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Capital Structure Decisions in Energy Companies Listed on the Oslo Stock Exchange

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Abstract

In this thesis, we have analyzed which factors that may affect the capital structure choices of the oil and gas companies listed on the Oslo Stock Exchange, which historically have paid a huge contribution to the Norwegian economy and welfare. This sector consists of 48 companies which we have analyzed from 1998 until 2016. The companies in our dataset compete in a capital intensive industry where ongoing investments are required to develop and exploit projects and future growth prospects. Through this thesis, we aim to provide a contribution to the understanding of which factors the companies emphasize on when deciding how to finance their activities and operations.

We have created a model where the dependent variable representing capital structure is defined as debt ratio. The independent variables are the degree of asset tangibility, firm size, profitability, risk and growth. We have also included two control variables, oil price and interest rate to enrich our thesis with elements of macroeconomic nature.

The findings show that there is a positive relationship between debt ratio and firm size, profitability and interest rate. This means that the debt ratio increases when firm size, profitability and interest rate increase. We also found a negative relationship between debt ratio and asset tangibility, as well as between debt ratio which means that when the asset tangibility increases the debt ratio decreases. We found a negative relationship between debt ratio and our proxy for risk, the Z-score, which means that when the debt ratio increases, risk increases. The findings also revealed that there is no significant relationship between the dependent variable, debt ratio, and oil price and growth.

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Preface

This master thesis is the finishing work of our 2-year master's degree in Business and Administration at Oslo Metropolitan University, with specialization in finance.

Capital structure is a topic that hits some of the core subjects in finance, and is a topic we both thought was interesting and wanted to learn more about – while at the same time learning more about the finance field in general.

Working on this thesis has been interesting and challenging, with a steep learning curve in both finance, working with data and analytics. We want to thank our supervisor Muhammad Azeem Qureshi, and also Sturla Lyngnes Fjesme for helpful comments and feedback.

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1. Introduction

A company's capital structure is a mix of different securities. In general, a company can choose among many alternative capital structures. It can issue a large amount of debt or remain solely on equity financing. It can arrange lease financing, use warrants, issue convertible bonds, sign forward contracts or trade bond swaps. It can issue distinct securities in countless combinations. The capital structure decision is crucial for any business organization, because of the need to maximize returns to various organizational constituencies, and because of the impact such a decision has on a company's ability to deal with its competitive environment. Therefore, the company attempts to find the combination that maximizes its overall market value (Abor 2005).

The most known and acknowledged theories on capital structure are Modigliani and Miller's theorems (Modigliani and Miller 1958; 1963), the trade-off theory (Kraus and Litzenberger 1973), and the pecking order theory (Myers 1984; Myers and Majluf 1984). In more recent time the agency theory and the market timing theory (Baker and Wrugler 2002) has also entered the literature. Previous studies have investigated the relationship between different factors that may influence companies' capital structure, and at the same time find support for the theories on the subject. Most of the studies we have been through deals with American or European companies, while few studies on the topic of capital structure has been conducted in Norway. We therefore wish to contribute to the literature by conducting a study that investigates which factors that influence decisions regarding capital structure in Norwegian-noted energy companies. Our research question is:

"Which factors affect the capital structure decisions in energy companies listed on the Oslo Stock Exchange?"

The study is based on a period of 19 years, from 1998 to 2016, and involves companies in the energy industry, listed on the Oslo Stock Exchange (OSE). We divide the industry into seven different sub-industries, which will be presented in chapter 2. Based on theory and previous studies on the topic of capital structure, we have chosen four factors which may influence a company's decisions: tangibility, firm size, growth, and risk. We also want to include oil price and interest rate as control variables for macroeconomic relations which may influence the company's debt ratio.

This study is organized as follows: In chapter 2 we present the most known theories about capital structure, and we summarize previous studies done on the topic of capital structure. We will also give a brief explanation of our selected variables. In chapter 3 we will present our data and chapter 4 will provide some insight into the methodological foundation. Chapter 5 is a presentation of the results from our analyses, and chapter 6 is a discussion of the results. In chapter 7 we make our conclusion and present some limitations in our study and suggestions for further research.

2. Theory and literature on capital structure

2.1. Modigliani and Miller's theorems

In Modigliani and Miller's (MM) "The Cost of Capital, Corporation Finance and the Theory of Investment" (1958) the authors present their first theorem. This theorem states that in perfect capital markets, i.e. complete markets, no transaction costs, no tax, and no bankruptcy costs, company value is unaffected by changes in their capital structure. This is a result of the arbitrage opportunity that occurs if the company value changes when the capital structure changes. MM further states that company value is determined by its assets, and type of financing is therefore irrelevant.

In 1963 MM published "Corporate Income Taxes and the Cost of Capital: A Correction". In this paper, the authors present their second theorem, based on the first theorem. The second theorem states that the expected return on a share increases proportionally with increased leverage. This is because the shareholders will claim a higher return on their investment when the company takes on more debt, as the increase in debt will lead to a higher risk of default.

MM's theorems are based on unrealistic assumptions about perfect capital markets. In reality, perfect capital markets do not exist. The theorems are still important, because they tell us that the existence of an optimal capital structure must arise from market imperfections; taxes, bankruptcy costs, agency costs, and asymmetric information.

2.2. The pecking order theory

The pecking order theory was developed by Myers and Majluf (1984), and states that an optimal capital structure does not exist. Companies make their capital structure decisions based on a hierarchy of financing alternatives. Companies in need of financing can either use retained earnings, issue debt, or issue equity. According to the theory, companies should always use internal capital in form of retained earnings before turning to external capital. Internal capital does not involve transaction costs and loss of control due to transferring voting rights to new shareholders. If internal financing is not available to finance new investments, the company may seek external capital in the following prioritized order: issue debt, convertible obligations, and issue equity. The pecking order theory's explanation for this is that debt is the cheapest alternative of external financing. Convertible obligations may be retracted, so this is the second-best alternative. Issuance of equity involves transferring control to new shareholders and may involve agency costs as well as a reduction in share price, thus it is the least favorable option (Myers 1984).

The pecking order theory assumes that asymmetrical information contributes to explaining why issuing debt is preferable compared to issuing equity. If there is asymmetrical information where the management has better knowledge about the company and future growth than the investors, the investors will often overvalue the new issue, leading to a higher share price. Thus, the financing costs will increase with the degree of asymmetrical information. The theory also assumes that the management will act in the interest of current shareholder relative to new shareholders. The management may therefore choose not to invest in projects with a positive net present value, if the projects have to be financed with new equity. This is because an issuance of equity will lead to a reduction in share price and thus, the cost of issuing equity will offset the positive net present value for the current shareholders (Myers and Majluf 1984).

Myers and Majluf (1984) does not describe an optimal capital structure and does not address the tax benefit for companies issuing debt, costs of financial distress, agency costs, or transaction costs, but in “The Capital Structure Puzzle” (1984) Myers addresses the cost of financial distress. He encourages companies to keep some financial slack, so they do not have to seek external financing every time an investment opportunity occurs. Financial slack can be in the form of current assets or the ability to take on more debt to finance new projects. This revised form of the Pecking Order Theory allows the issuance of equity if it creates financial slack for the company.

Frank and Goyal (2003) tested the pecking order theory on a broad cross-section of publicly traded firms over the period 1971 to 1998. They find that internal financing is not sufficient to cover investment spending on average, and that external financing is heavily used. Also, they find that debt financing does not dominate equity financing in magnitude, and that equity becomes more and more important over time. Overall, the authors find little support for the theory. In a similar study by Kahn and Adom (2015), they find that the conclusion of Frank and Goyal (2003) also holds for the following decade (1999-2009). In fact, they find that firms are more likely to raise equity to finance investments than the “cheaper” debt financing.

In a study conducted by Bancel and Mittoo (2002), where they survey managers of firms in sixteen European countries to examine the link between theory and practice of capital structure, they find little support for the pecking order theory. They find that the two major considerations that seem to influence the capital structure decisions of managers are the search for financial flexibility and the impacts of capital structure on the financial statements.

2.3. Market timing theory

In the efficient capital markets studied by Modigliani and Miller (1958), the costs of different forms of capital do not vary independently, thus there is no gain from switching between equity and debt. However, in capital markets that are inefficient, market timing benefits current shareholders at the expense of new or retreating shareholders. Managers therefore have incentives to time the market if they think it is possible and if they care more about the current shareholders. The market timing theory states that companies determine their capital structure based on the relationship between the cost of equity and the cost of debt at the time of the financing. When the theory was presented by Baker and Wurgler (2002) it was considered an opponent to the established theories in capital structure. Capital structure decisions is according to the market timing theory always based on the cost of financing. This means that companies issue debt if there are lower costs related to debt relative to equity at the time of financing, and companies issue equity if the costs related to debt are higher. The theory assumes that companies can discover mispricing of shares in the market and act accordingly. The market-to-book relationship will enable companies to "time" their financing so that the financing costs are minimized. In their study, Baker and Wurgler (2002) find that fluctuations in market value have very long-run impacts on capital structure, which is hard to explain within the traditional theories of capital structure.

The market timing theory is supported by Huang and Ritter (2009), where the authors find that firms fund a larger proportion of their financing deficit with net external equity when the expected equity risk premium is lower. Also, they find that when a firm funds a smaller proportion of its financing deficit with debt, which occurs when the market equity risk premium is lower, leverage is lowered for many subsequent years, with the impact gradually diminishing over time. Alti (2006) show that market timing is an important determinant of financing activity in the short run, but its long-run effects are limited. Frank and Goyal (2009) argues that market timing could result from rational optimizing by managers. Almost any realistic optimizing model of corporate leverage is likely to have time-varying costs and benefits which will lead to time-varying optimal choices. They find little support for the market timing theory within their empirical framework.

2.4. The trade-off theory

The trade-off theory was developed by Kraus and Litzenberger (1973) where they introduced the effect of leverage on firm value because of market imperfections. In complete and perfect capital markets the firm value is independent of its capital structure, but as taxes on profits, transaction costs and bankruptcy costs are taken into consideration, the trade-off theory arises. The trade-off theory has sprung out of the second theorem by Modigliani and Miller (1963) and, assuming the firm meets its debt obligations with certainty, the firm's market value would be a linear function of the amount of debt used in its capital structure. Robichek and Myers (1965) then noted that both taxes and bankruptcy costs should be considered in the determination of optimal capital structure. So, the firm will achieve the highest value by balancing the present value of the tax benefits with the cost of bankruptcy, according to the trade-off theory.

This trade-off theory of capital structure recognizes that target debt ratios may vary from firm to firm dependent on several firm specific characteristics. Companies with safe, tangible assets and plenty of taxable income to shield will have high target ratios. Unprofitable companies with risky, intangible assets will in general rely on equity financing (Brealey et al. 2014).

While Kraus & Litzenberger (1973) claim that the companies will try to reach an optimal capital structure which is represented by the trade-off between the benefits of debt and the cost of debt, Myers (1984) suggests that each company point out their debt target and continuously approach this level. Frank & Goyal (2003) suggest differentiating between static and dynamic trade-off theory. Static trade-off theory refers to the balancing of debt and equity in a specific period, while dynamic trade-off theory argues that a company's optimal capital structure is determined by an area that gives the highest firm value. It is costly to change the capital structure, so the firm chooses to rearrange the relationship between debt and equity only if the benefits is greater than the cost of the recapitalization. The firms let their leverage ratios vary within an optimal range (Dudley 2007).

Figure 2.1 Summary of the static trade-off theory. Shows the relationship between firm value and debt level.

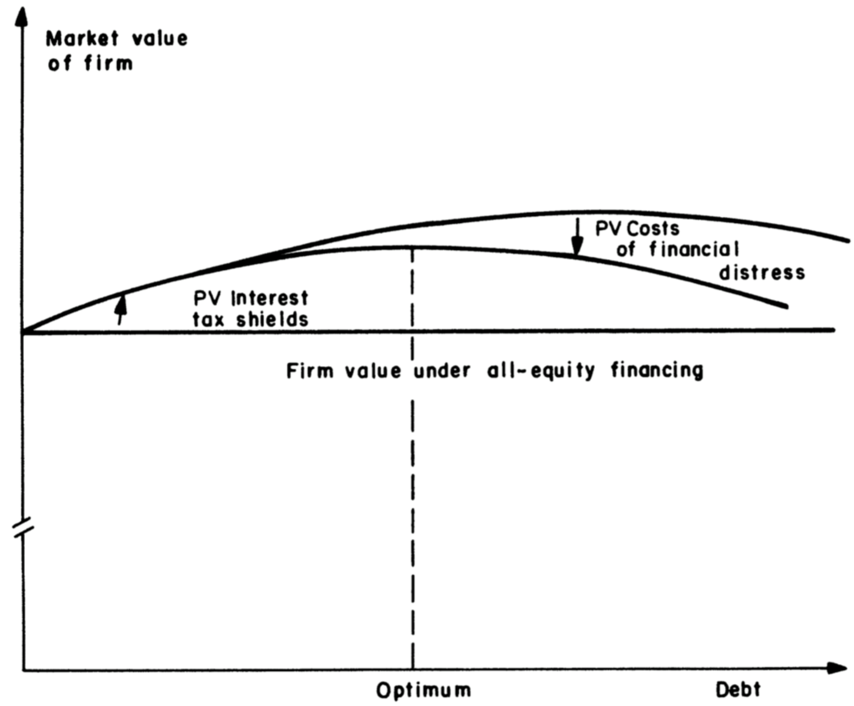


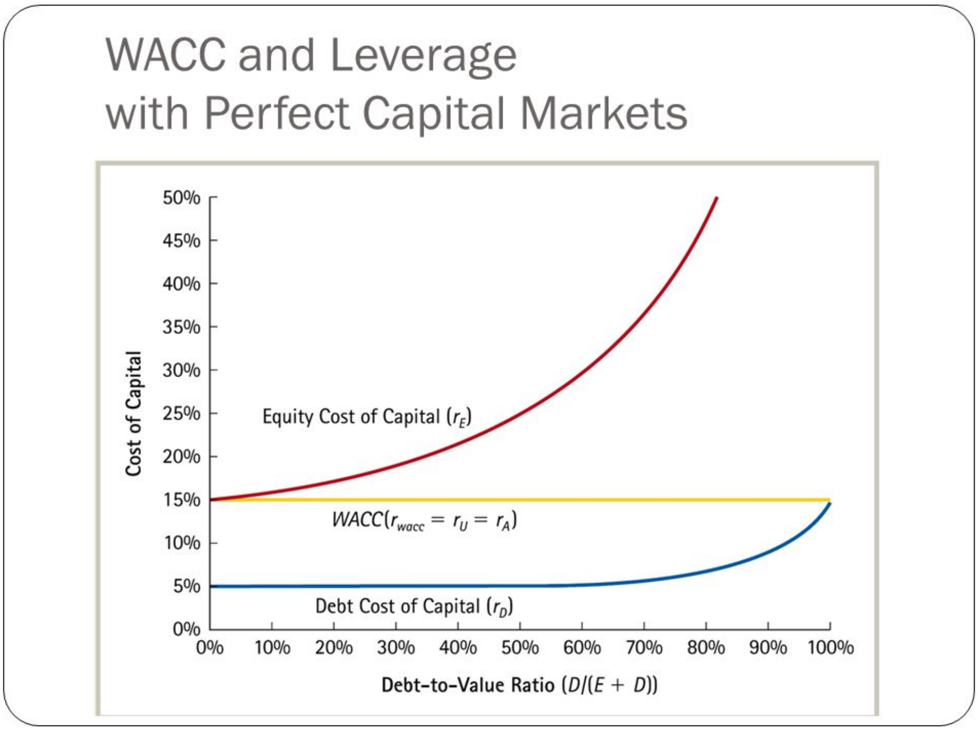
Figure 1. The static-tradeoff theory of capital structure.

(Myers 1984)

Figure 2.1 above summarizes the trade-off theory. The horizontal line represents MM's proposition 1, where the total market value of the firm is the total value of all its assets. This value is independent of its capital structure, assuming perfect capital markets, no taxes and transaction costs and that assets and investment policy is held constant. When taxes are taken into consideration, we can see that the firm will increase their debt level until they reach the dotted line where the present value of interest tax shields is balanced with the present value of cost of financial distress. This is the optimal capital structure which maximizes the value of the firm.

Myers (2001) argue that a company tries to find the optimal capital structure by choosing a mix between debt and equity that maximizes the value of the company and/or minimizes the total cost of capital. Proposition 2 by Miller and Modigliani claims that the total average cost of capital for a company remain constant independent of the company's capital structure because of the relationship between debt and risk. An increase in debt will result in a higher level of risk, which in turn will lead to a higher required cost of equity. Therefore, the cost of equity will increase proportionally with the leverage due to bankruptcy risk. The Miller and Modigliani theorems assume perfect capital markets, which does not reflect reality. According to the trade-off theory by Kraus and Litzenberger (1973), which emphasizes on the tax shields relevant to interest payments, there is an optimal capital structure which balances costs and benefits of debt. The companies' striving to achieve this optimal capital structure are according to the trade-off theory trying to exploit the benefits of debt, which means that they simultaneously take on more risk. The costs related to financial distress will affect the daily operations of the business negatively. This might be direct costs attached to restructuring and issuance of debt, and also indirect costs as e.g. deregulated credit ratings because of increased risk related to debt liabilities, which in turn will affect their access to the capital markets and also their conditions and terms.

Figure 2.2 The relationship between equity cost of capital, debt cost of capital, and WACC.



2.5. Agency theory

"The directors of such (joint-stock) companies, however, being the managers rather of other people's money than of their own, it cannot well be expected, that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own" (Smith 1776, 574-575). We think this statement made by Adam Smith (1776) touches the core of agency theory, which we will now look further into.

Agency theory has developed to become one of the dominant paradigms in the financial economics literature over the last decade (Ross 1973; Jensen and Meckling 1976) and the relationship of agency is established as one of the oldest and most common codified modes of social interaction (Ross 1973). An agency relationship can be defined as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision-making authority to the agent. If both parties to the relationship are utility maximizers, there is a good reason to believe that the agent will not always act in the best interest of the principal (Jensen and Meckling 1976). All contractual arrangements are examples of this matter, as of employer (principal) and employee (agent). The separation of security ownership and control can be an efficient form of economic organizing when determining the managerial structure of the firm. The firm is viewed as a set of contracts among factors of production, with each factor motivated by its self-interest. Because of its emphasis on the importance of rights in the organization established by contracts, this literature is characterized under the rubric of "property rights" (Jensen and Meckling 1976). The basic intention of the agency relationship is that the agent will make the choices that in turn will maximize the principal's welfare. This is not always the reality as the individual behavior in organization often depend on the nature of the contracts and the fact that interest conflicts might arise. This situation is known as the agency problem, when the agent is tempted to pursue personal interests.

Although this situation is well-known and relatively common, the principal can limit the agent's decisional freedom by structuring the contractual relation that will provide appropriate incentives for the agent (Jensen and Meckling 1976). Economists have long been concerned with the incentive problems that arise when decision making in a firm is the province of managers who are not the firm's incentive holders (Fama 1980). By establishing the correct incentives, the principal may be able to lead the agent in the favorable direction and therefore align the divergence between the interests of the principal and the agent. These actions taken by the principal will not come at zero cost. The costs related to the monitoring and the incentives of the agent in addition to the loss which derive from decisions not maximizing the shareholder wealth, is called agency costs (Brealey et al. 2014).

We can divide the agency costs into two categories; the agency costs of equity and the agency costs of debt. The agency costs of equity arise when there is free cash flow available so that the management can choose to deploy this cash in negative net present value investments or extend the executive perks instead of paying out dividend to the shareholders. The board can therefore increase the level of debt in the company to discipline the management (the agent) in their use of excess cash and investment decisions (Jensen 1986).

The agency cost of debt is related to investment policy and the risk associated to the different sources of capital. Managers may choose to make high risk investment as a consequence of high return expectations. When investment like these are persecuted, the creditors will bear higher risk of default without getting any share of the return. The cost related to the monitoring of behavior like this is called agency costs of debt (Jensen and Meckling 1976).

2.6. Previous empirical studies

The comprehensive and diverse alternatives of constructing a company's capital structure is crucial for any business organization in the pursuit of maximizing the shareholders' wealth. In this section we will present previous empirical research related to capital structure. A natural starting point is to look at previous studies that analyze which factors that affect the capital structure decisions companies make.

Titman and Wessels (1988) introduce a factor-analytic technique for estimating the impact of unobservable attributes on the choice of capital structure. They find that debt levels are related to the "uniqueness" of a company's line of business. Their results also indicate that transaction costs may be an important determinant of capital structure choice. Short-term debt ratios are shown to be negatively related to firm size, possibly reflecting the relatively high transaction costs small firms face when issuing long-term financial instruments. Since transaction costs are generally assumed to be small relative to other determinants of capital structure, their importance in this study suggests that the leverage-related costs and benefits may not be particularly significant. None of the other factors examined in this study, including non-debt tax shields, volatility, collateral value, and future growth, provides support for an effect on debt ratios. However, the authors point out the possibility that effects are not uncovered because the indicators of the attributes do not adequately reflect the nature of the attributes suggested by theory.

Ozkan (2001) extends the empirical research on capital structure by focusing on the dynamics of capital structure and the adjustment process towards the long run target. He suggests that firms have target leverage ratios and they adjust to the target ratio relatively fast. This adjustment process is driven by the balance between the cost of being away from the target ratio and the cost of adjusting towards the target ratio. He also finds that current liquidity and profitability of firms have a negative relationship with the borrowing decision and that there is a positive relationship between past profitability and debt ratio. Non-debt tax shields and growth opportunities are other firm-specific variables which appear to influence leverage decisions. In the study, there is only limited evidence that firm size exerts an impact on capital structure decisions.

Rajan and Zingales (1995) investigates the determinants of capital structure choice by analyzing the financing decisions of public firms in the major industrialized countries. They analyze the major institutional differences across the G-7 countries and their likely impact on financing decisions by looking at 8000 companies from 31 countries since 1987-1991 and pre-1987 data as robustness check. In their research, they try to uncover the impact on leverage from four independent variables; tangibility, market-to-book, size and profitability. They define tangibility as the ratio of fixed assets to total assets, where the rationale underlying this factor is that tangible assets are easy to collateralize and therefore they reduce the agency costs of debt. Therefore, they expected a positive relationship between the degree of asset tangibility and leverage, which their research result supported. Regarding the market-to-book measure, this is a measure of a company's growth opportunities. This ratio is defined by the market capitalization of a company divided by the book value of the shareholder equity. Their research finds a negative relationship between market-to-book and leverage, which they explain with market timing theory and the fact that companies will try to issue equity when the share price is perceived to be high. The rationale behind the variable of size is that this may be a proxy for the (inverse) probability of default. According to their study, it is a positive relationship between firm size and leverage which means that an increase in firm size results in an increase in leverage. The variable of profitability is defined as EBITDA in relation to book values of total assets. They find a significant negative relationship between profitability and leverage, which means that companies prefer internal financing before external financing.

Frank and Goyal (2009) examines the relative importance of 38 factors in the leverage decisions of publicly traded U.S. companies from 1950 to 2000. Financial firms and firms involved in major mergers are excluded, as well as firms with missing data. They measure leverage as long-term debt to assets (LDA), total debt to assets (TDA), total debt to market value of assets (TDM), and interest cover ratio. The 38 factors are split into value factors, growth factors, industry factors, the nature of assets, financial constraint factors, stock market factors, debt market condition factors, and macroeconomic variables. Linear regressions are used to study the effect of these factors on leverage, and seven factors are selected to be included by the minimum BIC criterion. These seven factors account for 31,8% of the variation in the data. They find that firms in a high leverage industry tend to have higher leverage. This is quite natural since firms in the same industry are likely to face many common forces. Leverage is also positively related to firm size measured as log of sales, which seems empirically to be a better measure of size compared to log of assets. Leverage is positively related to collateral – firms with more assets can provide the necessary security to take on more debt. Firm risk is measured by Altman's Z-score in this study, and is negatively related to leverage. Firms take actions to avoid bankruptcy costs and cost related to the risk of having to downsize or other disruptions in normal business, by reducing leverage. Frank and Goyal (2009) also find that dividend-paying firms have lower leverage. This might be a result of avoidance of transaction costs to underwriters involved in accessing the public financing markets. The market-to-book ratio is negatively related to leverage. More profitable firms should have a higher market value; thus, we might expect that high market-to-book firms would have lower leverage, in accordance with the findings in this study. Lastly, expected inflation is positively related to leverage. This may reflect features in the tax code, and efforts on part of managers to time the market.

Chang, Lee and Lee (2009) apply a multiple-indicators-multiple-causes model to cross-sectional and pooled samples for the period 1988 to 2003. They measure capital structure by ratios of long-term debt, short-term debt, and convertible debt to the market value of equity. Chosen from financial theories on capital structure, they examine eight attributes that may affect the capital structure choice; assets collateral value, non-debt tax shields, growth, uniqueness, industry classification, size, earnings volatility, and profitability. Their results show that growth is the most important determinant of capital structure choices, followed by profitability, collateral value, volatility, non-debt tax shields, and uniqueness. They find that long-term debt is the most important proxy of capital structure, followed by short-term debt, then convertible debt.

Another important and interesting question concerning capital structure is whether the financing decisions are driven by firm specific characteristics or the institutional environment they operate in.

In their study from 1983, Bradley et al. attempts to test for the existence of an optimal capital structure. In this study, the authors find that there exist strong industry influences across firm leverage ratios. The cross-sectional regressions on industry dummy variables explain 54% of variation in firm leverage ratios. The volatility of firm earnings is an important, inverse determinant of firm leverage which helps explain both inter- and intra-industry variations in firm leverage ratios. The intensity of R&D and advertising expenditures is also related inversely to leverage. They also find a strong direct relation between firm leverage and the relative amount of non-debt tax shields. The authors suggest that a possible explanation is that more securable assets lead to higher leverage ratios. The conclusion of the study is that there are strong intra-industry similarities in firm leverage ratios, as well as persistent inter-industry differences.

Psillaki and Daskalakis (2009) analyze the determinants of capital structure for small and medium sized enterprises (SMEs) in France, Greece, Italy and Portugal using panel data methods for the period 1998-2002. They compare the capital structure of SMEs across countries and consider if differences in country characteristics such as financial development and institutional features impact capital structure choices. The study shows that SMEs in these countries seem to determine their capital structure in similar ways. Psillaki and Daskalakis (2009) find that size is positively related to leverage, while the relationship between leverage and asset structure, profitability and risk is negative. Their main conclusion is that firm-specific rather than country factors explain differences in capital structure choices of SMEs in these countries.

Jong, Kabir and Nguyen (2008) examine the role of firm-specific determinants of corporate leverage decision around the world, with the main objective to verify the role of various country-specific factors in determining corporate capital structure. They analyze a large sample of 42 countries, divided equally between developed and developing countries over the period 1997-2001. Further on, they look at direct effects on leverage and the indirect effects through the influence on firm-specific determinants of corporate leverage. They find that the impact of several firm-specific factors such as tangibility, firm size, risk, growth and profitability on cross-country capital structure is significant and consistent with the prediction of conventional capital structure theories. Analyzing the direct impact of country-specific factors on leverage, the evidence suggests that creditor rights protection, bond market development and GDP growth have significant influence on corporate capital structure. Measuring the impact indirectly, they find evidence for the importance of legal enforcement, creditor/shareholder right protection and macro-economic measures such as capital formation and GDP growth rate. This implies that in countries with a better legal environment and more stable and healthy economic conditions, firms are not only likely to take on more debt, but the effects of firm-level determinants of leverage are also reinforced. They conclude that country-specific factors do matter in determining and affecting the leverage choice around the world, and it is useful to consider these factors in the analysis of a country's capital structure.

Mjøs (2007) examines the capital structure in both private and listed companies on Oslo Stock Exchange from 1992-2005. Based on book values, he tests the relationship between industrial characteristics and leverage in ten industries. He finds a significant negative relationship between dividend and leverage, which indicates that the companies' dividend policy is affected and customized by the governmental tax regime.

Frydenberg (2004) examines determinants of capital structure in Norwegian manufacturing companies from 1990-2000. In his study, the dependent variables are book values of total debt and he looks at long-term and short-term debt as individual variables. As independent variables, he looks at size, fixed assets, operational profit, uniqueness, non-debt tax shields, growth and industry characteristics. His research finds support for fixed assets as the variable with the most impact on leverage and he also found a significant negative relationship between non-debt tax shields and leverage. Companies achieving high growth increased the short-term debt without increasing the long-term debt. Relative to the total debt, he finds support for a positive relationship regarding size, fixed assets, uniqueness and growth. Regarding dividend policy, operating profit and tax shields, he finds a negative relationship on leverage. Relative to short-term debt, size, dividend policy, uniqueness tax shields and growth has a positive effect, while fixed assets, operating profit and tax shields had a negative impact. Relative to long-term debt, size, fixed assets, uniqueness, tax shields and growth has a positive effect, while dividend policy and operating profit had a negative impact.

Abor (2005) investigates the relationship between capital structure and profitability of 22 listed companies on the Ghana Stock Exchange (GSE) during a five-year period (1998-2002). Through regression analysis, he finds a positive relation between the ratio of short-term debt to total assets and return on equity (ROE), which suggests that short-term debt tends to be less expensive, and increasing the short-term debt will lead to increased profit levels. He finds a negative relation between the ratio of long-term debt to total assets and ROE. Abor explains this by the fact that long-term debt is relatively more expensive, and therefore employing a larger proportion of this could lead to lower profitability. The study finds a positive relationship between total debt and profitability, and Abor's main conclusion is that profitable companies depend more on debt as their main financing option.

Gill, Biger and Mathur (2011) provide an extension of Abor's study from 2005. They investigate the relationship between capital structure and profitability for 272 American service and manufacturing companies listed on the New York Stock Exchange from 2005 to 2007. In line with Abor (2005) they find a positive relationship between short-term debt and ROE. However, they also find a positive relationship between long-term debt and ROE, which is contrary to the findings in Abor (2005). This may be because of the economic downturn in the United States at the time, with associated low long-term interest rates. The finding indicates that increasing short- and long-term debt will lead to increased profit levels.

Both Abor (2005) and Gill, Biger and Mathur (2011) include firm size and sales growth as control variables, but neither variables show a significant effect on profitability in either of the studies.

Tailab (2014) analyzes the effect of capital structure on financial performance in American energy companies. He considers a sample of 30 energy companies for a period of nine years, from 2005 to 2013. ROE and ROA are used as proxies for financial performance, and short-term debt, long-term debt, total debt, debt to equity ratio, and company size are independent variables used to indicate capital structure. Multiple regressions indicate that 10% of ROE and 34% of ROA are predicted by the independent variables. Tailab hypothesizes either positive or negative effect of short-term debt, long-term debt, total debt, and debt to equity on financial performance. He further hypothesizes a positive effect of company size measured as total sales and total assets, on financial performance. The findings show that short-term debt has a significantly positive effect on ROE, while total debt has a significantly negative effect on both ROE and ROA. In addition, size measured as sales has a significantly negative effect on ROE. None of the other variables show a significant effect on the financial performance of the companies in this study.

Dilrukshi (2015) study the impact of capital structure on the risk premium of SMEs in UK. They use panel data econometrics to investigate the determinants of profitability on non-financial SMEs in the UK, and their main objective is to find the important factors in determining profitability. Their results show a significant negative relationship between capital structure and profitability. Especially, long-term debt to total assets ratio is negatively related with the profitability which is an indication that SMEs are averse to use more equity because of the fear of losing control. Dilrukshi analyzes all available observations from 1998-2008 using panel two stage least squares to examine the relationship between capital structure and profitability. Return on assets and return on capital employed where set as dependent variables for measuring firms' financial performance, and ratios for debt to equity, long-term debt to assets, short-term debt to assets, and short-term debt to total debt were set as independent variables and controlling for size sales growth and liquidity.

2.7. Defining capital structure

A company can organize their capital structure in several ways, as already mentioned, so a complete definition of leverage may be quite comprehensive. In our thesis, we will look at the total debt - both long-term and short-term debt - in relation to total assets. Some may argue that this ratio is too simple, but past empirical studies have provided consistent results.

Regarding whether to use book- or market leverage ratios, many different empirical definitions have been used. Myers (1977) claims that book leverage is preferred because financial markets tend to fluctuate extensively and that managers believe market leverage numbers are unreliable as a guide to corporate financial policy. Further on, Graham and Harvey (2001) find a large number of managers that indicate they do not rebalance their capital structure as a consequence of equity market movements because of the cost related to rebalancing continuously. Frank and Goyal (2009) claim market values are preferable when analyzing capital structure, but there is limitations and difficulties regarding valuation of debt because of volatility and the fact that not all debt is publicly traded.

People in favor of market values argue that book value of equity is primarily a plug number used to balance the left-hand side and the right-hand side of the balance sheet. Welch (2004) also emphasizes that the book measures are backward looking and that the markets generally are assumed to be forward looking. Hence, there is no reason that book values should be a relevant managerial number to focus on.

We are confident that book values will give us satisfactory results, even though there are many arguments for using market values. Also, limitations in available data makes it both safer and easier to use book values. The two measures' differences may not be that appreciable in the end, and for this purpose it is the firm's assets that is our focus, not the future growth (Myers, 1977). We also assume a long-term perspective in terms of capital structure decisions which may offset the short-term volatility. Another justification for using book values is that market values are included extensive risk and are no true estimates of future cash flows. We have therefore chosen to rely on book values, both in terms of debt and assets, in our thesis.

2.8. Definition of the variables

Two important questions are how many and which variables to include in order to get the best possible model and results. Excluding variables that should be included in the analysis may lead to an overestimation of the impact of the chosen variables on capital structure. It is also important to not include variables that are irrelevant. We base our decision on previous research and theory when choosing which variables to include. Previous research within the field of capital structure has often included growth, risk, firm size and tangibility as independent variables. We also choose to include the macro economic variables oil price and interest rate as a control variables, since we are looking at the energy industry which is highly dependent on oil, and capital structure which might be influenced by the interest rate. Following is a brief presentation of our selected variables, and how the variables are calculated is presented in appendix 2.

2.9. The dependent variable

Our dependent variable is defined as total debt over total assets. This ratio measure the companies' leverage to value and is defined as total debt over total assets, hence how their assets are financed. This means that the higher this ratio is, the higher is the company's leverage.

2.10. The independent variables

When corporations decide on the use of debt financing, they are reallocating some expected future cash flows away from equity claimants in exchange for cash up front (Frank and Goyal, 2009). Now we will go into a brief introduction of some of the factors that drive this decision and may affect the firm's choices regarding capital structure. These are factors we include in our model to ensure the accuracy of the result and to reflect the reality as much as possible.

2.10.1. Size

We are testing the impact of firm size on capital structure by using the natural logarithm of the book value of total assets. In high capital intensive companies like our sample, this measure will be more accurate than e.g. log of sales, which Mjøs (2007) explains in his study. This measure is also more applicable to our dataset because it will reduce the magnitude of the differences in company size represented in our dataset.

Mjøs (2007) argue that larger companies have better access to capital markets, so leverage will increase with company size. The trade-off theory also supports this view because of a larger value base of collateral with following better borrowing conditions due to reduced risk of default, and the fact that bigger firms often are listed on an exchange which means that their stock is liquid, unlike privately held companies.

Larger companies also tend to be more diversified than smaller companies. Therefore, larger companies have lower risk due to reduced risk of bankruptcy. Bigger firms also have lower degree of asymmetric information, which again reduces the risk and may improve the conditions.

We therefore expect the relationship between size and leverage to be positive, according to the arguments mentioned above. This means that companies with a high portion of assets will have more debt, which is in line with both Rajan and Zingales (1995) and Daskalakis and Psillaki (2008).

2.10.2. Risk

As a measure of risk, we use the Altman's Z-score in our study. This is a measure of risk developed by Edward Altman (1968), a statistical tool which purpose is to reveal the likelihood that a company will default. As an addition to traditional ratio-analysis techniques, the Z-score uses a statistical technique called multivariate analysis which allows us to consider how the traditional ratios affect each other's usefulness in the model. The Z-score was developed after evaluating 66 companies in which half of them had filed for bankruptcy between 1946 and 1965. To start with, Altman considered 22 ratios classified into 5 categories which finally resulted in 5 ratios; liquidity, profitability, leverage, solvency and activity, and the formula is defined below.

X1 = Working Capital / Total Assets
X2 = Retained Earnings / Total Assets
X3 = Operating Earnings / Total Assets
X4 = Market Capitalization / Total Liabilities
X5 = Sales / Total Assets

$$Z\text{-}Score = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5$$

This formula considers a a measure of net liquid assets of the company relative to capitalization (X1), a measure of cumulative profitability over time implicitly considering the age of a company (X2), a measure of the true productivity of a company's assets (X3), a measure of how the much a company's assets can decline in value (X4) and at lastly a measure of management's capability in dealing with competitive conditions (X5).

In general, the lower the Z-score, the greater the chance of bankruptcy. The levels can be divided into the following zones of discrimination.

$Z > 2.99$	- non-bankrupt
$1.81 < Z < 2.99$	- zone of ignorance
$Z < 1.81$	- bankrupt

Though this measure is one of many credit scoring models, it has developed into a reliable predictor of bankruptcy which combines quantifiable financial indicators with a small number of variables in an attempt to predict whether a company will fail. It is also worth to mention that when considering the measure solely, the changes in a company's Z-score are as important as the Z-score itself.

Including this ratio as a measure of risk is in line with Frank and Goyal (2009) who presents a negative relationship between risk and leverage. They explain this finding with firms' actions to avoid bankruptcy costs and costs related to the risk of having to downsize or other disruptions in normal business, by reducing leverage (Altman 1968).

As a higher Z-score means lower risk, we expect, in line with Frank and Goyal (2009), a negative relationship between risk and debt ratio: higher risk means lower debt ratio.

2.10.3. Growth

The growth variable in our analysis models the effect of the under-investment hypothesis introduced by Myers (1977). The variable is calculated by the revenue in year t divided by the revenue in year t-1 and is in line with Frydenberg (2004). A growth option partly financed by debt will require a higher return than an equity financed growth option which is a sunk cost the management do not have to consider when deciding whether to exercise or not.

In the already mentioned study by Myers (1977), he points out that companies should make strategic decisions according to their future growth opportunities and investment prospects. To be able to exploit their future opportunities, a company with significant prospects should rely more on equity financing.

Rajan and Zingales (1995) incorporate market timing theory when explaining the relationship between capital structure and growth opportunities. According to market timing theory, companies will issue equity when they value their share price as less than the market's perception and vice versa.

Considering this, firms with significant growth opportunities have less debt than the average firm in the industry and the coefficient should be negative, in line with both Myers (1977) and Rajan and Zingales (1995). It is important to mention that their research use another definition of the variable, but we still think that it is reasonable to believe that the rationale behind the variable can be considered to be the same.

2.10.4. Tangibility

Tangible assets are calculated as fixed assets over total assets, so this will give us insight regarding the companies' asset structure and the degree of asset tangibility. Intangible assets on the other hand are assets that cannot be seen, touched or "easily" converted into cash. Tangible assets, such as property, plant and equipment are also easier for outside investors to value than intangible assets, such as goodwill, human capital etc. (Frank and Goyal 2009), and can therefore more easily be converted into cash.

The companies included in our study is part of a capital intensive industry where their fixed assets often generate the companies' positive cash flow. When companies decide to raise new debt, their tangible assets are often used as collateral. Companies with a high level of tangible assets have more collateral for the creditor to claim in case of financial distress than companies with a lower level of tangible assets. According to Myers (1984), tangible assets are more liquid than intangible assets, so this aspect may be an important factor for the creditors before lending out capital.

According to the trade-off theory, it is reasonable to assume that a company with a high share of fixed assets relative to total assets is facing less costs of financial distress. Hence, this will lower the level of asymmetrical information and facilitate a higher leverage capacity (Drobetz et al., 2013).

The pecking order theory is arguing that companies with a high level of tangible assets have lower degree of asymmetrical information, which in turn make the process of raising new capital less expensive. Hence, companies with a high degree of tangible assets will have less debt in their capital structure.

Daskalakis and Psillaki (2008) found a negative relationship between asset tangibility and leverage in their study. They explain their findings with the argument that profitable companies with a high level of tangible assets have found a stable source of income so they do not have the need for external financing.

Even though the findings by Daskalakis and Psillaki (1998) find a negative relationship between asset tangibility and leverage, we find it reasonable to expect a positive relationship between asset tangibility and leverage which is in line with the findings by Rajan and Zingales (1995) as well as the trade-off theory.

2.10.5. Profitability

The variable for profitability in our model is calculated as earnings before taxes, depreciation and appreciation over total assets, which represent the return their assets generate. Companies who manage to stay profitable and generate large positive cash flow have the possibility to take advantage of tax shields relative to income. This state of business also give a profitable company the advantage of lower cost of financial distress. According to the trade-off theory, we can therefore expect a positive relationship between profitability and leverage (Frank and Goyal, 2009).

Jensen (1986) argue that profitable companies keep their levels of debt relatively high to reduce free cash flow problems and prevent managers to overinvest and increase executive perks.

According to the pecking order theory, companies favors internal financing instead of external financing. A profitable company will therefore retain a big share of their profits assuming constant investment and dividend policy, which leads to lower levels of leverage in profitable companies according to no need for external financing. Frank and Goyal (2009) have found support for this in their study.

The theory and previous studies are inconsistent on whether high profitability increases debt ratio or not, but for our industry we expect a positive relationship between profitability and debt ratio, which is in line with the trade-off theory and Jensen (1986).

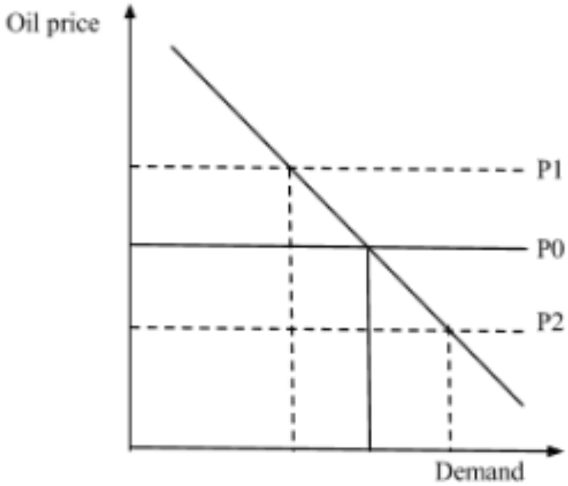
2.11. The control variables

2.11.1. The effect of the oil price

The companies in our study are contributors to the production or supply of oil and gas, and is thus naturally affected by the oil price. From the summer 2014 and onwards the oil price fell from a top of USD 115 to a bottom well below USD 50 in early 2015. There may be several reasons for oil price changes, and the oil price is usually highly volatile. We will not go into the details as to why the oil prices change, but rather focus on the effects of the changes to the energy industry.

An increase in the oil price leads to a decrease in the demand for oil, and a decreased oil price leads to an increase in demand.

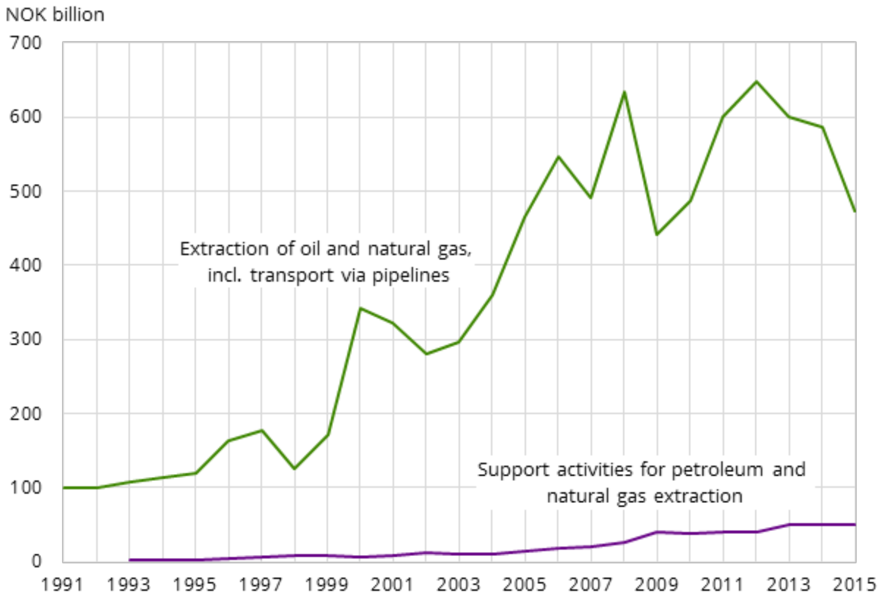
Figure 2.3 The relationship between oil price and demand in the energy industry.



A decrease in demand for oil will naturally lead to a decrease in the demand for the services of the companies in the energy industry. Examples of this are many, the latest big change was in 2014 to 2015.

The decrease in the price of oil and gas in 2014 to 2015 resulted in a decrease in the production value from the oil and gas extraction and related services of 16%. The price drop had the most impact on the extraction industry, by as much as 19%. At the same time, the investment dropped by 10%. Both were related to and caused by the oil and gas price drop. In addition, there was a decrease in the employment rate in the energy industry by 9% from 2014 to 2015, and a reduction in wage costs by 7% (Statistisk Sentralbyrå 2016). We include this variable to get an understanding of whether changes in the oil price affects the capital structure decisions of companies or not.

Figure 2.4 Value added in the extraction of oil and natural gas sector (green line), and the support activites for petroleum and natural gas extraction (purple line).



(Statistisk Sentralbyrå 2016, figure 2)

The oil price will no doubt affect the performance of the companies in the energy industry, so we will include this variable as a control variable.

When the oil price drops, it is natural to assume that the profitability of the companies in the energy industry also decrease. In line with the Pecking order theory we therefore assume that debt ratio will increase when oil prices decrease.

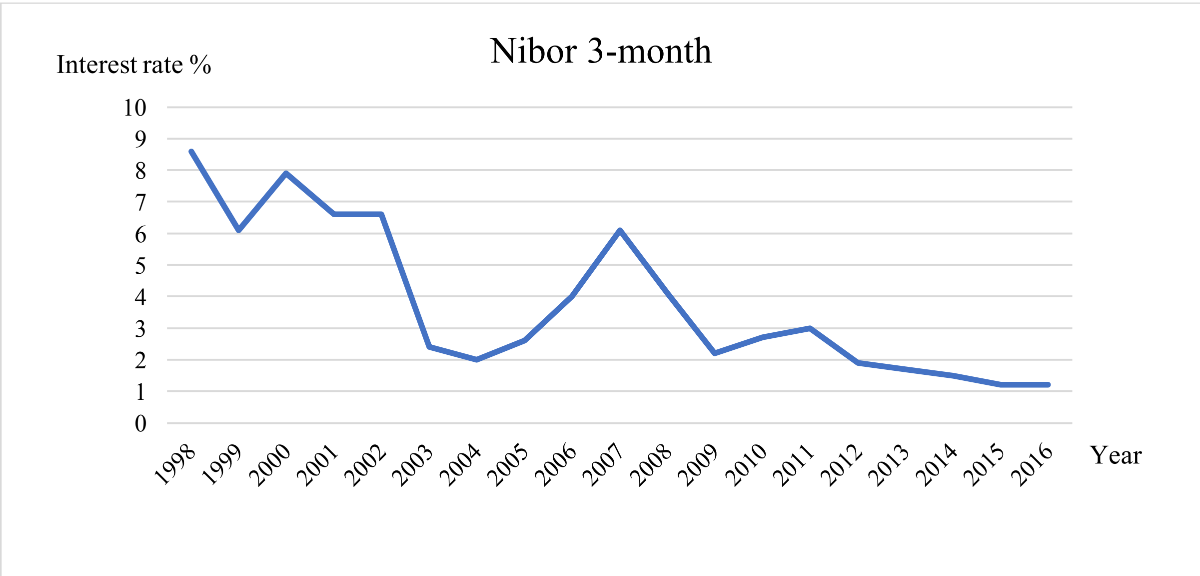
2.12. The effect of the interest rate

We include interest rate, measured as the year-average of the three-month Nibor, in our study. Interest rates are an everyday part of business. Companies pay interest on money they borrow, and when they have extra cash, they receive interest if they place that cash in a safe investment. Companies also charge interest when their customers buy goods and services on credit. A rise or fall in interest rates affects these business activities as well as the buying habits of the company's customers. We assume the interest rate to be an effect when firms decide how much debt to take on, and therefore include this variable in our study.

The Norwegian Interbank Offered Rate (Nibor) is a collective term for Norwegian money market rates at different maturities. Nibor is intended to reflect the interest rate level a bank requires for unsecured money market lending to another bank. The rate is calculated as a simple average of the interest rates the Nibor banks has delivered, and published by Oslo Børs with maturities of one week, one month, two months, three months and six months. According to Norske Finansielle Referanser (NoRe), the Nibor is the most used reference rate in Norway. It is common to use the Nibor three-month average as reference rate in the professional market, as well as in the private market (Oslo Børs 2018), and this is the rate we use as proxy for our control variable Interest rate.

In accordance with the market timing theory, we expect a positive relationship between interest rate and debt ratio. Companies adjust to the market conditions and which alternative that suits them best. This means that they issue equity when the perceive their company is overvalued, and issue debt in the opposite situation.

Figure 2.5 The development in the Nibor 3-month year-average interest rate from 1998-2016.



Source: Statistisk Sentralbyrå. Statistikkbanken. Nibor 3-month historical. Access date: 04.26.2018.

3. Data

3.1. Data collection

The study is based on secondary data gathered from Thomson Reuters Eikon (Eikon). Eikon is a set of software products provided by Thomson Reuters to enable monitoring and analysis of financial information. It provides access to real time market data, news, fundamental data, analytics and trading. We consider Eikon as a reliable source as it is used actively over the whole world by banks, financial institutions and analytics. In addition to this, the database has received several awards over the years, including second rank in "Finance Data Services" in the period 2009 to 2016 (Thompson Reuters 2016). We have gathered key metrix', income statements and balance sheets from the last 19 years (from 1998 to 2016) for the companies in our analysis.

We have gathered financial data for energy companies listed on the OSE. OSE10GI (the Energy index) is the biggest sector noted on the OSE, and gives us a representable selection. We want to look at the capital structure within one industry, thus the energy industry is the clear choice. We choose to investigate public companies in this study, as it is easier to access data about this type of companies. Because of the range and time limit of the thesis we choose public companies as Eikon makes it possible to gather data simultaneously for many companies over several years. We choose to look at a period from 1998 to 2016 to include changes in capital structure over some time. The year 2017 is excluded, as not all companies had completed their annual report when we gathered the data in March 2018.

3.2. Different types of data sets

A central choice for how investigations are conducted is the time dimension. An often-used division of data is cross-sectional data, time series data and panel data. Cross-sectional data consists of observations of different individuals in the same, limited time period, often at a given point in time. Time series data consists of multiple observations of the same individuals over time, while panel data is a combination of the two and contains of observations of multiple individuals over multiple time periods. The different types of data have their advantages and disadvantages when it comes to opportunities, limitations and complexity regarding regression analyses and results. The choice of data is therefore a central choice to complete the investigations in an appropriate manner (Johansen, Kristoffersen, and Tufte, 2004). Panel data is particularly well suited for investigating dynamic change. The combination of multiple individuals over several time periods leads to a high number of observations which provides more information, variability, less collinearity between the variables, and more degrees of freedom, which strengthens the investigation (Wooldridge, 2014).

In this study we are examining how different firm-specific and macro-economic variables influence the capital structure of several companies over time. For this purpose, panel data is well suited and therefore chosen for further analysis.

3.3. Advantages and disadvantages of panel data

By following the same individuals over time we can, by using panel data, control the individuals for heterogeneity. Another advantage of panel data is that it is often a better foundation for detecting causality when otherwise difficult to do so. Combining the cross-sectional and time dimension often gives a considerable data set and reduces the problems related to a modest selection which complicates the detection of causality (Wooldridge, 2014).

Disadvantages of panel data is mainly related to gathering good quality information, as well as resource intensive maintenance. Quality is reduced when the gathered data has measurement errors, misleading or missing observations (Gujarati, 2003).

3.4. Our data

Not all companies have been noted on the Oslo Stock Exchange for 19 years, so our data is an unbalanced dataset. Panel data is often incomplete (Verbeek, 2008). This means that complete information about all individuals in a period of time does not exist, and that there are some missing observations in the data. A data set without complete information about all individuals in all time periods is called unbalanced. Whether missing observations is a problem or not depends on the reason why the observations are missing, and if this reason is random or not. If the reason for the missing observations is uncorrelated with the stochastic error term, and thereby is random, an unbalanced data set does not cause any problems (Wooldridge, 2014). If some individuals are missing some observations for an endogenous reason, on the other hand, using an unbalanced data set may lead to biased estimators and misleading statistical tests (Verbeek, 2008). In our data set the missing observations are missing because not all companies have been listed for an equal number of years, and there is no endogenous reason why they are not in the data set. We therefore assume that there is no problem using our data in the analyses.

We exclude companies that have been listed for less than four years, and companies with extreme observations, such as negative assets, etc. Observations that in a high degree differ from the rest of the data are called outliers and may have a big influence on the OLS estimates.

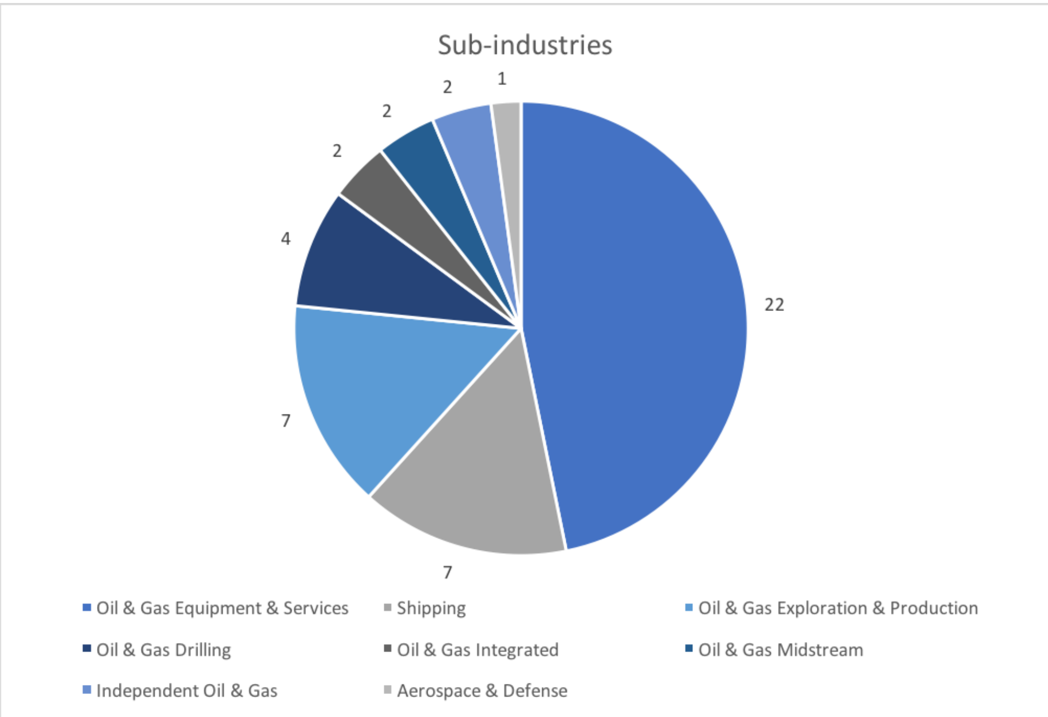
These outliers may be caused by incorrect entry and can easily be corrected - but are not always easy to detect. Another reason for outliers may be unusual behavior by the company. One should be careful removing too many of the outliers because of the risk of losing crucial information by decreasing the variation in the independent variables.

The criteria of the company being listed for at least four years caused us to exclude only one company from the data set. This leaves us with a basis of 48 companies and 621 observations. We also exclude some observation years because of outliers. This process is described in chapter 3.7.

3.5. The energy industry

We have chosen to look at one particular industry; the Energy Industry. Our selection consists of energy companies listed on the Oslo Stock Exchange (OSE). OSE10GI, the GICS Energy Sector, comprises companies whose businesses are denominated by either of the following activities: The construction or provision of oil rigs, drilling equipment and other energy related service and equipment, including seismic data collection. Companies engaged in the exploration, production, marketing, refining and/or transportation of oil and gas products, coal and other consumable fuels (Oslo Børs 2018).

Figure 3.1 The division of the OSE10GI Energy Index into sub-industries.



The 48 OSE-listed energy companies are split into eight different sub-industries, as shown in figure 4.1 above. *Oil & Gas Equipment & Services* is the largest sub-industry with 22 companies, followed by *Shipping and Oil & Gas Exploration & Production* with 7 companies in each sub-industry, then *Oil & Gas Drilling* with 4 companies, *Oil & Gas Integrated*, *Oil & Gas Midstream,* and *Independent Oil & Gas* with two companies in each sub-industry, and with one company: *Aerospace & Defense*.

The *Oil & Gas Equipment & Services* sub-industry consists of companies engaged in oil and gas related services on a contract basis, such as cleaning, testing, erecting, repairing and dismantling oil and gas field rigs and derricks, as well as pipeline related services. Other services include exploration related operations, such as geological surveying and mapping. Companies engaged in the manufacturing of oil and gas well, pipeline, pumping, drilling and other related equipment are also included in the industry (New York Times 2018).

The *Shipping* sub-industry consists of companies that transport the services and equipment related to the oil and gas companies.

The companies in the *Oil & Gas Exploration & Production* sub-industry are involved in exploration and production focus on finding, augmenting, producing and merchandising different types of oil and gas. Drilling and exploration is known as the upstream segment of the oil and gas industry. The resource owners and operators work with a variety of contractors, such as engineer's procurement and construction contractors, as well as with joint-venture partners and oilfield service companies (Investiopedia 2018).

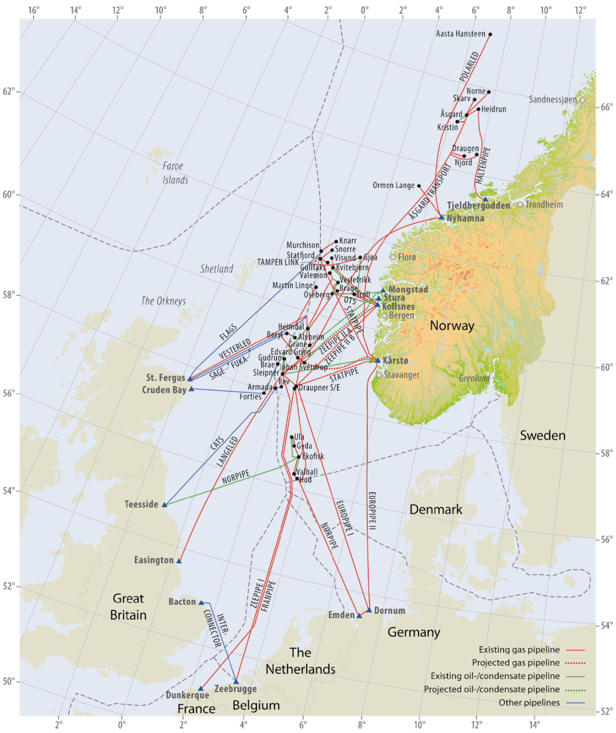
The *Oil & Gas Drilling* sub-industry consists of companies engaged in oil and gas drilling services on a contract basis. Services include directional drilling, well drilling and reconditioning of oil and gas field wells. The Oil & Gas Drilling industry excludes oil and gas drilling on a non-contract base, classified as Oil & Gas Exploration & Production; and manufacturing of drilling equipment, classified as Oil & Gas Equipment & Services (New York Times 2018).

The basic definition of an *Independent Oil & Gas* Company is a non-integrated company which receives nearly all its revenues from production at the wellhead. They are exclusively in the exploration and production segment of the Energy industry, with no downstream marketing or refining within their operation (Epus Global Energy 2018).

The Oil & Gas Integrated sub-industry consists of companies engaged in exploration, production, refinement and distribution of oil and gas. Companies classified in this sub-industry usually have global operations and significant activities in both exploration and production, and refining and marketing operations. Companies in this sub-industry are also frequently engaged in energy related equipment and services operations (New York Times 2018).

Oil and gas produced from a field need to be transported to customers. On many oil fields, oil is loaded directly on to tankers, but in other cases oil and gas are transported by pipeline to onshore facilities. This is what the companies in the sub-industry *Oil & Gas Midstream* do. Below is a visual representation of the vast pipelines on the Norwegian continental shelf.

Figure 3.2 Overview of the Gas Pipelines in the Nordic Sea.



(Norwegian Petroleum 2018)

The companies classified *Aerospace & Defense* includes companies that make aircraft and related parts and accessories, along with other parts used in national defense. The segment includes nuclear and biological defense, weapons and navigation systems, missiles, military telecommunications equipment and advanced electronic devices (U.S. World & News Report L.P. 2018).

3.6. Descriptive statistics

In the table below we present the descriptive statistic for our selection before excluding outliers, to give an overview of their size and systematics, and direct attention to the variables where there might be extreme observations. The table shows minimum and maximum values of the variables, as well as mean and the standard deviation.

Table 3.1 Descriptive statistics of the variables in our study. Minimum value, maximum value, mean, and standard deviation.

Variable	Min.	Max.	Mean	St. dev.
Debt ratio	0.000	1.207	0.376	0.247
Profitability	-1.811	1.063	0.090	0.181
Tangibility	-1.547	1.595	0.327	0.288
Firm size	3.970	18.800	13.450	1.805
Growth	0.000	1332.688	4.551	57.620
Risk	-11.567	2455.917	7.713	108.506
Oil price	10.530	111.110	67.660	30.718
Interest rate	0.012	0.086	0.030	0.019

3.6.1. Debt ratio

The industry has over time had a mean debt ratio of 0.376. The standard deviation is 0.247, and the distance between the minimum and maximum value implies that the debt ratio varies a lot within the energy industry over time. The maximum value is 1.207 which means that one or more companies at some point in time has had more debt than assets.

3.6.2. Profitability

The mean profitability in the companies in this study is 0.090 with a standard deviation of 0.181. The minimum and maximum values are -1.811 and 1.063, which means that the profitability of the companies varies moderately over time.

3.6.3. Firm size

The mean value of firm size is 13.45. This is a result of the natural logarithm of total assets, which means that in dollar terms, the average firm size measured in assets is USD 693 842. The variation in this variable is moderate, with a minimum value of 3.970 and a maximum value of 18.80, and a standard deviation of 1.805.

3.6.4. Growth

The growth in the companies has on average been 4.551, while the minimum growth is 0.0 and maximum is 1332.688. The standard deviation of the growth variable is very high, at 57.62. With the extreme spread between minimum and maximum value, as well as a high standard deviation, we here suspect the presence of outliers which needs to be adjusted for.

3.6.5. Risk

Risk has a large spread with a minimum value of -11.567 and a maximum value of 2455.917. The standard deviation is 108.506, while the mean is 7.713. This indicates outliers in the data set, that needs to be adjusted for.

3.6.6. Oil price

The oil price is, as expected, highly volatile. The lowest oil price in the years we are investigating is USD 10.53, while the highest is USD 111.11. The mean oil price is USD 67.66, and the standard deviation is 30.718. This means that the oil price has varied a lot over the last 19 years, but this is as mentioned expected.

3.6.7. Interest rate

The lowest year-average interest rate in our period is 1.2%, while the highest is 8.6%. The mean interest rate over the years is 3.0%. This means that the interest rate varies over time, but with a standard deviation of 0.019, is mainly centered around the mean.

3.7. Adjusting for outliers

The assumptions of OLS mentioned earlier must hold, and the presence of outliers in the data may lead to a breach in the assumptions. This will make the model sensitive to such observations. Outliers are defined as significantly high or low values which deviates from the rest of the observations. By removing these from the data, it is possible to achieve data that is more normally distributed. There is no objective way to remove outliers (Wooldridge, 2014). In other words, there should be a good explanation as to why the observations are removed.

They are actual observation which should be included in the model if the explanation is not accounting errors, mistyping of data or are values that is not in line with reality.

In this study, we use scatter plots for each variable to identify outliers, in addition to the descriptive statistics. In our data, the variables growth and risk show signs of outliers in the descriptive statistics, and we choose to look at the scatter plots for these variables to conclude on which observations to exclude from the data. The scatter plots before and after the adjustment can be found in appendix 3. In the growth variable, we choose to exclude values higher than 10, and for the risk variable we exclude values higher or lower than 20 and -20, respectively. There is still a satisfactory spread in the data, but within a smaller interval.

3.8. Descriptive statistics after adjustment

We have been careful adjusting the data for outliers, since our data set is relatively small. The descriptive statistics after adjusting for outliers is presented in table 3.2 below.

Table 3.2 Descriptive statistics after adjusting for outliers.

Variable	Min.	Max.	Mean	St. dev.
Debt ratio	0.000	1.207	0.380	0.246
Profitability	-1.811	1.063	0.091	0,182
Tangibility	-1.547	1.595	0.320	0.281
Firm size	3.970	18.800	13.480	1.793
Growth	0.000	8.830	0.998	0.838
Risk	-11.567	18.528	1.326	2.257
Oil price	10.530	111.110	67.550	30.719
Interest rate	0.012	0.086	0.030	0.019

As we can see from table 3.2, the mean value and standard deviation of debt ratio, profitability, tangibility, firm size, oil price and interest rate has shifted minimally after the adjustment. However, removing the outliers from risk and growth has dramatically changed the minimum and maximum value of the variables, as well as mean and standard deviation. There is a much smaller spread and significantly lower standard deviation. The exclusion of outliers leaves us with 48 companies and 595 observations.

3.9. Correlation in the independent variables

Correlation analysis is an analysis which is applied to show the degree of covariation between variables. The degree of covariation is quantified in a correlation coefficient that varies between -1 and +1. The number expresses how strong the covariation is, and the sign (-/+) indicates is the variables are negatively or positively correlated, respectively. A correlation of -1 indicates perfect negative covariation, +1 indicates perfect positive covariation, while a coefficient of 0 means no covariation (Løvås 2013). If there is a high correlation between the independent variables, there is a risk of inaccurate estimates which leads to misinterpretation of the coefficient. The table below shows a general interpretation of the correlation coefficients.

Figure 3.3 Interpretation of correlation coefficients.

Size of coefficient	*Indication of correlation*
Between 0.9 and 1.0	*Very high*
Between 0.7 and 0.9	*High*
Between 0.5 and 0.7	*Moderate*
Between 0.3 and 0.5	*Low*
Less than 0.3	*Insignificant*

3.10. Correlation in our data

Table 3.3 Correlation matrix. The degree of correlation between the independent/control variables.

	Profitability	Tangibility	Firm size	Growth	Risk	Oilprice	Interest rate
Profitability	1.000						
Tangibility	-0.016	1.000					
Firm size	0.386	-0.076	1.000				
Growth	0.164	-0.012	0.179	1.000			
Risk	0.310	0.522	0.114	-0.052	1.000		
Oil price	0.052	-0.012	0.159	0.082	0.023	1.000	
Interest rate	-0.008	0.008	-0.062	0.026	-0.032	-0.336	1.000

The correlation matrix shows no perfect correlation between any of the variables. Three of the correlations coefficients have higher values than 0.3. These are between firm size and profitability, which shows a positive correlation between firm size and profitability, between oil price and interest rate, which shows a negative relationship between interest rate and the oil price, and between profitability and risk, which shows a positive relationship between profitability and risk. The correlation coefficient between risk and tangibility is higher than 0.5, which is moderate correlation. None of the values in the matrix have unacceptably high values, so the OLS assumption is not breached.

4. Methodological foundation

The intention of this chapter is to explain the design and method used to answer our research question. The theoretical approaches to the different methods used in our analyses are presented in the following sections.

4.1. Regression analysis

"Econometrics is based upon the development of statistical methods for estimating economic relationships, testing economic theories, and evaluating and implementing govern and business policy" (Wooldridge 2014, 1).

Regression analyses is an appropriate method to uncover causality, and therefore we will conduct regression analysis to investigate how different factors affect the capital structure in energy companies. An analysis of the relationship between two variables, x and y, is called simple regression. Here is y, as the dependent variable, tried explained by the explanatory variable x. Contrary to simple regression, multiple regression has several explanatory variables. In this case, y is explained by several independent variables. The dependent variable is often better explained as the number of explanatory variables increase - assuming that the variables are relevant. The methods estimate coefficients for each explanatory variable under the assumption that the squares of the error terms are minimized (Wooldridge 2014). Based on the intent of this study, ordinary least squares (OLS) method is suited.

4.2. Assumptions of OLS

For OLS to give valid results, certain assumptions must be fulfilled. The most common problems related to OLS are linearity, normality, multicollinearity, homoskedasticity, and serial correlation. At the same time outliers and the number of independent variables may cause problems. Following is a presentation of the assumptions.

4.2.1. Linearity

One assumption is that the dependent variable is a linear function of the independent variables. If the criteria of linearity is not fulfilled, the model will still try to estimate a linear relationship. This may result in biased results, since the coefficients of the independent variables will be misleading. By transforming the form of the different variables, one can improve or remove the problem (Keller 2008). The transformation may be done on both dependent and independent variables and is executed by changing the form of the variable, e.g. by changing in to logarithmic form.

4.2.2. Normality

Normality implies that the error terms must be normally distributed with a mean $\mu = 0$ and variances σ^2 ($\varepsilon \sim N(0, s^2)$). This does not apply, however, to the other independent variables. If the error terms are not normally distributed there will be problems when deciding significance level. Normality is not necessary to achieve unbiased estimates, and even a large normality issue may give reliable results (Torres-Reyna 2007).

When testing for normality, we use a quantile-quantile (Q-Q) plot. This is a graphical tool to help assess if a set of data plausibly comes from a normal distribution. A Q-Q plot is a scatterplot created by plotting two sets of quantiles (percentiles) against one another. If normally distributed, we should see the points forming a line that is roughly straight (Ford 2015). It is also possible to perform a Shapiro-Wilk test to numerically test for normality (Shapiro and Wilk 1965).

4.2.3. Homoskedasticity

A third assumption for a valid multiple regression is whether the error term, e, has constant variance, regardless of the value of the independent variables, x_i. In the case of heteroskedasticity some data points are more likely to be affected by noise than others. This will make the data points affected by noise less reliable. If the error terms show signs of varying variance, OLS will not be a good estimator, and no conclusions should be based on the model (Wooldridge 2014). To test for heteroscedasticity a Breusch-Pagan test may be executed.

4.2.4. Multicollinearity

Multicollinearity are situations where two or more independent variables are correlated. These situations are problematic when there is approximately perfect correlation, i.e. correlation coefficients of close to -1 or 1. Weak correlation between independent variables is accepted. When assumed independent variables correlate, it is difficult to understand the relation between the independent variables and the dependent variable (Keller 2008). At the same time, high correlation will create noise, which then will lead to unreliable results. Multicollinearity may be tested by looking at the correlation matrix for the variables in question, or by executing a

VIF test (Torres-Reyna 2007). A VIF test captures multivariate relations and is applied to supply the analysis. A general rule of thumb is that VIF values lower than 10 indicates absence of multicollinearity (Wooldridge 2014).

4.2.5. Serial correlation

Serial correlation occurs when the error term, e, correlates over time, and is often the case when working with time series data (Stock and Watson 2012). If there is serial correlation it may lead to biased standard errors. To fulfill this assumption the correlation between the residuals in two different time periods must be zero (Wooldridge 2014).

A Breusch-Pagan/Wooldridge test may be applied to test for serial correlation in a panel data set (Wooldridge 2014). If the data set contains serial correlation one can use robust standard errors to remove the problem. It is also possible to add excluded variables and/or change the specification of the variables to reduce the effect of serial correlation.

4.2.6. Outliers

Outliers are observations that severely deviates from the other values in the data. A weakness of OLS is that the method is very sensitive to such observations, since outliers may distort the regression coefficient estimate (Wooldridge 2014). The regression may therefore give unreliable results and a misleading representation of the actual situation. By using OLS the sum of the squared error terms is minimized, so that outliers have a disproportionately strong effect on the estimated coefficients. Thus, significant outliers should be excluded.

4.2.7. Number of independent variables

Excluding variables that should be included in the analysis may lead to an overestimation of the impact of the chosen variables on capital structure. It is also important to not include variables that are irrelevant. To check for omitted variable bias a Ramsey's Reset test may be conducted (Wooldridge 2014). This test is, however, also a test for other misspecifications, as e.g. heteroskedasticity.

Regarding outliers, we have explained our approach to removing extreme observations in chapter 3.7.

4.3. Methods for panel data

We cannot blindly trust the results estimated by our methods. For example, they might not be significant if they have a high t-value. For our estimates to be reliable, the methods we apply should be compatible with our data. To find the preferred method we will look at what assumptions our data fulfills. This section discusses what methods and under which assumptions they give consistent and objective estimates. The three relevant methods are: Pooled ordinary least squares (pooled OLS), fixed effects (FE) and random effects (RE).

4.3.1. Pooled ordinary least squares

The Pooled OLS method combines all the observations and estimates one common regression model without considering that the data consist of both cross-sectional and time series data. By combining all the observations in this manner, we get a common coefficient for all the variables. Thus, the model assumes that there are no differences between the individuals - company number one is equal to company number two. This assumption is difficult to maintain, as there are differences between the companies. Pooled OLS ignores the heterogeneity of the companies, which may lead to correlation between the error term and the independent variables in the model. This correlation is called heteroscedasticity.

$$Y_{it} = \beta_0 + \sum_{k=1}^{m} \beta_k x_{kit} + \mu_{it}$$

Formula 4.1

The regression model of pooled OLS is shown in the formula 4.1. i is the companies, t is time period, m is the number of independent variables, β_0 is the intercept, k is the notation of the dependent variable, x is the coefficients of the independent variables, and μ is the error term. These notations will be used throughout this chapter.

Assuming the coefficients are constant across the companies and that there is no correlation between the error term and the variables, the pooled estimators are consistent. But, even if there is no correlation between the error term and the variables, the error term will most likely be correlated over time for a given company. Due to this fact, panel adjusted standard errors should be used for testing hypotheses (Gujarati and Porter 2009).

One of the advantages of Pooled OLS is that the method captures the effect of the cross-specific variables that do not vary over time. On the other hand, the individual unobserved error terms are often present and correlated with the independent variables. This will lead to inconsistent estimates. The method is often seen as the most restrictive of the panel data methods (Katchova 2013).

4.3.2. The unobserved effect

The heterogeneity ignored by pooled OLS is often called unobserved effect, heterogeneity effect or fixed effects in panel data. Unobserved effects can e.g. be differences in management which makes one company perform better than another. These effects are usually not directly observable and can therefore not be measured in a common regression model such as the pooled OLS. To be able to measure this indirectly, we have to add an element to the regression model. Formula 4.2 below describes the regression model which includes the unobserved effect α_i.

$$Y_{it} = \beta_0 + \sum_{k=1}^{m} \beta_k x_{kit} + \alpha_i + \mu_{it}$$

Formula 4.2

The unobserved effect reflects the effect of company-specific variables on the dependent variable Y. This effect will in reality be several different factors leading one company to be different from another. Since α_i cannot be observed directly it is considered as a part of the error term μ_{it} and thus we can write the expression for the error term as $v_{it} = \alpha_i + \mu_{it}$. The regression model is then expressed in formula 4.3.

$$Y_{it} = \beta_0 + \sum_{k=1}^{m} \beta_k x_{kit} + v_{it}$$

Formula 4.3

The unobserved effect is now included in the expression for the error term and the assumption of no correlation between the error term and the variables is no longer present. In this case, you can use the fixed effects model (Dougherty 2011).

4.3.3. The fixed-effects within-groups model

There exist three different fixed effects models one may use in panel data studies: within-groups fixed effects, first-differences fixed effects and least squares dummy variable (LSDV) fixed effects. The first two models are manipulated so that the unobserved effect is eliminated. To be able to eliminate the unobserved effect in the within-group model we first have to calculate the mean of all the observations and get the following expression:

$$\bar{Y}_i = \beta_0 + \sum_{k=1}^{m} \beta_k \bar{x}_{ki} + \alpha_i + \bar{\mu}_i$$

Formula 4.4

The data is manipulated to appear as cross-sectional data by calculating the mean of all the observations over time within each company. This removes the time series element in panel data and provides the companies with a mean value. Since α_i constant over time, this term equals the mean value. The fixed effects within-groups model is then subtracted from the unobserved effects model, and we get the following expression for the regression model:

$$Y_{it} - \bar{Y}_i = \sum_{k=1}^{m} \beta_k \left(x_{kit} - \bar{x}_{ki}\right) + \left(\mu_{it} - \bar{\mu}_i\right)$$

Formula 4.5

This transformation eliminates the unobserved effect α_i, and is called the within transformation. The estimates are called the mean adjusted estimates because the data is manipulated into using mean values. The formula above can be simplified and expressed by the formula below, where $\ddot{Y}_{it} = (Y_{it} - \bar{Y}_i)$.

$$\ddot{Y}_{it} = \sum_{k=1}^{m} \beta_k \, \ddot{x}_{kit} + \ddot{\mu}_{it}$$

Formula 4.6

The formula is used to estimate the mean adjusted coefficients by using OLS called fixed effects estimation. When using mean adjusted values, the unobserved effect disappears, and we no longer have the correlation which interferes with the assumptions of OLS. The fixed effects model causes the β_0 to disappear, but the intercept will be the unobserved effect (Dougherty 2011).

4.3.4. *The first differences fixed effects model*

In the second variant of the fixed effects model, the unobserved effect is eliminated by subtracting the observation from the last time period from the observation in the current time period. This is done in all time periods in the data. The regression model for last time period is expressed by:

$$Y_{it-1} = \beta_0 + \sum_{k=1}^{m} \beta_k \, x_{kit-1} + \alpha_i + \mu_{it-1}$$

Formula 4.7

By subtracting this formula from the formula for the unobserved effect, we get the expression for the first differences fixed effects regression model.

$$\Delta Y_{it} = \sum_{k=1}^{m} \beta_k \Delta x_{it} + \mu_{it} - \mu_{it-1}$$

Formula 4.8

Like in the fixed effects within-groups model, the unobserved effect is eliminated. The first differences method and the within method provides the same value of the estimators if there are two time periods, but in the instance of multiple time periods the estimators will differ.
Both the fixed effects within-groups model and the first differences model has the disadvantage that by manipulating the variables, through mean adjustment or lagging, you may lose important information about the variables effect on the dependent variable. When investigating dynamic change first differences is the most suitable model, while fixed effects may be better suited for investigating relations (Dougherty 2011). If further tests show that FE is the preferred model, the within-groups model is the relevant model to use in this study.

4.3.5. *The least squares dummy variable model*

The first two models handle the heterogeneity issue by eliminating the unobserved effect. The least squares dummy variable (LSDV) model solves the issue by allowing heterogeneity in the companies by adding a dummy variable D_i.

$$Y_{it} = \sum_{k=1}^{m} \beta_k \, x_{kit} + \sum_{i=1}^{n} \alpha_i D_i + \mu_{it}$$

Formula 4.9

This method gives us an intercept for each company, and thereby makes the unobserved effect smaller. It also gives us a higher R^2 value as the explanatory value increases with the dummy variables (Dougherty 2011).

4.3.6. The random effects model

The random effects model makes it possible to estimate the effects of the independent variables that are constant over time or across companies, and at the same time consider the unobservable individual effects. RE assumes that the unobserved effects have a mean value of zero, which means that the unobserved effects are random across companies. It is also assuming that the unobserved effects are not correlated with any of the independent variables (Wooldridge 2014). The random effects model uses GLS estimation instead of OLS estimation. The advantage of using random effects is that the estimates will be unbiased even if there is heterogeneity and serial correlation in the data (Wooldridge 2014). By using GLS estimation biased estimates which would occur by using OLS is hence avoided.

The regression expression for a random effects model is the same as for the unobserved effect, formula 4.3.

4.3.7. Inclusion of dummy variables

The unobserved effect catches the individual properties that e.g. makes a firm more profitable than others. This may be due to more competent management, or e.g. the firm's good reputation. Several of these properties may be identified by using dummy variables. These variables represent different categories and are defined to be either 0 or 1. An example is reputation as dummy variable, where a good reputation gets the value 1 and bad reputation gets the value 0. A general rule when including dummy variables is to include "K-1" categories in the regression analysis, where one of the categories is used as reference dummy. The parameters in the dummy variables represent the estimated differences in intercept between the categories (Wooldridge 2014).

In our study, we investigate 48 firms in the energy industry, and they are divided into seven different sub-industries. We use dummy variables to separate the sub-industries, using the largest sub-industry Oil & Gas Equipment & Services as reference dummy. The different sub-industries have somewhat different operations and using dummy variables helps us identify differences in capital structure based on type of sub-industry.

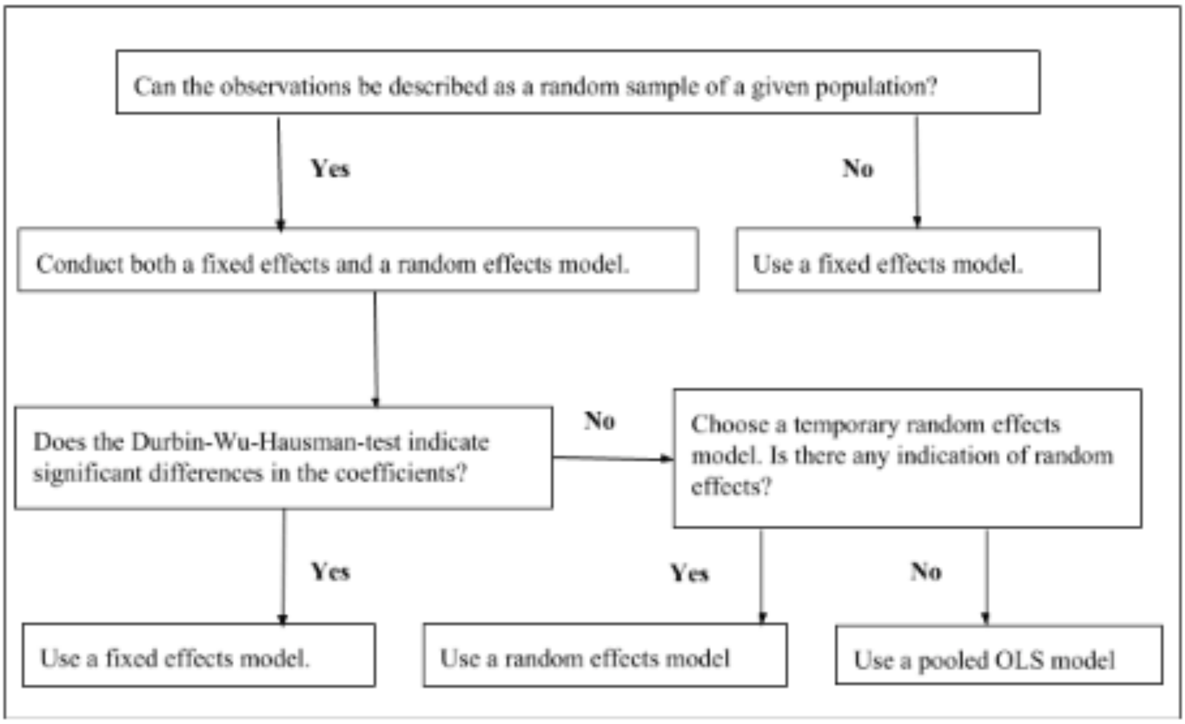
4.4. Model choice

RE and FE are the advanced methods that is generally used if pooled OLS does not give consistent estimates. The methods are therefore compared. Generally, RE will give a more accurate estimate compared to FE. This is among other things because RE retains more degrees of freedom than FE. Increased degree of freedom generally provides significantly lower standard errors and increases the likelihood of significant estimates. From a statistical standpoint, FE will always estimate consistent results, but the strength of the consistent results is weakened by increased standard errors. Larger standard errors make it harder to detect significant estimates (Reyna-Torres 2007).

An aspect that often is considered in the choice between the methods is RE's ability to detect causality between the dependent variable and the independent variables that are constant over time. FE does not have this ability, as the transformation method applies eliminated time-constant variables from the regression (Gujarati 2003). Dependent on the data this aspect of FE may make the method undesirable, especially in contexts where variables without variation are central.

Based on the aforementioned reasons RE is the preferred method, even if the regression does not contain time-constant variables. RE can, however, only be used when the error term does not correlate with the independent variables. Under conflicting conditions RE will give inconsistent estimates, and one should use FE. The Hausman test gives an indication on which method is preferred and is explained further in chapter 4.5.1.

Figure 4.1 Model choice illustration.



(Dougherty 2011)

4.5. Applied tests for model choice

This chapter presents statistical tests which helps us decide which is the preferred estimation method for our data. These tests are necessary to ensure that the chosen method gives correct and valid results. For the same reason, they are also central in our further analysis.

4.5.1. *The Durbin-Wu-Hausman test*

The choice between the fixed effects and the random effects model is often made using a statistical test called the Durbin-Wu-Hausman (Hausman) test. First, coefficients for both models are estimated and second, it is tested for significant differences in the coefficients of the independent variables. The null hypothesis of the test states that the variation in the coefficients are unsystematic and if the hypothesis is rejected, one should use the fixed effects model rather than the random effects model (Wooldridge 2014).

4.5.2. *F-test: testing for fixed effects*

The choice between pooled OLS and fixed effects is made by performing an F-test. When this test is significant at the 5% level individual heterogeneity is present, and fixed effects is preferred (Wooldridge 2014).

4.5.3. *Breusch-Pagan Lagrange Multiplier (BPLM) test*

To test for random effects, a BPLM test may be applied. The null hypothesis in the BPLM test is that variances across entities are zero. This is, no significant difference across units. If the test is significant at the 5% level random effects are present, and the random effects model is preferred over pooled OLS (Torres-Reyna 2007).

4.6. Validity and reliability

Validity and reliability are to central terms for quality assurance of research. Validity focuses on whether the applied method is suited to investigate the research question. Reliability refers to how reliable the data is, and to what degree a study can be verified (Grønmo 2004).

Validity can be split into an internal and an external part. Internal validity expresses to what degree the results preserve the research question and is in this matter valid for energy companies listed on the OSE. Whether the used variables are suited for the study's research question is in this way central. The variables are chosen and constructed based on previous empiricism for similar selections and is therefore considered valid for answering our research question. External validity expresses to what degree the results are transferable to other selections and situations (Dalen 2011). Our selection is considered to cover the Norwegian-noted energy industry and is thus valid. Findings in similar empiricism has proven to be transferable between different countries and industries, and we also consider our results as transferable to similar data. The risk of breach of validity is therefore considered to be low.

In quantitative research transparency is central, and a high degree of reliability is obtained by being consistent in the process of gathering data and analysis. By using quantitative secondary data from an acknowledged database (Eikon), we consider the risk related to error in measurement and inconsistent treatment of data to be low. Transparent data gathering and processing makes sure that replicating studies obtain matching results. Applied econometrics builds on general econometric methods and are considered easy to verify. This study is hence considered to be reliable.

5. Results

In this chapter, we first present the results from the model choice tests and decide which model to use in further analysis, then we describe the results of the regression analyses. We have also tested the OLS assumptions and the results of these tests are presented toward the end of the chapter.

5.1. Results from the model choice tests

In our analysis, we use the fixed effects model (FE) to estimate the coefficients of the independent variables. The Hausman test investigates if the variation in the coefficients is unsystematic, and with a p-value of 0.003 we reject the null hypothesis. This implies that we should use the fixed effects model (FE). Further, using RE over FE means that we are willing to assume that the unobserved effect is uncorrelated with all explanatory variables. This situation should be considered the exception rather than the rule (Wooldridge, 2014). We consider it unlikely that all our independent variables are uncorrelated with the unobserved effect. Based on theory and the results from the test, we choose to use FE for further analysis.

The results from the Hausman test is presented in figure 5.1 below.

Figure 5.1 Hausman test

Hausman Test

data: td ~ ebitda + tangibility + firmsize + growth + risk + oilprice + ...
chisq = 21.81, df = 7, p-value = 0.002739
alternative hypothesis: one model is inconsistent

We also conduct an F-test to decide whether we should use pooled OLS or FE. The test is presented in appendix 4, and has a p-value of <0,001, so we conclude that FE is preferred over pooled OLS.

To estimate the effect of the sub-industry specific variables we also use a least squares dummy variable (LSDV) model. The LSDV model corrects for heteroskedasticity, but not serial correlation. The results from the variables are thus discussed based on the fixed effects model, while the LSDV is only used to describe the time consistent dummy variables.

We make conclusions based on the 5% significance level throughout the study, which is the common level within statistics in finance.

5.2. Our regression models

Based on the variables presented in chapter 2 and the tests for model choice, the expression for the regression model included fixed effects is presented in formula 5.1. Formula 5.2 includes dummy variables and represents the LSDV model. In the formula *D* represents the dummy variables.

$$\begin{aligned} Debt\ ratio = {} & \beta_1 Profitability + \beta_2 Tangibility + \beta_3 Firm\ size + \beta_4 Growth + \beta_5 Risk \\ & + \beta_6 Oil\ price + \beta_7 Interest\ rate + \mu_{it} \end{aligned}$$

Formula 5.1

$$\begin{aligned} Debt\ ratio = {} & \beta_1 Profitability + \beta_2 Tangibility + \beta_3 Firm\ size + \beta_4 Growth + \beta_5 Risk \\ & + \beta_6 Oil\ price + \beta_7 Interest\ rate + \beta_8 D(Oil\ \&Gas\ E\&S) + \beta_9 D(Shipping) \\ & + \beta_{10} D(Oil\ \&\ Gas\ E\&P) + \beta_{11} D(Oil\ \&\ Gas\ Drilling) \\ & + \beta_{12} D(Oil\ \&\ Gas\ Midstream) + \beta_{13} D(Oil\ \&\ Gas\ Integrated) \\ & + \beta_{14} D(Indep. Oil\ \&\ Gas) + \beta_{15} D(Aerospace\ \&\ Defence) + \mu_{it} \end{aligned}$$

Formula 5.2

5.3. Results from the regression analysis

The regression model is conducted using the fixed effects model. The least squares dummy variable (LSDV) model represents the coefficients for the dummy variables for sub-industries. The coefficients for the independent variables in the LSDV model are not shown in the table, since these variables are discussed based on the fixed effects model. The table shows number of observations, number of companies, R^2 and adjusted R^2 for both models, in addition to the coefficients, the standard error, the t-values, and the p-values of the coefficients.

Table 5.1 Results from the regression models

Fixed effects regression with HAC robust standard errors

			Observations	595
			Companies	48
			F(7, 540)	46.2149
			p-value	< 2.22e-16
			R^2	0.37464
			Adj. R^2	0.31211

	Coefficient	Standard error	t-value	p-value
Profitability	0.1747327	0.0706894	2.4718	0.01372 *
Tangibility	-0.3316647	0.0540533	-6.1359	1.557e-09 ***
Firm size	0.0466435	0.0094960	4.9119	1.171e-06 ***
Growth	-0.0019758	0.0094567	-0.2089	0.83457
Risk	-0.0123789	0.0055394	-2.2347	0.02581 *
Oil price	-0.0002005	0.0002252	-0.8903	0.37366
Interest	0.7753243	0.3543525	2.1880	0.02906 *

Least squares dummy variable (LSDV)

			Observations	595
			R^2	0.4900
			Adj. R^2	0.4777

	Coefficient	Standard error	t-value	p-value
Shipping	-2.409e-01	2.292e-02	-10.511	< 2e-16 ***
Oil & Gas E&P	-2.504e-02	2.232e-02	-1.122	0.262253
Oil & Gas Drilling	-2.054e-01	5.333e-02	-3.851	0.000131 ***
Oil & Gas Midstream	-2.399e-01	3.825e-02	-6.273	6.93e-10 ***
Oil & Gas Integrated	6.697e-02	2.513e-02	2.665	0.007910 **
Indep. Oil & Gas	4.692e-02	5.237e-02	0.896	0.370651
Aerospace & Defence	1.440e-01	3.762e-02	3.827	0.000144 ***

*Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1*

To be certain that there is an actual relationship between the dependent variable and the independent variables in the regression model, R automatically conducts an F-test where the null hypothesis states that all coefficients equals zero. The results of the test are presented in table 5.1 above, and has a p-value of <2.22e-16. Therefore, we reject the null hypothesis, and conclude that there is a significant relationship between debt ratio and the independent variables. The FE regression calculates an R^2 of 0.37464 (adjusted R^2 of 0.31211), which means that approximately 38% of the variation in debt ratio between the companies are explained by the independent variables. In the LSDV model, the R^2 increases to 0.49 (0.4777) because the model includes the sub-industry dummy variables which explain more of the variation in the debt ratio.

The FE regression shows a positive relationship between debt ratio and profitability, with a coefficient of 0.175 and a standard error of 0.071. The variable is significant at the 5% level, so we conclude that the effect on debt ratio is significant. According to the regression tangibility has a negative effect on the debt ratio, the coefficient of the variable is -0.332 with a standard error of 0.054. Firm size has a positive effect on debt ratio, the coefficient has a value of 0.047 and a standard error of 0.009. Both tangibility and firm size are highly significant with p-values <0.000. Increased Z-score seems to have a negative effect on the debt ratio, with a coefficient of -0.012 and a standard error of 0.006. Interest rate has a positive effect on debt ratio, the coefficient is 0.775 and the standard error is 0.354. Risk and interest rate are significant at the 5% level. Growth and oil price are the only two variables in the fixed effects model who are not significant, and we cannot reject the null hypothesis that the variables have no effect on debt ratio. The p-values of the coefficients are shown in table 5.1.

The LSDV model is used to investigate differences between the different sub-industries. The sub-industry Oil & Gas Equipment & Services is used as a reference dummy and the results for the remaining sub-industries are presented in comparison with the Oil & Gas Equipment and Services sub-industry. Shipping has a significantly lower debt ratio with a coefficient of -0.241 and a standard error of 0.023. Oil & Gas Drilling as well as Oil & Gas Midstream also have significantly lower debt ratio, the coefficients have values of -0.205 and -0.240, and standard errors of 0.053 and 0.038, respectively. Oil & Gas Integrated as well as Aerospace & Defence have significantly higher debt ratio than Oil & Gas Equipment and Services, with coefficients of 0.067 and 0.144, and standard errors of 0.025 and 0.037, respectively. From our results, we cannot say that any of the other sub-industries have a significantly different debt ratio than Oil & Gas Equipment and Services.

Before we conducted the regression analyses we tested the OLS assumptions about linearity, normality, multicollinearity, heteroskedasticity, serial correlation, and number of independent variables.

5.4. OLS assumptions tests

5.4.1. Linearity

The linearity assumption in a regression may be investigated by plotting the error terms against each of the independent variables. We use the Partial-Residual Plots function in R when examining the linearity assumption. Partial-residual plots attempts to show the relationship between the dependent and the independent variable given that there are several independent variables in the model. The blue line shows the actual relationship between the dependent and the independent variables, while the purple line is the linear relationship that R predicts. If the two are far from coinciding, it means that there is non-linearity in the variables (Larsen and McCleary 2012).

Figure 5.1 Partial-Residuals Plot

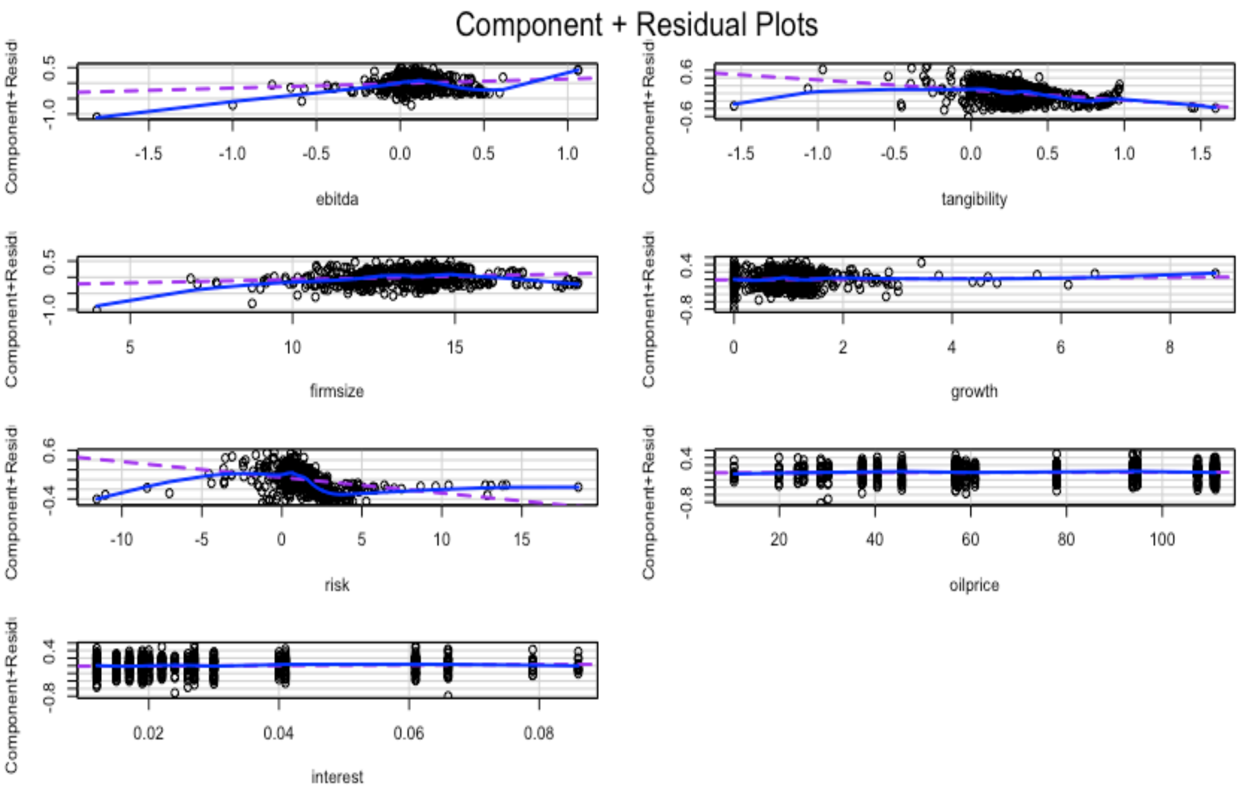
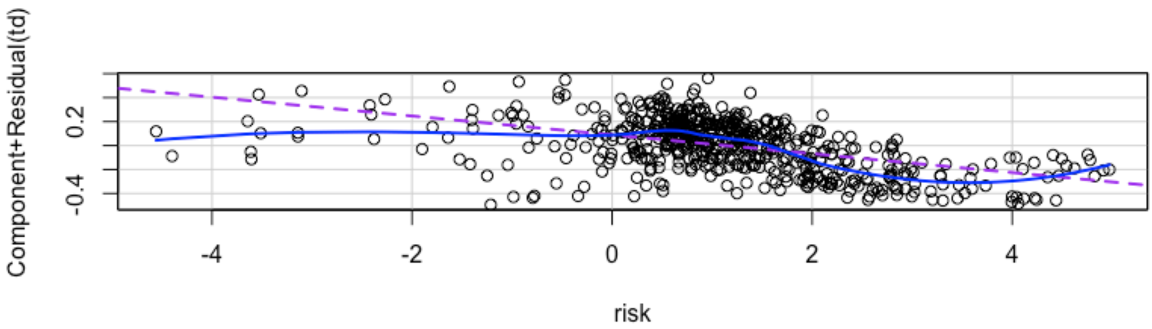


Figure 5.1 presents the Partial-Residual plots for all the independent variables. In the graphs representing profitability ("ebitda"), tangibility, and firm size, the purple line deviates

somewhat from the blue line. However, there is linearity where the majority of observations are, and we therefore assume linearity in these variables. The graphs for growth, oil price and interest rate show only minimal deviations between the purple and blue lines, which suggests linearity in the variables. We conclude that the deviations are not large enough for it to be necessary to transform the mode into logarithmic or square form. Hence, we conclude that the OLS assumption is not breached. In the graph for risk, it might seem that there is non-linearity. This may be caused by outliers, and figure 5.2 shows the Partial-Residuals plot of risk for observations within the interval of +/- 5. The blue line deviates less than in the original graph, and we therefore assume that Risk is actually linear, and the outliers makes it look non-linear.

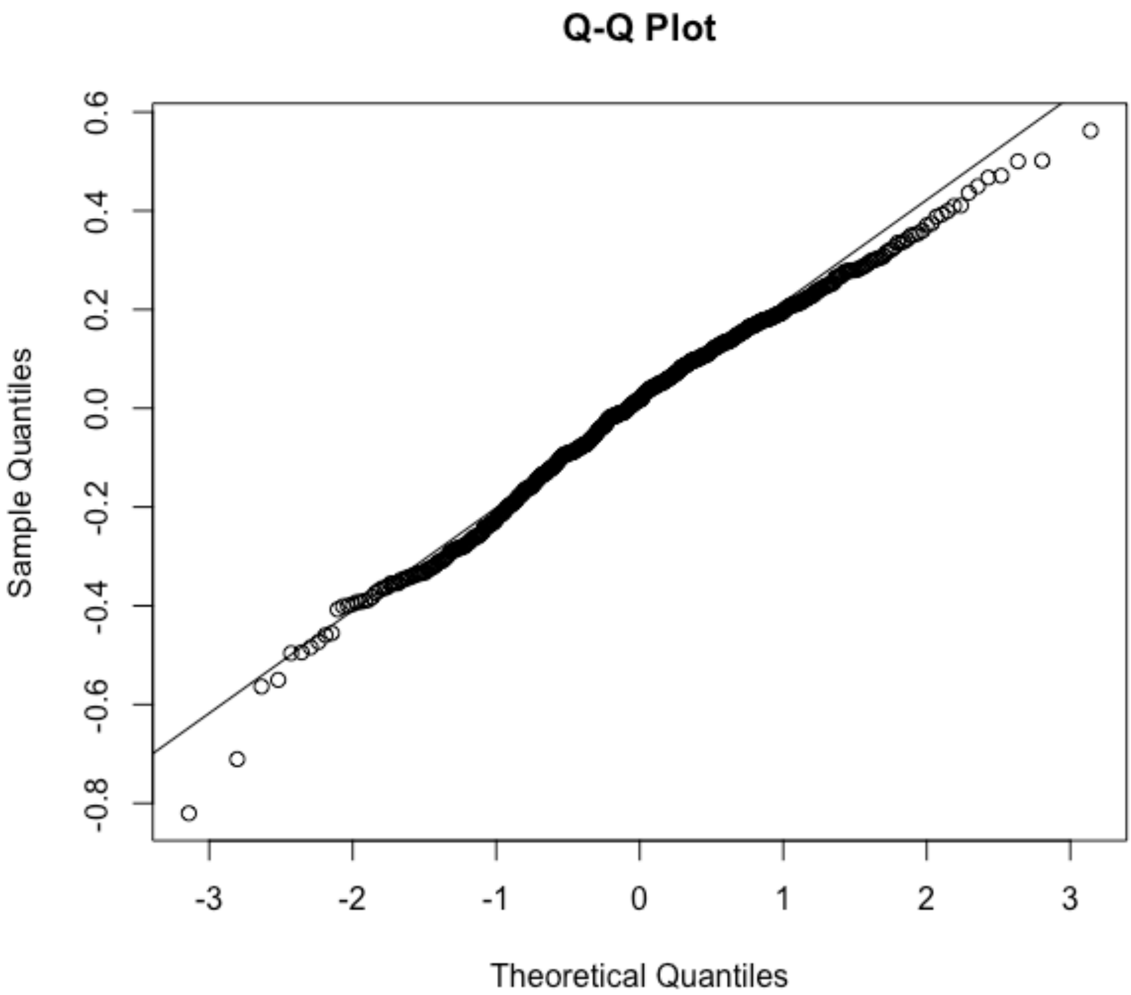
Figure 5.2 Partial-Residual Plot for the independent variable Risk



5.4.2. Normal distribution

To examine if the error terms are normally distributed, we use the quartiles of a normal distribution plot (Q-Q plot). The Q-Q plot is sensitive to non-normality around the tails (Chen et al. 25.03.2016). This is illustrated in figure 5.3, where the Q-Q plot shows some deviations around the tails. We assume that the error term in the regression is approximately normally distributed since the deviations in the test are modest. We also assume normal distribution based on the central limit theorem which states that the mean of a selection will be approximately normally distributed if the selection size is large enough. Our data contains of 595 observations and is assumed to be normally distributed based on the rule of thumb that a data set is normally distributed if the number of observations is larger than 20 (Løvås, 2013).

Figure 5.3 Q-Q Plot for normality near the tails.



5.4.3. Multicollinearity

To investigate for multicollinearity between the independent variables a Variance inflation factor (VIF) test is used. The VIF test provides an index that measures how much the standard deviation increases due to multicollinearity. A VIF value of 10 is the most used benchmark to exclude suspicion of multicollinearity in data sets (Wooldridge, 2014). The VIF values of our model is significantly lower than 10, and we therefore conclude there is no problem with multicollinearity in our model.

Figure 5.4 Variance Inflation Factor (VIF).

	VIF
Profitability	1.414219
Tangibility	1.487243
Firm size	1.798687
Growth	1.073459
Risk	1.759595
Oil price	1.185969
Interest rate	1.153627
Sector (dummy)	1.814110

5.4.4. Homoskedasticity

To examine for heteroskedasticity there are several tests that may give indication of its presence. The Breusch-Pagan test is one of the tests for heteroskedasticity (Wooldridge, 2014). The Breusch-Pagan test investigates if the variation in the error term is constant. Constant variation in the error term means that there is no heteroskedasticity in the model, thus the null hypothesis is homoskedasticity. Heteroskedasticity in the error term leads to incorrect confidence intervals and t-values constructed by the standard errors. The Breusch-Pagan test is presented in appendix 5 and shows a p-value of <0.001, so the null hypothesis is rejected. The test indicates heteroskedasticity in our model.

5.4.5. Serial correlation

The occurrence of correlation between the error terms in two time periods is called serial correlation, which is common in panel data. To test for serial correlation, we use the Breusch-Godfrey/Wooldridge test of serial correlation for the idiosyncratic component of the errors in the data. The test is presented in appendix 5. The null hypothesis is that there is no serial correlation. With a p-value <0.001, the null hypothesis is rejected and we conclude there is serial correlation in our model.

5.4.6. Number of independent variables

Misspecification occurs with the presence of heteroskedasticity in the model, and one of the reasons for the misspecification may be omitted variables which may have strong explanation power on the dependent variable. Ramsey's regression specification error test (RESET) is used to control for omitted variables, and the null hypothesis is no omitted variables. The test is presented in appendix 5 and has a p-value <0.001, thus we reject the null hypothesis. This suggests that our model has omitted variables. However, RESET also tests for other misspecifications and heteroskedasticity, which means that the result of the test is not necessarily due to omitted variables. The result is nevertheless significant and we view this as a weakness in our model. We still believe that there are so many variables that may explain the choice of capital structure that it would be difficult to include all of them. We therefore choose to keep our model as presented in formula 5.1 and 5.2.

5.5. Conclusion based on the OLS assumptions

The conducted tests show breach of both the homoskedasticity and the serial correlation assumption of OLS. Based on the tests for heteroskedasticity and serial correlation, we use heteroskedasticity and autocorrelation consistent (HAC) standard errors in the regression analysis.

6. Discussion

The regression analysis shows results in line with our expectations in three of the significant variables, and contrary to our expectations in the other two. Growth and oil price showed no significant effect on the capital structure, and will hence not be discussed. Below is a summary of our hypotheses for the significant variables, and the results.

Table 6.1 Summary of our expectations/hypotheses.

	Hypothesis	Result	P-value	Conclusion
Profitability	H1: Positive	Positive	0.013	Keep H1
Tangibility	H2: Positive	Negative	0.000	Reject H2
Firm size	H3: Positive	Positive	0.000	Keep H3
Risk	H4: Negative	Negative	0.026	Keep H4
Interest rate	H5: Negative	Positive	0.029	Reject H5

There is a positive relationship between profitability and debt ratio, and with a p-value of 0.013 we reject the null hypothesis that there is no relationship between the two variables. Our result suggests that if profitability increases by 1%, debt ratio increases by 0.17%. This result is expected as profitable companies have lower cost of financial distress and thus are able to take on more debt. The finding is in line with the trade-off theory, where it is assumed that companies with high taxable income will have high target debt ratios. It is also in accordance with agency theory which states that profitable companies take on more debt to lower the risk of e.g. over investments by the managers which may occur with available free cash flows. Abor (2005) and Gill, Biger and Mathur (2011) also find positive relationships between debt ratio and profitability, which further supports our hypothesis and finding.

On the contrary, the pecking order theory assumes that companies prefer to use internal financing before turning to external financing, and according to the theory one would expect profitable companies to have a lower debt ratio. This is supported by Rajan and Zingales (1995), who in their study find that companies prefer internal financing before external financing.

The interest rates in Norway have been historically low for some time. This may be one factor affecting why profitable companies have higher debt ratio - debt is relatively cheap, and the return on equity is relatively low. Exploiting the tax shield benefits may therefore motivate companies to take on more debt and use external financing for new investments. In addition, Norway rank number 8 of 190 on the ranking for ease of doing business. The ranking is calculated by, among other factors, the strength of legal rights when taking on credit, and resolving insolvency. A high ranking makes Norway a country in which it seems safe to take on debt. These facts support our finding of a positive relationship between profitability and debt ratio.

There is a negative relationship between tangibility and debt ratio, and with a p-value of 0.000, we reject the null hypothesis that there is no relationship between the two variables. The finding means that when tangibility increases by 1%, the debt ratio is reduced by 0.33%. We expected a positive relationship between the two variables because of the foundation the tangible assets create regarding collateral for creditors in case of default. Our expecation is in line with the trade-off theory which suggest that firms with a high share of fixed assets relative to total assets are facing less costs of financial distress, and lead to a higher leverage capacity, i.e. more debt. A high degree of tangibility and the liquidity of the assets makes the creditor's risk lower, which in turn makes the companies' borrowing conditions better. This in turn will make debt financing more attractive from the companies' point of view, which was the rationale behind our projected hypothesis. We also want to point out the fact that the oil and gas industry is a capital intensive industry which requires large ongoing investments to take a part in new projects and develop their businesses. This is another explanation behind our expectation of a positive relationship between tangibility and debt ratio.

The pecking order theory and several industry specific factors representing the oil and gas industry may explain our opposite finding. The pecking order theory argue that companies with a high level of tangible assets have lower degree of asymmetrical information, which in turn make the process of raising capital less expensive, hence less debt in their capital structure. According to the theory, companies are in favor of using retained earnings which might be an explanation for our finding. The companies that form our data set are mostly companies with a great record of big earnings which have given them the possibility to build up large holdings of equity in which they can rely on when deciding to invest. This is in line with the same finding by Daskalakis and Psillaki (2008), who claim that profitable companies with a high level of tangible assets have found a stable source of income so they don't have a need of external financing.

There is a positive relationship between firm size and debt ratio, and with a p-value of 0.000, we reject the null hypothesis of no relationship between the two variables. According to our results, an increase in firm size of 1%, results in an increase in the debt ratio by 0.04%. The finding is in line with Mjøs (2007), who claims that this may be a result of better access to capital markets. The fact that the companies' total assets are being used as collateral for the debt issued by creditors, which is in line with the trade-off theory, is in favor of our result. This relation can further on be explained by the rationale that the higher the asset base for collateral is, the risk of default is reduced which in turn provide the companies with better borrowing conditions. This again will make it more attractive for bigger firms to finance their operations with debt. Smaller firms often have more risk according to less record of business, which in turn will make creditors require a higher return on their investment. In addition to this, managers might be more reluctant to lever up their firm and obligate to a big portion of debt liabilities in light of their revenues.

In line with the pecking order theory, companies prefer to rely on retained earnings before debt financing. According to this theory, it is reasonable to assume that bigger companies will have less debt than smaller companies, hence a negative relationship between firm size and debt ratio. This view has to be seen in light of a much more comprehensive picture and the underlying conditions that firms and industries are subject to. As already mentioned, the companies in our analysis are part of a capital intensive industry who demands continuously high investments in addition to equity holders' dividend requirements and other competitive factors concerning the companies analyzed. These factors may be the explanation for our contradictory finding of a positive relationship between firm size and debt ratio relative to the pecking order theory.

Another rationale behind our finding is that bigger firms often are listed on an exchange which make them more liquid as well as the fact that firm conditions and financials are more transparent, hence less asymmetrical information. Again, this may reduce the risk and improve the borrowing conditions which can make the managers more positive to debt financing. The finding of a positive relationship between firm size and debt ratio is also in line with the findings by Rajan and Zingales (1995) and Daskalakis and Psillaki (2008).

Regarding our third variable, there is a negative relationship between the risk measure and the debt ratio, and with a p-value of 0.026 we reject the null hypothesis of no relation between the two variables. Note that the coefficient of the risk variable is negative - this means that an increased Z-score leads to a lower debt ratio. The interpretation of this variable is quite technical, considered the Z-score's definition. Regarding our definition of the Z-score in chapter 2, the greater the Z-score, the lower the risk. Therefore, this finding is contrary to the natural interpretation of a negative relationship. The finding suggests that when the Z-score increases by 1%, the debt ratio decreases by 0.01%. When we say higher Z-score, we in fact mean lower risk.

This finding is expected - that a higher Z-score, i.e. lower risk, leads to a lower debt ratio. This in line with Frank and Goyal (2009). They argue that the negative relationship between risk and debt ratio is a consequence of firm's actions to avoid bankruptcy and related costs. Therefore, companies try to maintain their risk at a comfortable level and focus on their business without the interruptions of default and related costs and consequences.

In general, a high debt to assets ratio means that the company has been aggressive in terms of financing its growth with debt. Hence, aggressive leveraging is often associated with high levels of risk, i.e. low z-score, which in turn may lead to volatile cash flows as a result of taking on interest expense liabilities. Myers (2001) argue that a company tries to find the optimal capital structure by choosing a mix between debt and equity that maximizes the value of the company and/or minimizes the total cost of capital. Proposition 2 by Miller and Modigliani claim that the total average cost of capital for a company remain constant independent of the company's capital structure because of the relationship between debt and risk. An increase in debt will result in a higher level of risk.

Our expectation for the variable interest rate was that increased interest rate leads to decreased debt ratio. In addition to being the most logic reasoning, it is also supported by the pecking order theory and the market timing theory. According to the pecking order theory, companies prefer the cheaper financing option which is internal capital. When interest rates increase, external capital will become relatively more expensive, hence companies will rely more on internal capital and the debt ratio will decrease. According to the market timing theory, companies issue debt when this is the cheaper option, and issue equity when issuing equity is the more desirable option, hence, issue less debt and more equity when the interest rates increase.

Our results show the contrary. In fact, when interest rate increases with 1%, the debt ratio also increases by 0.77%. The result has a p-value <0.5, so we reject the null hypothesis that there is no relationship between debt ratio and interest rate.

When interest rates increase, it usually carves into a company's profitability because the cost of capital required to expand increases. In this way, to keep up investments, companies are required to take on more debt. This may be one explanation to why debt ratio increases with increased interest rate in our sample. According to the trade-off theory, companies balance the present value of interest tax shield with the present value of cost of financial distress. Increased interest rates lead to increased interest tax shields, and might make up for the increased costs of financial distress which higher interest rates contribute to.

If we look at the companies’ economic situation and the time period we are analyzing, we may be able to point out some viable explanations of our contradictory finding. The mean debt ratio in our sample is quite low and the profitability of the companies is also quite high. An increase in interest rates might therefore not be that significant when deciding to use debt financing or not. The interest rate has also been steadily decreasing during the period we are analyzing, which may make the companies perceive the interest rate level as low.

7. Conclusion

In this study, we have investigated if and in what way profitability, tangibility, firm size, growth, risk, interest rate, and oil price affect the choice of capital structure in energy companies listed on the Oslo Stock Exchange. We chose to use panel data to answer our research question as we were interested in relations both over time and across companies. We also wanted to look at differences between the different types of companies within the energy industry, and included dummy variables representing each sub-industry.

Our results showed a negative relationship between profitability and debt ratio, tangibility and debt ratio, and risk and debt ratio, and a positive relationship between firm size and debt ratio and between interest rate and debt ratio. Three of our expectations for the independent and control variables were confirmed, two were contradicted. Our analysis of effects of growth and interest rate on debt ratio gave insignificant coefficients, so we cannot conclude that these variables have an effect on debt ratio.

The results show that capital structure decisions are backed both by the pecking order theory and the trade-off theory, as well as market timing theory and agency theory. However, one theory alone cannot explain the choices regarding capital structure, as multiple factors play a role and all theories added have explanatory power.

We conclude that capital structure is a complex and complicated "puzzle" which vary from industry to industry as well as within a specific industry.

7.1. Further research

The purpose of this study was to investigate capital structure decisions in Energy companies listed on the OSE. Our chosen variables, and how we have chosen to calculate our proxies, are only a few in many variables to choose from, and ways to calculate proxies. As two of our independent variables came out as insignificant, it might be interesting to look at other proxies for these variables in further research. In addition to this, it would be interesting to include more companies, also non-listed, into the research to get a better view of the whole energy industry.

7.2. Limitations

Limitations regarding this research include among others our choice of variables. There are several studies concerning capital structure and it is a demanding process to pick out the most relevant variables. We could have used other or more measures to define capital structure, and independent and control variables. By including measures of markets values as well as book values, our research could have provided more information and better reflect the true relationships.

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Appendices

Appendix 1 – list of companies and their respective sub-industry

Company	Sub-industry
Oceanteam	Oil & Gas Equipment & Services
I.M. Skaugen	Shipping
Atlantic Petroleum	Oil & Gas Exploration & Production
Sevan Drilling	Oil & Gas Equipment & Services
EMAS Offshore	Oil & Gas Equipment & Services
Petrolia	Oil & Gas Equipment & Services
SeaBird Exploration	Oil & Gas Equipment & Services
Interoil Exploration and Production	Oil & Gas Exploration & Production
Bergen Group	Aerospace & Defense
Aqualis	Oil & Gas Equipment & Services
Havila Shipping	Oil & Gas Equipment & Services
Electromagnetic Geoservices	Oil & Gas Equipment & Services
Reach Subsea	Oil & Gas Equipment & Services
Eidesvik Offshore	Oil & Gas Equipment & Services
Panoro Energy	Independent Oil & Gas
Wentworth Resources	Independent Oil & Gas
Polarcus	Oil & Gas Equipment & Services
Sevan Marine	Oil & Gas Equipment & Services
S.D. Standard Drilling	Oil & Gas Equipment & Services
Seadrill	Oil & Gas Drilling
Prosafe	Oil & Gas Equipment & Services
Fred. Olsen Energy	Oil & Gas Drilling
Avance Gas Holding	Oil & Gas Integrated
Archer	Oil & Gas Drilling
Solstad Farstad	Shipping
RAK Petroleum	Oil & Gas Exploration & Production
Siem Offshore	Oil & Gas Midstream
Norwegian Energy Company	Oil & Gas Exploration & Production
DOF	Oil & Gas Equipment & Services
Questerre Energy Corporation	Oil & Gas Exploration & Production
Spectrum	Oil & Gas Equipment & Services
Kværner	Oil & Gas Equipment & Services
Höeg LNG Holdings	Oil & Gas Midstream
Bonheur	Shipping
Akastor	Oil & Gas Equipment & Services
FLEX LNG	Shipping
BW LPG	Shipping
Frontline	Shipping
Odfjell Drilling	Oil & Gas Drilling

Petroleum Geo-Services	Oil & Gas Equipment & Services
Ocean Yield	Shipping
DNO	Oil & Gas Exploration & Production
Aker Solutions	Oil & Gas Equipment & Services
TGS-NOPEC Geophysical Company	Oil & Gas Equipment & Services
Subsea 7	Oil & Gas Equipment & Services
Aker BP	Oil & Gas Exploration & Production
Statoil	Oil & Gas Integrated
BW Offshore Ltd	Oil & Gas Equipment & Services

Appendix 2 – Calculation of the proxies for the variables

$$Debt\ ratio = \frac{Total\ debt}{Total\ assets}$$

$$Profitability = \frac{EBITDA}{Total\ assets}$$

$$Tangibility = \frac{Total\ assets - Intangible\ assets - Total\ liabilities}{Total\ assets}$$

$$Firm\ size = ln(Total\ assets)$$

$$Growth = \frac{Total\ revenue_{t}}{Total\ revenue_{t-1}}$$

$$Risk = Z\text{-}Score = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5$$

$$X1 = Working\ Capital\ /\ Total\ Assets$$

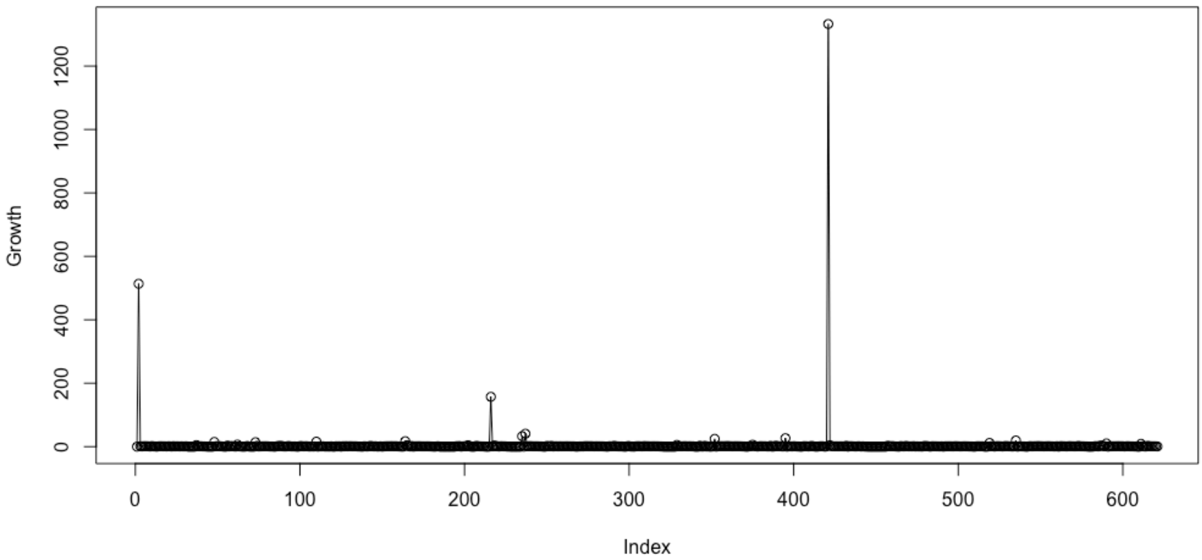
$$X2 = Retained\ Earnings\ /\ Total\ Assets$$

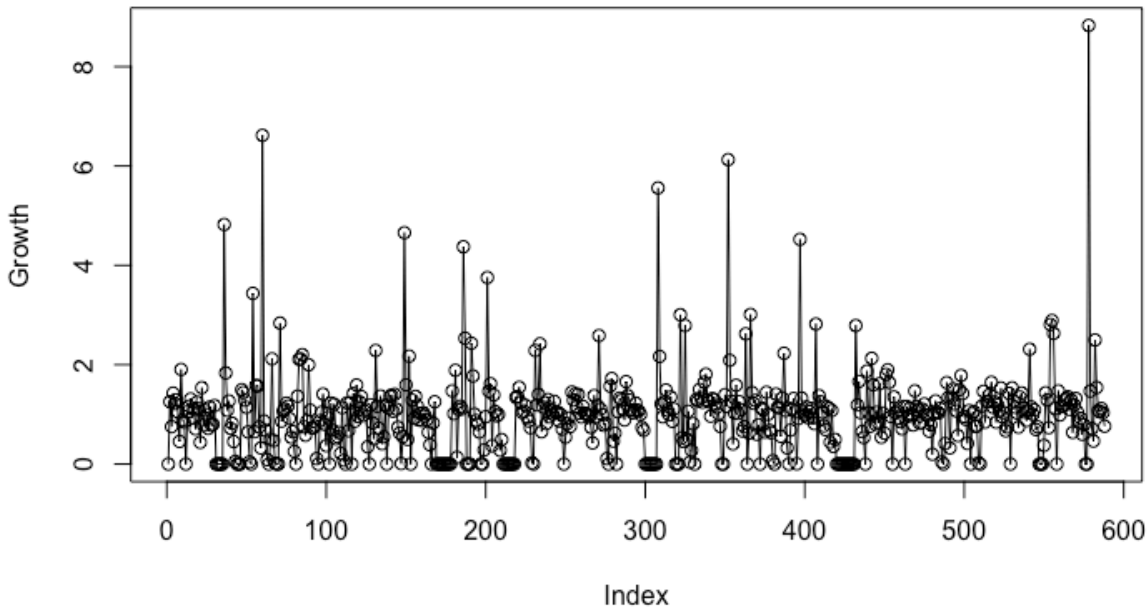
$$X3 = Operating\ Earnings\ /\ Total\ Assets$$

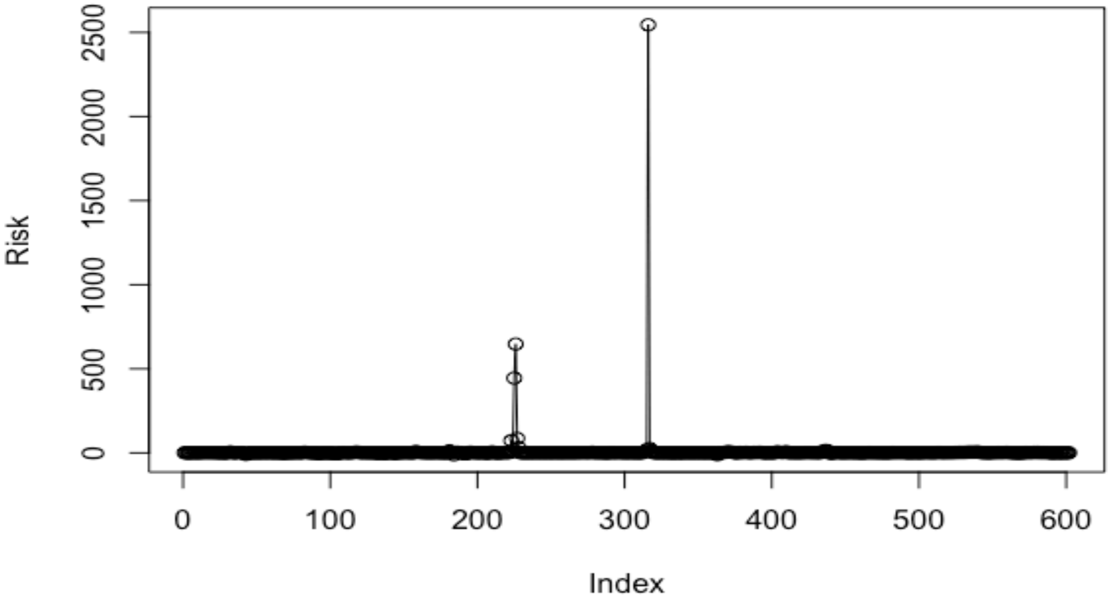
$$X4 = Market\ Capitalization\ /\ Total\ Liabilities$$

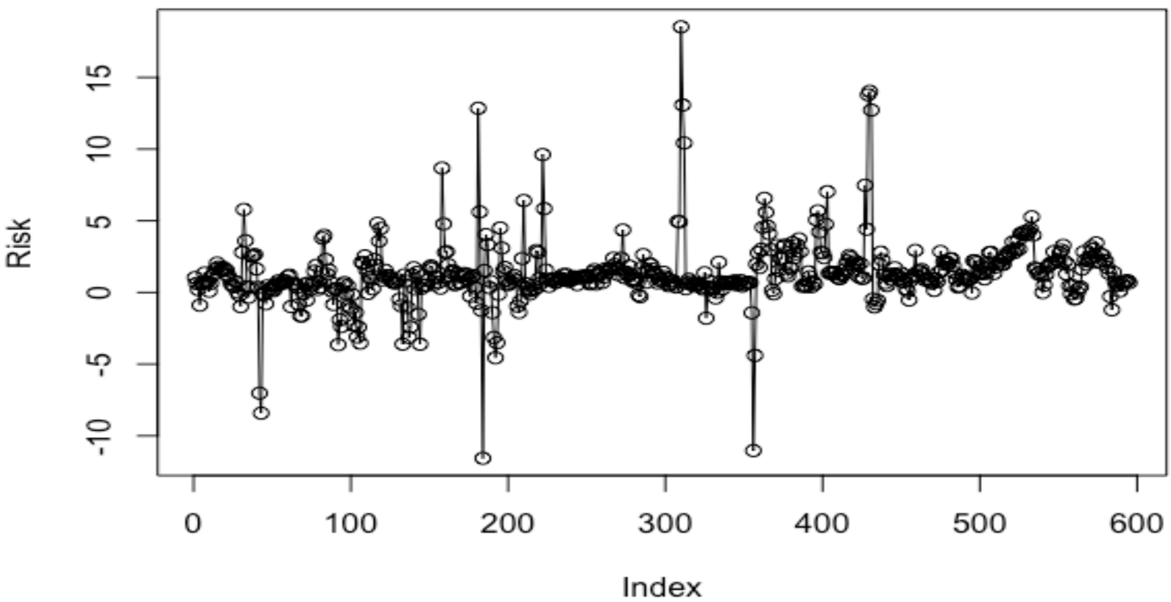
$$X5 = Sales\ /\ Total\ Assets$$

Appendix 3 – Scatterplots of the variables Growth and Risk






2500
2000
1500
1000
500
0
Risk
0
100
200
300
400
500
600
Index


15
10
5
0
-5
-10
Risk
0
100
200
300
400
500
600
Index

Appendix 4 – Model choice tests

Hausman test

Hausman Test

data: td ~ ebitda + tangibility + firmsize + growth + risk + oilprice + ...
chisq = 21.81, df = 7, p-value = 0.002739
alternative hypothesis: one model is inconsistent

F-test for fixed effects

F test for individual effects

data: td ~ ebitda + tangibility + firmsize + growth + risk + oilprice + ...
F = 21.999, df1 = 47, df2 = 540, p-value < 2.2e-16
alternative hypothesis: significant effects

Appendix 5 – OLS assumptions tests

Homoskedasticity

studentized Breusch-Pagan test

data: fixed
BP = 121.37, df = 7, p-value < 2.2e-16

Serial correlation

Breusch-Godfrey/Wooldridge test for serial correlation in panel models

data: td ~ ebitda + tangibility + firmsize + growth + risk + oilprice + interest
chisq = 74.556, df = 2, p-value < 2.2e-16
alternative hypothesis: serial correlation in idiosyncratic errors

Reset test

RESET test

data: lmfixed
RESET = 18.671, df1 = 2, df2 = 585, p-value = 1.379e-08