statoil has delivered strong financial results and generated high cash flows, mainly due to the high oil price. However, the oil price drop in 2014 changed that and profits plunged. Statoil's high costs, make the company particularly exposed to price risk in the oil market, and their high debt burden makes Statoil particularly exposed to the interest rate risk in the financial markets. This is not a good combination. A combination of lower oil prices and higher interest rates may make it difficult for Statoil to continue paying out high dividends. The policy of high dividends is supporting the share price and it is likely that the share price will drop should this policy change (Noreng, 2017, 23.03).

2.3 The Oil and Gas Industry

The oil and gas industry can be divided into three sub-sections; the upstream, the midstream and the downstream sectors. The upstream sector is also known as the exploration and production (E&P) sector.

Exploration, development and production are all part of the upstream sector. Exploration involves searching for oil and gas and is by nature a speculative activity which involves a high degree of investment risk. The development of new oil and/or gas fields requires large upfront investments. The profitability of an investment is highly dependent on the future oil price. The project may be profitable given that the assumed oil price is correct, however if the price falls and remains at a lower level over the lifespan of the project, the investment may no longer have a positive net present value (NPV). Cyclical downturns in the oil and gas price have a large effect on both the level of exploration activity and research and development (Brown, Moles, Vagneur and Robinson, 2011).

The midstream sector involves the shipping and storage of oil and gas, i.e. taking the crude oil retrieved in the upstream sector and transporting it to the downstream processing facilities (STI Group, 2013, 01.02).

The downstream industry can be split into the downstream oil sector and the downstream gas sector. As the oil price is the main concern in this thesis, only the downstream oil sector is described. The downstream oil sector includes refining, distribution and marketing (Brown et al., 2011). Before crude oil can be used it needs to be processed into finished products, such as petrol, diesel, paraffin, jet fuel and lubricants. This process is known as refining (Planete Energies, 2015, 17.08).

The upstream sector is the riskiest part of the oil and gas industry as it is heavily exposed to crude oil price risk. The revenues are dependent on the price of crude oil, which is much more volatile than the price of petroleum products, yet the production costs are largely fixed. Another element that adds to the risk is the success rate of exploration, the value of oil and gas reserves discovered per dollar spent on exploration. A third element that adds to the risk is that oil production often takes place in politically unstable areas of the world, where there is a high risk of such events as armed conflicts, which can disrupt production and increase the cost of production, and abrupt changes to the political system, which can lead to changes in fiscal terms for operating in the country (Brown et al., 2011). On the flip side of the coin, the upstream industry can be very rewarding and yield very high returns on invested capital.

Historically, large oil companies have been integrated, i.e. they have had operations in all sectors. Integrated oil companies can be more robust against fluctuations in crude oil prices than oil companies that only have upstream operations. The benefit of being exposed to all sectors is that crude oil prices and oil product prices do not tend to move in unison, they move asymmetrically. When the price of crude oil rises, prices of oil products also rise. However, when the price of crude oil falls, there is usually only a moderate price reduction on oil products. Nevertheless, profitability in the downstream sector is usually much lower than in the upstream sector (Noreng, 2017, 23.03).

Historically, Statoil has been an integrated company. However, they have been mostly active in the upstream sector. In recent years Statoil has divested refining and distribution, and invested heavily in the upstream sector. This has made Statoil more exposed to price risk in the oil market (Noreng, 2017, 23.03).

2.4 Investments

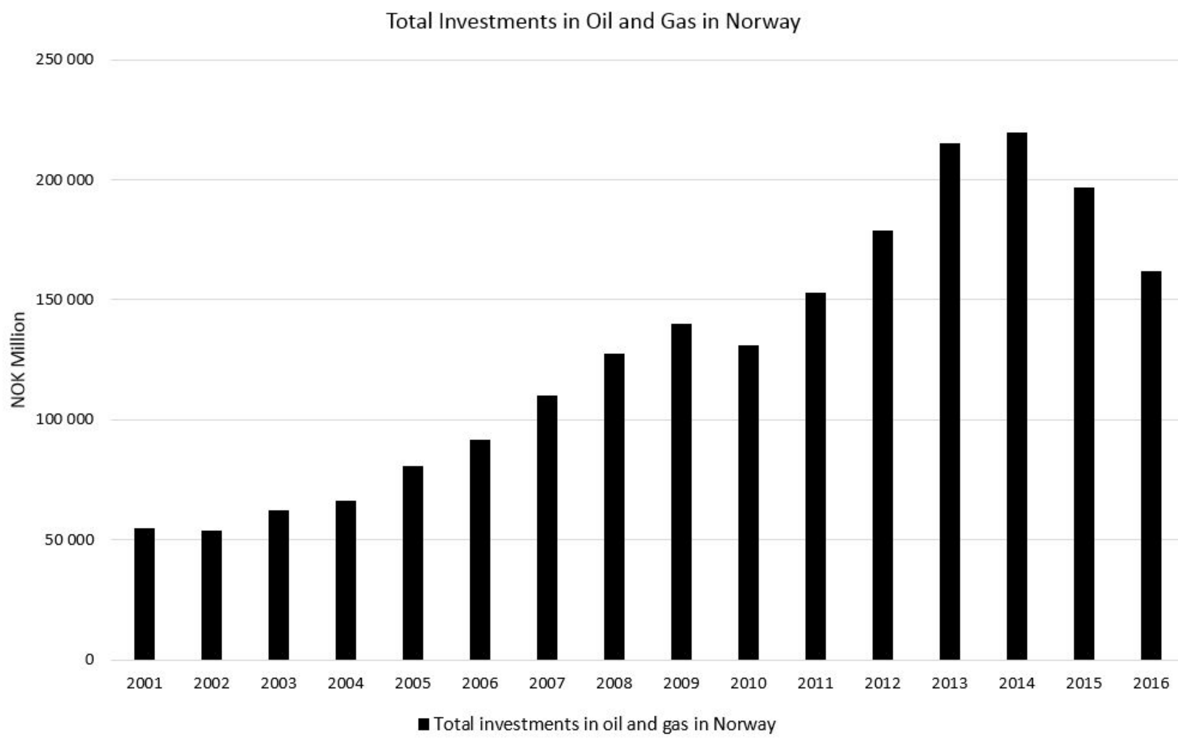

Figure 5: Investments in oil and gas in million NOK (Statistisk Sentralbyrå, 2017).

Under the economic crisis in Asia that started in 1997 the oil price fell to a historically low level, with a yearly average price in 1998 of USD 13 per barrel. Since then the oil price gradually rose to over USD 100 per barrel and stayed at that level, only interrupted by the financial crisis in 2007 - 2008. This prolonged period of strong oil prices ended in the autumn of 2014 due to oversupply. The investments in the Oil and Gas sector in Norway increased during this period to a very high level. The highest level was seen in 2014 at NOK 220 billion.

In the autumn of 2014 there was a large drop in oil prices. This led to cutbacks in the oil and gas industry. In the period 2010 - 2014, when the oil price was over USD 100 per barrel, the investments in Norway increased by 70%. In the period from 2014 to 2016, a period with falling oil prices, investments fell approximately 27%. From 2015 to 2016, the investments were reduced by 19% to NOK 163.3 billion. In 2017, the Oil companies in Norway expect to invest NOK 149.4 billion, a further 8.5% reduction from 2016 (Hovland, 2017, 23.02).

Statoil has reduced investments from around USD 20 billion in 2014 to USD 10.1 billion in 2015, and expects to invest USD 11 billion in 2017. Thereafter, in the period 2018 - 2020, Statoil expects to invest USD 12 - 14 billion per year (Hovland, 2017, 23.02).

How companies respond to dropping oil prices differ. Most companies cut in exploration activities (Lorentzen, 2015, 04.05). Development drilling is cut back on projects where the investments, or sunk cost, are relatively small. However, development drilling tends to be maintained on projects where the investments are high, as long as each new well is profitable.

2.5 OPEC

The Organisation of Petroleum Exporting Countries (OPEC) is a cartel that aims to manage the supply of oil in an effort to set the price of oil on the world market. OPEC was founded in 1960 by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. At that time the organisation had a large influence on the oil price as the member countries produced a large part of the total world supply of oil. When oil was found in the North Sea and the Gulf of Mexico in the 1970s and '80s OPEC's influence on the oil price weakened.

Today, OPEC consists of 12 of the world's major oil exporting nations, in addition to the five countries mentioned above, these are; Algeria, Angola, Ecuador, Libya, Nigeria, Qatar and the United Arab Emirates. OPEC currently controls 40% of the world's oil production, thus they still have a significant impact on the oil market (Globalis, 2017).

3. Theory

3. Theory

3.1 What Determines the Oil Price?

The oil price is determined by the supply and demand of oil. Further, speculators, market sentiment and global politics affect the supply and demand.

Supply and demand is an economic model of price determination in a market. Demand refers to the quantity of a product or service that is desired by buyers, while supply refers to how much the market can offer. The quantity demanded is the amount of a product consumers are willing to buy at a given price and the quantity supplied refers to the amount producers are willing to supply at a given price. The law of supply states that the higher the price of a good, the higher the quantity supplied, all else equal. The law of demand, on the other hand, states that, all else equal, the higher the price of a good, the lower the quantity demanded. When quantity supplied and quantity demanded are equal, the economy is at equilibrium. In equilibrium, a price is established through competition that is such that the quantity demanded is equal to the quantity supplied, and the allocation of goods is at its most efficient. According to the concept of supply and demand, the oil price should increase with increasing demand or decreasing supply. Further, the oil price should decrease when demand decreases or when supply increases (Heakal, 2017).

Market participants cannot only buy and sell the physical quantities of oil, they can also trade contracts for future delivery of oil. The futures market of oil plays a role in influencing the spot price of oil. The futures market consists of hedgers and speculators. Hedgers in the oil futures market try to offset potential price changes in the spot price of oil by buying or selling oil futures contracts. Hedgers are usually producers or users of the hedged commodity. Their goal is to protect their profits and limit risk. Speculators, on the other hand, try to profit from changes in price, and have no intention of actually buying the commodity. A speculator who believes the spot price of oil will increase, can buy a futures oil contract to try to gain on this price increase. Every transaction in the futures market must involve both a buyer and a seller, and the number of participants who wants to go long, or buy, does not necessarily equal the number who wants to go short, or sell. Banks, hedge funds or others can then add liquidity to future markets by taking the other side of transactions. If there are more market participants that want to go long than those that want to go short, the futures price will increase. (U.S. Energy Information Administration, 2017).

Oil is a highly demanded global commodity, thus the oil price can have a major economic impact. In order to reduce the unnecessary price fluctuations that often arise from expectations, OPEC has a function to balance the demand projections with supply.

3.1.1 Oil Price History

Figure 6: Europe Brent Spot Price in NOK from 2000 - 2016.

The oil price crash in 2014 marked the end of a 15 year period with exceptionally strong oil prices. Since the end of the Asian financial crisis in 1997 until the oil price crash in 2014, the oil price was increasing, only interrupted by a short drop during the financial crisis in 2007 - 2008. In the early 2000s, the oil price started gaining momentum due to growth in global economies. The oil price headed towards the highest level since 1981. In the mid 2000s, the combination of declining production and growing Asian demand pushed the oil price up. In 2007 - 2008 the financial crisis caused a large drop in the oil price. Due to a bubble-bursting sell off, the price plummet 78.1% from July 2008 - December 2008 (McGuire, 2015, 22.07), however, the oil price quickly recovered. The economic recovery that began in 2009 pushed the demand for oil up again and the oil price again exceeded USD 100 per barrel. The oil price stayed at that level until the surprising oil price drop in 2014 (DePersio, 2015, 03.03).

The fall in oil price, from a peak of USD 115 in June 2014 to under USD 35 in the end of February 2016, has been one of the most important global macroeconomic developments during the past few years. The decline has similarities to the oil price fall in 1985 - 1986 and in 2008 - 2009. It is essential to look at and understand the underlying causes of oil price drops, when analysing their macroeconomic effects. This thesis focuses on the price decline in 2014 - 2016, but looking at earlier price drops can give a better understanding of the drop in 2014 - 2016. The oil price drop in 1985 - 1986 was almost entirely supply-driven, while the 2008 - 2009 decline was mainly due to a collapse in demand. It appears that the most recent decline is a mix between the two (Rogoff, 2016, 02.03).

To understand what caused the oil price plummet in 2014, the events leading up to it must be studied. In the mid 2000s global demand was surging, and there was not enough oil production to keep up. This caused the oil price to rise sharply. (Plumer, 2015). During the years between 2009 and 2014, the shale oil revolution in the US gained momentum, and the production increased from zero to approximately 3 million barrels of oil per day (bopd). At the same time, there was historically high supply outages due to geopolitical unease. As the geopolitical situations eased and production from countries like Libya, Iran and Iraq was available again, there was a huge oversupply of oil in the market (Kjus, 2014). On the demand side the oil demand in Asia and Europe weakened, due to slowdowns in the Chinese and the German economies. In the United States, gasoline consumption was stagnating as cars became more fuel-efficient. The combination of lower demand and rising supply caused oil prices to drop to USD 80 per barrel by mid November 2014. Many expected OPEC to cut back on production to push prices back up, however, OPEC kept the production unchanged. Saudi Arabia refused to cut production because they wanted to maintain their market share. This caused the oil price to drop even further (Plumer, 2015) and by the end of February 2016 the oil price was under USD 35 per barrel (Rogoff, 2016, 02.03). At this point there was huge uncertainty in the market, there were bearish predictions that the oil price would continue dropping, and bullish predictions that this was the bottom of the trough and that the price would start to recover. In actuality, the price did recover and stabilised around USD 50 - 55 by year end (Blas, Smith & Habiby, 2017, 07.03). There is, however, still high uncertainty in the market regarding the future price development.

3.2 Stock Price Theory: Discounted Cash Flow Model

Various methods can be used for valuing firms and company stock. One commonly used method is the discounted free cash flow model (DCF). Future cash flows are estimated and discounted at the weighted cost of capital (WACC) to determine the present value of the company. This valuation method determines the firm value to both the equity and debt holders, thus the existing value of debt must be subtracted to find the value of equity. The equity value can be divided by the number of outstanding shares to find the intrinsic share price (Bodie, Kane, & Marcus, 2014, p. 617).

The discounted cash flow formula shows that a factor which affects the stock return can do so through the cash flow, the risk-free interest rate, or the risk premium. Næs, Skjeltorp, and Ødegaard (2009) have studied the impact of the oil price on stock prices on the Oslo Stock Exchange (OSE), they found that the oil price affects the cash flows of most industry sectors on the OSE. For oil producers, an increase in the expected future oil price should affect the cash flow positively as it increases their expected income. Companies with oil as an input factor can expect the opposite effect. Næs et al. further found that oil is not a priced risk factor in the Norwegian market. The main effect of oil price volatility on stock returns is thus through the companies' cash flows.

4. Methodology

4. Methodology

The aim of this study is to investigate how oil price movements affect Statoil's investments, costs and share price. The thesis is based on empirical financial data. Regression analysis is the main tool for evaluating the data and arriving at results and conclusions. The theory on the method is from Wooldridge (2014).

Statistical calculations have been performed in Stata 14 and Excel.

4.1 Data

The dependent variables that have been used in this thesis are Statoil's share price, capital expenditure and operating expenditure. Independent variables used are Brent oil price, NIBOR interest rate and Standard & Poor's 500 Index.

The time period studied is July 2001 - December 2016. For the regression analysis two shorter periods within this time frame have been studied, one period with increasing oil prices and another with decreasing oil prices. The upturn period is the period from Q4 2001 to Q3 2008, and the downturn period is from Q3 2014 to Q4 2016. The reason for studying the upturn and the downturn periods separately is to find out whether Statoil's response to these events differ.

To measure Statoil's investment levels, capital expenditures have been chosen as the best fit. CAPEX refers to funds used by a company to acquire or upgrade physical assets, such as property, machinery or equipment, to expand the company's abilities to generate profits (Capital Expenditure (CAPEX), 2017).

To measure Statoil's costs, operating expenses have been used. OPEX refers to expenses incurred in the course of ordinary business, such as wages, maintenance, repair of machinery and general and administrative expenses (Operating Expense, 2017).

OPEX and CAPEX are not reported monthly, only quarterly, thus this time interval has been chosen for all variables in this study. When estimating parameters using regression, larger sample sizes generally lead to increased precision. In this case quarterly interval gave the highest sample sizes possible.

Daily data for Oil price, USD/NOK exchange rate, S&P500 and Oslo Stock Exchange Energy Index have been collected and respective quarterly averages have been calculated. Quarterly averages have been calculated from monthly data for the interest rate.

This study uses NOK as the main currency. Data collected in USD have been converted to NOK. Monthly averages of the NOK/USD daily exchange rate have been collected from Norges Bank. Based on this, quarterly average exchange rates have been calculated and used to convert data from USD to NOK. This applies to S&P500 and the oil price.

4.1.1 Independent Variables

The aim of this study is to reveal how the oil price affects various dependent variables. However, other independent variables have been included, in addition to the oil price, to avoid the omitted variable bias (OVB). If an independent variable that is correlated with both the dependent variable and at least one of the independent variables is not included in the model, OVB may occur. The model compensates for the missing factor by over- or underestimating the effect of one of the other factors (Wooldridge, 2014, p. 76 - 78). Three independent variables have been included in the regression models, these are the oil price, the interest rate and the S&P 500. To represent the oil price, the Europe Brent Spot Price has been used.

A lot of research has been done on the causal relationship between stock returns and the interest rate. Gjerde & Sættem (1999) found a significant relationship between the interest rate and stock returns in the Norwegian market. They showed that the Norwegian stock market reacted negatively when the 3-month NIBOR increased, based on data from 1974 - 1994. However, they were unable to find a significant causal relationship between real stock returns and inflation. Due to these findings, the interest rate has been included as an independent variable in the models. The three-month nominal Norwegian InterBank Offered Rate (NIBOR) has been used to represent the interest rate, which is a common NIBOR parameter to use in these contexts.

Further, a market index has been included to account for the general economic sentiment in the market. The S&P 500 index is a broad market index that tracks the 500 most widely held stocks on the New York Stock Exchange or NASDAQ. It seeks to represent the entire stock market by reflecting the risk and return of all large cap companies (Amadeo, 2016). The S&P 500 has been included in the models to represent the general economic climate in the global market.

4.1.2 Data Statistics

Dataset (Q4.01 - Q3.08)	**OilPrice**	**S&P500**	**NIBOR**	**CAPEX**	**OPEX**	**STL**
Number of observations	28	28	28	28	28	28
Min value	173	6 067	1.97	2 089 M	15 201 M	55
Max value	616	10 082	7.22	24 957 M	127 478 M	186
Mean	333	7 855	4.25	9 087 M	65 211 M	118
Standard deviation	131	991	1.93	5 891 M	27 133 M	49

Table 1: Data statistics for the upturn period.

Dataset (Q3.14 - Q4.16)	**OilPrice**	**S&P500**	**NIBOR**	**CAPEX**	**OPEX**	**STL**
Number of observations	10	10	10	10	10	10
Min value	293	12 339	0.99	22 101 M	77 831 M	119
Max value	636	18 308	1.71	40 843 M	145 065 M	181
Mean	431	16 290	1.28	29 409 M	110 524 M	141
Standard deviation	96	1 863	0.25	5 722 M	22 564 M	16

Table 2: Data statistics for the downturn period.

4.1.3 Type of Data

There are two different types of data; qualitative data and quantitative data. Qualitative data is nonnumeric, while quantitative data is measured numerically (Glen, 2017). In this thesis, quantitative data has been used. The data has been organised systematically and used in statistical calculations.

Further, there are two main sources of data; primary and secondary data. While primary data is collected by the researcher himself, secondary data is data that already exists (Iacobucci & Churchill, 2010, p. 30 - 31). In this thesis, secondary data has been used.

4.1.4 Data Credibility

The data used in this thesis is all available in the public domain. Only credible sources have been used to collect the data. These sources are Thomson Reuters Eikon, Yahoo Finance, Norges Bank, Oslo Stock Exchange and U.S. Energy Information Administration, which are all considered credible sources. Eikon is a software product from Thomson Reuters for financial professionals. It has been used to collect data on Statoil. Eikon has been chosen as a primary source of data because it is considered to provide trusted and accurate information. Eikon gives access to segment data, including both real-time and historical data.

4.2 Regression Model

To evaluate the impact of oil price volatility on Statoil's investment levels, costs and share price, several multiple linear regression models have been estimated. The regression models have been estimated for two time periods, one period with increasing oil prices, and another with falling oil prices. The regression models are of the following form:

$$Y_t = \beta_0 + \beta_1 X_{t1} + \beta_2 X_{t2} + \ldots + \beta_k X_{tk} + u_t$$

In this equation Y is the dependent variable, the X's are the independent variables and u is the error term. T is the number of observations and k is the number of independent variables used. The purpose of multiple regression is to find the relationship between the dependent variable and a set of independent variables. The beta values (excluding β_0) describe the relationship between the independent variable and the dependent variable. β_0, the intercept parameter, is a constant. The error term (u_t), represents the stochastic variation in the dependent variable that is not explained by the independent variables (Wooldridge, 2014, p. 4 - 5, 18 - 19, 59 - 60).

4.2.1 Ordinary Least Squares

There are various methods for estimating the regression coefficients. For linear regression models, ordinary least squares (OLS) is the most common method used. The goal of OLS is to minimise the sum of the squares of the differences between the observed observations and those predicted by a linear function. The residual is the difference between the observed and the estimated value (Wooldridge, 2014, p. 25).

4.2.2 OLS Assumptions

For OLS to provide good estimates for the regression coefficients, the following assumptions must hold true:

1. Linear in Parameters
   The stochastic process follows the linear model: $y_t = \beta_0 + \beta_1 x_{t1} + \beta_2 x_{t2} + \ldots + \beta_k x_{tk} + u_t$

2. No Perfect Collinearity
   In the sample (and thus in the underlying time series process), no independent variable is constant nor a perfect linear combination of the others.
   This assumption allows the independent variables to be correlated, but they cannot be perfectly correlated. For this assumption to hold true, the sample size, n, must also be

large enough, at least k + 1 observations, where k is the number of independent variables in the model.

3. Zero Conditional Mean: $E(u_t | X) = 0$
   The expected value of the error, u_t, given the independent variables, X, for all time periods is equal to zero. If $E(u_t)$ is zero and u_t is independent of the independent variables, then this assumption automatically holds true.

4. Homoscedasticity: $Var(u_t | X) = Var(u_t) = \sigma^2$
   The errors are homoscedastic. The error terms are the same for all values of the independent variables.

5. No Serial Correlation: $Corr(u_t, u_s) = 0$, for all $t \neq s$
   Conditional on the independent variables, the errors in two different time periods are uncorrelated.

6. $u \sim N(0, \sigma^2)$
   The errors are independent of the independent variables and normally distributed.

If assumptions 1 through 3 hold true, the OLS estimators are unbiased, thus $E(\beta_j) = \beta_j$, j = 0, 1, 2, …, k. Further, if assumptions 1 through 5 hold true, the OLS estimators are BLUE (best linear unbiased estimator). To perform exact statistical inference for any sample size, assumption 6 also needs to hold true (Wooldridge, 2014, p. 279 - 285).

4.2.3 Hypothesis Testing

Once an econometric model is specified, various hypotheses of interest can be stated in terms of the unknown parameters. Hypothesis testing is used to draw conclusions with a certain probability based on results from regression analysis. A null hypothesis (H_0) and an alternative hypothesis (H_1) must be stated (Wooldridge, 2014, p. 97 - 99). If the null hypothesis is rejected even though it is true, there is a type I error. A type II error occurs if the null hypothesis cannot be rejected even though it is false. In statistical hypothesis testing, the accepted probability of a type I error is set, this is known as the significance level (Minitab, 2016). A 5% significance level is commonly used, thus the accepted probability of a type I error is 5%. If H_0 is rejected in favour of H_1, there is strong evidence that the alternative hypothesis is true. If H_0 cannot be rejected, it does not necessarily mean that the null hypothesis is true, the quality of the data may be insufficient to demonstrate sufficient evidence for the alternative hypothesis. Thus, if H_0 cannot be rejected, it is not accepted, it is simply not rejected (Wooldridge, 2014, p. 97 - 99).

4.2.4 Analytical Interpretation

A regression analysis provides several statistical measures. The most important ones are presented in the following.

When measuring how close the data is to the fitted regression line the R-squared (R^2) is examined. R^2 can be defined as the proportion of the total sample variation in the dependent variable that is explained by the independent variables. R^2 is a value between 0 and 1. The closer R^2 is to 1, the more of the variation is explained by the independent variables. In general, the higher the R^2 the better the model fits the data, however a low R^2 is not always bad and a high R^2 is not always good (Frost, 2013).

The adjusted R-squared is a modified version of R-squared for the number of predictors in a model. The adjusted R-squared is a value of 1 or lower, and it can be negative. A major difference between R^2 and adjusted R^2 is that R^2 assumes that every independent variable in the model explains the variation in the dependent variable. It gives the percentage of explained variation as if all independent variables in the model affect the dependent variable. The adjusted R^2, on the other hand, gives the percentage of variation explained by only those independent variables that in reality affect the dependent variable. When adding another independent variable the R^2 always increases and never decreases. The adjusted R^2 , however, only increases if the new independent variable enhances the model above what would be obtained by probability, and decreases when a predictor enhances the model less than what is predicted by chance. Due to this, the adjusted R^2 is a more suitable measurement in multiple regression (Investopedia, 2015).

The p-value for each beta coefficient tests the null hypothesis that the beta coefficient is equal to zero (there is no effect). If the p-value is less than 0.05, the null hypothesis can be rejected at a 5% significance level. Significance levels of 5% and 1% are most commonly used. If the null hypothesis is rejected, the independent variable has a significant effect on the dependent variable (Wooldridge, 2014, p. 109 - 110).

5. Econometric Analysis

5. Econometric Analysis

In this chapter, the results from the regression analysis are presented, analysed and used to attempt to answer the sub-questions linked to the research problem.

The chapter starts with a correlation analysis of all variables in the study. This is utilised in order to see how and to what extent the variables are associated with each other. However, the correlation analysis measures only the degree of linear association between two variables. Therefore, this alone cannot explain the cause-and-effect relationship between the variables.

Next, the OLS assumptions presented in section 4.2.2 are tested. Heteroscedasticity is tested using the Breusch-Pagan test, serial correlation is tested using the Durbin Watson test and normal distribution of the residuals is tested using the Skewness and Kurtosis test.

After the OLS assumptions have been tested, the results from the regression analysis are presented. Based on these results, it can be determined whether the oil price has an explainable effect on Statoil's investment level, costs and share price, and if the effects are positive or negative.

5.1 Correlation Analysis

A correlation coefficient is a statistical measure of the linear dependency between two random variables. It measures the degree to which the two variables move in relation to each other. Values of the correlation range between -1 and +1. A correlation coefficient of +1 indicates that two variables are perfectly correlated in a positive linear sense. A correlation coefficient of -1 indicates that the two variables are perfectly correlated in a negative linear sense. If the correlation coefficient is 0, then the two variables are not linearly related (Wooldridge, 2014, p. 20-21, 569). Correlation coefficients with absolute values between 0.9 and 1.0 indicate variables which are very highly correlated, absolute values between 0.7 and

0.9 indicate variables which are highly correlated, absolute values between 0.5 and 0.7 indicate variables which are moderately correlated, absolute values between 0.3 and 0.5 indicate variables which have a low correlation and, absolute values between 0.3 and 0 indicate variables which have little, if any, correlation (Andrews University, 2017).

	OilPrice	**STL**	**CAPEX**	**OPEX**	**NIBOR**	**S&P500**	**OSLEX**	**NOK/ USD**
OilPrice	*1.00*	0.75	0.64	0.54	-0.35	0.03	0.80	-0.67
STL	0.75	*1.00*	0.49	0.41	-0.34	0.17	0.90	0.23
CAPEX	0.64	0.49	*1.00*	0.49	-0.59	0.52	0.08	-0.11
OPEX	0.54	0.41	0.49	*1.00*	-0.36	0.29	0.23	-0.20
NIBOR	-0.35	-0.34	-0.59	-0.36	*1.00*	-0.43	0.58	0.08
S&P500	0.03	0.17	0.52	0.29	-0.43	*1.00*	-0.53	0.61
OSLEX	0.80	0.90	0.08	0.23	0.58	-0.53	*1.00*	-0.70
NOK/ USD	-0.67	0.23	-0.11	-0.20	0.08	0.61	-0.70	*1.00*

Table 3: Correlation matrix.

The correlation between the variables used in this study are presented in the correlation matrix in table 3. The correlations are based on quarterly data from Q3 2001 - Q4 2016. Correlations with OSLEX are based on quarterly data from Q2 2012 - Q4 2016. The highest correlation observed is 0.90 and is between the Oslo Energy Index and Statoil's share price. This is as expected, as Statoil operates in the energy sector and all the stocks in the energy index are influenced by the same factors. Also, Statoil has a dominating effect on the index, as it is weighted based on market value (Oslo Børs, 2017). The correlations between the oil price and Statoil's share price, and between the oil price and Oslo Energy Index are also positive and high, 0.75 and 0.80 respectively. As both Statoil and Oslo Energy Index are highly influenced by the oil price, and a higher oil price is beneficial to both, such a high positive correlation is reasonable.

Statoil's capital expenditures have the highest correlations with the oil price and the interest rate. CAPEX is negatively correlated with the interest rate, while it is positively correlated with the oil price. A negative correlation with the interest rate indicates that as the interest rate increases, Statoil's capital expenditures tend to decrease. This makes sense, as a higher interest rate reduces the return on investments. A higher oil price increases the profitability of Statoil's investments, thus the correlation is positive.

Statoil's operating expenses and the Brent oil price have a correlation of 0.54. This indicates a moderate positive relationship, thus Statoil's operating expenses and the oil price tend to move in the same direction. This may, however, not be a causal relationship. OPEX should be independent of the oil price. However, from approximately year 2000 until the oil price crash in 2014, the oil industry experienced hyperinflation, the costs of goods and services increased by 10% annually (Rystad Energy, 2014, 10.11). Even though there is a correlation between OPEX and the oil price, the reason for the increase in OPEX may be other factors, such as hyperinflation, which is not one of the variables in this study.

The oil price and the NOK/USD exchange rate have a correlation of -0.67. Thus, the USD tends to weaken when the oil price increases and strengthen when the oil price decreases. Historically, this is the typical relationship that has been observed between the USD and the oil price, and this has been explained by the huge flow of US oil imports. However, since the shale oil revolution, this relationship has weakened (Holodny, 2014, 08.10). The NOK tends to strengthen when the oil price increases. This can be explained by the importance of the income from the oil and gas industry on the Norwegian economy.

5.2 Residual Analysis

If the OLS assumptions, stated in section 4.2.2, do not hold true, the regression models may be invalid. Time series data have special characteristics, and these require special attention when applying OLS. Therefore, the OLS assumptions have been tested. Figure 7 gives a graphical overview of the residual analysis that has been conducted.

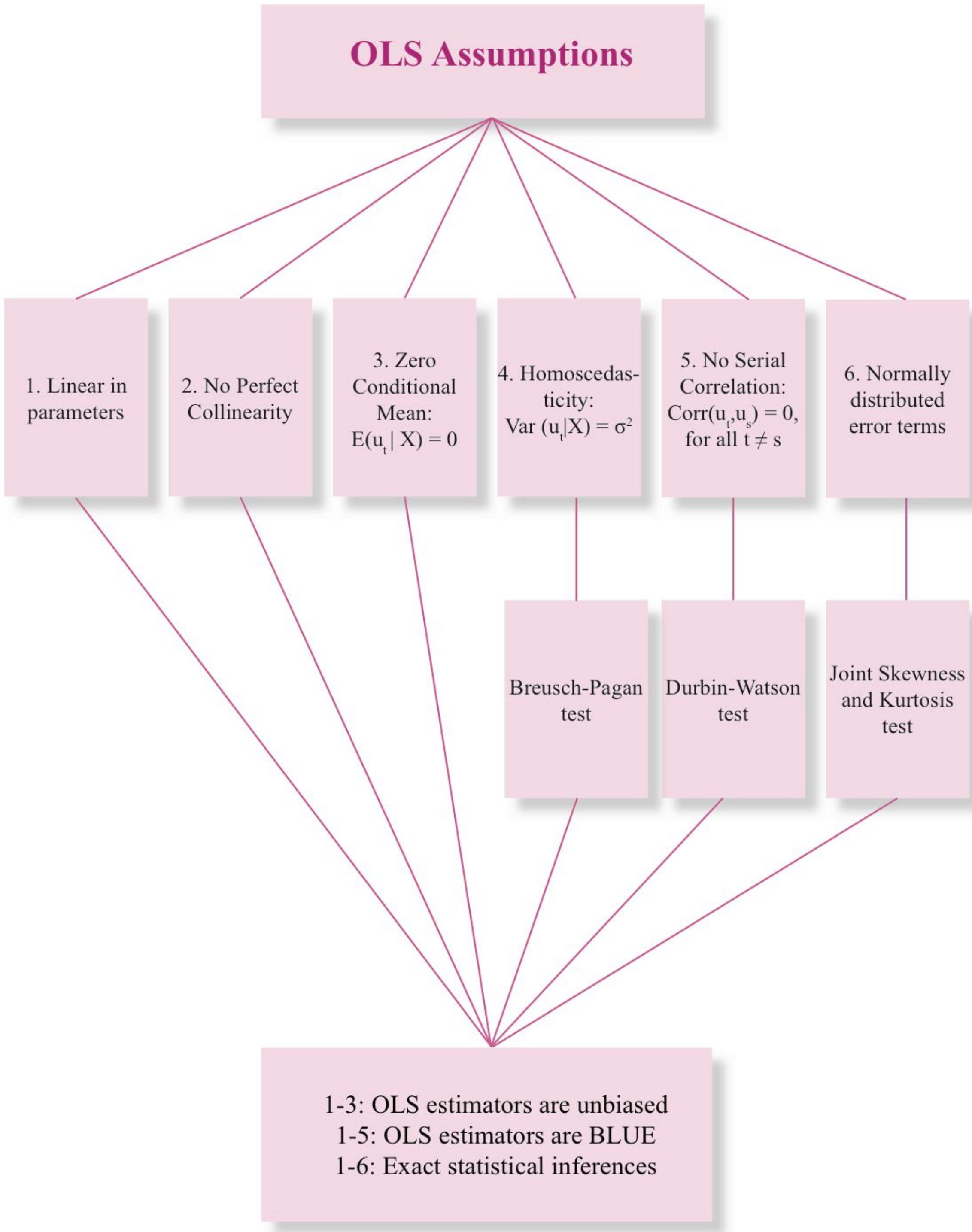

Figure 7: OLS Assumptions.

5.2.1 Unbiased Estimators

If OLS assumptions 1 through 3 hold true, the OLS estimators are unbiased.

The first assumption is that the regression model is linear. This assumption does not require that the underlying theory is linear, only that the form of the equation is linear. In the models in this thesis all variables are in logarithmic form. Such models are known as log-log models. However, the equations are in linear form, thus the OLS assumption still holds true. It is also assumed that the equations are correctly specified. This implies that the equations are in the correct functional form and that no variables are omitted from the equations (Studenmund, 2013, p. 98 - 99). The omitted variable bias has been discussed in section 4.1.1.

The second OLS assumption holds true as long as none of the variables in the models are perfectly correlated. The correlation matrix in table 3 revealed that none of the variables are perfectly correlated. Further, the sample size, n, must be at least k + 1. The models in this thesis all have three independent variables, thus k is equal to three. Therefore the sample sizes must be at least four for OLS assumption 2 to hold true. The sample sizes that have been used are 10 and 28, thus it can be concluded that the second assumption holds true.

The third OLS assumption assumes that the expected error term is zero, and that all independent variables are uncorrelated with the error term. The expected error is zero as long as a constant term is included in the model (Studenmund, 2013, p. 100). As a constant, β_0, has been included in all the models, this holds true. Further investigation has been done to be sure that the error terms are in fact zero. For all the models the residual means are negligible, smaller than 10^{-9}. The assumption of the error terms and the independent variables being correlated is violated most frequently when an important independent variable is omitted from an equation (Studenmund, 2013, p. 101). Several independent variables have been included in the models to avoid this problem, this has been discussed in section 4.1.1.

Based on this, it is concluded that the first three OLS assumptions hold true. Thus, the OLS estimators are unbiased. Next, the assumptions of homoscedasticity and no autocorrelation are tested. If these assumptions hold true, OLS is the best linear unbiased estimator.

5.2.2 Homoscedasticity

A central assumption in OLS regression is homoscedasticity. Homoscedasticity describes a situation in which the error terms are constant across all the values of the independent variables. If the size of the error terms differ across the values of the independent variables, the assumption of homoscedasticity is violated and the residuals are heteroscedastic (Statistics Solutions, 2013).

A Breusch-Pagan test has been conducted to test for heteroscedasticity. The null hypothesis in this test is constant variance, and the alternative hypothesis is that the residuals are heteroscedastic. Thus, if the null hypothesis is rejected, heteroscedasticity is present, and OLS assumption 4 is violated. If the null hypothesis cannot be rejected at a sufficiently small significance level, it is usually concluded that the residuals are homoscedastic. However, the null hypothesis is never accepted, it is simply not rejected (Wooldridge, 2014, p. 220 - 221).

In an attempt to avoid heteroscedasticity, the data used in the regression analysis have been transformed into logarithmic form, this rescales and reduces the impact of extreme observations.

Dependent variable Q4.01 - Q3.08	**chi2(3)**	**Prob > chi2**
Log(CAPEX)	13.21	0.004**
Log(OPEX)	18.99	0.000**
Log(STL)	2.10	0.551

Table 4: Breusch-Pagan test for the upturn period.

Dependent variable Q3.14 - Q4.16	**chi2(3)**	**Prob > chi2**
Log(CAPEX)	1.43	0.699
Log(OPEX)	6.87	0.076
Log(STL)	1.29	0.731

Table 5: Breusch-Pagan test for the downturn period.

Tables 4 and 5 show the results from the Breusch-Pagan test, for the upturn period and the downturn period respectively. P-values below 0.05 are marked with *, and p-values below 0.01 are marked with **. In the upturn period heteroscedasticity is present in two models, the CAPEX model and the OPEX model. In the downturn period, however, heteroscedasticity is not present in any of the three models at a 5% significance level.

OLS regression seeks to minimise the error terms and produce the smallest possible standard errors. All observations are given equal weight, however, when the residuals are heteroscedastic observations with large disturbance impact the results more. If that is the case, the coefficients from the regression are inefficient, however they are still unbiased. A more serious issue is that the standard errors are biased when the residuals are heteroscedastic. As the standard errors are central when conducting statistical inference, the biased standard errors may lead to incorrect conclusions regarding rejecting or not rejecting the null hypotheses (Statistics Solutions, 2013).

To avoid incorrect conclusions in the statistical inference, standard errors that are robust to heteroscedasticity have been used. This is further presented in section 5.2.5.

5.2.3 Serial Correlation

Serial correlation, also known as autocorrelation, is a common problem for time series data. Serial correlation is present when the error terms are correlated across time. Consider the case of error terms from adjacent time periods. Suppose that when $u_{t-1} > 0$ then, on average, the error in the next time period, u_t, is also positive. Then, $Corr(u_t,u_{t-1}) > 0$, and the error terms suffer from serial correlation. If serial correlation is measured to be zero, there is no correlation and each of the observations are independent of each other. If there is serial correlation, future observations are affected by previous observations. Thus, residuals that are serially correlated follow a pattern and are not random (Wooldridge, 2014, p. 283).

To test for first order serial correlation, the Durbin-Watson test has been used. The Durbin-Watson statistic is a number between 0 and 4. A value of 2 signifies no serial correlation in the sample. Values approaching 0 indicate positive serial correlation, while values approaching 4 indicate negative serial correlation. Positive serial correlation is present if a positive error for one observation increases the chance of a positive error for another observation. Negative serial correlation, on the other hand, is present if a positive error for one observation increases the chance of a negative error for another observation (Wooldridge, 2014, p. 336 - 337).

Testing for autocorrelation at the significance level α can be done by comparing the Durbin-Watson statistic to an upper and lower critical value, $d_{U,\alpha}$ and $d_{L,\alpha}$. Both positive and negative serial correlation can be tested for.

When testing for positive serial correlation the following rules apply:

- If DW < $d_{L,\alpha}$, there is statistical evidence that the error terms are positively serially correlated.
- If $d_{L,\alpha}$ < DW < $d_{U,\alpha}$, the test is inconclusive.
- If DW > $d_{U,\alpha}$, there is no statistical evidence that the error terms are positively serially correlated.

When testing for negative serial correlation the following rules apply:

- If (4 - DW) < $d_{L,\alpha}$, there is statistical evidence that the error terms are negatively serially correlated.
- If $d_{L,\alpha}$ < (4 - DW) < $d_{U,\alpha}$, the test is inconclusive.
- If (4 - DW) > $d_{U,\alpha}$, there is no statistical evidence that the error terms are negatively serially correlated (Wooldridge, 2014, p. 336 - 337).

Dependent variable	**Durbin-Watson statistic Q4.01 - Q3.08**	**Durbin-Watson statistic Q3.14 - Q4.16**
Log(CAPEX)	2.00	2.98
Log(OPEX)	2.62	2.54
Log(STL)	1.13	2.56

Table 6: Durbin-Watson statistics.

Table 6 show the results from the Durbin-Watson test. As many of the values are quite far from 2, the Durbin-Watson statistics have been compared to the upper and lower critical values at a 1% significance level. For a sample size of 28, $d_{U,o.o1}$ is 1.415 and $d_{L,0.01}$ is 0.97. For a sample size of 10, $d_{U,o.o1}$ is 1.73 and $d_{L,0.01}$ is 0.34.

The CAPEX model in the upturn time period has a DW-statistic of 2, and both the tests for positive and negative autocorrelation conclude that there is no statistical evidence that the error terms are serially correlated. On the other hand, the STL model in the upturn period has a quite low DW-statistic. The test for negative serial correlation concludes no statistical evidence for serial correlation. The test for positive serial correlation, however, is inconclusive.

The remaining four models all have DW-statistics approaching 3. The tests for positive serial correlation conclude no statistical evidence for positive serial correlation, but the tests for negative serial correlation are inconclusive.

According to these results it cannot be concluded that there is serial correlation in any of the models, however it cannot be ruled out either. Therefore, standard errors that are robust to serial correlation have been used in the statistical inference, this is further presented in part 5.2.5.

In the next section the final OLS assumption, normality of the error terms, is examined. When conducting hypothesis tests with small sample sizes, this assumption must hold true.

5.2.4 Normal Distribution

The assumption of normally distributed error terms is especially important for small sample sizes. For sufficiently large sample sizes, violation of the normality assumption is not as important (Studenmund, 2013, p. 105). The sample sizes used in this thesis are only 10 and 28, hence it is important that the normality assumption holds true for the statistical inference to be truly applicable.

Normally distributed residuals have a symmetrical, bell-shaped curve, with greatest frequency around zero. To test whether the residuals in the models are normally distributed, a skewness and kurtosis test has been conducted. This includes three tests, a test for skewness, a test for kurtosis, and a test that combines the two tests into an overall normality test.

Skewness is a measure of how far a distribution is from being symmetric. A skewness of 0 means that the tail on both sides of the mean balance out overall, which is the case for a symmetric distribution (NIST/SEMATECH, 2012). However, the skewness can also be 0 in cases where there is an asymmetric distribution, but the asymmetries even out, for example if one tail is long and thin while the other is short and fat (Revolvy, 2017). A negative skewness is present if the left tail is longer, and the mass of the distribution is concentrated to the right, this is known as a left-skewed distribution. A distribution is positively skewed, or right-skewed, when the right tail is longer, and the mass of the distribution is concentrated to the left (NIST/SEMATECH, 2013).

To measure the peakedness of the probability distribution in a random variable, the probability theory kurtosis is used. Kurtosis is a measure of the thickness of the tails. The kurtosis for a standard normal distribution is 3. Kurtosis higher than 3 indicates a heavy-tailed distribution, while distributions with kurtosis lower than 3 indicate a light-tailed distribution. A normal distribution has a skewness of 0 and a kurtosis of 3 (NIST/SEMATECH, 2013).

Dependent variable Q4.01 - Q3.08	**Skewness**	**Kurtosis**	**Joint test**
Log(CAPEX)	-0.79 (0.061)	5.51 (0.014*)	8.21 (0.017*)
Log(OPEX)	-1.61 (0.000**)	5.27 (0.019*)	12.84 (0.002**)
Log(STL)	-0.24 (0.539)	2.47 (0.752)	0.49 (0.781)

Table 7: Skewness and kurtosis test for the upturn period.

Dependent variable Q3.14 - Q4.16	Skewness	Kurtosis	Joint test
Log(CAPEX)	0.24 (0.671)	2.16 (0.804)	0.24 (0.886)
Log(OPEX)	-0.45 (0.428)	3.33 (0.232)	2.46 (0.293)
Log(STL)	-0.94 (0.102)	2.71 (0.593)	3.50 (0.174)

Table 8: Skewness and kurtosis test for the downturn period.

Table 7 and 8 summarise the results from the skewness and kurtosis tests for the time periods Q4 2001 - Q3 2008 and Q3 2014 - Q4 2016, respectively. In the second column the skewness for the residuals in the various models are shown and in the third column the kurtosis for the residuals are shown. In the fourth column the results from the joint normality test are presented, these statistics are called the chi-squared statistics and a high value indicates that the null hypothesis is false. The numbers presented in parentheses are the p-values for the various tests. The null hypotheses in the tests are normality, while the alternative hypotheses are non-normality. Thus, if the null hypothesis for a model is rejected, the error terms are not normally distributed. If this is the case, OLS assumption 6 is violated. P-values that are marked * represent values that are significant at a 5% significance level. P-values marked ** are significant at a 1% significance level. Thus, the values that are marked violate the assumption of normality. In uncovering if the normality assumption is violated in any of the models, the joint skewness and kurtosis test has been focused on.

First, the upturn period, Q4 2001 - Q3 2008, shown in table 7, is examined. The residuals in the STL model have a kurtosis below 3, while the residuals in the CAPEX and OPEX models, have a kurtosis above 3. The CAPEX and OPEX models thus have heavy-tailed distributions, while the STL model has a more light-tailed distribution.

The residuals in all the models in the upturn period have a negative skewness, thus they are left-skewed. The model with skewness closest to being normally distributed is STL, with a skewness parameter of -0.24 This is quite close to a symmetric distribution. The question is how much skew render the data non-normal? For real-world data a skewness of exactly 0 is quite unlikely. Using hypothesis testing, it can be determined whether residuals are normally distributed based on their skewness. If the p-value is above 0.05, the null hypothesis cannot be rejected at the 0.05 level, and it can be concluded that the residuals follow a normal distribution.

Based on skewness, the probability that the residuals in the STL model are normally distributed is 0.539. Thus, the null hypothesis is not rejected. This is also the case based on kurtosis, the p-value for the kurtosis test is 0.752 and the null hypothesis is not rejected. Based on both skewness and kurtosis, Stata reports a p-value of 0.781, thus normality of the residuals is concluded.

For the CAPEX model, the null hypothesis cannot be rejected based on skewness, but based on kurtosis, the null hypothesis of normality is rejected at the 0.05 level. The normality test based on both skewness and kurtosis reports a probability of normality of 1.7%. Thus the null hypothesis of normality is rejected at a 5% significance level. The residuals in the CAPEX model do not follow a normal distribution.

Turning to the OPEX model, the null hypotheses of normality are rejected for all three tests. The normality test based on both skewness and kurtosis has a p-value of 0.002 and is thus rejected at a 1% significance level.

Next, the downturn period, Q3 2014 - Q4 2016, shown in table 8, is studied. In this period the residuals in all three models follow a normal distribution. At a 5% significance level, none of the null hypotheses are rejected. Thus, there is not enough evidence to conclude that the residuals are not normally distributed. In other words, the null hypotheses are accepted and normality is assumed. However, it cannot be concluded that the residuals follow a normal distribution. What can be said, however, is that the hypotheses that the residuals are normally distributed cannot be rejected. Accepting the null hypotheses may be an indication that the sample from the downturn period is too small to pick up any deviations from normality that there might be. A sample of 10 is quite small, such that any possible deviations from normality may not be detected.

To conclude, for the CAPEX and OPEX models in the upturn period, the null hypotheses are rejected, and it is concluded that the residuals in these two models do not follow a normal distribution. Therefore, these two models violate the OLS assumption of normally distributed residuals. If the sample sizes used in the statistical inference had been large enough, non-normality would not have impacted the regression results. For small sample sizes, however, it can impact the results. It is important that OLS assumption 6 holds true to be able to perform exact statistical inference on small samples. When analysing the regression results for the models with non-normal residuals, it is important to be aware that the statistical inference may be incorrect due to assumption 6 not holding true.

5.2.5 Robust Standard Errors

In the upturn period, it was found that the residuals in the CAPEX and OPEX models were heteroscedastic. Therefore, OLS assumption 4 does not hold true for these models. Further, serial correlation could only be ruled out in the CAPEX model for the upturn period. For the other models, the test for serial correlation was inconclusive. Thus, it cannot be concluded that OLS assumption 5 holds true.

When assumptions 4 and/or 5 do not hold true, OLS is not the best linear unbiased estimator. This means that the coefficients from the OLS regression are not the most efficient. The coefficients are, however, not biased. The biggest problem that arises from these assumptions not holding true is that the standard errors are biased. As hypothesis tests are used in this thesis, biased standard errors could lead to incorrect conclusions in the hypothesis tests.

In recent years it has become popular to estimate models by OLS, even though it is inefficient, but to correct the standard errors for serial correlation or heteroscedasticity. Newey and West have made a framework for estimating standard errors that are both heteroscedasticity and serial correlation robust. In time series literature these standard errors are known as HAC, or heteroscedasticity and autocorrelation consistent, standard errors. There are different orders of serial correlation, first-order serial correlation occurs when errors in one time period are correlated directly with errors in the following period, second-order serial correlation occurs when error terms two periods apart are correlated, and so on. When using the Newey framework, how many orders of serial correlation the standard error should be robust for must be determined. Newey and West recommended the number of lags to be the integer part of $4*(n/100)^{2/9}$, thus it grows with larger sample sizes (Wooldridge, 2014, p. 349 - 350). For the models in this thesis, this means using a lag of three for the upturn time period, and a lag of two for the downturn period.

As heteroscedasticity and serial correlation are present in some of the models, HAC standard errors have been used in the statistical inference. The normal OLS standard errors have also been estimated for comparison.

5.3 Regression Models

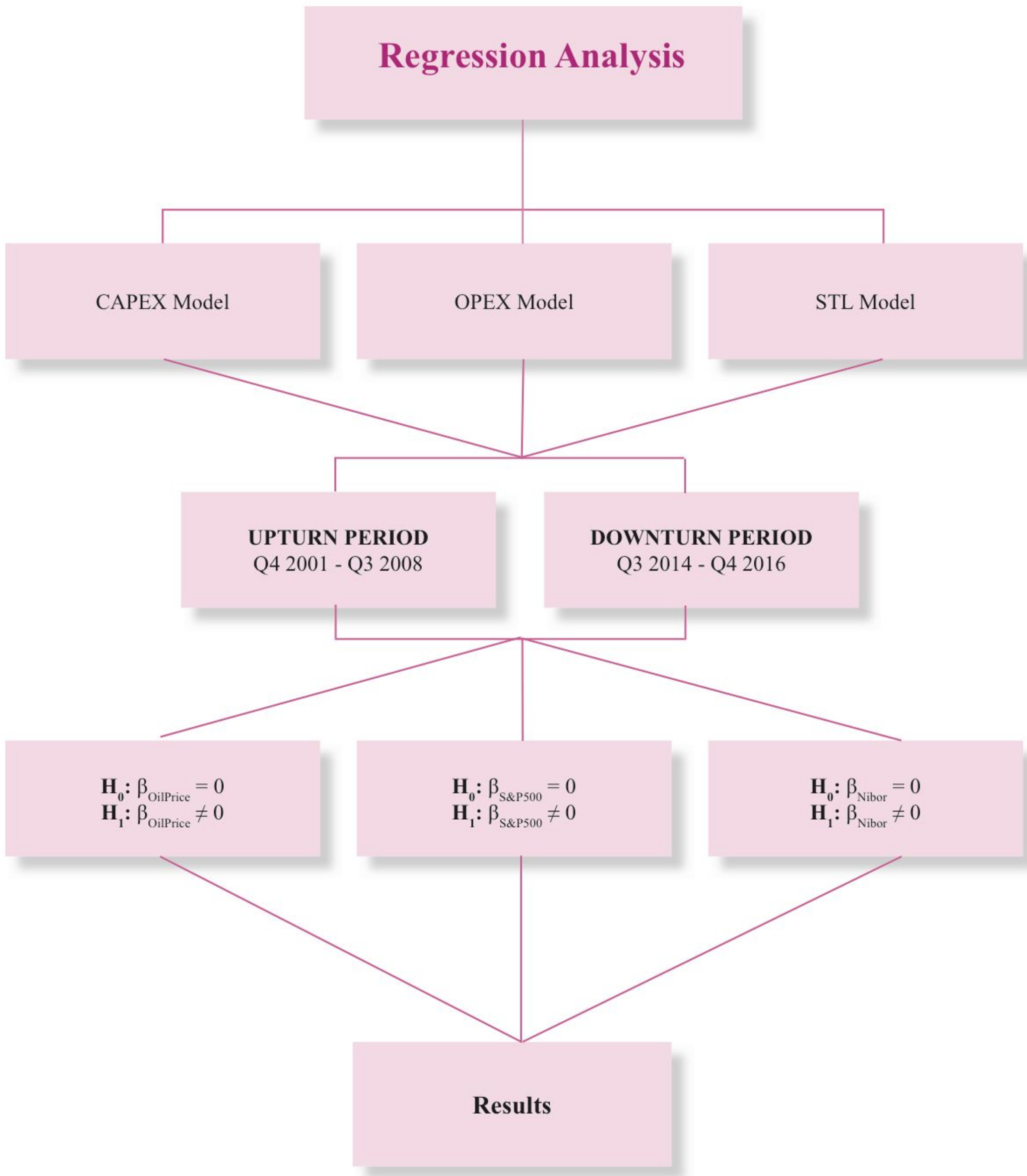

Figure 8: Regression analysis.

Figure 8 gives a graphical overview of the regression analysis that has been conducted in this thesis. Three regression models have been estimated. The dependent variables in the models are Statoil's capital expenditures, operating expenditures and share price. The independent variables used in all models are Brent oil price, NIBOR and the S&P 500. The three models are:

$$\log(CAPEX) = \beta_0 + \beta_{OilPrice} * \log(OilPrice) + \beta_{NIBOR} * \log(NIBOR) + \beta_{S\&P500} * \log(S\&P500) + u$$

$$\log(OPEX) = \beta_0 + \beta_{OilPrice} * \log(OilPrice) + \beta_{NIBOR} * \log(NIBOR) + \beta_{S\&P500} * \log(S\&P500) + u$$

$$\log(STL) = \beta_0 + \beta_{OilPrice} * \log(OilPrice) + \beta_{NIBOR} * \log(NIBOR) + \beta_{S\&P500} * \log(S\&P500) + u$$

5.3.1 Hypothesis Tests

Hypothesis testing has been used to study how the independent variables affect the dependent variables.

The null hypotheses are of the form: H_0: $\beta_k = 0$

This hypothesis states that the independent variable, k, has no effect on the dependent variable, for example Statoil's share price.

The alternative hypotheses are of the form: H_1: $\beta_k \neq 0$

This hypothesis states that the independent variable, k, has an effect on the dependent variable. Thus, if the null hypothesis can be rejected for an independent variable, this variable has an explainable effect on the dependent variable.

These hypotheses have been applied to all the independent variables; OilPrice, NIBOR, and S&P500. The hypotheses have been studied for all three dependent variables and for both time periods. Table 9 summarises the hypotheses tests in this thesis.

Hypothesis	H_0	H_1
OilPrice	$\beta_{OilPrice} = 0$	$\beta_{OilPrice} \neq 0$
S&P500	$\beta_{S\&P500} = 0$	$\beta_{S\&P500} \neq 0$
NIBOR	$\beta_{NIBOR} = 0$	$\beta_{NIBOR} \neq 0$

Table 9: Hypothesis testing.

5.4 Regression Results

In the following, the results from the regression analysis are presented and interpreted. First, the results from the capital expenditure model for both time periods are summarised and explained. Next, the same is done for the operating expense model and finally for the share price model.

5.4.1 CAPEX Model

Upturn	OLS	Robust OLS
Intercept	1.71 (0.82)	1.71 (0.80)
OilPrice	0.75 (0.007**)	0.75 (0.000**)
S&P500	0.35 (0.66)	0.35 (0.63)
NIBOR	-0.17 (0.42)	-0.17 (0.15)
R^2	0.288	
Adjusted R^2	0.199	

Table 10: Regression results for the CAPEX model in the upturn period.

Tables 10, 11, 12, 13, 14 and 15 summarise the results from the regression analysis. Beta values are presented for the intercepts and the independent variables, as well as the p-values which are in parentheses. Values marked * are significant within a 5% significance level.

Values marked ** are significant within a 1% significance level. Both the normal p-values and the heteroscedasticity and autocorrelation robust p-values have been estimated.

Table 10 summarises the results from the regression model with CAPEX as the dependent variable in the upturn period, Q4 2001 - Q3 2008. In the CAPEX model there is one significant variable, the oil price. The oil price is significant according to both the standard OLS standard error and the robust standard error. The null hypothesis of no relationship between CAPEX and the oil price can be rejected at a 1% significance level. According to the results, a 1% increase in the oil price is associated with a 0.75% increase in capital expenditures.

The interest rate and the S&P 500 are not significant in this regression model and the null hypotheses cannot be rejected regarding these variables. Thus, the interest rate and the S&P 500 did not have an explainable impact on Statoil's capital expenditures in the upturn period.

This model has an adjusted R-square of 0.199, thus 19.9% of the variation in Statoil's capital expenditure is explained by the regression model.

Downturn	**OLS**	**Robust OLS**
Intercept	-6.04 (0.56)	-6.04 (0.29)
OilPrice	-0.01 (0.98)	-0.01 (0.96)
S&P500	1.65 (0.12)	1.65 (0.03*)
NIBOR	1.54 (0.07)	1.54 (0.02*)
R^2	0.569	
Adjusted R^2	0.354	

Table 11: Regression results for the CAPEX model in the downturn period.

In table 11 the results for the CAPEX model in the downturn period, Q3 2014 - Q4

2016 are summarised. In this period, a significant effect of the oil price on capital expenditure was not found. Thus, the null hypothesis cannot be rejected. Using standard OLS standard errors the interest rate and the S&P 500 are not significant at a 5% level. However, according to the robust standard errors, both the S&P 500 and the interest rate have a significant effect on Statoil's capital expenditures. Thus, the null hypotheses regarding these two variables can be rejected, and it can be concluded that there is a relationship between S&P 500 and Statoil's capital expenditures, and between NIBOR and Statoil's capital expenditures. A 1% increase in the S&P 500 increases CAPEX by 1.65%, while a 1% increase in the NIBOR is associated with a 1.54% increase in CAPEX. The adjusted R-squared in this model is 0.569. This implies that 56.9% of the variation in Statoil's CAPEX is explained by the independent variables in the model.

5.4.2 OPEX Model

Upturn	OLS	Robust OLS
Intercept	12.02 (0.12)	12.0233 (0.003**)
OilPrice	0.21 (0.44)	0.2050 (0.20)
S&P500	-0.23 (0.78)	-0.2347 (0.58)
NIBOR	-0.09 (0.69)	-0.0862 (0.31)
R^2	0.034	
Adjusted R^2	-0.086	

Table 12: Regression results for the OPEX model in the upturn period.

Downturn	OLS	Robust OLS
Intercept	1.03 (0.93)	1.03 (0.94)
OilPrice	0.44 (0.45)	0.44 (0.36)
S&P500	0.80 (0.46)	0.80 (0.48)
NIBOR	0.77 (0.36)	0.77 (0.24)
R^2	0.546	
Adjusted R^2	0.317	

Table 13: Regression results for the OPEX model in the downturn period.

Table 12 and table 13 show the results from the regression on Statoil's operating expenses in the upturn period and the downturn period, respectively. None of the independent variables are significant in any of the time periods, and therefore the null hypotheses cannot be rejected. Thus, it cannot be concluded that the oil price, the S&P 500 or the interest rate have an explainable effect on Statoil’s operating expenses.

The model for the upturn period has a very low adjusted R-squared of -0.086. In the downturn period 31.7% of the variation in Statoil’s operating expenses can be explained by the independent variables included in the model.

5.4.3 STL Model

Upturn	**OLS**	**Robust OLS**
Intercept	-9.01 (0.000**)	-9.01 (0.000**)
OilPrice	1.09 (0.000**)	1.09 (0.000**)
S&P500	0.85 (0.000**)	0.85 (0.002**)
NIBOR	-0.12 (0.003**)	-0.12 (0.010**)
R^2	0.965	
Adjusted R^2	0.961	

Table 14: Regression results for the STL model in the upturn period.

In the regression analysis on Statoil's share price in the upturn period all three independent variables are significant. A 1% increase in the oil price is associated with a 1.09% increase in Statoil's share price, and a 1% increase in S&P 500 leads to a 0.85% increase in STL. An increase in NIBOR affects STL negatively, a 1% increase in NIBOR leads to a 0.12% drop in STL.

This model has an extremely high adjusted R-squared of 0.961. Such a high R^2 is typical of a time-series regression with a good fit. Most of the variation has been explained by the model, but there is still a portion of the variation that is random or unexplained by the model (Studenmund, 2013, p. 52).

In general, the higher the R^2 the better the model fits the data, however a high R^2 is not always good. Due to the high R-squared in this model, the residual plot has been examined to make sure the residuals are random and do not follow a pattern. Residual plots can reveal unwanted residual patterns that indicate biased results.

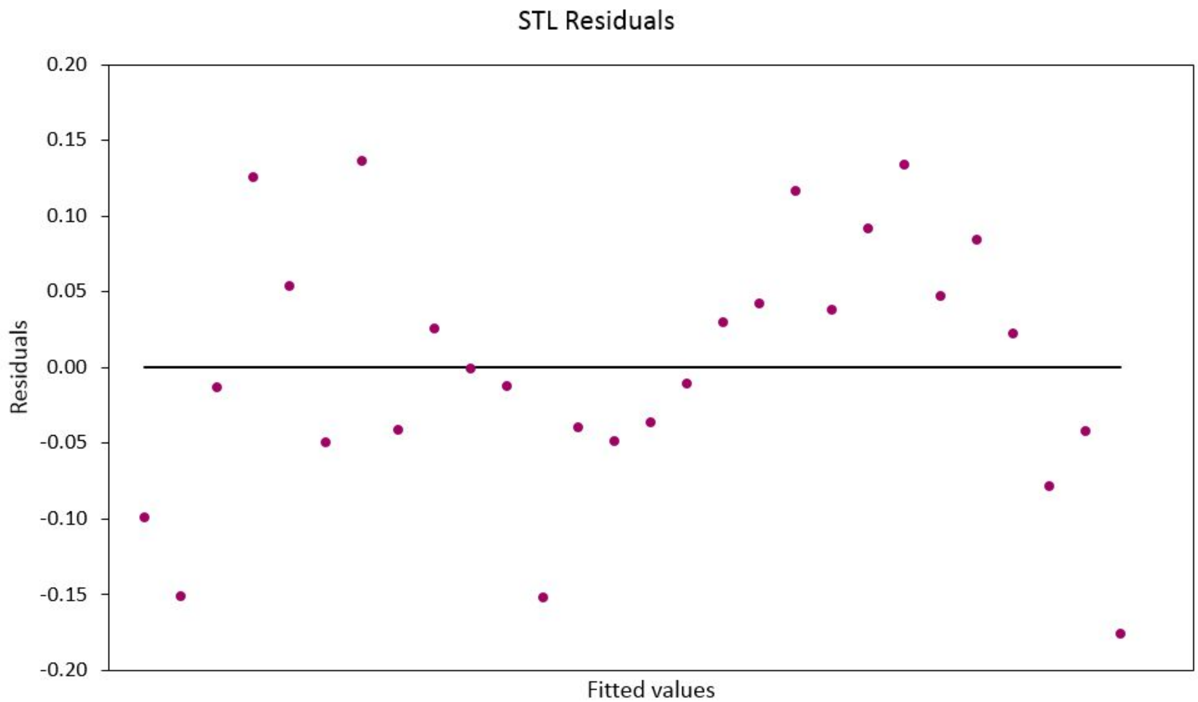

Figure 9: Residual plot for the STL model in the upturn period.

The residual plot is presented in figure 9. There is no clear pattern in the residuals, thus it is concluded that the results are in fact unbiased.

Downturn	OLS	Robust OLS
Intercept	2.67 (0.40)	2.67 (0.25)
OilPrice	0.56 (0.009**)	0.56 (0.003**)
S&P500	-0.11 (0.70)	-0.11 (0.60)
NIBOR	-0.18 (0.44)	-0.18 (0.28)
R^2	0.883	
Adjusted R^2	0.824	

Table 15: Regression results for the STL model in the downturn period.

For the downturn period, from Q3 2014 - Q4 2016, only the oil price had a significant effect on Statoil's share price. A 1% increase (decrease) in the oil price leads to a 0.56% increase (decrease) in STL. The effect in the downturn period is only half of what was found for the upturn period, but the oil price and STL still move in the same direction. The R-squared in this model is 0.883, not quite as high as in the upturn period. This implies that 88.3% of the variation in Statoil's share price can be explained by the regression model.

In the next chapter, the results from the regression analysis are discussed.

6. Discussion

6. Discussion

In this chapter the results from the regression analysis are discussed and interpreted. How the oil price volatility affects Statoil is examined and compared to theory. In cases where no significant relationship was found, reasons why this might be the case is discussed.

6.1 Share Price

In the period 2001 - 2008, all the independent variables in the regression model had an explainable effect on Statoil's share price. In the period from 2014 - 2016, however, only the oil price was found to have an explainable effect on the share price. The direction of the effect of the oil price on the share price was the same in both periods, an increase (decrease) in the oil price caused an increase (decrease) in the share price. Further, in the period 2001 - 2008, an increase in the interest rate had a negative effect on the share price. The effect of the interest rate on the share price, however, was very small. The results show that the oil price has the largest effect on Statoil's share price.

These findings are as expected according to the discounted cash flow model discussed in section 3.2. This model states that a firm's share price is decided by the net present value of all future cash flows. Statoil is a producer of oil, thus if the oil price increases, Statoil's profits will increase, and their future cash flow will therefore also increase. Further, it can be expected that an increase in the interest rate will decrease the share value. A higher interest rate increases the WACC, this reduces the present value of the firm, and thus also reduces the intrinsic share price.

A relationship between Statoil's share price and the interest rate was only found in the upturn period from 2001 - 2008. The fact that the same relationship was not found for the second time period, 2014 - 2016, was surprising. Further, looking at the magnitude of the effect the oil price had on Statoil's share price, the effect was almost double in the period 2001 - 2008 compared to the period 2014 - 2016. One reason for the difference in magnitudes might be the large uncertainty in the future development of the oil price since 2014. In the period 2001 - 2008 there was much more optimism regarding the future of the oil industry. Since the oil price drop in 2014, there has been high uncertainty in both the supply and demand side of oil. On the demand side, growing capacity in renewable energy sources and the growth in sales of electric cars will reduce the demand for oil and gas. However, to which degree is difficult to predict. On the supply side, the revolution in shale oil and shale gas has increased the oil and gas reserves dramatically and has outcompeted some of the conventional oil and gas reserves. There is a risk that some of Statoil's conventional oil and gas reserves cannot be developed economically in competition with unconventional reserves. During the period 2014 - 2016, and still today, many of Statoil's potential investors will focus on all these risk factors before they consider the development in the interest rate. In the period 2001 - 2008 these risk factors were much less relevant.

6.2 Investments

When it comes to Statoil's capital expenditures, it was expected that an increase in the oil price would increase capital expenditures. This is expected as an increase in the oil price will make more investments profitable, and thus more investments may be made. On the other hand, it was expected that a lower oil price would lower investments, as a lower oil price reduces the possible return from investments. However, whether the change in the oil price is expected to be long lasting is also an important factor to whether investments may be affected. If, for example, the oil price drops but the drop is expected to be temporary, reducing investments may not be necessary. Any unexpected changes in the oil price may be associated with higher expected volatility in the oil price. Whether the oil price increases or decreases, increased volatility in the oil price may serve to effect the investment level.

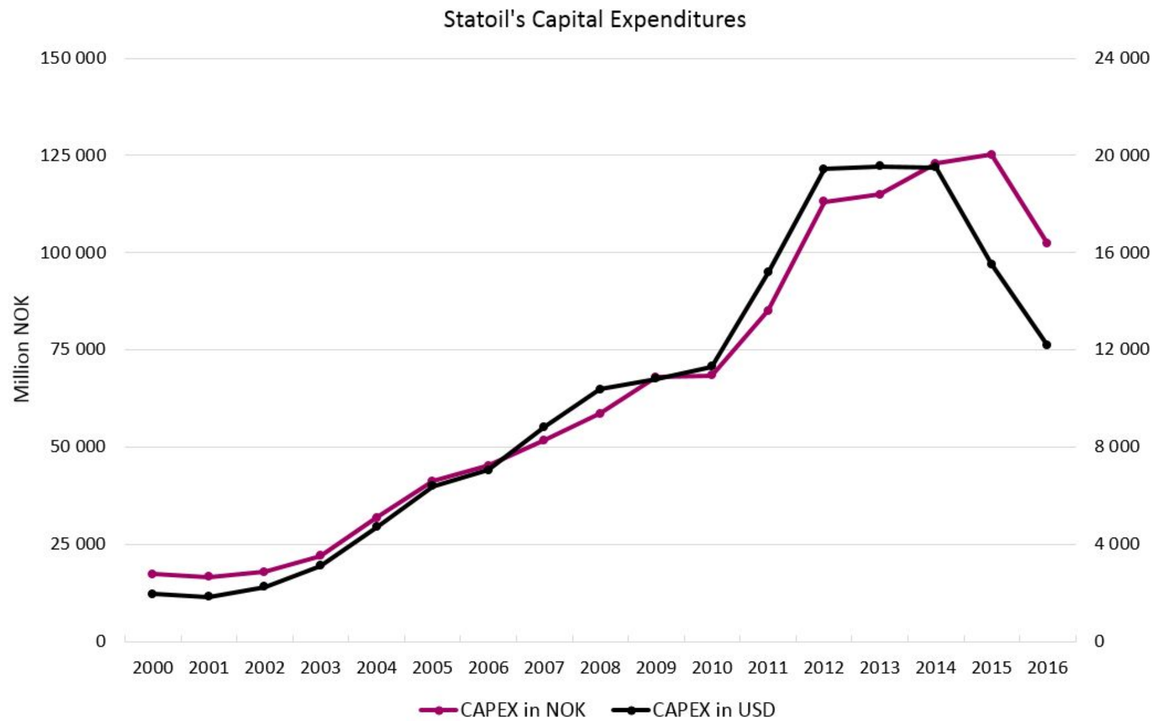

Figure 10: Statoil’s capital expenditures in NOK and USD from 2000 - 2016.

Figure 10 shows Statoil's capital expenditures from 2000 - 2016, measured in both NOK and USD. In the period 2000 - 2014 oil prices were increasing, only interrupted by a short term drop after the financial crisis of 2007 - 2008. From figure 10 it can be observed that Statoil’s capital expenditures also rapidly increased in this period, following the increasing oil price. In 2014 the oil price dropped significantly. Measured in USD, Statoil’s capital expenditures also dropped significantly. Measured in NOK, however, the capital expenditures did not drop until 2015.

In the regression analysis, a significant relationship between the oil price and capital expenditures was only found in one of the two time periods that have been studied. In the period 2001 - 2008, the relationship between capital expenditures and the oil price was as expected, an increase in the oil price was associated with an increase in capital expenditures. In the period from 2014 - 2016, on the other hand, no significant relationship between the two variables was found. This was unexpected and some possible explanations have been considered.

One reason may be Statoil management's expectations of the future oil price, which is what they use when assessing the profitability of potential investments. A second reason may be that there is a considerable lag between investment decisions and actual investments. The capital expenditures in 2014 - 2016 may be a result of investment decisions made in prior years. A relevant example is the Johan Sverdrup field development. This field was discovered in 2010. Plans for field development were made over the next few years, pre drilling started in 2016, and the platforms are scheduled to be installed in the field ready for first production in Q4 2019. Costs have been incurred between the years between 2010 and 2019 and revenues are scheduled to start in Q4 2019 (Statoil, 2017). Thus, the decision to invest in the Johan Sverdrup field, which was made prior to the oil price drop in 2014, has affected the investments also after 2014.

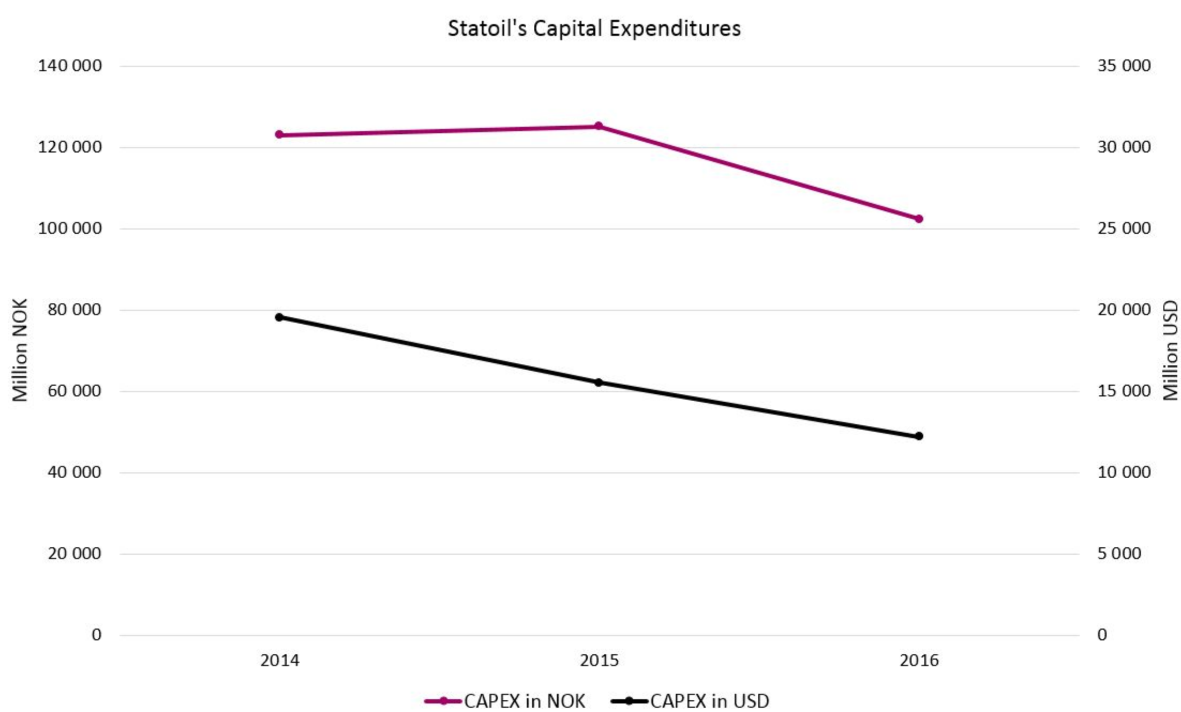

Figure 11: Statoil's CAPEX in NOK and USD from 2014 - 2016.

A third reason may be that the analysis is based in Norwegian kroner. Figure 11 shows Statoil's capital expenditures in 2014 - 2016 in both NOK and USD. Looking at the graph, there is a significant difference in CAPEX measured in USD versus CAPEX measured in NOK. CAPEX measured in USD fell both from 2014 to 2015 and from 2015 to 2016. Looking at CAPEX measured in NOK, however, there was a higher level of CAPEX in 2015 than in 2014. This difference is probably due to the large movement in the NOK/USD exchange rate in the period. In 2014 the average exchange rate was 6.30 NOK/USD, while in 2015 it was 8.06 NOK/USD, a movement of 28%, which has had a huge effect on the costs. The negative effect the oil price drop has had on Statoil's CAPEX is much larger measured in USD than in NOK. If the regression had been done in USD there is a possibility that a significant relationship between CAPEX and the oil price would have been found also in the period 2014 - 2016.

A fourth explanation can be Statoil's stock price volatility. This study analyses the direct effect of oil price shocks on Statoil's capital expenditures. However, looking at the effect of the oil price shock on the investment level in relation to Statoil's stock price volatility could explain why no significant relationship was found in the period 2014 - 2016. Uncertainty tends to increase dramatically after major economic and political shocks. Higher uncertainty, measured by stock price volatility, may cause firms to temporarily pause their investment and hiring activities. It is found that oil price shocks depress investment levels more for firms with high stock price volatility (Bloom, 2007). Therefore the stock price volatility could be an element that provides an understanding for the non-significant relationship in the period 2014 - 2016.

Interestingly, empirical results indicate that oil price shocks may not affect the investment levels in the short term, however, the long term effects on investment levels are there.

6.2.1 Investments and Uncertainty

Bernanke (1980) and Pindyck (1991) study the relationship between uncertainty and irreversible investment decisions. According to their study, increased uncertainty can explain why firms delay investments. Delays of investments can further cause reductions in capital expenditures. The extent of the reduction depends on the level of uncertainty and the potential positive and negative effects from delaying investment.

Most investment expenditures have two important characteristics. Firstly they are largely irreversible, that is they are mostly sunk costs that cannot be recovered. Secondly, most investments can be delayed, thus the firm has the opportunity to delay investments and wait for new information regarding prices, costs and the market condition. Investments should be undertaken only when the cost of deferring the investment exceeds the expected value of information gained by waiting.

The oil price drop in 2014 was associated with high uncertainty about the future development of the oil price. According to Bernanke and Pindyck, it would be expected that this increase in uncertainty would cause Statoil to delay investments, and therefore also a drop in Statoil's capital expenditures. However, in contrast to Bernanke's and Pindyck's findings, no significant relationship was found between Statoil's capital expenditures and the oil price after the oil price drop in 2014. Their findings can however explain the positive significant relationship between the oil price and Statoil's capital expenditures in the upturn period from 2001 - 2008. In this period, the fear of a drop in the oil price was low. Thus, the uncertainty in the market was low, and the benefit of deferring investments also low.

6.3 Operating Expenses

There was no significant relationship between any of the dependent variables and Statoil's operating expenses found in any of the two time periods studied. For the upturn period this was as expected. Operating expenses are related to the operation of the production and transportation of oil and gas. The operations that are required are not related to the oil price as such. The factors that may influence OPEX are starting up or shutting down production facilities, buying or selling ownership in production facilities operated by other companies, the exchange rate, changes in the price level of goods and services, changes in headcount, etc.

However, it was expected to see a significant relationship between OPEX and the oil price in 2014 - 2016 because of the severity of the oil price drop and the drastic cost cutting that has taken place. The newspapers have reported massive layoffs of personnel, dramatic reductions in contractor remuneration and delayed maintenance efforts. There was, however, no significant relationship during this period either.

6.4 Analytical Weaknesses

There are some weaknesses in the regression models that should be pointed out.

Results from econometric analysis are highly sensitive. Small changes in the dataset and the model specifications can have large impacts on the results. Incorrectly specified models can show a spurious relationship, a relationship may be found even though it is not a causal relationship. One way of increasing the accuracy of the model could be by adding more variables, for example inflation and exchange rate.

In this thesis OLS regression has been used, even though the data used is time series data. The OLS model is mostly used for cross-sectional data, yet with some modifications it can also be used for time series data. However, using a time series regression model, for example a vector autoregression model, may have improved the accuracy of the results.

Another weakness with the regression analysis is the small sample sizes that have been used, 10 and 28. The reasons for the small sample sizes were that some of the data was only available quarterly and that the period was divided into one downturn period and one upturn period, in order to reveal if Statoil's reactions were different during an upturn compared to a downturn. If monthly data had been available and only one period had been studied, the sample size would have been much larger and the probability of not detecting violations of the OLS assumptions would have been significantly reduced. Consequently, the probability of incorrect conclusions from regression analysis would have been reduced.

Finally, a lot of data has been processed manually for use in the regression analysis. This has been done with caution and the calculations have been verified to minimise the risk of human error.

7. Conclusion

7. Conclusion

The object of this thesis was to study how the oil price affects Statoil's investment levels, Statoil's costs, and Statoil's share price. Two periods have been studied, one with increasing oil prices and one with falling oil prices.

The results of this thesis conclude that the oil price does affect Statoil. Using regression analysis, it was found that in both the upturn period, Q4 2001 - Q3 2008, and in the downturn period, Q3 2014 - Q4 2016, oil price movements have had a significant effect on various key measurements.

Firstly, it was found that the oil price has an explainable effect on Statoil's share price. An increase in the oil price has a positive effect on the share price and opposite. The effect the oil price had on the share price was much larger in the upturn period from 2001 – 2008 than in the downturn period from 2014 – 2016. This is most likely due to the high uncertainty in the future development of the oil prices since 2014.

Regarding Statoil's investment levels, measured as CAPEX, it was found that in the upturn period, the increasing oil price had a positive effect on Statoil's capital expenditures. However, in the downturn period no explainable effect of the oil price on the capital expenditures was found. There are several factors that could justify this result. However, as there was a large movement in the NOK/USD exchange rate from 2014 - 2015, the reason why a significant relationship was not found may be due to the currency market. There is a possibility that a relationship would have been found if the analysis was based in USD.

Finally, no explainable relationship between the oil price and Statoil's operating expenses was found in any of the time periods. After the oil price drop in 2014 the media has reported massive headcount reductions and dramatic cuts in vendor contract prices. Therefore, the fact that no relationship was found between the oil price and the operating expenses in this period was surprising.

This thesis has relevance for investors and suppliers of goods and services to Statoil. The investors are interested in the relationship between the oil price and the Statoil share price, to ensure their investment is sound. Suppliers of goods and services are interested in Statoil's capital and operating expenditures. These expenditures become the suppliers' revenue and create jobs for the suppliers and their sub-suppliers. The Norwegian state and local communities are interested in CAPEX and OPEX expenditures which are spent in local communities in Norway, as these expenditures create jobs and activity for a number of large and small businesses.

7.1 Suggestions for Further Analysis

The topic of this thesis is quite defined and several interesting conclusions have been found. Some relationships were not detected within the defined topic and further studies are recommended to look into such relationships.

It could be interesting to see how the regression results differ by basing the data in USD compared to in NOK. As discussed, no significant relationship between the oil price and capital expenditures was found in the period 2014 - 2016, but it is suspect that a different conclusion would have been reached if the data was based in USD.

When looking at Statoil's investment levels, investment decisions made in the past will have an impact on the CAPEX several years after the initial investment decision. Thus, the CAPEX for one year can consist of investments that were planned many years prior. It would be of interest to examine how new investment decisions are impacted by oil price volatility.

Further, it could be interesting to divide the capital expenditures into various types of investments, for example exploration activity, new field development and production drilling. This would give insight into whether some investment activities are more or less affected by the oil price.

This thesis focuses on two recent time intervals, one where the oil price increased and one where the oil price decreased. It would be interesting to see whether the results would be the same looking at earlier periods with price increases/decreases. The main driver behind an oil price increase/decrease may differ and Statoil may react differently depending on the main drivers.

It would also be of interest to use the analysis to further investigate how Statoil could face the current oil price outlook in a way that is both successful in the short run and sustainable in the long run. Statoil follows a value over volume strategy, they focus on the value of the oil they produce, rather than the volume of oil production. After the oil price drop in 2014, they continued following this strategy. It could be interesting to investigate whether this strategy is the best way to face an oil price drop, or whether other strategies could be better.

Finally, it could be interesting to compare the results to other similar companies, to see whether they react in the same manner, or if there are differences. Statoil is a large oil company, and due to their size they may not be as sensitive to oil price changes as small oil companies.

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9. Appendix

9.1 Regression Output for the STL Model

9.1.1 Upturn Period

```
. regress LSTL LNIBOR LOilPrice LSP500

      Source |       SS       df       MS              Number of obs =      28
-------------+------------------------------           F(3, 24)      =  222.51
       Model |  5.44955049     3  1.81651683           Prob > F      =  0.0000
    Residual |  .195925966    24  .008163582           R-squared     =  0.9653
-------------+------------------------------           Adj R-squared =  0.9610
       Total |  5.64547646    27  .209091721           Root MSE      =  .09035

------------------------------------------------------------------------------
        LSTL |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |  -.1207511   .0359774    -3.36   0.003    -.1950048   -.0464975
   LOilPrice |   1.092303   .0444547    24.57   0.000     1.000553    1.184053
      LSP500 |   .8455802   .1392672     6.07   0.000     .5581469    1.133013
       _cons |  -9.005195     1.2678    -7.10   0.000    -11.62181   -6.388584
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  4,    28) =  1.125566

. hettest LNIBOR LOilPrice LSP500

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: LNIBOR LOilPrice LSP500

         chi2(3)      =     2.10
         Prob > chi2  =   0.5513
```

```
. sktest RESLSTL

                    Skewness/Kurtosis tests for Normality
                                                          ------ joint ------
    Variable |        Obs  Pr(Skewness)  Pr(Kurtosis) adj chi2(2)   Prob>chi2
-------------+---------------------------------------------------------------
     RESLSTL |         28     0.5385        0.7518         0.49         0.7809


. newey LSTL LNIBOR LOilPrice LSP500, lag(3)

Regression with Newey-West standard errors      Number of obs      =        28
maximum lag: 3                                  F(  3,        24)  =    140.42
                                                Prob > F           =    0.0000

------------------------------------------------------------------------------
             |             Newey-West
        LSTL |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |  -.1207511   .0432963    -2.79   0.010    -.2101104   -.0313919
   LOilPrice |   1.092303   .0630902    17.31   0.000     .9620916    1.222515
      LSP500 |   .8455802   .2420034     3.49   0.002     .3461098    1.345051
       _cons |  -9.005195   2.081241    -4.33   0.000    -13.30066   -4.709725
------------------------------------------------------------------------------


. summarize RESLSTL, detail

                          Residuals
-------------------------------------------------------------
      Percentiles      Smallest
 1%    -.1755646      -.1755646
 5%    -.1516963      -.1516963
10%    -.1509336      -.1509336       Obs                  28
25%    -.0453572       -.099116       Sum of Wgt.          28

50%    -.0055058                      Mean          -3.87e-10
                        Largest       Std. Dev.      .0851852
75%     .0505416       .1168211
90%     .1255839       .1255839       Variance       .0072565
95%      .133667        .133667       Skewness      -.2430339
99%      .136008        .136008       Kurtosis       2.474346
```

9.1.2 Downturn Period

```
. regress LSTL LNIBOR LOilPrice LSP500

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(3, 6)       =   15.04
       Model |  .095292838     3  .031764279           Prob > F      =  0.0034
    Residual |  .012669004     6  .002111501           R-squared     =  0.8827
-------------+------------------------------           Adj R-squared =  0.8240
       Total |  .107961842     9   .01199576           Root MSE      =  .04595

------------------------------------------------------------------------------
        LSTL |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |  -.1757962   .2101788    -0.84   0.435    -.6900852    .3384928
   LOilPrice |   .5621431    .147269     3.82   0.009      .201789    .9224973
      LSP500 |  -.1113858   .2704957    -0.41   0.695     -.773265    .5504933
       _cons |   2.665907   2.935985     0.91   0.399     -4.51819    9.850003
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  4,    10) =  2.556779

. hettest LNIBOR LOilPrice LSP500

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: LNIBOR LOilPrice LSP500

         chi2(3)      =     1.29
         Prob > chi2  =   0.7309

. sktest RESLSTL

                   Skewness/Kurtosis tests for Normality
                                                       ------- joint ------
    Variable |        Obs  Pr(Skewness)  Pr(Kurtosis) adj chi2(2)   Prob>chi2
-------------+---------------------------------------------------------------
     RESLSTL |         10      0.1022        0.5926        3.50         0.1737
```

```
. newey LSTL LNIBOR LOilPrice LSP500, lag(2)

Regression with Newey-West standard errors          Number of obs     =         10
maximum lag: 2                                      F(  3,          6) =      42.38
                                                    Prob > F          =     0.0002
```

LSTL	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
LNIBOR	-.1757962	.1467866	-1.20	0.276	-.5349701	.1833777
LOilPrice	.5621431	.1172776	4.79	0.003	.2751751	.8491112
LSP500	-.1113858	.2006414	-0.56	0.599	-.6023376	.379566
_cons	2.665907	2.111167	1.26	0.254	-2.499932	7.831746

```
. summarize RESLSTL, detail
```

Residuals

	Percentiles	Smallest		
1%	-.0729097	-.0729097		
5%	-.0729097	-.0560925		
10%	-.0645011	-.011274	Obs	10
25%	-.011274	.0043727	Sum of Wgt.	10
50%	.0080144		Mean	2.33e-10
		Largest	Std. Dev.	.0375189
75%	.0234353	.0216824		
90%	.0373785	.0234353	Variance	.0014077
95%	.0445401	.0302169	Skewness	-.942459
99%	.0445401	.0445401	Kurtosis	2.70901

9.2 Regression Output for the CAPEX Model

9.2.1 Upturn Period

```
. regress LCAPEX LNIBOR LOilPrice LSP500

      Source |       SS       df       MS              Number of obs =      28
-------------+------------------------------           F(  3,    24) =    3.24
       Model |  2.62000145     3  .873333818           Prob > F      =  0.0400
    Residual |  6.47849192    24  .269937163           R-squared     =  0.2880
-------------+------------------------------           Adj R-squared =  0.1990
       Total |  9.09849338    27  .336981236           Root MSE      =  .51955

------------------------------------------------------------------------------
      LCAPEX |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |  -.1712317    .206881    -0.83   0.416     -.598213    .2557496
   LOilPrice |   .7492177    .255628     2.93   0.007     .2216274    1.276808
      LSP500 |   .3537549   .8008288     0.44   0.663    -1.299075    2.006584
       _cons |   1.708008   7.290239     0.23   0.817     -13.3383    16.75432
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  4,    28) =  1.997389

. hettest LNIBOR LOilPrice LSP500

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: LNIBOR LOilPrice LSP500

         chi2(3)      =    13.21
         Prob > chi2  =   0.0042


. sktest RESLCAPEX

                   Skewness/Kurtosis tests for Normality
                                                         ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis) adj chi2(2)    Prob>chi2
-------------+---------------------------------------------------------------
   RESLCAPEX |     28      0.0606         0.0136         8.21         0.0165
```

```
. newey LCAPEX LNIBOR LOilPrice LSP500, lag(3)

Regression with Newey-West standard errors      Number of obs     =         28
maximum lag: 3                                  F(  3,        24) =       7.80
                                                Prob > F          =     0.0008
```

LCAPEX	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
LNIBOR	-.1712317	.1140729	-1.50	0.146	-.4066667	.0642032
LOilPrice	.7492177	.1720607	4.35	0.000	.3941018	1.104334
LSP500	.3537549	.7141833	0.50	0.625	-1.120247	1.827757
_cons	1.708008	6.77244	0.25	0.803	-12.26962	15.68564

```
. summarize RESLCAPEX, detail
```

Residuals

	Percentiles	Smallest		
1%	-1.573518	-1.573518		
5%	-.6806121	-.6806121		
10%	-.5272978	-.5272978	Obs	28
25%	-.1950724	-.4745873	Sum of Wgt.	28
50%	.0181278		Mean	2.00e-10
		Largest	Std. Dev.	.4898409
75%	.2121141	.436744		
90%	.7173499	.7173499	Variance	.2399441
95%	.8706417	.8706417	Skewness	-.7880706
99%	.9663933	.9663933	Kurtosis	5.511641

9.2.2 Downturn Period

```
. regress LCAPEX LNIBOR LOilPrice LSP500

      Source |       SS           df       MS      Number of obs   =        10
-------------+----------------------------------   F(3, 6)         =      2.64
       Model |  .185526324         3  .061842108   Prob > F        =    0.1435
    Residual |  .140355597         6  .023392599   R-squared       =    0.5693
-------------+----------------------------------   Adj R-squared   =    0.3540
       Total |  .325881921         9  .036209102   Root MSE        =    .15295

------------------------------------------------------------------------------
      LCAPEX |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |   1.544315   .6995722     2.21   0.069    -.1674761    3.256107
   LOilPrice |  -.0113266   .4901792    -0.02   0.982    -1.210752    1.188099
      LSP500 |   1.653672   .9003348     1.84   0.116     -.549368    3.856712
       _cons |  -6.035077   9.772315    -0.62   0.560    -29.94707    17.87692
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  4,    10) =  2.976261

. hettest LNIBOR LOilPrice LSP500

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: LNIBOR LOilPrice LSP500

         chi2(3)      =     1.43
         Prob > chi2  =   0.6992


. sktest RESLCAPEX

                    Skewness/Kurtosis tests for Normality
                                                          ------ joint ------
    Variable |        Obs  Pr(Skewness)  Pr(Kurtosis) adj chi2(2)   Prob>chi2
-------------+---------------------------------------------------------------
   RESLCAPEX |         10     0.6714        0.8041        0.24         0.8862
```

```
. newey LCAPEX LNIBOR LOilPrice LSP500, lag(2)

Regression with Newey-West standard errors          Number of obs     =        10
maximum lag: 2                                      F(  3,         6) =     17.70
                                                    Prob > F          =    0.0022
```

LCAPEX	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
LNIBOR	1.544315	.5062656	3.05	0.023	.3055281	2.783103
LOilPrice	-.0113266	.2385688	-0.05	0.964	-.5950835	.5724303
LSP500	1.653672	.5908582	2.80	0.031	.2078938	3.09945
_cons	-6.035077	5.160124	-1.17	0.287	-18.66145	6.591292

```
. summarize RESLCAPEX, detail
```

Residuals

	Percentiles	Smallest		
1%	-.1842148	-.1842148		
5%	-.1842148	-.1406147		
10%	-.1624148	-.0688469	Obs	10
25%	-.0688469	-.0676539	Sum of Wgt.	10
50%	-.0191211		Mean	-2.79e-10
		Largest	Std. Dev.	.1248802
75%	.0784776	.0709154		
90%	.1750898	.0784776	Variance	.0155951
95%	.2194345	.1307451	Skewness	.2375417
99%	.2194345	.2194345	Kurtosis	2.162777

9.3 Regression Output for the OPEX Model

9.3.1 Upturn Period

```
. regress LOPEX LNIBOR LOilPrice LSP500

      Source |       SS           df       MS      Number of obs   =        28
-------------+----------------------------------   F(3, 24)        =      0.28
       Model |  .243383746         3  .081127915   Prob > F        =    0.8358
    Residual |  6.83582371        24  .284825988   R-squared       =    0.0344
-------------+----------------------------------   Adj R-squared   =   -0.0863
       Total |  7.07920746        27  .262192869   Root MSE        =    .53369

------------------------------------------------------------------------------
       LOPEX |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |  -.0862111   .2125098    -0.41   0.689    -.5248098    .3523876
   LOilPrice |   .2050026   .2625832     0.78   0.443    -.3369425    .7469477
      LSP500 |  -.2347097   .8226179    -0.29   0.778     -1.93251     1.46309
       _cons |   12.02332   7.488593     1.61   0.121    -3.432376    27.47902
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  4,    28) =   2.61805

. hettest LNIBOR LOilPrice LSP500

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: LNIBOR LOilPrice LSP500

         chi2(3)      =    18.99
         Prob > chi2  =   0.0003


. sktest RESLOPEX

                    Skewness/Kurtosis tests for Normality
                                                          ------ joint ------
    Variable |        Obs  Pr(Skewness)  Pr(Kurtosis) adj chi2(2)   Prob>chi2
-------------+---------------------------------------------------------------
    RESLOPEX |         28      0.0009        0.0187       12.84        0.0016
```

```
. newey LOPEX LNIBOR LOilPrice LSP500, lag(3)

Regression with Newey-West standard errors          Number of obs     =        28
maximum lag: 3                                      F(  3,        24) =      1.56
                                                    Prob > F          =    0.2244

------------------------------------------------------------------------------
             |             Newey-West
       LOPEX |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |  -.0862111    .0835217    -1.03   0.312    -.2585914    .0861692
   LOilPrice |   .2050026    .1547388     1.32   0.198    -.1143627    .5243679
      LSP500 |  -.2347097    .4137856    -0.57   0.576    -1.088721    .6193017
       _cons |   12.02332    3.709341     3.24   0.003     4.367616    19.67902
------------------------------------------------------------------------------

. summarize RESLOPEX, detail

                          Residuals
-------------------------------------------------------------
      Percentiles      Smallest
 1%    -1.359686      -1.359686
 5%    -1.340914      -1.340914
10%     -1.13049       -1.13049       Obs                  28
25%    -.0624483      -.1249338       Sum of Wgt.          28

50%     .0576409                      Mean          -1.16e-09
                        Largest       Std. Dev.      .5031686
75%     .2378973       .4511345
90%     .5218656       .5218656       Variance       .2531787
95%     .6308689       .6308689       Skewness      -1.608546
99%      .646883        .646883       Kurtosis       5.273121
```

9.3.2 Downturn Period

```
. regress LOPEX LNIBOR LOilPrice LSP500

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(3, 6)       =    2.39
       Model |  .207740956     3  .069246985           Prob > F      =  0.1674
    Residual |  .173799419     6   .02896657           R-squared     =  0.5445
-------------+------------------------------           Adj R-squared =  0.3167
       Total |  .381540375     9  .042393375           Root MSE      =   .1702

------------------------------------------------------------------------------
       LOPEX |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      LNIBOR |   .7723836   .7784699     0.99   0.359    -1.132464    2.677231
   LOilPrice |    .443204   .5454615     0.81   0.448    -.8914923      1.7779
      LSP500 |   .7958405   1.001874     0.79   0.457    -1.655658    3.247339
       _cons |   1.027436   10.87444     0.09   0.928    -25.58135    27.63622
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  4,    10) =  2.537605

. hettest LNIBOR LOilPrice LSP500

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: LNIBOR LOilPrice LSP500

         chi2(3)      =     6.87
         Prob > chi2  =   0.0762

. sktest RESLOPEX

                   Skewness/Kurtosis tests for Normality
                                                      ------- joint ------
    Variable |    Obs   Pr(Skewness)   Pr(Kurtosis) adj chi2(2)    Prob>chi2
-------------+--------------------------------------------------------------
    RESLOPEX |     10      0.4275         0.2317         2.46         0.2926
```

```
. newey LOPEX LNIBOR LOilPrice LSP500, lag(2)

Regression with Newey-West standard errors      Number of obs     =         10
maximum lag: 2                                  F(   3,         6) =      15.39
                                                Prob > F          =     0.0032
```

LOPEX	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
LNIBOR	.7723836	.5958645	1.30	0.243	-.6856443	2.230411
LOilPrice	.443204	.4505223	0.98	0.363	-.6591842	1.545592
LSP500	.7958405	1.045329	0.76	0.475	-1.761987	3.353668
_cons	1.027436	12.15148	0.08	0.935	-28.70617	30.76104

```
. summarize RESLOPEX, detail
```

Residuals

	Percentiles	Smallest		
1%	-.2883341	-.2883341		
5%	-.2883341	-.0939258		
10%	-.1911299	-.0458779	Obs	10
25%	-.0458779	-.0240079	Sum of Wgt.	10
50%	-.0220372		Mean	-1.12e-09
		Largest	Std. Dev.	.1389642
75%	.0741521	.0687367		
90%	.1766656	.0741521	Variance	.019311
95%	.2293134	.1240178	Skewness	-.4466226
99%	.2293134	.2293134	Kurtosis	3.326799