HØGSKOLEN I OSLO
OG AKERSHUS

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Is leverage dependent on oil price?

A study on capital structure in the Norwegian energy sector

Master Thesis in Business and Administration
Oslo Business School, Oslo University College of Applied Sciences
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Sammendrag

Vi undersøker kapital strukturen i 93 børsnoterte selskaper innenfor den norske energisektoren fra 2001 til slutten av 2016. I tillegg til å se på faktorer som har bevist påvirkningskraft i tidligere studier, mener vi også at oljeprisen i seg selv kan påvirke, og inkluderer denne. Vi kontrollerer for ekstreme perioder ved å inkludere finanskrisen og oljekrisen i 2014. Gjennom regresjonsanalyse justert for faste effekter har vi undersøkte vårt eget datasett. Vi beviser at oljeprisen, fortjeneste og vekstmuligheter er negativt korrelert med gjeldsgrad. Firmastørrelse og materielle eiendeler viser seg å ha en positiv sammenheng med gjeldsgrad. Bedriftene hadde høyere gjeldsgrad gjennom finanskrisen.

Abstract

We investigate capital structure in 93 exchange listed firms of the Norwegian energy sector from 2001 until late 2016. In addition to investigating factors that has been proven valid through previous studies, we believe oil price itself is an explanatory factor. We control for the extreme periods of the financial crisis of 2008 and the oil crisis of 2014. The panel data set used is self-made, and our analysis is done through a fixed effects regression method. Our research proves that oil price, profitability and growth opportunities are negatively correlated with leverage. While firm size and tangibility are positively correlation. The firms had higher leverage during the financial crisis.

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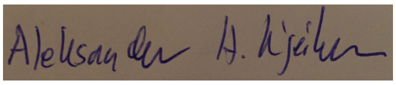
Acknowledgement

This is our master thesis and the final piece of our degree in business and administration. The authors have different backgrounds from a bachelor's degree in business and administration to a bachelor's degree in accounting and audit. While both have chosen finance as the major field of study in our master's degree. During lectures in corporate finance in 2015, both found capital structure to be especially interesting. The subject is partly chosen because we wanted to write about a subject that is currently relevant and that the result of our studies can give a new angel on the matter. This combined with the competence we have achieved during our studies led to our choice.

Research and data collecting and finally writing this paper has taken a full semester. During this time our tutor, Muhammad Azeem Qureshi, has given us great guidance and help along the way. For assisting us with econometrics and programming, we want to thank Øystein Strøm and Andreea Ioana Alecu. We are very thankful for all the help we have gotten. We also thank our friends and family for support.

May 25, 2017

Aleksander Halhjem Kjeilen



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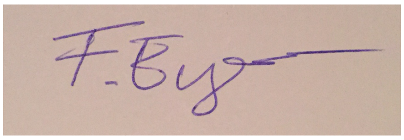

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2 Introduction

The topic of capital structure has been widely discussed in many academic journals and theses from many different perspectives. With our contribution, we particularly want to investigate capital structure and financing activities in the light of the oil price decline, which started in the summer of 2014. We find it interesting to compare this to the financial crisis, where the oil price also dropped and the authors have not found any studies investigating financing decisions in the light of these events combined. We will investigate capital structure from a market value perspective and a book value perspective to make sure we get the complete picture.

Since the first findings of Oil in 1962, the Norwegian economy has grown significantly as the oil industry has emerged along the west coast of Norway. The Norwegian economy has become more reliable on the profitable and highly taxed industry which contributes a lot to the Norwegian wealth model. Oil price falls such as in 2014 therefor make big impact in the nation's economy but especially the Norwegian energy industry. Projects that previously were profitable, no longer are which cause reductions in investments. The rapid drop in oil price has caused energy firms that where less solid to end up in financial distress or bankruptcy.

Another recent crisis of modern economy was the financial crisis of 2008. During this crisis, the oil price also dropped significantly. Starting with a collapse in the US housing markets and devaluations of financial markets, the financial crisis emerged. In September 2008, the financial crisis made its full impact on the world economy, also affecting oil price and the Norwegian markets. The two incidents of financial and oil crisis, made major impact on the economy but was caused by different events. With a strong relationship between the energy sector and oil price, we are curious on how the firms in the energy sector are financed and whether the oil price causes them to adjust their leverage.

This oil dominated energy sector of Oslo stock exchange relies on trading worldwide and the price is continuously affected by international macroeconomic fluctuations. If we combine this with the fact that most firms in the oil sector are capital intensive and the fact that from a potential project starts to the oil is delivered to the market it might take several years. The long time frame to delivery and that the price of the commodity is highly fluctuating creates an uncertainty that makes it hard to know if the project will be profitable in the future or not. We find it very interesting to see if firms in the oil sector accommodate this uncertainty by adjusting their leverage.

2.1 Hypothesis

Previous literature points to different explanations of capital structure. No theory or evidence can be generalized for all firms. Various factors contribute depending on industry, country, economic cycle, etc. We find it reasonable that financing decisions depends on the macroeconomic fluctuations. Because oil price fluctuates from macroeconomic events like wars and geopolitical instability, we believe the two aspects has a correlation that maybe can add some explanation to the understanding of the capital structure in the energy sector along with factors that previously has proven valid. We define our hypothesis as the following:

Hypothesis 1: There are similarities in terms of change in capital structure with the financial crisis and the oil crises in 2014 in Norwegian Energy firms

Hypothesis 2: The international oil price drive financing decisions in the energy sector on Oslo Stock Exchange

Hypothesis 3: Factors from previous empirical studies of leverage are also affecting leverage in Norwegian Energy firms

2.2 Limitations and the scope of this paper

Given that this paper is a master thesis and has a limited time frame, our research possibility becomes somewhat limited. Our population will therefore be limited to the main index at Oslo Stock Exchange. We will use well known theories along with some newer evidence to evaluate our findings. To be able to contribute and provide evidence on the latest trace of capital structure on the Norwegian energy sector, we have had to make our own data set.

2.3 Disposition and structure

We open by generally presenting characteristics of the Norwegian energy sector. We will bring in some studies of the oil price to get a picture of the relationship with market equity prices. We briefly discuss some of the most common theories and literature on capital structure before moving on and discussing the variables we will be using in our analysis. Further comes the methodology used in the analysis. A lot of time has gone into making the data set, which we will present here. At the end, we will present and discuss our analysis and the results before we draw our conclusion and recommend further research.

3 Oil Price and Capital Structure on the Energy Sector of Oslo Stock Exchange

3.1 Characteristics of the Energy Sector

Per March 2017 there are 187 firms listed within the main index at Oslo stock exchange[1], where 51 are within the energy sector. That is, almost 30% of the companies listed on the stock exchange are within the energy sector, and the entire energy sector is related to the oil industry. Per December 2014 the market value of the energy sector on OSEBX was 34,3 percent of the entire value of the OSEBX. Oslo Stock Exchange describes itself as oil exposed, even though reductions in market value of the sector have reduced the OSEBX`s oil exposure. (Aase and Eikerem 2014)

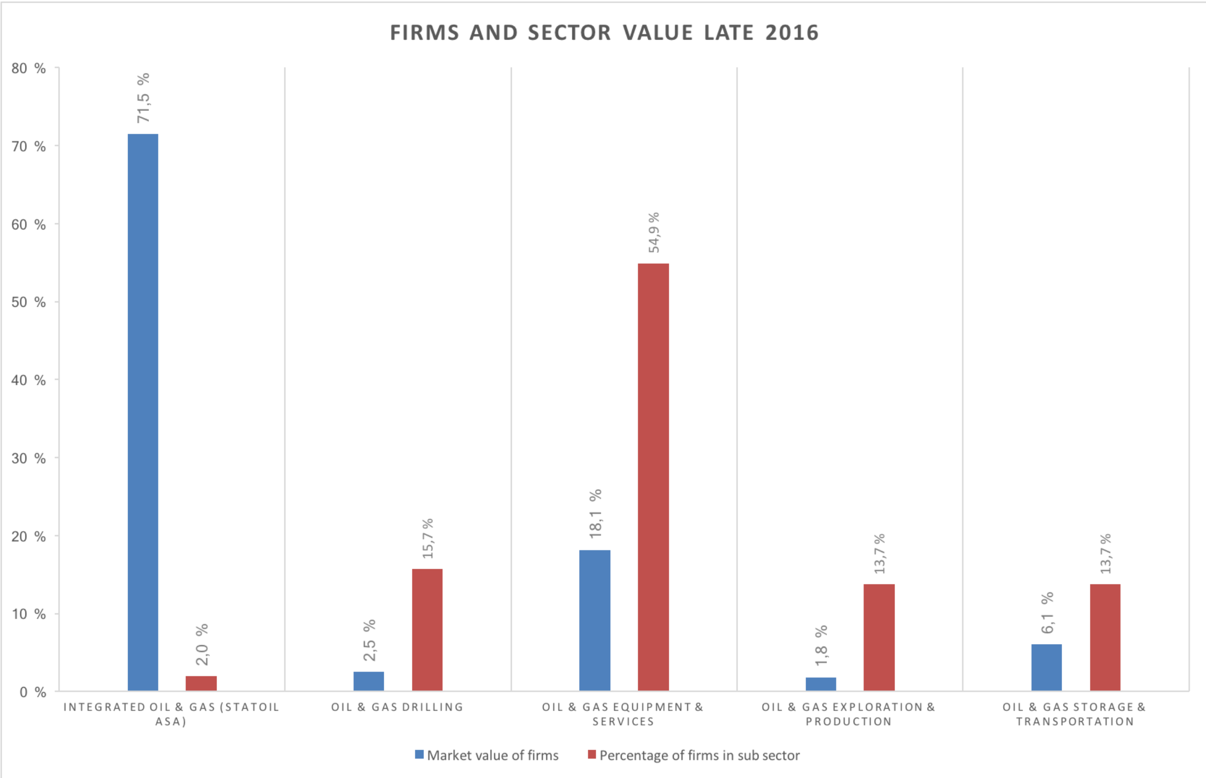

Figure 1 Value and number of firms in different sub sectors of the energy sector on Oslo Stock Exchange.

The energy sector of OSEBX is divided into five sub sectors by GICS code (MSCI 2016), where most of the firms are within Oil and Gas Equipment & Services. As figure 1 shows, Statoil ASA is relatively large compared to the other firms in terms of market value, and the only firm within Integrated Oil & Gas. Though all firms within the energy sector are related to oil, there are firms who also contribute to other energy activities.

[1] From here we will use OSEBX as short for the main index of Oslo Stock Exchange when needed.

3.1.1 Equity

The market value of firms' equity, or stock price, is a good measure of capturing future expectations of earnings as it also considers the order book's solvency, quality, liquidity and macroeconomic conditions that affect prospects of earnings. Book value of equity is not affected by macroeconomic factors in the same way. In late 2015, the market-to-book value of equity was far below one, which indicates a pessimistic future for the industry. (Hjelseth, Turtveit og Winje 2016)

A pessimistic future for the industry would mean that equity financing will be less preferred and firms would have to consider other options. The alternative in terms of equity is to issue new stock, but in a pessimistic market a firm would have to issue more stocks to get the needed amount of capital. Figure 2 shows the relationship between oil price and market value of equity in the energy sector. We can see how fluctuations in oil price and market value of equity in energy firms follows almost the same pattern.

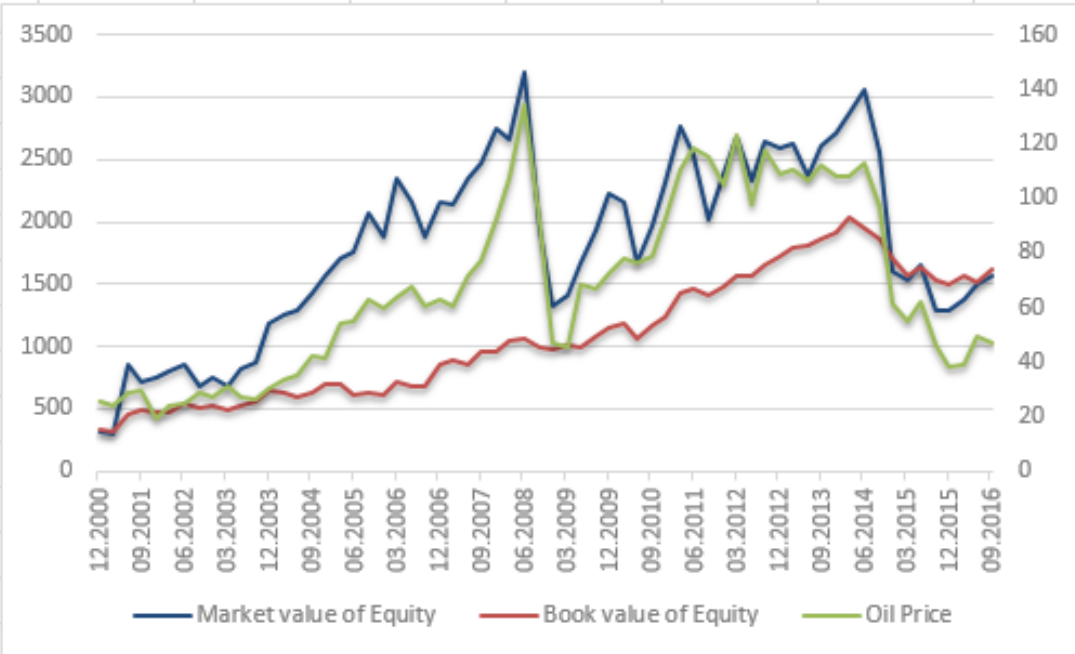

Figure 2 Both Market value of Equity and Book value of Equity are both in million USD and follows the left y-axis. Oil Price is in USD and follows the right y-axis.

Previous empirical literature such as (Sørensen 2009) and (Driesprong, Jacobsen og Maat 2008) have investigated if oil prices changes can predict stock returns. Their findings suggest that there is a relationship between oil price changes and stock returns, when investigating monthly lagged prices. Stock returns are weaker after the oil price has increased and higher if oil price has fallen in the previous month. (Driesprong, Jacobsen og Maat 2008)

Filis, Degiannakis and Floros, has investigated the dynamic correlation between stock market and oil prices. Correlation increases positively in response to oil price shocks caused by the demand-side, which again are caused by fluctuations in business cycle's or global turmoil. On the supply side, the lagged correlation indicates a negative relationship with the stock market. The exception is during the Financial crisis, where lagged oil price shows a positive correlation with the stock market. (Filis, Degiannakis og Floros 2011)

Mollick & Assefa also finds that before the financial crisis equity returns were negatively correlated with oil price, but from mid-2009, it changes to being positive. (Mollick og Assefa 2012) The change occurs when the Financial crisis ended. Declining oil prices like in 2014 leads to job losses and declining investments in hydrocarbon related industries. It weakens fiscal positioning and shrinks economic activities. (Khan 2017)

3.1.2 Debt

The alternative to financing through equity is debt. Norwegian oil firms generally have low direct credit exposure to banks. This means that debt is issued in internal capital market such as from a parent or sister company. Alternatively, firms can issue bonds to raise capital. Since 2014, bond prices on issues by oil service firms has dropped significantly. This suggests that investors consider the risk of bankruptcy increased and that the remaining assets are not as valuable.

In 2016 and 2017 the energy sector has approximately 25 billion NOK of bond debt that will mature, in addition to bank debt. Because of very high-risk premiums and short time to maturity, a lot of the debt might be difficult to refinance. Banks now practice stricter credit standards for oil-related firms. (Hjelseth, Turtveit og Winje 2016)
Mjøs claims that many firms in the Norwegian oil sector are sophisticated when it comes to debt, as their bank debt ratio is zero. (Mjøs 2007) We find that twelve off the currently listed firms (oslobørs.no 2017) within the energy sector has issued exchange listed bonds on Oslo Stock Exchange.

The level of leverage was steady before the financial crisis of 2008. Earnings rose, but leverage rose in the same pace. Just as during the financial crisis, debt capacity between Norwegian non-financial firms has now fallen. It is hard to identify what a normal level of debt capacity is and what the limit would be before the firms end up in financial distress.
As oil price and petroleum investments has fallen recently, the firms' revenue base has weakened as well. The oil service firms have had their debt capacity decreased. Recently the debt capacity[2] within the oil sector has fallen sharply. (I. N. Hjelseth 2016)

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[2] Debt capacity is in Hjeltnes 2016 calculated as: Debt-servicing capacity = earnings*100 / interest bearing debt.

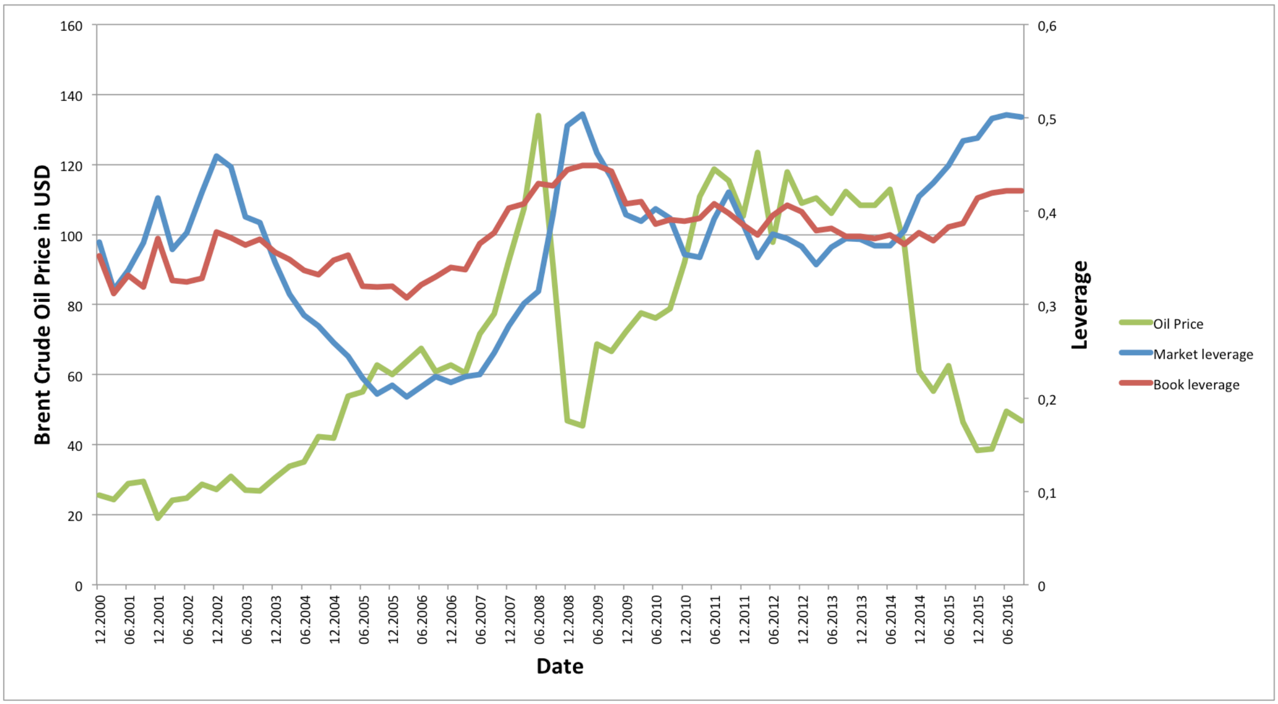

Figure 3 The average leverage for the energy sector at Oslo Stock Exchange for the last fifteen years and the Brent Crude Oil price for the same period.

As we can see from figure 1 the leverage seems to increase when there is a large decrease in the oil price. In times where the oil price is stable or increasing there is hard to identify a pattern. Our data shows that the average leverage[3] of the energy sector on Oslo Stock Exchange has risen from 0,396 in 2014 to 0,42 in 2016. Where there has been a decrease in oil price the same period. From figure 1 we observe that there might be a negative relation between leverage and the oil price, which we will investigate further in the thesis.

3.2 Oil Price

Oil is by far the largest commodity in the world. The Goldman Sachs Commodity Index (S&P GSCI) reflects commodities by weight in relation to world production quantities. As of the autumn 2008 energy accounted for 75% percent of the index, of which 40% were crude oil and 15% Brent crude oil. As oil is such large proportion of this index, it is not unreasonable that larger fluctuations will affect the world economy. (Driesprong, Jacobsen og Maat 2008)

Unanticipated changes in oil price of are referred to as an oil price shock. Such shocks will make the oil price different from the expected market price. Shocks affect expectations about future oil price, and such expectations go into calculations of firms' future projects net present value. For this thesis, we can assume it may affect firms´ decisions on whether or not to build new equipment, invest in new assets for the oil industry or start new projects. Future oil price and its expected path is important for calculating net

[3] When leverage is book value of total debt divided by book value of total assets.

present value of projects. The price shock itself is therefore not necessarily alone in affecting the cash flow calculations. (Baumeister og Kilian 2016)

3.3 Previous Crisis and shocks

In 1973/74 the oil price increased due to a supply shock. The production fell and price increased, consistent with a shift in the supply curve to the left when demand is held still. Many point to a war between a coalition of Arab countries and Israel as the reason for this outburst in oil price. The 73/74 crisis was followed up by a crisis of 79/80 WTI[4] rose from 15$ to 40$. The US Government started regulating markets with price controls, rationing gasoline, causing long lines at gas stations. Some points to the reason for this was the Iranian Revolution and their reduction in oil production. In the 1980s and 90s the oil price also saw shocks and inclined such as under the Iran-Iraq war. (Baumeister og Kilian 2016)

3.4 Oil Price and the Financial Crisis of 2008

The greatest oil price incline in history was from mid-2003 to mid-2008, when oil price inclined from $28 to $134 per barrel (WTI). There is a common understanding that this surge comes from widespread small increases in demand over the period. During late 2007 and going on approximately until late 2009, the world saw the financial markets crumble. The financial crisis gave a rapid drop in demand for industrial commodities which naturally lead to the price for these commodities to fall rapidly as well. The fall in demand and price also included oil. The price for crude oil fell from $134 in mid-2008 to $39 per barrel in the beginning of 2009. After this, prices started stabilizing again and rose to $100 per barrel. (Baumeister og Kilian 2016)

The oil price decline in the fourth quarter of 2008, can be explained by fast deleveraging of speculative funds, rapid closing of oil positions and liquidity drying up. (Bhar og Malliaris 2011) As we show in figure 3, the oil price fell significantly during this period.

Post the financial crisis of 2008 the overall sectors of Norway have had a relatively stable debt capacity, though it is a bit lower than before. The oil sector has considerably lower debt capacity compared to the other sectors. (I. N. Hjelseth 2016)

[4] West Texas Intermediate

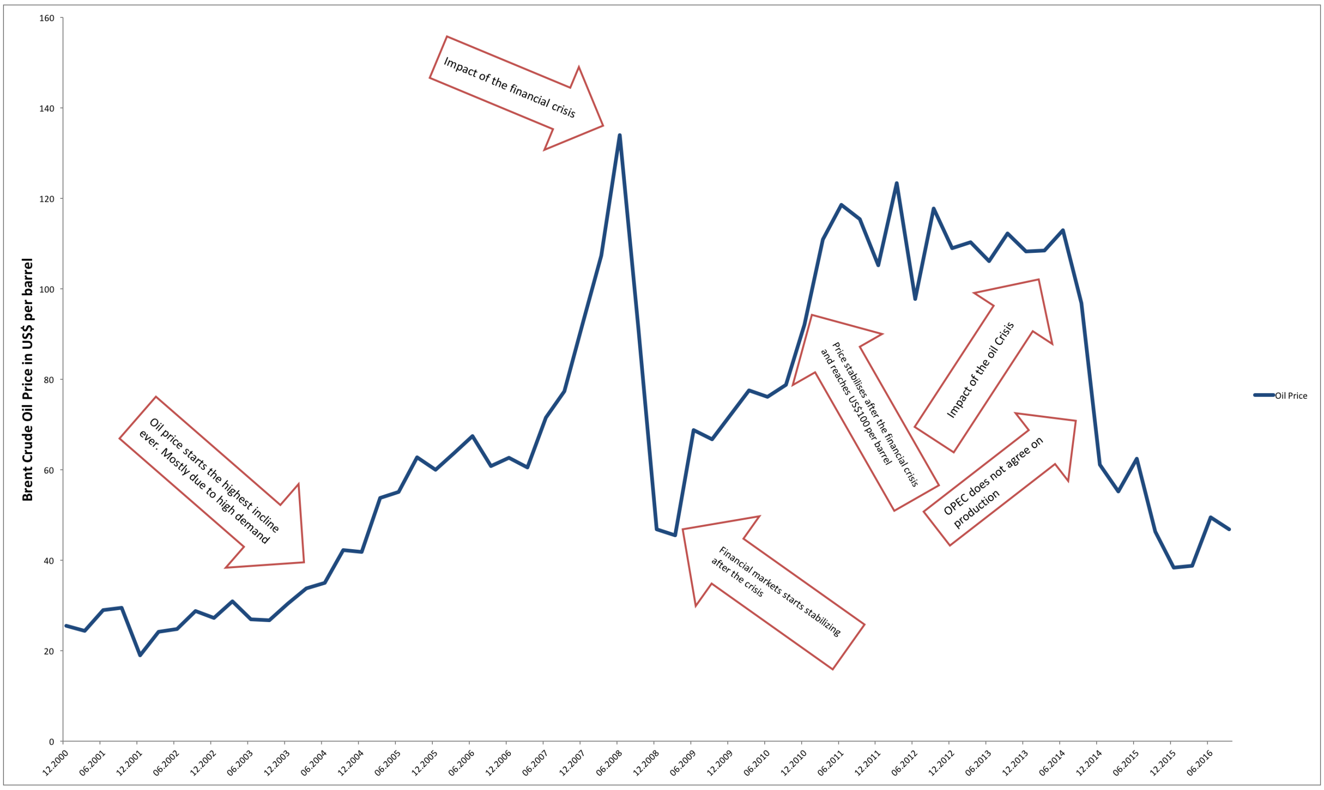

Figure 4 Plotted monthly prices on Brent Crude Oil in USD

3.5 Oil Crisis of 2014

In June 2014, the price fell from $112 to $47 per barrel in very short time. Some of the fall was related to global real economic activity and reflected in other industrial commodity prices as well. Some of the rapid price fall are likely related to the unexpected growth in US shale oil production, but also the increase in production in countries such as Canada and Russia. Another two price shocks came in the second half of 2014. The first one is related to storage demand for oil and the second one can be explained by unexpected weakening in the global economy. (Baumeister og Kilian 2016)

The rise of shale oil production has changed the economics of global oil production. OPEC[5] is afraid to cut production because they will lose market shares to shale oil. Attempts to cut production will rapidly speed up shale oil production to fill the supply gap. (Khan 2017)

In November 2014 OPEC, failed to establish a new agreement on terms of production. Many believe that this also created a shock to the oil price, when OPEC chose not to cut production, despite increase in non-OPEC production. The shale oil revolutions also pushed many of the countries that previously was exporting to USA, to new markets such as Asia. Production in the Middle East, Saudi Arabia and Iraq has also been stable. Alongside this, the growth of the Chinese economy has slowed down. (Clifford 2016)

[5] Organization of Petroleum Exporting Countries

Trading has also affected oil prices to some extent. A price fall of this magnitude cannot be explained by supply and demand by itself. PRA´s[6] are also a factor for this fall. PRA´s are used assessing benchmarks of crude, like Brent or WTI. Traders then use the assessments in making contracts. (Khan 2017)

4 Theoretical Framework

In this chapter, we will go through and discuss the most well-known theories and empirical studies that has been done on capital structure. This creates the foundation for what we know of capital structure today. Economically the target for capital structure is to maximize the firm's total value and minimize the total capital cost. The theories presented will provide insight in how firms are thought to decide the composition of debt and equity, and whether a specific model of capital structure is preferred. (S. Myers 2001) We will also use previous empirical studies to create the foundation for our regression models by using similar variables in some cases. There is no single model that today fully explains company´s leverage, but we have several theories that can explain in rough terms what leverage ratio a firm prefers given a certain situation. This means we cannot assume it will ever be a universal theory. (S. Myers 2001) Among these theories that partly describe leverage are Static Trade of Theory, Pecking Order Theory and Market Timing Theory. In this section, we briefly go through these theories to make sure that we have a solid framework of this thesis. The foundation for all capital structure theories lay within the fundamental theory of Miller and Modigliani from 1958. They state that the capital structure of a firm should have no impact on the value of a company. Even though that some of the theories we present are relatively old, we include these to better understand the evolution of capital structure theory and get a full picture of previous research.

4.1 Miller and Modigliani

In 1958 Merton H. Miller and Franco Modigliani (from here on, MM) published what has become the foundation of capital structure theory and therefore a natural starting point for our review of theoretical framework. Their research has been altered in different forms, and other deviations of their perfect marked model (No cost of financial distress, efficient markets, exogenous cash flows, symmetrical information and no taxes.). MM made further improvements to their theory through two articles that where published a few years after their initial article. Both in (Miller and Modigliani 1961) and in (Modigliani and Miller 1963) they added critical elements to improve their model. The adjustments made in their article from 1961 and the correction added later in their 1963 article are especially interesting as it creates a foundation where leverage affects the firm value. The new approach included the benefit by debt

[6] PRA is short for Pricing Reporting Agencies

financing because of the tax-shield that occurs when having interest bearing debt (Modigliani and Miller 1963). This conclusion makes it reasonable to assume that there is a debt structure that could be more favorable than others. The static trade-off theory build on this by taking it one step further and not only consider the advantages of debt financing, but also the disadvantages.

4.2 Trade-off theory

The static trade-off theory is based on the positives and negatives of a firm carrying debt. The most recognized theory is the trade-off between the tax shield a company would receive by borrowing and paying interest, and the cost of financial distress. Financial distress is defined as bankruptcy costs, meaning the cost that arises when threat of bankruptcy is increasing. Such costs include administrative costs and legal fees, agency, moral hazard, monitoring and contracting costs. According to the theory there is an optimal ratio of debt to equity. This is where the marginal change in cost of financial distress is equal to the marginal change in the tax shield. When this point is reached, an increase in debt will cause the cost of financial distress to outweigh the increase in tax shield. A decrease in debt and tax shield causes a reduction that outweighs the reduction in cost of financial distress. (S. Myers 2001)

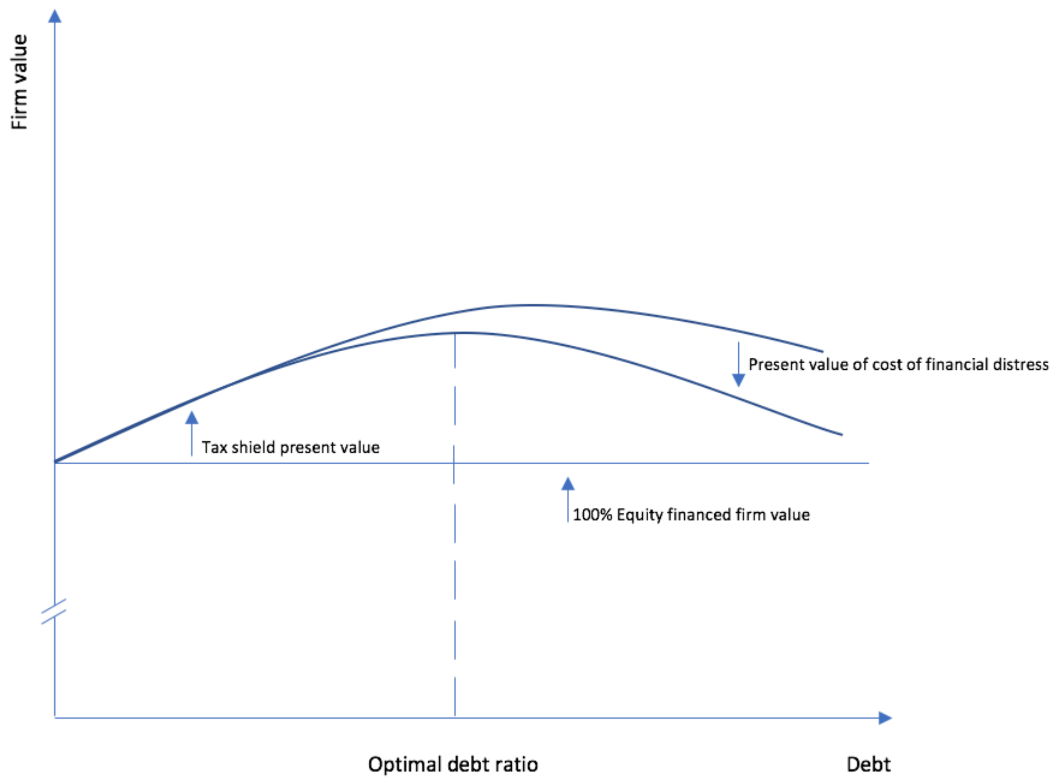

Figure 5 Illustrates the relationship between the value of the tax shield and financial distress in static trade off theory

Given trade off theory one can state that risky firms should borrow less because they sooner might meet financial distress. A second statement is that firms holding tangible assets should borrow less because the expected costs of distress also relates to the value lost if problems arise. (S. C. Myers 1984)

It has also been discussed whether companies make full use of their potential tax shields. John Graham estimates that a typical tax-paying company firm could increase their company value with up to 7,5%. He states that this adjustment in the capital structure would still leave the companies with a conservative debt ratio. (Graham 2000) The trade-off theory is reasonable, but relatively old at its original state. We know today that a lot of large and stable firms with good capabilities to issue debt have very conservative debt ratios. Which is a contradiction to the theory. (S. C. Myers 2001)

Some researchers point to a "dynamic trade-off theory". The theory is different in for instance that the leverage ratio is allowed to drift more, and are adjusted when it approaches financial distress. (Frank og Goyal 2009)

4.3 Agency Theory

Agency cost occurs when there is a conflict of interest between the stakeholders in a firm. It occurs often in financial theory between the manager and shareholders, where the shareholders are called the principal and the manager is the agent. A frequent problem related to capital structure is regarding the possibility for the shareholders to increase the debt ratio. When the debt ratio increases, the shareholders risk decreases and the creditor must carry a larger part of the risk. The debt issuer sometimes uses covenants to reduce their own risk. A typical form of covenant could be that when the debt ratio increases past 75% the whole loan matures and must be repaid. This way the debt issuer limits the flexibility of the shareholders to expose them for unlimited risk.

Another part of agency theory that is relevant for capital structure is regarding the possibility to use a high debt ratio as a management tool to enforce a disciplinary effect on the management. The high debt ratio may prevent the management from overinvesting. Overinvestments can happen when the free cash flow exceeds the available profitable projects (Jensen 1986).

4.4 Pecking Order

The pecking order theory has been shaped through the years, although (S. C. Myers, The Capital Structure Puzzle 1984) was the first one who referred to it as The Pecking Order theory. It states that a company will start with internal financing of its projects. Firms will issue their safest marketable securities or debt if their cash balance is not enough. As the least favourable source of financing, they will issue new stock. In this way, the company goes up a pecking order of financing, from internal to external. (Myers og Majluf 1984)

There are also costs related to issuing stock, where issuing debt or financing internally is in general cheaper. The theory has flaws and there are situations where it cannot explain the behaviour of firms leverage. For instance, many firms who could have issued investment-grade debt, instead issues new stock, which is strictly the opposite of the pecking order (S. C. Myers 1984).

4.4.1 Asymmetric information in pecking order

One theory of the pecking order is due to asymmetric information, as discussed by (Myers og Majluf 1984). They developed a model where the information on a firm project available to an investor is much more restricted compared to the manager, who knows the true value of the project. By relying on external financing a firm may choose not to go with external financing because the manager does not think the market price is reflecting the true value of the firm. In the opposite case, the possible new investor is not willing to pay the stock price the manager want. This is, if the managers inside information are positive. If the firm then does not have enough internal financing for the project, and debt is not an alternative, they might turn down a positive NPV project. According to this, if a firm is moving upwards on the pecking order, it will face a higher probability of positive NPV projects being rejected. It will also face higher risk and costs of financial distress. (S. C. Myers, The Capital Structure Puzzle 1984)

4.5 Market timing theory

The core of the market timing theory is that companies will look at the different conditions in different debt and capital markets when they are considering to get more capital. They will then choose the most favourable market. If none are good, they might drop issuance. If markets conditions are exceptionally good, companies may even raise capital even when they do not have to. For this theory market conditions of debt and stock returns will be an important factor, it does not say anything about the more common factors discussed in other theories. (Frank og Goyal 2009)

4.6 About taxes and debt

In Norway like in most other countries all firms must pay a fixed tax on their earnings. The tax base can be reduced by tax-deductible costs such as for example production cost and interest costs. Since interest costs is for the most related to capital cost this possibility to reduce the cost of capital through deductible interest cost. In other words, a firm that issues debt gets a tax shield provided by the interest. The marginal tax rate for Norwegian firms within the oil industry (production and ex companies) is at 78%. It consists of 24% as regular corporate tax on all income and 54% special tax paid to the government on income related to extraction, processing and pipeline transportation. (Liland, Nyberg and Samuelsen 2017).

To prevent taxable income to be transferred to other low tax countries the Norwegian government uses a norm price set by Petroleumsrådet (Petroleum Council). This is to ensure that intercompany sales are made at an arm´s length price. This often results in a miss match between 78% of income and the actual tax. (Liland, Nyberg and Samuelsen 2017)

There are substantial effects from tax effects on financial choices. Firms with low marginal tax rates like for instance tax loss carry-forwards would have less incentive to issue debt and more likely issue equity, compared to firms with "full taxable income". (MacKie-Manson 1990)

4.7 Previous empirical studies

The trade-off theory and pecking order are maybe the theories that have been tested to the largest extent. Shyram-Sunder & Myers have tested these two theories against each other. They used a data set with observations from 1971 to 1989 with 157 industrial firms. (Shyam-Sunder og Myers 1999) In their study, they used the book values of long-term debt to book value of assets as leverage measurement. They constructed explanatory variables for pecking order and optimal debt ratio. Their findings are that both pecking order and static trade off seems to perform well when tested individually. When tested together the pecking order performs better and even if there is an optimal debt ratio, managers do not seem eager reach it. All together the pecking order seems to perform a slightly better. Frank & Goyal research is on which factors that are most important to determine capital structure. (Frank og Goyal 2009) They investigated publicly traded firms in the US from 1950 to 2003. Many factors were tested, and they found that with a dependent variable of market value of leverage, there were six core factors[7] that stood for more than 27% of the variation in leverage. Some of their findings are that firms with a lot of tangible assets tend to have more debt, more profitable firms have less debt, firms with high book values of assets tend to have higher debt and a high market-to-book ratio tends to give low debt ratios.

Rajan & Zingales has studied the capital structure across different countries and accounted for several country specific factors in their study, in addition to firm specific variables. [8] They discover that some factors such as tangibility is positively correlated across all countries. The rest of the factors are also mostly consistent across countries, although there are exceptions. In (Mjøs 2007)´s doctoral thesis he investigates 138990 Norwegian firms, both non-public and publicly traded firms from 1992 to 2005. His data is also split into sub sectors, which includes the oil sector. His data shows that the oil sector has the highest equity ratio in between all sectors. And a bank debt ratio of zero, which he says is financially sophisticated as they only use market debt or internal debt markets. The regressions are done on interest bearing debt and although many variables are included, many of his variables are the same ones that are used in previous research such as firm size and tangibility. Three months NIBOR were used instead of inflation. Drobetz, et al. investigated capital structure of shipping companies, an industry with many similarities to the oil industry, with high degree of tangible assets and high capital intensity. (Drobetz, et

[7] The six core factors were: Industry median leverage, Tangibility, Profits, Firm Size, market-to-book assets ratio, expected inflation.

[8] Rajan & Zingales have looked at 4 firm specific factors: Tangybility, market-to-book, firmsize and profitability. The countries in their study was: USA, Germany, France, Japan, Italy, Canada and United Kingdom. (Rajan og Zingales 1995)

al. 2013) The research included 115 firms from 1992 to 2010, a time period that included the financial crisis. They found that tangibility has a positive correlation, while profitability, asset risk and operating leverage has a negative relationship.

Harvey & Graham has interview 392 executives in US firms. (Harvey og Graham 2001) When asked about other factors to their debt policy, 46% answered that they will issue debt when interest rates are low. 47% said they would issue debt when their recent internal funds are not enough for projects and 31% said they use debt when their shares are undervalued in the market.

Baker & Wurgler found high explanatory power in their market timing and capital structure theory. (Baker og Wurgler 2002) They report that company's capital structure is the cumulative outcome of earlier attempts to raise equity when market timing is good. Through their research found that low-leverage firms are the ones that issue equity when their valuations are high and that high-leverage firms do raise new equity when their valuations are low.

With his study, Welch found evidence of stock returns being a large first order determinant of leverage ratio. (Welch 2004) This while the more common explanatory factors in previous studies explain leverage ratio through factors correlated with stock returns.

	Frank & Goyal 2009 Market Core model	Frank & Goyal 2009 Book Core model	Rajan & Zingales 1995 Market model	Rajan & Zingales 1995 Book model	Mjøs 2007	Drobetz et al. 2013 Book model	Drobetz et al. 2013 Market model	Our prediction Market model	Our prediction Book model
Firm Specific Variables									
Tangibility	+ ***	+ ***	+	+ ***	+ ***	+ ***	+ ***	+	+
Profitability	- ***	- ***	- ***	- **	- ***	- *	- **	-	-
Firmsize	+ ***	+	+ ***	+ ***	+ ***	+	-	+	+
Growth	- ***	+ *	- ***	- ***	NA	+	+	-	-
Population	*American listed firms*	*American listed firms*	*Firm leverage across G7 countries, financial firms excluded*	*Firm leverage across G7 countries, financial firms excluded*	*Norwegian listed and non-listed firms*	*Shipping firms listed on various stock exchanges*	*Shipping firms listed on various stock exchanges*	*Norwegian listed energy sector*	*Norwegian listed energy sector*

**** significant at 1% level. ** significant at 5% level. * is significant at 10% level.*

Rajan and Zinagles have investigated capital structure across G7 countries and their significace. For this table results for Canada is presented as they are an net oil exporter such as Norway.

Table 1 Gives an overview of previously empirical studies done on capital structure.

4.8 Regression variables

In this section, we discuss the variables that have been used in previous studies and that we have chosen to use when we investigate financing decisions in the energy sector. We present the calculations and discuss each variable in relation to theory and previous studies, and afterwards present what we are expecting to find in the Norwegian energy sector.

4.8.1 Dependent variables - Ratios of Debt

Rajan & Zingales conclude with that the effects of past financing decisions are best represented by a total debt to capital ratio, where total capital is total debt plus equity. (Rajan og Zingales 1995) They used two measures of debt, one where they used book values of equity, and one with market values of equity. For our study, we have chosen to use dependent variables more like (Frank og Goyal 2009) which includes both total debt to book value of total assets and total debt to market value of total assets. We have also the long-term debt to book value of total assets and the long-term debt to market value of total assets. This study is relatively newer compared to the other studies. The variables also include both market perspective and book perspective. In previous literature (Frank og Goyal 2009) often refers to market value of leverage as forward looking, while the book value of leverage is backward looking. We have used both market- and book value of assets to make sure that we capture both perspectives.

Our data from the balance sheets includes the total assets of each firm. To get the complete overview, we have chosen to analyse both long term debt and total debt, too both book values and market values. Table 2 below, shows the four dependent variables.

Model 1: *Total debt ratio with book values* $= \frac{Total\ Debt}{Total\ Assets}$

Model 2: *Total debt ratio with market values* $= \frac{Total\ Debt}{Total\ Assets\ - Book\ Value\ of\ Equity + Market\ Value\ of\ Equity}$

Model 3: *Long term debt ratio with book values* $= \frac{Long\ Term\ Debt}{Total\ Assets}$

Model 4: *Long term debt ratio with market values* $= \frac{Long\ Term\ Debt}{Total\ Assets\ - Book\ Value\ of\ Equity + Market\ Value\ of\ Equity}$

Table 2 Regression models with their difference in dependent variable definition

4.8.2 Firm specific explanatory variables

When using the long-term debt to assets Frank & Goyal found six robust factors and they explained 29% of the variance in the model. (Frank og Goyal 2009) These were industry median leverage, tangibility, profits, firm size, market to book ratio, expected inflation. Looking at long term debt to book values, they ended up with only three of these factors as robust. The variables were: industry median leverage, tangibility and profits. (Frank og Goyal 2009)

Wald, found that profitability was a large determinant for the debt to asset ratio in a cross-sectional test over different European countries. (J. K. Wald 1999)And that this measure was consistent over several countries. Other measures that were consistent over different countries were moral hazard, tax deductions and costs related to research and development. He found that the variables that show different effects and differ from countries were risk, growth, firm size, inventories.

Our explanatory variables are variables that have been used repeatedly in previous empirical studies to explain capital structure, and that we see relevant to answer our research question. We have added some additional variables when we want to test what we believe are additional factors that can explain capital structure that are specific for the Norwegian Energy sector.

Tangibility

Our proxy for tangibility is net fixed assets divided by total assets. To estimate the net fixed assets, we have used the total assets minus the total current assets. The output provides an indication on how much of the firm's total assets that can be relatively easily converted to cash. Such tangible assets are easier to value from an investors and lenders perspective then intangible asset. It can work as a proxy for safety when firms issue debt or equity. If a firm has large tangible assets should then have more debt capacity. (S. C. Myers 2001) and (Rajan og Zingales 1995) In trade-off theory tangibility is therefore positively correlated. Pecking order theory does not conclude, but states that the tangibility might have both a positive relation and a negative relation with the leverage. The reason why the pecking order is so ambiguous regarding tangibility is that even if the increased tangibility reduces the information asymmetry and makes the issuance of equity less costly, the increase in adverse selection should increase the debt ratio. (Frank and Goyal 2009) For instance, it will be easier for an investor to see what an oilrig or supply ship is worth, compared to intangible assets. Tangibility is defined as a proxy by:

$$Tangibility = \frac{Net\ Fixed\ Assets}{Total\ Assets}$$

Firm size
We have chosen to use the natural logarithm of assets as a measure of firm size in our study. Previous literature has used this as a proxy. (Frank og Goyal 2009) A good alternative also used in previous literature, is the log of sales. (Rajan og Zingales 1995) The reason why we did not choose this approach was to avoid problems with logging because some firms have reported zero sales in one or more periods. We also prefer total assets since the industry is capital intensive. The pecking order theory refers to firm size as a negative relationship with debt. (Frank og Goyal 2009) If a firm is large its most likely to have existed over a longer period and therefore had been able to build up retained earnings. In trade-off theory, it is reasonable to believe that larger firms should have a positive relationship with debt because they often are more diversified and have lower risk and more stable income. Smaller firms with higher business risk will tend to have less debt because income will fluctuate more. This relates to the bankruptcy costs of the trade-off theory. (Frydenberg 2004) Our proxy is defined as:

$$Firm\ Size = \ln\left(Total\ Assets\right)$$

Growth Opportunities
Market to book asset ratio is often used as a proxy for growth opportunities. It is defined by Frank & Goyal as market value of assets to assets, where market value of assets is the market value of equity plus short term debt plus long term debt plus preferred liquidation value minus deferred taxes and investment tax credit. (Frank og Goyal 2009) They found that firms that have a high market-to-book ratio tend to have a lower leverage. Frank & Goyal writes that firms with higher market-to-book ratios, tend to have higher future growth opportunities. And (Determinants of Corporate Borrowing) says that if a firm already has high debt, there might be less opportunity for growth when the opportunity comes because the firm might not be able to issue more debt if that is needed.

Another way to measure growth opportunities are by the change in total assets, or by change in sales approach such as Wald used in his research. (J. K. Wald 1999) By using this method one is more likely to get a picture of how a firm already has grown, and such is more backward looking. By using the market to book method one gets a more forward-looking proxy for growth. Rajan & Zingales uses market value of assets minus the book value of equity plus the market value of equity and divide this by the book value of assets as a proxy for growth opportunities. For our study, we have used total assets minus book value of equity plus the market value of equity, divided by book value of total assets.
Trade-off theory predicts growth opportunities to have negative correlation because firms in the growth stage often don´t produce as large profit as more mature firms and will therefore in general have lower taxable income. Pecking Order would predict a positive relationship with leverage and growth

opportunities since growth firms will have little retained earnings and need to grow, they would need financing through debt. Our proxy is defined as:

$$Growth\ Opportunities = \frac{Total\ Assets - Book\ Value\ of\ Equity + Market\ Value\ of\ Equity}{Total\ Assets}$$

Profitability

The measure gives us insight in the firms' capabilities of debt payments, investing or dividend pay outs without external financing. It is calculated as net income before taxes, depreciation and amortization, divided by total assets. Frank & Goyal have used operating income before depreciation to assets as a ratio to measure profits. (Frank og Goyal 2009)

When we look at profitability from a pecking order perspective it predicts a negative relationship with debt. Since the amount of profit a firm has will be used to finance projects before considering financing with debt, it then means that a higher profitability should reduce the leverage, and vice versa. In trade-off theory one will expect the opposite. Higher profits results in more taxes, and a firm should then take on more debt to reduce tax payments. Higher profits will also result in lower financial distress. Agency theory predict the same as static trade of theory since the value of the disciplinary effect of increased leverage is higher for a more profitable firm since they are more likely to have severe free cash flow issues. (Frank and Goyal 2009) We define profitability as:

$$Profitability = \frac{EBIT}{Total\ Assets}$$

Past profitability

We have used retained earnings divided by total assets as a proxy for past profitability. Since our proxy for profitability only contains earnings of the present year, we find it interesting to investigate if past earnings have more explanatory power when it comes to financing decisions. Wald discusses how a negative relationship between profitability and leverage would point towards the pecking order theory. (J. K. Wald 1999) According to the pecking order theory retained earnings is favorable over all other financing sources because of information asymmetries. Our proxy is defined as:

$$Past\ Profitability = \frac{Retained\ Earnings}{Total\ Assets}$$

4.8.3 Macroeconomic explanatory variables

Interest rate

Interest rates are an important factor in relation to debt and capital structure. Magnitude in fluctuations of interest will make impact in the tax deductibles and interest payments. Harvey & Graham found good evidence that fits the market timing theory, especially for larger firms. 46% of the asked executives answer that they issue debt when interest rates are low. (Harvey og Graham 2001)

In static trade-off, an increased interest rate would give an increased tax shield, and the theory predicts a positive relation. Pecking order suggests that increase in cost of debt should make it less favourable and therefore predicts a negative relation. Market timing theory also predicts a negative relation because of the reduced cost to lend when the interest is low.

Because of the relatively large part of the Norwegian GDP is dependent on oil export, the government would have to stimulate Norwegian economy with for instance an adjustment in interest rates (NIBOR)[9], if the oil production / export would change significantly.

From Figure 1 we see the relationship between oil price and interest rates in Norway. We notice the correlation during the financial crisis. Since there are several other influencing forces, it is expected that these two macro variables do not follow each other too close. Still it is easy to see that large macro shocks like the financial crisis of 2008, makes the correlation higher. For our regression variable, we have used three month annual NIBOR rate as a, interest rate proxy. This is also used by (Mjøs 2007). Variables are defined as:

$$Interest = 3\ month\ quarterly\ NIBOR\ continously\ compounded$$

For book values, we find it reasonable to believe that debt is not renegotiated overnight, and therefore the impact of interest rate (if any) would probably not impact the debt ratio until a later period. To accommodate for this, we lag the interest rate three months (one period) in the regressions with book values.

$$Lag\ Interest_t = 3\ month\ quarterly\ NIBOR\ continously\ compounded_{t-1}$$

[9] Norwegian Interbank Offered Rate (NIBOR)

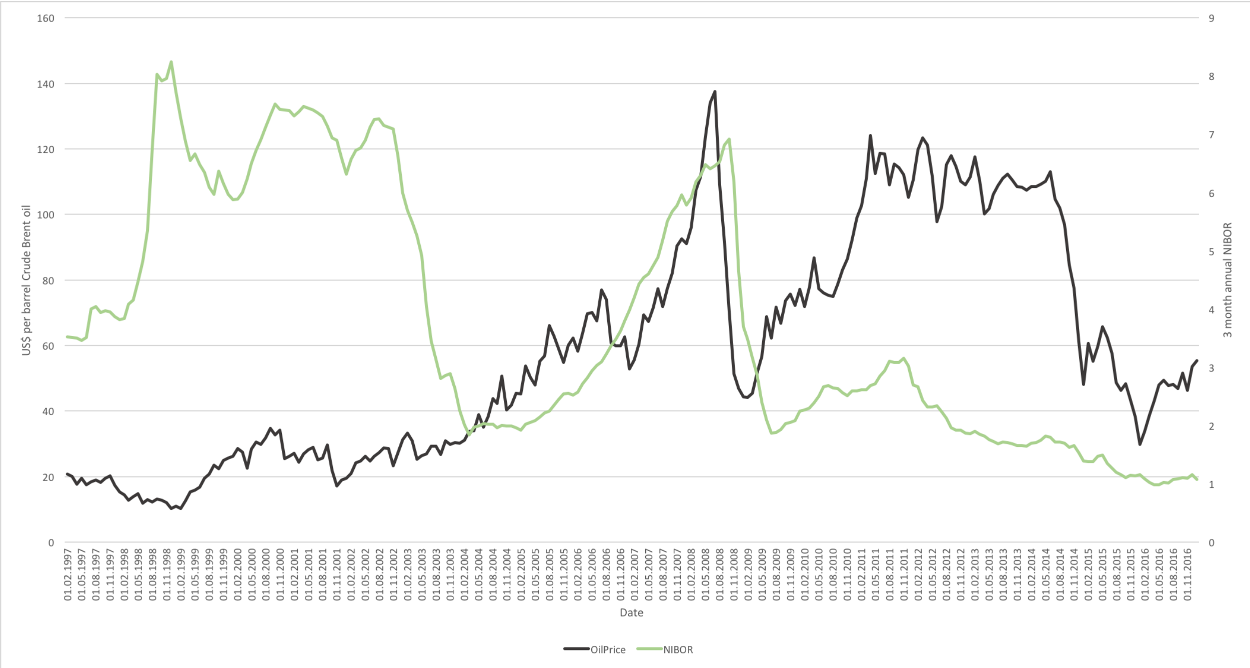

Figure 6 Shows the relationship between oil price and 3 months annual Norwegian Interbank Offered Rate (NIBOR).

Oil price

Oil price is one of the factors that we want to examine further to see if this commodities price fluctuation has explanatory power over capital structure in the energy sector. For this factor, we have used the crude Brent oil us dollar price per barrel. As (Baumeister og Kilian 2016) writes, this is the most correct oil when referring to the world oil price and preferred over WTI. As mentioned in section 2, there is a strong relationship between oil price and the energy sector. Our prediction is as oil price declines the profitability of the firms will decline as well and there will be less earnings left to finance new projects, pay-out's and dividends. Variables are defined as:

$$Oil = ln(Oil\ Price)$$

As with the interest rate, we use a three month (one period) lagged oil price in our regression models where book values are used as dependent variable. The variable must then later be interoperated as the three-month previous book values explains the present leverage ratio.

$$Lag\ Oil_t = ln(Oil\ Price)_{t-1}$$

Dummy variables for Financial Crisis and Oil Crisis

To encounter and capture the effects of the two crisis periods, we apply dummy variables to these periods of our data. The exact beginning of the financial crisis is hard to pinpoint. We use the period from March 2008 until winter 2009. The oil price had a significant drop in the summer of 2014. It is harder to determine when this non-normality period ends, because the oil price still after two and a half year has been near the levels of what it was in the summer of 2014. Our ending period is therefore set to the last reported financial statements we have in our data set, which is 30.09.2014. As we show in Figure 2, market leverage seems to have a negative relationship with oil price before and after the financial crisis, while there seems to be abnormality during the crisis.

From the previous research of (Driesprong, Jacobsen og Maat 2008) we would expect a reversed relationship between the proxies that includes market values and the oil price. Our variables are defined as, "FinanceCrisis" and "OilCrisis" where:

$$Crisis\ Period = 1$$

$$Non - Crisis\ Period = 0$$

*Table 3 Gives an overview of theory predictions of variables. For the macro variables presented, this is our own interpretation since oil price and interest rate are not commonly discussed in all theories. *Frank & Goyal 2009 marks that the modern dynamic trade-off has negative relationship, while the static trade off would suggest a positive correlation.*

	Trade off theory	*Pecking Order*	*Agency theory*	*Market timing*
Firm Specific variables				
Tangibility	+	-	+	NA
Profitability	+ (*)	-	+	NA
Firmsize	+	-	+	NA
Growth	-	+	NA	-
Past Profitability	+	-	+	NA
Macro variables				
Oil Price	+	-	+	-
Interest rate	+	-	-	-
Financial Crisis	NA	NA	NA	NA
Oil Crisis	NA	NA	NA	NA

5 Methodology and Data

5.1 Panel data

Panel data is a data set constructed from repeated cross sections over time. With a balanced panel, the same units appear for every single time period. An unbalanced panel occurs when some units does not appear in all time periods. Panel data has the advantage of being able to observe the effects of variables independent of different individuals and time, and is therefore a good tool to detect causality. Panel data includes several observations for every single time period and provides more informative data, more degrees of freedom, less collinearity among variables and more efficiency compared to cross-section and time series alone. (Gujarati and Porter 2009)

5.2 Correlation analysis

In correlation analysis, we look at the statistically link between to variables. Correlation results give numerically expression of the strength and sometimes the direction in which two variables correlate. Variables may be positively and negatively correlated. If the coefficient is zero there is no correlation between the variables. The coefficient may vary from 1 (perfect positive correlation) to -1 (perfect negative correlation). (Ringdal 2014)

The equation used for correlation is:

$$Correlation\ (X, Y) = \rho(X, Y) = \frac{COV(X, Y)}{\sigma X * \sigma Y}$$

Correlation analysis may help us understand if two variables have any correlation, but it cannot help us predict future observations and consider other variables included in the analysis that affects the result. In our case a correlation matrix can be used to identify potential multicollinearity, but would not be a suitable without further analysis.

5.3 Regression Analysis

Ordinary Least Square (OLS) is a commonly used regression method. OLS fits a linear line that gives the lowest sum of squared distances from the regression line to the observed values. The regression equation for OLS:

$$y = \beta_0 + \beta_1 x_i + u_i$$

The dependent variable is y and x is the explanatory variable. β_0 Represents the constant and β_1 is the coefficient of x and u represents the error term. The error term u contains the variation in y that cannot be explained by the explanatory variable. Regression is useful as it helps predict how much influence factors have in the analysis. (Wooldridge 2013)

5.4 Multiple Regression Analysis

Multiple regression analysis is defined as: "A type of analysis that is used to describe estimation of and inference in the multiple linear regression model." (Wooldridge 2013, 596) Since it is not very likely that y in our case can be explained by only one variable, a simple regression would not be an efficient method for our purposes. In Multiple Regressions Analysis, the variation of the dependent variable is explained by multiple independent variables. (Wooldridge 2013) The equation of multiple regression models is:

$$y = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik} + u_i$$

In the multiple regression model, the β coefficient represents the individual explanatory variables causality with the dependent variable adjusted for the effect of other included variables in the model. The k represents the number of individual variables and u the term of error.

The following assumptions must be satisfied for us to be able to use a multiple regression model:

1. Linearity in Parameters
2. Random Sampling
3. No Perfect Collinearity
4. Zero Conditional Mean
5. Homoskedasticity
6. Normality
7. Autocorrelation

Gaus-Markov Theorem states that if the five first assumptions are met the OLS estimator $\hat{\beta}_j$ for β_j is the best linear unbiased estimator (BLUE). By best means the estimate with the smallest variance. Linearity is only achieved if the relationship can be explained by a linear function. The theorem says that the corresponding linear combination of the OLS estimators achieves the smallest variance among all linear unbiased estimators. MLR.1 to MLR.5 are therefore known as the Gauss-Markov assumptions. (Gujarati and Porter 2009) The assumption of normality distribution of the error terms is included to make it possible to test the model. This is often referred to as a sixth assumption.

5.5 Methods of estimation with panel data

OLS can be used if the data satisfy all the Gaus-Markov assumptions and the assumption of no autocorrelation. OLS on panel data will disregard all the unit specific information and all observations will be treated equally. These assumptions must apply because our data set consist of independent cross-sectional data over time and the observed unit in period t will be different from the observed in $t - 1$.

5.6 Fixed effects estimation

The fixed effect approach is a method to eliminate the effects that don't change over time and that have little to no correlation with the dependent variable. In the equation below a_i represents the fixed effects.

$$y_{it} = \beta_0 + \beta_1 x_{it1} + \beta_2 x_{it2} + \cdots \beta_k x_{itk} + a_i + u_{it}$$

"The fixed effects estimator allows for arbitrary correlation between a_i and the explanatory variables in any time period. Because of this, any explanatory variable that is constant over time for all i gets swept away." (Wooldridge 2013, 398) In the process the fixed effects model subtract the average of each observation and since both β_0 and a_i is constant. The time invariant unobserved heterogeneity is there for removed and we are left with the following equation.

$$\ddot{y}_{it} = \beta_1\ddot{x}_{it1} + \beta_2\ddot{x}_{it2} + \cdots + \beta_k\ddot{x}_{itk} + \ddot{u}_{it}$$

If the assumption of no heteroscedasticity and autocorrelation is violated there might be more suitable to use a random effects model. Fixed effects regression also allows us to account for unobserved heterogeneity both at firm level and across time.

5.7 **Random effects estimation**

Random effects separate from fixed effects estimation by using GLS (Generalised least squares). An advantage compared to OLS is that random effect models are less sensitive to heteroscedasticity. The results will be accurate even if there is heteroscedasticity present. The transformation in the random effects model is the same as fixed effects model in the way they both subtract the mean from each. It differs from the fixed effects in the way that instead of removing the variation that is between the different units it assumes that they are uncorrelated with the error term. This results in that random effect models only removes the optimal amount (δ) of the average from the original observed variables.

If $\delta = 0$ an OLS and a random effects model would be identical and if $\delta = 1$ the model would be identical to a fixed effects model. The fact that random effects model only removes an optimal part opens the possibility to include variables that are constant over time in random effects models. (Wooldridge 2013)

5.7.1 Pros and cons with random effects and fixed effects

Since the fixed effects model removes all effects that are constant over time, the random effects model has an advantage if we want to observe these effects because it captures these causalities. On the other hand, a fixed effects model will always provide consistent results, but the reliability of the results comes with a cost, as it increases the standard error. Increased standard error will make it harder to get significant results. Fixed effect models are widely thought to be the best approach for estimating effects between variables when all else is equal. (Wooldridge 2013)

5.8 Data

Although there are several non-listed firms that suffer the same effects of the oil price declining as the firms listed at the Oslo Stock Exchange, it is more complex and time consuming to collect data for these compared to the exchange listed firms. Due to the scope of this study, we have limited our research to focus on the exchange listed firms. All firms in the sample are within the energy sector, on Oslo Stock Exchange[10]. There are several subsectors beneath the energy sector. The sample firms vary in subsector, but are all within the oil- or oil service industry. Oslo Stock Exchange have no public history of which subsector delisted firms were placed in, only the overall sectors.

There are continuous changes to the number of firms listed within the energy sector of Oslo Stock Exchange. To avoid a survivorship bias, we have included delisted firms in the time frame we observe. The latest account statement data available on the firms within the data set is the reported third quarter results of 2016. Selection bias can also be a problem. Since our starting point of data set is the entire energy sector at Oslo Stock Exchange, we have the entire population which helps minimize the selection bias. The data set stretches over a period of 15 years which helps us minimize the selection bias in terms of firms being listed or delisted at specific time periods. If there is especially profitable for a firm to be listed at some point in time, this should be encountered for since we include both highs and lows of the financial market through the 15 years.

Mergers and demergers has been controlled for by investigating accounting statements, annual reports and stock information. Our dataset includes a few points where firms have reported zero total assets. The number of observations are relatively small and have therefore been omitted. A few delisted firms showed missing values in their accounting statements, and are therefore excluded from the sample. In total, eight firms have been excluded from our sample due to few observations and ten firms have not been included due to the fact that we weren't able to find data in Thomson Reuters Eikon. Appendix 8.1 includes a complete list of firms.

When gathering balance sheets, income statements and cash flow statements from the Thomson Reuters Eikon financial terminal we used standardized, restated data in US dollars. Firms listed at the main index of Oslo stock exchange are since 2005 obligated to use the International Financial Reporting Standard (IFRS). Our dataset contains approximately four years where firms including to IFRS, also used the US GAAP reporting standard. According to these standards, firms must report financial statements quarterly.

[10] Due to the scope of the study the firms referred to at Oslo Stock Exchange are the firms of the Oslo Stock Exchange Main Index. Firms listed at Oslo Axess and Mercury Markets are not included. Rules and regulations for firms on Axess and Mercury Markets also differ from OSE Main Index, making comparison possibly more bias.

Even though IFRS and US GAAP should be trustworthy accounting standards as they are chosen as the standard for Oslo Stock Exchange, we must consider the possibility that firms could use accounting principles to their advantages.

Three of the firms in our data set have divergent fiscal year. Though this should not influence any analysis, because that data is still there. After the reporting standards of IFRS and US GAAP, firms must report quarterly financial statements. We want to obtain as many data points as possible in our study and have therefore used the quarterly reports, instead of the annual reports of the firms.

5.9 Extreme observations

Our data set consists of real observations from the Norwegian market. With all data collected from the real world, there will be some observations with values differing of various extent from the majority of the population. There is also the possibility for human mistakes and errors in the collecting of the data from the Thomson Reuters Eikon terminal. Observations that significantly differ from the other observations are referred to as extreme observations (Vogt og Ghosh 2012). These observations are not consistent with the population. To be able to say something about the population from the analysis, these extreme observations need to be dealt with. Although we have been thorough during the data gathering process, we will need to test for these kinds of observations.

5.10 Correcting for extreme observations

The reason that we need to remove extreme observations are that we want to observe normal firms in the market and not for example let companies in extreme distress that are close to bankruptcy affect our results.

As we observed in table 4, there are several extreme observations in both positive and negative direction. Examining these extreme observations closer it seems like most of our observations have correct values, but the respective firms are in a phase where they are close to bankruptcy. This has led us to the decision to remove those observations from our data set completely instead of winsorizing. This because we want to observe companies with normal behaviour and not when they are in deep financial distress.

The number and magnitude of the extreme observations vary between the variables. To be sure the data is trustworthy, we go through the variables one by one and investigate the top and bottom tails of the distribution. On the other side, it is important not to remove too many observations so that analysis will be biased by the removal of observations. This is a trade-off we are considering for each variable. We have used a general rule during this process not to remove more than 5% of the total data in our population. For profitability, a total of 5 observations was removed. In past profitability 3 percentage of the lower tail in the distribution was removed, and in the growth opportunities variable 13 observations was removed.

After corrections and controlling, our sample contains approximately 15 years of data from our sample of 93 firms. Starting in 2001 and stretches to late 2016. This gives a data set that contains multiple observations on different firms over different time periods. As mentioned, some firms have been listed and some delisted from the stock exchange, and there is variation in how long the firms have been listed. This gives us an unbalanced panel data set. Frank and Goyal states in their paper that there is nothing in the pecking order theory that requires a balanced panel. (Frank og Goyal 2002) To our knowledge, this is neither an issue with any theories discussed in this paper. Table 5 shows descriptive statistics of the data after the removal of extreme observations.

Table 4: Descriptive statistics before controlling for extreme observations

Stats1	LagInterest	Tangibility	Firmsize	Oil	LagOil	Past Profitability	GrowthOpportunities	Interest	OilCrisis	Profitability	FinanceCrisis
N	3,049	3,048	3,048	3,049	3,049	3,048	3,048	3,049	3,049	3,039	3,049
Mean	0.008	0.728	6.552	1.826	1.824	−0.402	1.394	0.008	0.162	0.008	0.180
St. Dev.	0.005	0.191	1.665	0.206	0.209	7.877	3.351	0.005	0.369	1.690	0.384
Min	0.002	0.000	−1.609	1.234	1.234	−265.500	0.185	0.002	0	−47.600	0
Pctl(25)	0.005	0.645	5.514	1.671	1.683	0.000	0.868	0.005	0	−0.005	0
Median	0.006	0.782	6.662	1.838	1.838	0.000	1.072	0.006	0	0.014	0
Pctl(75)	0.011	0.867	7.593	2.026	2.026	0.180	1.471	0.010	0	0.032	0
Max	0.019	1.000	11.926	2.127	2.127	0.964	159.600	0.019	1	67.850	1

Table 5: Descriptive statistics after controlling for extreme observations

Stats2	LagInterest	Tangibility	Firmsize	Oil	LagOil	Past Profitability	GrowthOpportunities	Interest	OilCrisis	Profitability	FinanceCrisis
N	3,049	3,048	3,048	3,049	3,049	2,956	3,035	3,049	3,049	3,034	3,049
Mean	0.008	0.728	6.552	1.826	1.824	0.042	1.259	0.008	0.162	0.007	0.180
St. Dev.	0.005	0.191	1.665	0.206	0.209	0.333	0.688	0.005	0.369	0.091	0.384
Min	0.002	0.000	−1.609	1.234	1.234	−1.666	0.185	0.002	0	−1.735	0
Pctl(25)	0.005	0.645	5.514	1.671	1.683	0.000	0.866	0.005	0	−0.005	0
Median	0.006	0.782	6.662	1.838	1.838	0.000	1.069	0.006	0	0.014	0
Pctl(75)	0.011	0.867	7.593	2.026	2.026	0.189	1.465	0.010	0	0.032	0
Max	0.019	1.000	11.926	2.127	2.127	0.964	9.467	0.019	1	0.819	1

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5.11 Regressions

Our study is done through regression analysis of the self-collected panel data. Given panel data we have used OLS adjusted for fixed effects. We have done several regression analyses based on the equations presented below. Leverage varies with the four different dependent variables as described in section 4.8.1

The first equation includes firm specific variables.

$$Leverage = \beta_0 + \beta_1 Tangibility_{it} + \beta_2 FirmSize_{it} + \beta_3 Profitability_{it} + \beta_4 PastProfitability_{it} + \beta_5 Market\ to\ book_{it} + a_i + u_{it}$$

The second equation includes firm specific variables and macroeconomic variables.

$$Leverage = \beta_0 + \beta_1 OilPrice_{it} + \beta_2 Tangibility_{it} + \beta_3 FirmSize_{it} + \beta_4 Profitability_{it} + \beta_5 Growth\ opportunities_{it} + \beta_6 Interest\ rate_{it} + \beta_7 FinanceCrisis + \beta_8 OilCrisis + a_i + u_{it}$$

As we mention in section 4.8, we use a lagged oil price and lagged interest rate in our models where book values of equity are used in the dependent variable. These variables are replaced with their respective equivalent variables above.

5.12 Validity and reliability

To ensure that the quality of our research we must make sure that our data and method both are valid and reliable. By valid means that our test and models test the actual things we are trying to test. By reliability means that the data we have collected are accurate, trustworthy and that it is possible to replicate/recreate our data and tests. (Grønmo 2004)

Validity consists of both internal and external validity. Internal validity refers to how well the results answer our hypotheses and if they are valid for the population of Norwegian oil companies. Since we use the entire population there is no risk that the results should not be valid because of excluded companies or to small representative sample. There are however a wide range of companies and sub groups within the oil sector so generalizing for all sub sectors might be an issue that can lower our internal validity. External validity relates to possibility to use the variables across different situations and samples. As mentioned above several of the variables in our models have been used across different studies in different countries. This will improve our external validity. The results should therefore be able to transfer to other samples and situations. We consider the risk of violation of validity in our master thesis low based on the arguments above.

Reliability in quantitative research relies on the transparency and the consistency in the collecting of data and analysis. Data are gathered from the financial database, Thomson Reuters Eikon. The exchange rates and oil data are gathered from the Thomson Reuters Eikon Datastream financial database. Since both databases are reliable we consider the possibility of measurement error and/or inconsistency in the data for little. According to our understanding it would be possible for others to replicate our studies and get the same results. As a conclusion, we consider both validity and reliability are satisfied in our study.

5.13 Performed Statistical Tests

In this part of our master thesis we will try to shed some light on the evaluation we have done to decide which estimation methods to use. Unless other mentioned the significance level in our tests is at $p < 5\%$.

5.13.1 Multicollinearity and correlations

Multicollinearity occurs when two or more independent variables are highly, but not perfect correlated. As we can see from table 6 on the next page, all correlation between the different variables are relatively low, which indicates no multicollinearity. Correlation between dependent variables are also included in table 3, though will not high correlation be an issue since there never will be more than one dependent variable in each regression. There are no correlations higher than 0,7[11] in the correlation matrix and multicollinearity will not give any implications.

We supplement test for multicollinearity with a VIF-test[12]. VIF is a measure (index) on how much the standard deviation changes because of correlation between two or more variables. VIF is a function of R^2_j the equation below shows:

$$VIF = \frac{1}{1 - R^2 \text{j}}$$

Values below 10 suggest absence of multicollinearity[13]. (Dormann, et al. 2012). We have found no indications of multicollinearity in our data set. Appendix 8.6 includes all VIF results on coefficients.

[11] 0,7 has been widely used in previous studies a threshold for multicollinearity.
[12] VIF is short for Variance Inflation Factor.
[13] Alternatively values of $1/VIF < 0,1$.

Table 6: Correlation matrix including all variables

	Tangibility	Firmsize	Oil	LagOil	GrowthOpportunities	Interest	LagInterest	PastProfits	Profits	OilCrisis	FinanceCrisis	Tot.Debt.Book	Tot.Debt.Market	Long.Debt.Book	Long.Debt.Market
Tangibility	1														
Firmsize	0.21	1													
Oil	-0.068	0.172	1												
LagOil	-0.064	0.184	0.925	1											
GrowthOpportunities	-0.309	-0.172	0.12	0.063	1										
Interest	0.033	-0.126	-0.23	-0.232	0.097	1									
LagInterest	0.05	-0.13	-0.316	-0.286	0.031	0.96	1								
PastProfits	0.132	0.293	0.038	0.032	-0.057	-0.006	-0.006	1							
Profits	-0.015	0.215	0.04	0.017	-0.028	0.016	-0.007	0.211	1						
OilCrisis	0.021	0.099	-0.107	-0.018	-0.196	-0.421	-0.414	-0.039	-0.032	1					
FinanceCrisis	0.004	0.038	0.156	0.161	0.031	0.433	0.479	0.024	0.01	-0.205	1				
Tot.Debt.Book	0.4	0.176	0.068	0.07	-0.089	-0.03	-0.014	-0.063	-0.172	0.008	0.088	1			
Tot.Debt.Market	0.463	0.211	-0.043	-0.005	-0.465	-0.104	-0.05	0	-0.093	0.15	0.022	0.817	1		
Long.Debt.Book	0.445	0.235	0.012	0.012	-0.116	0.036	0.04	0.019	-0.006	-0.012	0.068	0.83	0.716	1	
Long.Debt.Market	0.502	0.239	-0.084	-0.051	-0.405	-0.031	0.009	0.064	-0.002	0.11	0.005	0.714	0.882	0.863	1

5.13.2 Breuch-Pagan Langrange Multiplier

Breuch-Pagan Lagrange Multiplier test is a test to identify the presence of heteroscedasticity in our data sample. The test results tell us if we need to adjust for heteroscedasticity in our model. It investigates whether there is individually specific variance in the error term or not.

$$H_0: \sigma_u^2 = 0$$
$$H_A: \sigma_u^2 \neq 0$$

If the test results are significant, the null hypothesis is rejected, there is heteroscedasticity in our model and we must consider different options to deal with the heteroscedasticity. A solution is to use a random effects model instead of OLS, if so, we would have to test if a random effects model is a good fit.

Test results are significant for all our models and we must therefore reject the null hypothesis of homoscedasticity. A way to adjust for heteroscedasticity, is either by adjusting the explanatory variables/dependent variable or introducing robust standard errors. All explanatory variables are set as ratios or natural logarithm to reduce the possibility of heteroscedasticity. An Arellano-method introduces robust standard errors and addresses both our issues with heteroscedasticity and autocorrelation. (which will be discussed in section 5.13.3) The method helps calculate standard errors that are consistent even with heteroscedasticity and autocorrelation present. (Arellano 1987)

Table 7 This result is for the market model with both firm specific and macro variables included. Our test for all regression models had similar conclusions.

```
        Breusch-Pagan test

data:  tot.debt.market ~ prof + MtoMB + Tangy + Log.Oil + LogTotAss +     Dummy.oil.crisis + Dummy.finance.crisis + Pastprof + intrerest
BP = 356.41, df = 9, p-value < 2.2e-16
```

The significant result indicates heteroscedasticity and as mentioned above we will address this issue by introducing robust standard errors.

5.13.3 Wooldridge-test for autocorrelation

To make sure that significance levels are accurate we must account for autocorrelation in our models. The Wooldridge-test checks that the null hypothesis of absence correlation in the error term of the same group. This makes it a good tool to check for autocorrelation both on individuals and generally. Wooldridge test checks for autocorrelation by investigating the covariance between μ_t and μ_{t-1}. The null hypothesis assumes that the covariance is zero and gives zero autocorrelation.

$$H_0: Cov(\mu_t, \mu_{t-1}) = 0$$
$$H_A: Cov(\mu_t, \mu_{t-1}) \neq 0$$

If we get significant results we must either choose a different model or adjust for the autocorrelation in our existing model.

Table 8 Test results is performed on Model 2 with macro explanatory variables. Test on the other explanatory variables can be found in the appendix and has the same result

```
        Wooldridge's test for unobserved individual effects

data:  formula
z = 4.2159, p-value = 2.488e-05
alternative hypothesis: unobserved effect
```

As the results in our analysis are significant, we must reject the null hypothesis and assume that we have autocorrelation in our model. We believe autocorrelation is natural to have in some of our variables. For instance, the debt ratio in one period is much dependent on the debt ratio in the period before. Variables such as profitability is more difficult to argue, since profitability in one period might not necessarily lead to profitability the next period.

5.13.4 Shapiro Wilk test

The Shapiro Wilk test checks for normality in the error term. To perform essential tests on our data we are dependent on that the residuals are normally distributed. Normal distribution in the residuals is important, because without the results we will not be able to test hypotheses on the parameters. Shapiro Wilks test is widely used in studies similar to ours, and we have chosen this to test for normality in the error term. The null hypothesis states that the residuals are normal distributed, and a significant result (p<0,05) would cause us to have to reject the assumption of normal distribution in the residuals.

Table 9 Results from model 2

```
        Shapiro-Wilk normality test

data:  ResMarket
W = 0.98067, p-value < 2.2e-16
```

The Shapiro-Wilks test concludes that there is non-normality in the residuals. However, when we plot[14] the residuals next to a normal distribution curve we see that the distribution is close to normally distributed. This combined with that fact that we have a relatively large number of observations makes it reasonable to assume that the Central Limit Theorem ensures that the residuals are approximately normal distributed. (Wooldridge 2013) We therefor conclude that the assumption of normally distributed residuals is met.

5.13.5 F-test

An F-test can be used to identify if there is individual heterogeneity in our data. Since we are using panel data with many different individual firms we must make sure that the individual effect of each firm does not affect our results in the regression. The null hypothesis states that there is no individual that affects the regressions results individually.

$$H_0: \theta_1 = \theta_2 = \cdots = \theta_{n-1} = 0$$
$$H_A: \theta_1 = \theta_2 = \cdots = \theta_{n-1} \neq 0$$

If the result of the test is significant we would have to reject the null hypothesis and OLS will not give consistent results due to the violation of one or more assumptions. (Wooldridge 2013) For such case one can for instance a fixed effects or random effects model might be a better fit.

The F-test is statistically significant for all our models and we must therefore reject the null hypothesis about non-individual heterogeneity. The test suggests that an OLS model would not adequate and we will address the issue by looking at a model with fixed effects or a random effects model as option that could adjust for this individual heterogeneity. These results[15] are expected because our data set contains multiple observations of the same firms, which is likely to have specific effects related to them.

5.13.6 Hausman-test

Since our F-test states that OLS is not adequate, we will choose a fixed effects or random effects model depending on goodness of fit. There are different approaches to identify this. A

[14] Plot of normality in the error term are in appendix 8.5
[15] All F-test results are found in regression tables in section 6

common approach is first to use α_i and evaluate if it is properly viewed as parameters to estimate or as a random variable to decide on fixed effects or random effects. Such considerations are often wrongheaded. We must consider it plausible that α_i is uncorrelated with all x_{itj}. (Wooldridge 2013) Since we cannot find any valid reasons to choose this approach we will stick with the Hausman-test to determine if we should use fixed effects or random effects model. The hypothesis of the Hausman-test is as follows:

$$H_0: cov(\alpha_i, x_{it}) = 0$$
$$H_A: cov(\alpha_i, x_{it}) \neq 0$$

A failure to reject the null hypothesis means that the estimators of RE and FE have no inconsistency between the models. In such case a RE model would be the best fit, if not an FE model would be preferred.

Table 10 Test results for model 2

```
        Hausman Test

data:  tot.debt.market ~ prof + MtoMB + Tangy + Log.Oil + LogTotAss +  ...
chisq = 108.49, df = 9, p-value < 2.2e-16
alternative hypothesis: one model is inconsistent
```

Result from Hausman-tests revealed inconsistency between the models. This means that a random effects model might produce inconsistent estimates because of the correlation between the explanatory variables and the error term. We therefor reject the null hypothesis and a fixed effects model is preferred over a random effects model.

5.14 Robustness test

Introducing robust standard errors are a common way to check validity/reliability of significance level. To do so in OLS with fixed effects, we use an Arrelano method which accounts for fixed effects and panel data. The method controls for both autocorrelation and heteroscedasticity. The impact when introducing robust standard errors increases the standard errors that in turn decrease the level of significance of the coefficients. (Arellano 1987)

6 Results and discussion

6.1 Interpretation

In this section, we go through our results and evaluate both the significance level and coefficient directions. Each variable result is with respect to other variables. We structure the discussion around each respective variable but also discuss correlation and logic related to other variables.

It is important to remember the difference of level-level[16] and level-log[17] interpretation. (Gujarati and Porter 2009) We therefore must interpret the results as shown below for the different scenarios.

Level-Level

$$\Delta y = \beta_k \times \Delta x$$

Level-Log

$$\Delta y = \frac{\beta_k}{100} \times \%\Delta x$$

6.2 Models with firm specific variables

In the table 4 below we present results from our four different models with firm specific variables. As concluded in the testing FE model is preferred over RE model for our purpose. We will compare the different models with each other and comment if there are any significant differences. For all commented coefficients in the results the result commented are controlled for all other included explanatory variables in the regression.

[16] Level-Level is referred to as when both explanatory and dependent variable are in their original form

[17] Level-Log is referred to as when explanatory variable is logged (natural logarithm) and dependent variable is in original form.

Table 11: Firm specific regression results

	(Model 1: TotalDebtBook)	(Model 2: TotalDebtMarket)	(Model 3: LongDebtBook)	(Model 4: LongDebtMarket)
Growth Opportunities	0.043 (0.027)	−0.082*** (0.018)	0.030** (0.013)	−0.057*** (0.015)
Profitability	−0.497** (0.211)	−0.344*** (0.098)	−0.058 (0.074)	−0.094 (0.071)
Tangibility	0.168** (0.071)	0.161*** (0.048)	0.190*** (0.053)	0.219*** (0.047)
Firm Size	0.070*** (0.010)	0.068*** (0.008)	0.049*** (0.007)	0.043*** (0.007)
Past Profitability	−0.170*** (0.033)	−0.132*** (0.033)	−0.107*** (0.031)	−0.074** (0.031)
Observations	2,939	2,939	2,939	2,939
R^2	0.214	0.317	0.100	0.190
Adjusted R^2	0.187	0.293	0.069	0.162
F Statistic (df = 5; 2841)	154.965***	263.253***	63.036***	133.078***
Note:				*p<0.1; **p<0.05; ***p<0.01

R^2 is a measure of how much of the variance of the dependent variable that is explained by our model and is used as a measurement of the explanatory power of the model. Adjusted R^2 is R^2 compensated for the fact that we have included several variables so that it only will increase if the new variable enhances the model more than what is by probability of chance. We observe that the adjusted R^2 for both market value models are significantly higher than for their equivalent book models.

Table 5 includes results after robustness test. The magnitude of the coefficients are unchanged and adjusted R^2 are therefore still the same for all the models as in table 4. After the adjustment two of our variables have had a reduction in significance level, but was still significant. Four variables went from being significant to not significant.

Table 12: Firm specific regression results after introducing robust standard errors

	(Model 1: TotalDebtBook)	(Model 2: TotalDebtMarket)	(Model 3: LongDebtBook)	(Model 4: LongDebtMarket)
Growth Opportunities	0.043	−0.082***	0.030**	−0.057***
	(0.027)	(0.018)	(0.013)	(0.015)
Profitability	−0.497**	−0.344***	−0.058	−0.094
	(0.211)	(0.098)	(0.074)	(0.071)
Tangibility	0.168**	0.161***	0.190***	0.219***
	(0.071)	(0.048)	(0.053)	(0.047)
Firm Size	0.070***	0.068***	0.049***	0.043***
	(0.010)	(0.008)	(0.007)	(0.007)
Past Profitability	−0.170***	−0.132***	−0.107***	−0.074**
	(0.033)	(0.033)	(0.031)	(0.031)
Note:				*p<0.1; **p<0.05; ***p<0.01

Profitability

For both models that uses total debt (Model 1 and 2) the results are significant at one percent level. For both significant models, there are a negative relation between the profitability and the leverage ratio. If we use model 2 to illustrate, then if the profitability increases by one percentage point the leverage decrease by 0,34 percentage points.

We know that previous empirical research has all found a negative relation between leverage and profitability. We find the same results when looking at total debt of the Norwegian energy sector. Our results show that firms that are profitable in the present year do not take on more debt. This contradicts the predictions of the static trade of theory and agency theory, but is in line with what pecking order theory predicts. We find it strange that the tax benefits and trade-off theory does not seem to fit better. If there was an industry that should relate to the trade-off theory, it should be industries such as the Norwegian Energy sector were income taxes are very high compared to other industries. Except for this, the results are in line with what we expected. We keep in mind that decisions about financing and issuing debt can be planned over longer periods. We therefore find it interesting to look at past profitability as well.

Past profitability

All the models are significant at one percent significance level except model 4 that only is significant at a five percent significance level. Just like profitability, past profitability are negatively correlated to leverage, and as we see in model 2: An increase in past profitability by one percentage point will decrease the leverage by 0,132 percentage points. The results indicate that a higher profitability both now and in the past, reduces the leverage of the firms. That the magnitude of past profitability is higher for the book models compared to their equivalent marked models may relate to the fact that the book models are backward looking, while market models are forward looking. It seems our sample firms do not take on new debt when they have retained earnings. From this perspective, their financing is according to the pecking order.

Growth opportunities (Market to Book)
For both market models the results are significant at one percent level. Model 3 is barely significant at a ten percent level. Both market models indicate a negative relation between the leverage and the growth opportunities. We use model 2 to illustrate the relationship. Here an increase in the growth opportunities by one percentage point will give a decrease in leverage at -0,082 percentage points. Model 3 indicates a positive relation between the leverage and growth opportunities where a one percentage point increase in growth opportunities will give an increase of 0,043 percentage points in leverage. The direction of the result is opposite in our market models compared to model 3. Our results are ambiguous, pecking order predicts a positive relation and static trade of theory and market timing predicts a positive relation.

Evidence from previous studies[18] when market value has been used as leverage proxy, shows a negative relationship, which is equal to our results. Previous studies that have used book values (Frank and Goyal 2009) found a positive relation, whilst (Rajan and Zingales 1995) found a negative relationship. Like (Frank and Goyal 2009) we got opposite direction on the coefficient between market and book models. This is according to our expectations because market values fluctuate daily, while book values need longer time to adjust. When a firm announces good outlooks, the market will price the stock accordingly at once.[19] The book values will not be adjusted before information and quarterly numbers are announced.

The results seem to be consistent with the market timing theory. This indicates that energy firms will use the high market to book ratio to their advantage, exploit market conditions and issue equity when market price of equity is high.

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[18] (Frank and Goyal 2009) and (Rajan and Zingales 1995)
[19] Given efficient markets theory (F. Fama 1970)

Our results are interesting in relation to (Welch 2004) findings, where he finds that stock returns explain most of the leverage ratio in market values. Welch states that stock returns are the first determinant of leverage. Market to book ratio reflects the stock price[20] and should then be a leading determinant to some extent. As mentioned in section 3.1.1 market value contains expectations and adjusts instantly[21]. We have no evidence beyond the relationship with market values of equity, but this indicates that stock returns are a determinant of leverage ratio in Norwegian energy firms.

The results from the book models point in the opposite direction and is in line with pecking order theory. Energy firms which are expected by the markets to grow, have little retained earnings and they will lend rather than issuing equity.

Tangibility

Our results for the tangibility proxy in our models are significant at one percent level for all our models except model 1 that only is significant at a five percent significance level. The models imply a positive relation between tangibility and debt ratio but there are some minor differences in the magnitude. Model 3 has a slightly larger magnitude than the other models. We will use model 2 to explain the relation. If the tangibility increases by one percentage point the debt ratio will increase with 0,161 percentage points.

The previous empirical studies we have investigated has all found a positive relationship between leverage and tangibility, just as we do. This can be explained by tangible assets such as oil rigs and oil service equipment that are relatively easy to value, and will then give lower information asymmetry between investor and firm. The same goes for banks and loan issuers who will have a lower threshold for lending. Both static trade of theory and our expectations predicted this result.

There are similarities in shipping industry and oil industry, such as the fact that both have high capital intensity. This might be the reason for our similarities with (Drobetz, et al. 2013) in tangibility.

[20] by including market value in the proxy
[21] According to efficient market hypothesis (F. Fama 1970).

Firm size

The coefficient for the natural logarithm of total assets is significant on all our models on a one percent level. We will use model 2 to explain effect of a change in this explanatory variable since all the models have the same positive relation and the magnitude is approximately the same too. An increase in total assets by ten percentage points will give an increase of 0,0068 percentage points in the debt ratio. In other words, the bigger the firm is the higher debt ratio it will have according to our proxy and model. This fits the predictions of static trade of theory that suggests that bigger firms will have a higher debt ratio.

All previous empirical studies that we have used that had significant result on firm size suggests a positive relation between leverage and firm size regardless of market or book models. The same results as we find in this study and according our expectations.

6.3 Results with macro variables

We now include the macro explanatory variables and discuss the results further. As in the models with only firm specific explanatory variables, we will present our results and then present results with robust standard errors. As mentioned in section 4.8, models with book values includes the lagged oil and interest variables so that x_{t-1} is collated with y_t.[22] This because it is not likely that the companies can adjust their book value of leverage in the same pace as their market value, oil price and interest changes.

[22] This results in a lag of three months.

Table 13: Firm and macro variable regression results

	(Model 1: TotalDebtBook)	(Model 2: TotalDebtMarket)	(Model 3: LongDebtBook)	(Model 4: LongDebtMarket)
Growth Opportunities	0.046***	−0.062***	0.034***	−0.041***
	(0.005)	(0.005)	(0.005)	(0.005)
Profitability	−0.507***	−0.330***	−0.076**	−0.095***
	(0.036)	(0.034)	(0.036)	(0.036)
Tangibility	0.155***	0.125***	0.165***	0.179***
	(0.023)	(0.022)	(0.023)	(0.022)
Firm Size	0.076***	0.093***	0.060***	0.068***
	(0.004)	(0.004)	(0.004)	(0.004)
Lag Interest	−0.468		2.703***	
	(0.773)		(0.775)	
Interest		−2.806***		1.028
		(0.699)		(0.724)
Finance Crisis	0.031***	0.016**	0.008	−0.005
	(0.008)	(0.007)	(0.008)	(0.008)
Oil Crisis	−0.013	0.008	−0.012	0.010
	(0.008)	(0.008)	(0.008)	(0.008)
Past Profitabiliy	−0.172***	−0.122***	−0.108***	−0.065***
	(0.013)	(0.012)	(0.013)	(0.013)
Lag Oil	−0.069***		−0.066***	
	(0.016)		(0.016)	
Oil		−0.228***		−0.190***
		(0.016)		(0.016)
Observations	2,939	2,939	2,939	2,939
R^2	0.224	0.370	0.118	0.233
Adjusted R^2	0.197	0.347	0.086	0.206
F Statistic (df = 9; 2837)	91.238***	184.780***	41.997***	95.997***

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

We see that adjusted R^2 has increased for all our models compared to their equivalent model with only firm specific explanatory variables. In the models with book values we have changed the oil and interest variables so that x_{t-1} is collated with y_t. This results in a lag of three months.

After introducing robust standard errors seven of our variables have had a reduction in significance level, but are still significant. Five variables are now insignificant.

Table 14: Firm and macro variable regression results after introducing robust standard errors

	(Model 1: TotalDebtBook)	(Model 2: TotalDebtMarket)	(Model 3: LongDebtBook)	(Model4 : LongDebtMarket)
Growth Opportunities	0.046* (0.026)	−0.062*** (0.016)	0.034** (0.014)	−0.041*** (0.013)
Profitability	−0.507** (0.209)	−0.330*** (0.098)	−0.076 (0.077)	−0.095 (0.075)
Tangibility	0.155** (0.077)	0.125** (0.049)	0.165*** (0.050)	0.179*** (0.045)
Firm Size	0.076*** (0.015)	0.093*** (0.011)	0.060*** (0.009)	0.068*** (0.009)
Interest		−2.806** (1.186)		1.028 (1.245)
Lag Interest	−0.468 (1.445)		2.703* (1.467)	
Finance Crisis	0.031* (0.018)	0.016 (0.016)	0.008 (0.017)	−0.005 (0.015)
Oil Crisis	−0.013 (0.017)	0.008 (0.018)	−0.012 (0.016)	0.010 (0.015)
Past Profitability	−0.172*** (0.032)	−0.122*** (0.032)	−0.108*** (0.028)	−0.065** (0.029)
Oil		−0.228*** (0.046)		−0.190*** (0.040)
Lag Oil	−0.069 (0.054)		−0.066* (0.037)	
Note:				*p<0.1; **p<0.05; ***p<0.01

For Firm Size, Profitability, Past Profitability and Tangibility there are no big changes in regression results. One reason for this can be that there is low correlation between the firm specific variables and the other macro variables, and that these do not take away any explanatory power from the firm specific variables. For Growth Opportunities, model 1 have changed from being not significant to significant at ten percent. There are no other significant changes in growth opportunities apart from this.

Oil Price

The variable is significant for both market models[23] at a one percent level. The results indicate a negative relationship between the oil price and debt ratios. For further discussion of the effect of oil price on debt ratio we will use model 2. The level-log interpretation indicates that if the natural logarithmic of the oil price increases by 10 percentage points, the dependent

[23] Not included in the book models, because it is replaced by the lagged oil price.

variable will decrease by 0,0228 percentage points. These results prove that oil price is a determinant of leverage in the Energy sector. We find the result of a negative relation to be according to our prediction and this confirms our second hypothesis. For the firms in our data set we assume that a higher oil price will be good for business. Meaning, an increase in oil price will increase earnings and this again may increase their retained earnings and firm´s accesses to internal financing of their projects may increase. Vice versa, a fall in the oil price will then reduce the firm´s availability to finance internally.

Because we have included profitability as a separate explanatory variable, we can conclude that oil price itself has a significant effect on the leverage and not only through profitability. To explain the effect of the oil price on the leverage we can view the oil price to day as a good estimate of the oil price for the future[24]. The oil price today may function as an indicator for future revenues for oil companies. Increasing the expected revenues and keeping all other factors equal, the expected future profitability will increase. We derive that the oil price has an impact on future profitability and this indicates that profitability, past profitability and future profitability[25] all has a negative impact on the leverage.

It is according to both pecking order and market timing theory since oil price affects the profitability in the Energy sector. Our results contradict the prediction of static trade-of theory that states that the financial distress that energy firms are subject to during an oil-price fall should give a reduction in the leverage. The reduction in profitability and the increase in risk of bankruptcy should according to static trade-of theory also reduce the leverage.

The increase in leverage when the oil-price reduces can also be driven by the need of financing through financial distress to avoid bankruptcy. External financing through issuing more debt is more favourable than for example emission when the firm needs liquidity. The banks that have lent capital to firms that at some point finds itself in financial distress, often agrees to lend them even more money while the firm is in financial distress. This is because banks find it likely that they would be better off if the firm survives. This way there is a bigger chance they can repay the whole initial loan.

[24] An even better proxy for future oil price would be to use oil futures. Due to the short time frame of this thesis we were not able to include this in our regressions.
25 If we use the oil price today as a proxy for future profitability.

Lagged Oil Price
The variable is not significant for model 1, but barley significant at ten percent for model 3. The result proves a negative relation between oil price and leverage. An increase in the oil price of ten percentage points will result in a decrease in book leverage of 0,0066 percentage points. Because our results only show significance in model 3, we have applied both a model with moving average with different lengths and moving average with different lags[26]. Neither of the different proxies gave any significant results.

The fact that there is a negative relation between the oil price with a three month shift and leverage in model 3 suggest that firms believes that when the oil price is low the previous period the firm should decrease their leverage to accommodate the increased risk of financial distress. This suggestion is in line with static trade of theory. Not surprisingly the effect of the oil price has the same direction as profitability. As mentioned under the "Oil Price" section this is expected due to the impact of the oil price on the profitability of the firms in the energy sector.

The magnitudes of the coefficients are significantly lower than for the equal market models. This suggests that book leverage is less driven by oil price than the market leverage. We find this reasonable since the managers often will have a longer time perspective compared to the investors and therefore will not make hasty decision to increase/decrease debt or write down equity.

Dummy on Financial Crisis and Oil Crisis
For Oil Crisis, none of the coefficients are significant for either models after introducing robust standard errors. The reason for this is that the time specific model we are using absorbs some of the effect from the dummy. Even though the variable is not significant we still want to include it to make sure that we eliminate the effect of the oil crisis, so that is does not affect other results. The same would also apply to the dummy for the financial crisis, even though we have significant results in model 1, at ten percent. The result shows that during the financial crisis the leverage ratio was 0,031 percentage points higher compared to the other periods in our data.

[26] Three, six, nine and twelve months lagged moving average.

As discussed in section 3.3, oil price fell rapidly during both crisis periods but for different reasons. Even though oil is the largest commodity in the world and the oil crisis had a major impact, the financial crisis had an impact on a larger scale and on several other markets as well. By including the oil price in our regression, we have taken some of the effect out of the oil crisis dummy. The financial crisis dummy is still significant, which leads us to that several factors affected leverage of energy firms during this period and not just oil price or the remaining variables in our analysis.

Market timing theory supports our results. During the crisis, market value of equity fell and firm´s would have gotten less if they issued equity. Governments lowered interest rates to boost the economy quickly after the crisis started, and lending money was cheap.

During the financial crisis, it became increasingly hard to lend money from traditional banks due to the financial distress they were in. It seems illogical that firms would manage to increase their leverage when it should be harder to lend money. An explanation might be that the firms started to use alternate debt financing such as bonds.

We observe in our data that with the exceptions of the crisis periods, the trend for oil service companies has been that market value has been significantly higher than book value of equity. During the two exceptions, the market value of equity has decreased and for many of the companies and been lower than the book value of equity. This may imply that the companies don't write down their assets as much as they should. If this is systematically the implication of this is either that there is market inefficiency due to asymmetrical information or that the board of directors are too reluctant to write down assets.

Interest rates

We get significant results in model 2 with total debt and model 3 on book values with long-term debt. For model 2, the relation between leverage and interest is negative, which means an increase of one percentage point in interest reduces the leverage by 2,806 percentage points. The result in model 2 shows that energy firms would rather finance projects with other than debt, when interest rates incline. Reversed, the energy sector will increase leverage when interest rates are low. This is in line with the pecking order theory, market timing theory and similar to the evidence from (Harvey og Graham 2001) on US firms. It is though inverse of what the trade-off theory predicts, which we find interesting due to the high taxes in the

Norwegian energy industry. From a trade-off perspective, this means firms are reluctant to expose themselves to even a small risk of financial distress.

The Norwegian government uses interest rates as a tool to adjust a distressed economy. Since the Norwegian economy largely relies on the performance of the oil sector, and we assume a positive relation between the Norwegian economy and interest rate, we then see that it is likely that when the interest rate increases the market value of the equity will increase. This might be the effect we observe when our evidence suggests the negative relation between the leverage and interest rates.

Lagged interest

Model 3 is significant at one percent level and an increase by one percentage point in the shifted interest rate will increase the long-term debt ratio by 2,703 percentage points. The reason why model 1 is not significant while model 3 is, it is unclear. One reason might be that long-term debt makes it worth adjusting according to interest rates since the cost of not adjusting might be larger than for short-term debt. A contradiction to this is the opposite result in model 2 which reflects market value of equity and non-lagged interest. The result coincides with the predictions of the static trade off theory, but is not in line with the prediction of pecking order theory and market timing theory. Just as in (Mjøs 2007) the coefficient is negative for interest rate and positive for lagged interest rate.

The result from model 3 can indicate that firms follow expectations of what is reasonable to believe about future interest rate. An increased interest rate in the last period[27] could be a sign of an increase in the next period. These make firms issue debt now rather than later, because they believe it will be more expensive to wait. This logic would only apply if the firms borrow at fixed rates. We did not have the information or time to investigate whether or not firms borrow at fixed or floating rates.

[27] The period referred to is a three-month period.

6.4 Conclusion

The purpose of this thesis has been to provide insight on the capital structure of Norwegian exchange listed firms within the energy sector controlled for crisis periods. We have used prior evidence and theory in our quantitative approach to provide an answer to our thesis. Accounting statements and data was obtained from Thomson Reuters financial database and processed to make a reliable panel data set for further analysis. Through fixed effects regression analysis, we found evidence according to previous studies and new evidence on the Norwegian energy market.

Our evidence shows that Profitability (included past profitability), Oil Price and Growth opportunities are indicators of leverage in Norwegian exchange listed energy firms and have a negative relationship. While firm size, tangibility and the financial crisis have a positive relationship with leverage.

Key findings we want to highlight:

- When oil price rises, the energy sector at Oslo stock exchange tend to increase their leverage.
- When the interest was high in the previous period firms in the energy sector tends to lend more.
- During the financial crisis firms in the Energy sector tended to increase their leverage.

The results of a significant negative relation between oil price and leverage confirms our first hypothesis. Results from our analysis confirms that the international oil price do affect financial decisions in the Norwegian energy sector.

We do not find any evidence that the Oil crisis in 2014 had any effect on the leverage ratio for firms in the Energy sector, when oil price is accounted for as an explanatory factor. Our result regarding the financial crisis in 2008 suggests that Norwegian energy firms increased their leverage during the financial crisis compared to more stable periods. We must then reject our second hypothesis regarding similarities between the two crises.

Our evidence shows that variables used in previous literature are important determinants of financing decisions in the Norwegian energy sector. Our findings[28] coincide with both (Mjøs 2007) and (Frank and Goyal 2009). They performed their test respectively on Norwegian[29] and American firms. This confirms our third hypothesis.

We conclude with that the Norwegian Energy sector´s financial decisions are driven by the oil price, along with factors as found in previous empirical studies.

6.5 Critique of our thesis

To make the data and analysis comprehendible we have chosen to omit some interesting topics for the benefit of others. The Norwegian bond market has risen relatively recently, compared to the US market, and is now a common source of debt financing in the market. We could use the bond prices to estimate market value of debt, and included it in our market models. This could alter our results, but it would take a lot of time, and there is no guarantee that we would have found sufficient data.

Excluded variables may correlate with included variables, and this may cause misleading interference that might alter our results. This is something that the reader of this master thesis should bear in mind while interpreting our results. There are no such interferences that the authors of this article know of, but such interferences are hard to identify.

As this thesis is written the oil price have not yet reached the relatively high level it had before the 2014 price fall. The closing price of Crude Brent Oil as of May 24th 2017 is USD 54,26 per barrel[30]. When choosing a topic so relevant it is difficult to say if the oil crisis is still ongoing or if it just has stabilized at a new and lower level.

6.6 Recommended further research

An interesting perspective would be to add oil price futures to the analysis. This could give an indication on if the difference between the predicted oil price and the actual oil price has any impact on the leverage.

[28] Only difference is that (Frank and Goyal 2009) had not significant results in their book model for firm size.
[29] Both listed and non-listed firms.
[30] From https://www.bloomberg.com/energy - downloaded May 24th 2017

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8 Appendix

8.1 List of included firms in this study

Firm	ISIN	Time period	Firm	ISIN	Time period
Akastor	NO0010215684	Jun. 2004 - Sept. 2016	Maritime Industrial Services	PAP644621073	Jun. 2006 - Jun. 2011
Aker	NO0010234552	Sept. 2004 - Sept. 2016	Nexus Floating Productions	SG9999002877	Mar. 2007 - Mar. 2013
Transocean Norway Drilling AS (Aker Drilling ASA)	NO0010287006	Dec. 2005 - Jun. 2011	Norse Energy Corp.	NO0003095507	Jun. 2001 - Sept. 2013
Aker Floating Production	NO0010308836	June. 2006 - Sept. 2011	Norwegian Energy Company	NO0010379266	Dec. 2007 - Sept. 2016
Aker Maritime	NO0003062507	Mar. 2000 - Sept. 2001	Nothern Offshore	BMG6635W1029	Sept. 2007 - Mar. 2015
Aker Solutions	NO0010716582	Dec. 2014 - Sept. 2009	Lotus Marine AS (Ocean Heavylift ASA)	NO0010290786	Jun. 2007 - Sept. 2008
Aqualis	NO0010715394	Sept. 2014 - Sept. 2016	Ocean Rig ASA	NO0003066300	Mar. 2000 - Mar. 2008
Archer	BMG0451H1170	Dec. 2010 - Sept. 2016	Ocean Yield	NO0010657448	Sept. 2013 - Sept. 2016
Atlantic Petroleum	FO000A0DN9X4	Dec. 2013 - Sept. 2016	Oceanteam	NO0010317316	Mar. 2007 - Sept. 2016
Avance Gas Holding	BMG067231032	May. 2014 - Sept. 2016	Odfjell Drilling	BMG671801022	Sept. 2013 - Sept. 2016
Awilco Offshore (Cosl Holding)	NO0010255722	Jun. 2005 - Jun. 2008	Odfjell Invest	BMG6740A1027	Jun. 2006 -Sept. 2008
Bergen Group	NO0010379779	Jun. 2008 - Sept. 2016	PA Resources	SE0000818569	Mar. 2002 - Sept. 2015
Bonheur	NO0003110603	Mar. 2000 - Sept. 2016	Panoro Energy	NO0010564701	Jun. 2010 - Sept. 2016
Bridge Energy	NO0010566235	Jun. 2009 - Jun. 2013	Petrojack	NO0010244346	Mar. 2005 - Sept. 2009
BW LPG	BMG173841013	Dec. 2013 - Sept. 2016	Petroleum Geo-Services	NO0010199151	Mar. 2000 - Sept. 2014
BW Offshore Limited	BMG1190N1002	Jun. 2006 - Sept. 2016	Petrolia	CY0102630916	Mar. 2000 - Jun. 2016
CanArgo Energy Corporation	US1372251082	Mar. 2000 - Sept. 2008	Polarcus	KYG7153K1085	Sept. 2009 - Sept. 2016
Crystal Production	NO0003015901	Mar. 2001 - Sept. 2003	Prosafe	CY0100470919	Mar. 2000 - Jun. 2016
Deep Ocean ASA	NO0010279821	Dec. 2005 - Mar. 2008	Prosafe Production Public	CY0100610910	Jun. 2006 - Mar. 2008
Deep Sea Supply	CY0100120910	Sept. 2005 - Sept. 2016	Questerre Energy Corporation	CA74836K1003	Mar. 2004 - Sept. 2016
Aker BP (Det norske oljeselskap)	NO0010345853	Dec. 2007 - Sept. 2016	Reach Subsea	NO0003117202	Jun. 2001 - Sept. 2016
DNO	NO0003921009	Mar. 2000 - Sept. 2016	Reservoir Exploration Technology	NO0010277957	Dec. 2006 - Mar. 2013
Dockwise	BMG2786A1062	Dec. 2007 - Dec. 2012	Wintershall Norge AS (Revus Energy)	NO0010270309	Jun. 2005 - Sept. 2008
DOF	NO0010070063	Dec. 2000 - Sept. 2016	Rocksource ASA (Pure E&P AS)	NO0003987901	Mar. 2002 - Mar. 2015
DOF Subsea	NO0010274608	Dec. 2005 - Sept. 2008	Roxar	NO0003073801	Mar. 2000 - Sept. 2008
Dolphin Group	NO0010170921	Jun. 2006 - Sept. 2015	Scorpion Offshore	BMG786761061	Jun. 2006 - Jun. 2010
Easterm Drilling	NO0010265168	Jun. 2005 - Mar. 2007	SeaBird Exploration	CY0101162119	Jun. 2006 - Sept. 2016
Eidesvik Offshore	NO0010263023	Jun. 2005 - Sept. 2016	Seadrill Ltd	BMG7945E1057	Dec. 2005 - Sept. 2016
Electromagnetic Geoservices	NO0010358484	Mar. 2007 - Sept. 2016	Sevan Drilling	BMG8070J1099	Jun. 2011 - Sept. 2016
EMAS Offshore	SG1AD2000008	Nov. 2006 - Nov. 2016	Sevan Marine	NO0010187032	Dec. 2004 - Sept. 2016
Fairstar Heavy Transport	NL0000026292	Dec. 2006 - Jun. 2012	Siem Offshore	KYG813131011	Sept. 2005 - Sept. 2016
Farstad Shipping	NO0003215303	Mar. 2000 - Sept. 2016	Sinvest ASA	NO0010215015	Mar. 2003 - Sept. 2006
Fred. Olsen Energy	NO0003089005	Mar. 2001 - Sept. 2016	Smedvig (Seadrill Norge AS)	NO0003390205	Mar. 2000 - Dec. 2005
Yinson Production AS (Fred. Olsen Production)	NO0010354020	Jun. 2007 - Sept. 2013	Solstad Offshore	NO0003080608	Mar. 2000 - Sept. 2016
Frontline	BMG3682E1921	Mar. 2000 - Sept. 2016	Songa Offshore	CY0100962113	Mar. 2006 - Dec. 2016
Ganger Rolf	NO0003172207	Mar. 2000 - Dec. 2015	Spectrum	NO0010429145	Sept. 2008 - Sept. 2016
GC Rieber Shipping	NO0010262686	Mar. 2001 - Sept. 2016	Statoil	NO0010096985	Jun. 2001 - Sept. 2016
Golar LNG	BMG9456A1009	Dec. 2002 - Sept. 2016	Subsea 7 SA	LU0075646355	Mar. 2000 - Sept. 2016
Havila Shipping	NO0010257728	Jun. 2005 - Sept. 2016	Subsea 7 Inc	KYG8549P1081	Dec. 2012 - Sept. 2010
Havila Supply (Bourbon Offshore)	NO0003107104	Jun. 2000 - Mar. 2003	Tanker Investments	MHY849271058	Mar. 2014 - Sept. 2016
Hydralift ASA	NO0003031908	Mar. 2000 - Sept. 2002	Teekay Petrojarl ASA	NO0010309560	Jun. 2006 - Mar. 2008
Höegh LNG Holdings	BMG454221059	Sept. 2011 - Sept. 2016	TGS-NOPEC Geophysical Company	NO0003078800	Sept. 2000 - Sept. 2016
I.M. Skaugen	NO0003072803	Mar. 2000 - Sept. 2016	Trefoil	BMG9027E1021	Dec. 2005 - Mar. 2008
InterOil Exploration and Production	NO0010284318	Sept. 2006 - Sept. 2016	Wavefield Inseis ASA	NO0010295504	Mar. 2007 - Sept. 2008
Kvaerner (Old Kvaerner Invest)		Mar. 2000 - Sept. 2005	Wentworth Resources	CA9506771042	Sept. 2005 - Sept. 2016
Kværner	NO0010605371	Sept. 2011 - Sept. 2016	Frontier Drilling ASA (Paragon Offshore Drilling AS)	NO0010094469	Mar. 2001 - Dec. 2002
AGR Group (Petroleum services group AS)	NO0010277171	Mar. 2005 - Sept. 2014			

8.2 Lists of excluded firms from our data set

The firms in the table below are excluded due to few observations. We have set a limit at a minimum of 5 observations, and all firms that don't satisfy this criterion are excluded. In the table below we have listed all the firms that are excluded because of too few observations. By excluding these firms we have excluded approximately twenty-five to thirty observations.

Firm	ISIN	Period
APL ASA	NO0010255862	Only one observation
BW Gas Limited	BMG174301025	Sept. 2008 - Mar. 2009
Consafe Offshore	SE0001389594	Mar. 2005 - Mar. 2006
Exploration Resources (Seabed Geosolutions R&D AS)	NO0010256142	Mar. 2005 - Jun. 2005
Floatel	BMG3597X1039	Dec. 2010 - Jun. 2011
Frigstad Discoverer Invest Ltd. (Saipem Discoverer Invest SARL)	VGG3724W1014	Jun. 2007 - sept. 2007
Scan Subsea ASA	NO0010375157	Mar. 2007 - Sept. 2007
SeaDrill Invest	BMG6709U1071	Dec. 2004 - Sept. 2005

Firms that were excluded due to that we couldn't find any data on them in Thomson Reuters Eikon are presented in the table below.

Firm
Altinex
APL PLC
Bergesen A akjser
Bergesen B akjser
Bjørge
BW Gas ASA
Grenland group
Nortrans offshore
Petrobank energy and resouces
RAK petroleum

8.3 GICS Overview of Energy Sub Sectors

GICS (Global Industry Classification Standard)

This structure is effective after close of business (US, EST) Wednesday - August 31, 2016

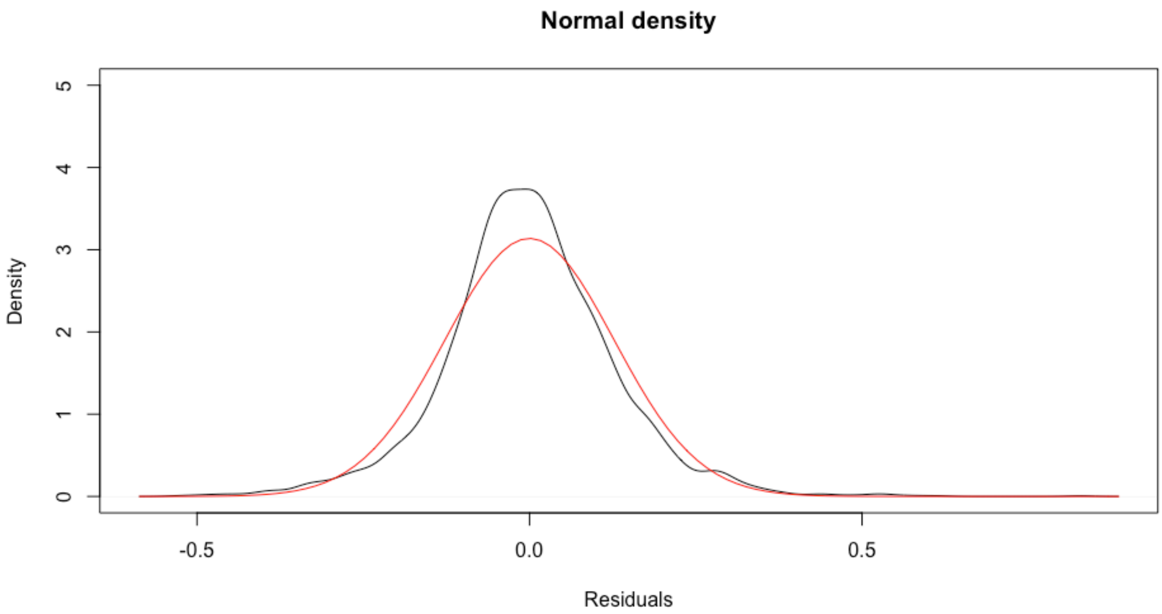
Sector		Industry Group		Industry		Sub-Industry	
10	Energy	1010	Energy	101010	Energy Equipment & Services	10101010	**Oil & Gas Drilling** Drilling contractors or owners of drilling rigs that contract their services for drilling wells
						10101020	**Oil & Gas Equipment & Services** Manufacturers of equipment, including drilling rigs and equipment, and providers of supplies and services to companies involved in the drilling, evaluation and completion of oil and gas wells.
				101020	Oil, Gas & Consumable Fuels	10102010	**Integrated Oil & Gas** Integrated oil companies engaged in the exploration & production of oil and gas, as well as at least one other significant activity in either refining, marketing and transportation, or chemicals.
						10102020	**Oil & Gas Exploration & Production** Companies engaged in the exploration and production of oil and gas not classified elsewhere.
						10102030	**Oil & Gas Refining & Marketing** Companies engaged in the refining and marketing of oil, gas and/or refined products not classified in the Integrated Oil & Gas or Independent Power Producers & Energy Traders Sub-Industries.
						10102040	**Oil & Gas Storage & Transportation** Companies engaged in the storage and/or transportation of oil, gas and/or refined products. Includes diversified midstream natural gas companies facing competitive markets, oil and refined product pipelines, coal slurry pipelines and oil & gas shipping companies.
						10102050	**Coal & Consumable Fuels** Companies primarily involved in the production and mining of coal, related products and other consumable fuels related to the generation of energy. Excludes companies primarily producing gases classified in the Industrial Gases sub-industry and companies primarily mining for metallurgical (coking) coal used for steel production. A company or Trust with significantly diversified operations across two or more property types.

8.4 Variable calculations

Name	*Definition*
Tangibility	Net Fixed Assets divided by total assets
Firm Size	Natural log of assets
Profitability	Net Income before depreciation? Divided by total assets
Market-to-book	Market value of assets divided by total assets. Market value of assets is defined by book value of assets minus the book value of equity plus the market value of equity.
Past Profitability	Retained earnings divided by total assets
Interest rate	3 month NIBOR
Oil Price	The natural logarithm of the oil price
Oil Price with shift	The natural logarithm of the oil price, 3 months past
Dummy Financial Crisis	Zero value when not in crisis, and one under crisis period
Dummy Oil Crisis	Zero value when not in crisis, and one under crisis period

8.5 Test for normality in the residuals

We have plotted the residuals against a normal distribution to see if our residuals are normally distributed. In the figure below the black line represents the distribution of the residuals from our final market model. The red line represents a normal distribution curve. From the figure, we can see that our residuals do not fit perfectly with our residuals. Even though the fit is not perfect, it is so close that we cannot reject the possibility of normally distributed residual on these results alone.



8.6 VIF-Test

M2B	profits	Tangy	Firmsize	interestrate
1.114	1.053	1.141	1.122	1.024

M2B	profits	Tangy	Firmsize	interestrate
1.114	1.053	1.141	1.122	1.024

M2B	profits	Tangy	Firmsize	laginterest
1.108	1.050	1.141	1.124	1.020

M2B	profits	Tangy	Firmsize	laginterest
1.108	1.050	1.141	1.124	1.020

M2B	profits	Tangy	Firmsize	interestrate	Dummy.finance.crisis	Dummy.oil.crisis	pastprofits	Log.Oil
1.174	1.083	1.152	1.248	1.762	1.319	1.323	1.130	1.391

M2B	profits	Tangy	Firmsize	interestrate	Dummy.finance.crisis	Dummy.oil.crisis	pastprofits	Log.Oil
1.174	1.083	1.152	1.248	1.762	1.319	1.323	1.130	1.391

M2B	profits	Tangy	Firmsize	laginterest	Dummy.finance.crisis	Dummy.oil.crisis	pastprofits	laglogoil
1.164	1.082	1.153	1.251	1.924	1.455	1.297	1.130	1.433

M2B	profits	Tangy	Firmsize	laginterest	Dummy.finance.crisis	Dummy.oil.crisis	pastprofits	laglogoil
1.164	1.082	1.153	1.251	1.924	1.455	1.297	1.130	1.433

>

VIF-test results for all models

8.7 Regression without the financial crisis

	Dependent variable:			
	(1)	(2)	(3)	(4)
prof	-0.483**	-0.309***	-0.051	-0.070
	(0.193)	(0.094)	(0.071)	(0.073)
MtoMB	0.072**	-0.063***	0.051***	-0.038**
	(0.033)	(0.019)	(0.016)	(0.016)
Tangy	0.166**	0.138***	0.155***	0.174***
	(0.079)	(0.052)	(0.059)	(0.051)
Lag.log.oil.1	-0.075		-0.078*	
	(0.060)		(0.043)	
Log.Oil		-0.183***		-0.151***
		(0.056)		(0.049)
LogTotAss	0.086***	0.095***	0.065***	0.069***
	(0.013)	(0.011)	(0.010)	(0.009)
Dummy.oil.crisis	-0.011	0.012	-0.012	0.016
	(0.020)	(0.020)	(0.016)	(0.015)
Pastprof	-0.164***	-0.120***	-0.102***	-0.058*
	(0.031)	(0.033)	(0.032)	(0.031)
LagInterest	0.868		2.056	
	(1.406)		(1.516)	
intrerest		0.070		2.566
		(1.531)		(1.632)

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