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TITLE:

Oil and Gas Investments: Agency Problems and Managerial Bias's effect on investment decisions.

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Abstract

This thesis examines classical and modern investment theory, and whether actual observations in the oil and gas industry coincide with the classical assumptions or if the modern theory more accurately explain observations. Classical investment theory presumes rationality and perfect capital markets, however actualities the recent years imply that the *market* development is in fact not supported by these assumptions. In the oil and gas industry, the capital expenditures have peaked over the last decade, as well as the oil price and earnings, while the oil companies' profits and share prices have experience a more moderate trend.

This investment theory study provides a systematic review of available literature on classical investment theory and modern investment theory. The review establishes a foundation to investigate whether recent contributions to investment decision theory can enhance quality, further than classical investment theory, to the explanation of later developments in oil and gas investments.

Furthermore, the thesis comprises a detailed analysis that focus on five peculiarities. These are accommodated by distinctive and recurring investment patterns observed in the market. First, oil and gas investments respond to short-term oil price change when these investments usually have a long-term horizon, and they retain dividend payouts sacrosanct when cash flows are under pressure. Second, investors are reluctant to raise debt to finance their investment plans, whereas rationality implies indifference about sources from where to collect capital. Further, announcement of cutbacks in investment are met by an increase in share price, a phenomenon that contradicts benchmark models of investment behavior and corporate finance. In addition, shareholders do not wish to receive scrip dividend instead of cash, even when offered a price discount per share that should be considered as “money in the street”.

The main finding is that modern contributions to investment theory can in fact provide explanations of the investment behavior in the oil and gas industry that correspond to a larger extent with the observed pattern, than classical investment theory. All the peculiarities may be explained by recognizing that the oil and gas industry could have been characterized by asymmetric information, agency problems, overconfidence and optimism, miscalibration, empire building and cost overruns. Whereas numerous of the investment decisions made by managers in the oil companies has not increased the firm and shareholder value, which contradicts a central principle in classical investment theory.

List of figures

Acknowledgements

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I emphasize that that this thesis is solely a result of my independent efforts, and that I am responsible for any statements or conclusions made.

Marit Fjellanger Bøhm

Stavanger, 15.06.2017

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1. Introduction

The purpose of this chapter is to give an introduction of the research topic and question at which this thesis seeks to analyze. Further the motivation and relevance of acquiring knowledge about the topic is given, followed by a presentation of its background.

1.1 Research Topic and Research Question

Oil and gas investments have fallen sharply in the recent years after 10 years of substantial growth. It is likely the high oil price that has driven the investments and made previously unprofitable oil and gas investments, profitable. The oil price more than halved from June 2014 to 2016 and the investments in the oil and gas industry declined sharply as a response.

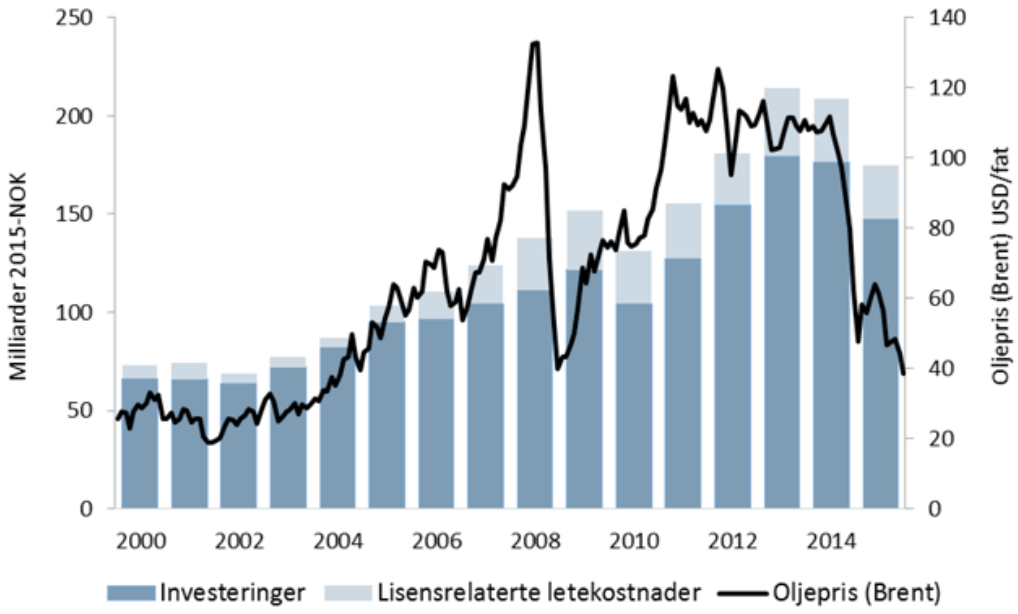


Figure 1: Investment developments including exploration costs and oil price (Norwegian Petroleum Directorate)

The increase in the oil price has increased the oil companies' income, however the companies' profits have not followed to the same extent due to a high cost level in the industry. Nor have the companies' share prices, that reflects that the oil company's investors are skeptical to manager's investment activity and cost level, and returns (Mohn 2014). Is it safe to conclude that the investment level in the oil industry can exclusively be explained by classical investment theory? Theory that is based on strong assumptions of rationality, symmetric information and homogenous expectations, where returns on investments are based on ex-ante expectations. What if the decision makers do not have rational expectations? What if information is not perfectly allocated among the actors in the market?

The aim of this thesis is to explore if recent theoretical contributions to investment theory can provide a more satisfactory explanation of the decline in oil and gas investments, than classical investment theory alone. There has been developed theories in agent theory and behavioral finance that can provide a more nuanced picture to why decision maker's actions may diverge from the classical investment theory's assumptions regarding human behavior.

Research question:

Can more recent contributions to investment decision theory add quality, beyond classical investment theory, to the explanation of the recent developments in oil and gas investments?

Method

The point of departure is a systematic review of available literature on classical investment theory and modern investment theory, including agency theory and managerial bias. This provided a base for an explanatory discussion to examine five peculiarities in the recent oil and gas investment pattern. These peculiarities are:

- Oil and gas investments have a long-term horizon, usually decades. Why do they respond to short- term changes in the oil price?
- The sharp drop in oil price has reduced the oil companies cash flow, and they have cut their investment plans. Why do the oil companies not cut in their dividend payouts to

shareholders when their cash flow is under pressure, in order to maintain their investment and production for future growth?

- The oil companies usually argue that the quality of their project-portfolio is high. If it is so attractive as they signal it to be, why do they hesitate in raising debt to finance their investment plans?
- Announcement of new investment projects usually gives an increase in the oil companies share price. Why has the typical pattern over the recent years been the opposite, that announcement of cutbacks in investment have been met with an increase in the share price?
- The percentage of shareholders who choose scrip dividend over cash dividend is much lower than anticipated, given the price discount they get per share taking this option. Why is the percentage not higher, when the price discount per share should be considered as "money on the street"?

The discussion of the peculiarities mentioned above is concerned around five of the largest oil companies in the industry, referred to as "Oil Majors". These companies are Exxon Mobile Corp, Chevron Corp, Royal Dutch Shell Plc, Bp Plc, and Total SA, who are all operating globally and set the standard in the industry. These are the companies it is natural for the Norwegian oil company Statoil ASA to compare itself with, who are also included in the discussion that seek to explain these peculiarities.

Disposition.

This thesis comprises five chapters. The first chapter provides information about the research topic and research question, together with motivation, relevance and background of the chosen research topic. In chapter two an overview of classical investment theory is given together with a presentation of a selection of investment decision rules. The third chapter presents modern investment theory, providing relevant literature and theories about agency theory and managerial bias. Chapter four gives an analysis of the investment pattern in the oil and gas industry in the light of the theories provided in the two preceding chapters. Lastly chapter five concludes the findings from the analysis.

1.2 Motivation and Relevance

The objective of this thesis is not necessarily to provide a final conclusion to the questions that are being raised, as much as to discuss hypotheses in the light of modern investment theory. This can establish an outset of more profound examinations of the topics discussed in the analysis, through a more thorough analyze, estimation and testing.

It is important to understand investment behavior in the oil and gas sector because the investment level determines the production level that in turn feeds back into the oil price. Also for some countries, investment in the oil and gas sector can be a large portion of total investment and may have macroeconomic consequences. For example, according to the Ministry of Petroleum and Energy (2016), the Norwegian oil and gas industry is an industry that has contributed with over 12 000 billion NOK to Norwegian GDP from early 1970s till today, thus play a huge role in the Norwegian economy. Figure (2) depicts the petroleum sector's contribution to the GDP in Norway, including relative shares of investments, export and state revenues, hence, the dependency of oil and gas. Through revenues from value creation, government revenues, export value and investments, the oil and gas sector seek to ensure that both current and future generations benefit from the Norwegian petroleum wealth (MPE, 2017).

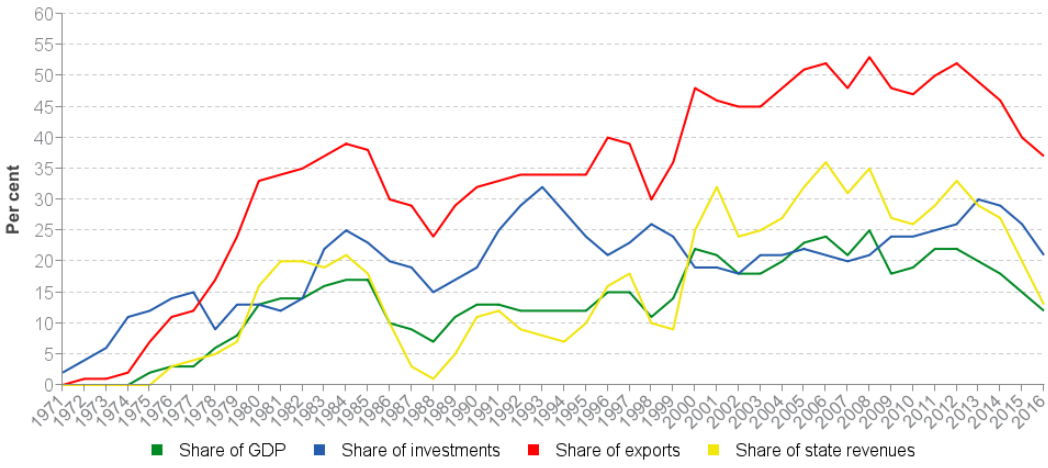


Figure 2: The importance of the petroleum sector (SSB, Department of Finance)

Understanding investment behavior in order to explain development in the oil and gas investments, and why share prices are not linear with investment level, can be useful in order to ensure stability and future wealth by being able to interpret market signals for future learning. Knowledge about investment behavior among the oil and gas companies should be included in the policy design, because countries where the oil and gas industry is a large part of the economy, such as Norway, the vulnerability for fluctuations in the oil industry is high.

1.3 Background

Global investment in the oil sector has historically followed the oil price development. Figure (3) show the global capital and exploration investment together with the average petroleum spot price.

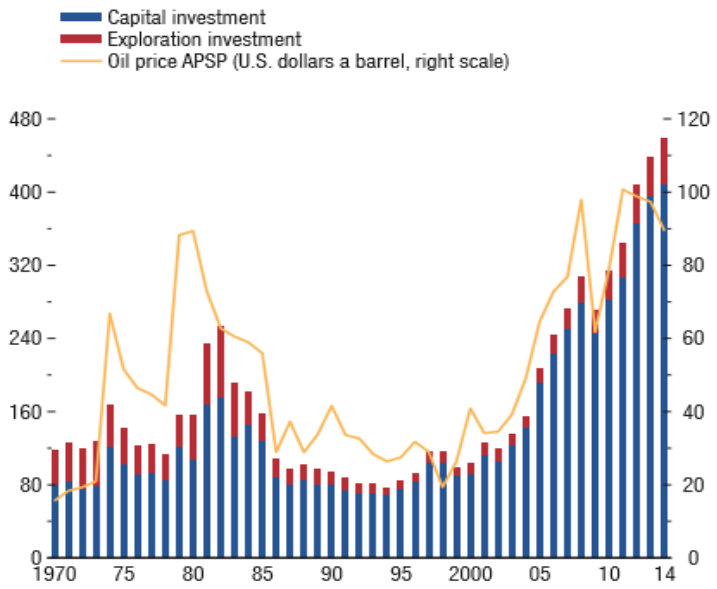


Figure 3: Global oil investment and oil price. Source: IMF

The International Monetary Fund (2015), gives an overview of oil investment respond to low oil prices. This report refers to an empirical study using annual historical data from 1970 to 2014 including 41 countries that represent over 90 percent of the world's oil investment and

production, that show the rapid and a quantitatively large effect lower oil price have on investment in the oil sector. Results from this study suggest that the largest effect occurs within one year, followed by a lagged effect with a duration up to eight years after a change in the oil price. After eight years, oil investment increase to the same level it reached during the first year after an oil price change (Figure 4).

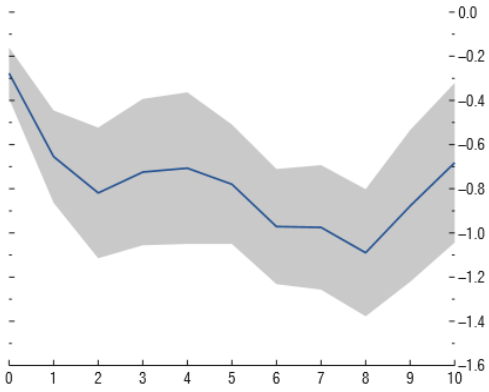


Figure 4: Response of oil investment to oil prices (Percent change; years forward on x-axis) Source: IMF

Historical examples that show how severe oil price declines has led to decrease in oil investments, is first in 1985, when Saudi Arabia voluntarily abandoned their role as a swing producer. A *swing producer* is a supplier that adjust production with a goal of achieving a target price for oil. This led to a dramatic plunge in oil price from $27 to $14 / barrel. At the beginning of that episode, investment spending in risky activities such as exploration dropped more than investment in project development activities. Also, during the global financial crisis in 2008, another dramatic decline in oil price occurred. However, this was a more temporary decline, and even tough oil investment dropped noticeably at that point, they bounced back sharply in the global economic recovery and increasing oil demand the year after.

Falling oil prices leads to a decline in investments, and falling investments is followed by a decrease in production. However, production response is not as rapid as the investment response. The long gestation periods connected to the translation of new investments into production creates a delay in the response of oil production to falling investment. It is the future production that is affected by lower oil prices and investments, due to lower exploration expenditures and investment drop in developing new fields. Showing evidence of the slow production response to falling investments, the same sample as for the study of investment response was used. Results from this study show that during the first year, falling investment

had no effect on oil production. The results show a lagged effect from the start of the second year after an investment change, whereas production was noticeably affected after five years, and continued to decline (Figure 5).

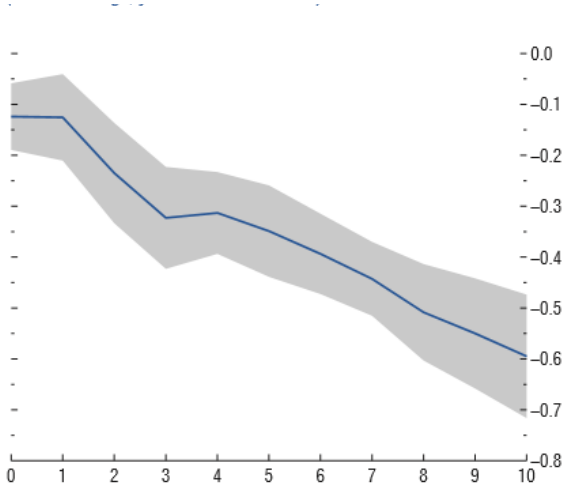


Figure 5: Response of oil production to oil investment (Percent change; years forward on x-axis) Source: IMF

The Organization of the Petroleum Exporting Countries (OPEC), is a permanent intergovernmental organization, with an objective to co-ordinate and unify petroleum policies among their member countries. Their aim is to secure conditions for producers, consumers and investors. OPEC has explicitly tried to influence oil prices, reflected in the example of Saudi Arabia mentioned above. The increase in production of unconventional oil from North America is a situation in resemblance to the Saudi Arabia example. The recent reluctance from Saudi Arabia to cut production, despite pressure from other OPEC members, could be perceived as a response in order to force more expensive oil production, such as U.S shale oil, out of the market. These are situations that show how the oil market is not fully competitive.

In the 2000s, global capital expenditure in the oil sector increased to a level that has never been observed before, and reflects the fact that high oil prices had been continuing for a long time. Oil prices had been driven up by a rapid increase in demand for oil from countries such as China and India, countries that are large emerging market economies. This again motivated further investment in tight oil formations[1] that had been uneconomical earlier at a lower oil price.

[1] Tight oil is crude oil trapped within tight geological formations with low permeability and porosity. This makes it hard to allow fluid to flow through the rocks and also for the rock to hold fluid. Tight oil then requires advanced drilling techniques to be recovered (Kabeya, 2017).

Break-even price is the oil price at which each barrel sold covers the costs of its production, thus the price at which it becomes worthwhile to extract oil. The development of break-even prices shows that in the 2000s prices were above break-even prices up to the price fall in 2014, when operating several fields became unprofitable. The gap that occurred between oil price and break-even price led to a halt in unprofitable fields.

Figure 6: Historical break-even prices. Source: IMF

Cut in investments, the fall in oil price, and efficiency measures has contributed to lower break-even prices in oil and gas projects. Cost reductions indicate the oil price is not expected to go back to the high level it has been at the last decade.

2. Classical Investment Theory

All decisions being made will have a future consequence that will affect a firm's value both in terms of costs and benefits. How do decision makers in a firm make good financial decisions for the firm's investors that provides benefits that brings a value that exceeds the costs, and accordingly increase the firms value? To answer this question, classical investment theory provides financial tools to convey all the costs and benefits into common terms. These tools have been developed because cost and benefits following a financial decision, often do not take place at the same time, or they appear in different currencies and some may come bearing risk connected to them. In this chapter, some of these classical investment theory decision tools are presented, drawing on theory of finance in general, and Berk & De Marzo (2011) and Bhattacharyya (2011) in particular.

Identifying costs and benefits of a decision and quantify these, provides the basis of financial decision making. Competitive market prices, that is, when a good can be bought and sold at the same price, decides the cash value of the good. Thus, costs and benefits can be evaluated in common terms by using competitive market prices. Having this information makes it possible to evaluate if a financial decision will increase the value of the firm and make its investors richer. This is a central principle in finance and it is called the *Valuation Principle*:

"The value of an asset to the firm or its investors is determined by its competitive market price. The benefits and costs of a decision should be evaluated using these market prices, and when the value of the benefits exceeds the value of the costs, the decision will increase the market value of the firm" (Berk & De Marzo, 2011)

As mentioned, costs and benefits takes place at different times. Investments typically involve a cost upfront, however the benefits may occur at some point in the future or over time preference. "The time value of money" is defined as the difference in value of money today and money in the future. It is the interest rate that gives information about today's market price of money in the future and the risk-free interest rate, gives information about the rate where money can be borrowed or lent over a period without risk. In addition to competitive market prices, risk free interest rate is another way of evaluating the value of costs and benefits in common terms.

This thesis focuses on explaining the development in oil and gas investments. Energy projects are characterized by high capital intensity, because the starting investment is usually very high

due to the advanced technology it requires. Assets in the energy industry often have a high degree of specificity and has a long life-time. The fact that the assets usually serve no purpose in other industries makes them more exposed to risk, and the longer life time of the asset, the higher degree of uncertainty of future costs and benefits connected to it. Another feature of energy projects is that the gestation period is long, and makes decision making vulnerable because market conditions can change during long construction periods.

When making investment decisions, firms and investors are interested in the present value of the investment, in other words the value of the investment measured in cash today. The Valuation Principle introduced previously in this chapter tells us that if the benefits of an investment decision exceed the costs, the decision will increase the value of the firm and make investors wealthier.

Investment decisions often involve making a decision about accepting or rejecting a project. After the present value of both cost and benefits has been determined using the interest rate, the value of an investment or a project can be computed, also referred to as the *Net Present Value* (*NPV*).

The net present value of an investment is given by the difference between the present value of its benefits and present value of its costs. Costs and benefits are usually represented by cash flows, where negative cash flows reflect the costs and positive cash flows reflects the benefits. Thus, the NPV is the sum of the PV of several cash flows.

$$NPV = PV\,(Benefits) - PV\,(Costs) \qquad (1)$$

2.1 Investment decision rules

Decision makers in firms such as managers and executives, seek to make decision that will increase the value of the firm. As mentioned in the previous section of this chapter, classical investment theory present financial tools and techniques as a contribution in evaluating investment and deciding wither to pursue a project or not. In the following section, the most practiced decision-making rules are presented.

2.1.1 Net Cash Flow

Net cash flow (*CF*) is the difference between a project revenues and expenditures in one period.

$$CF = P \cdot Y - W \cdot X \,, \qquad (2)$$

where revenues are given by price (*P*) times sales (*Y*) and expenditure by input price (*W*) times consumption of inputs (*X*). In equation *(2)* time subscripts are suppressed, implying that cash flow are constant and makes this a simplified presentation of cash flow. However, it is useful in order to picture where management in a firm should focus their attention in order to increase/maximize the firm value. Controlling the oil price (*P*) is not possible, but management can regulate the production level (*Y*). In most cases input prices (*W*) cannot be affected by the firm, thus management attention should be directed at efficiency in consumption of inputs (*X*) in order to increase *(CF)* to maximize firm value. The future income of an investment project divided into each year of the payback period is the net cash flow. The payback period depends on the project. The intention of measuring the net cash flow of a project is to find the sum of liquid funds gained or lost after completing an investment project, in order to show if the investment will give a yearly return or a larger return over time.

2.1.2 The Net Present value and the NPV decision rule

An investment project generates a series of cash flows at different points in time. Calculating the net present value involves converting all benefits and costs occurring at different times to their present value in order to get the overall worth of the benefits and costs of a project. *NPV* is illustrated by the following simplified formula:

$$NPV = -I + \sum_{n=1}^{\infty} \frac{CF}{(1+r)^n} \approx -I + \frac{CF}{r} \quad , \qquad (3)$$

where the net present value (*NPV*) is the sum of the net cash flows (*CF*) discounted by the expected rate of return (*r*), minus the initial investment in period zero (*I*). Equation (*3*) show that there are three factors affecting *NPV*. First, decreasing the initial investment cost (*I*) will increase (*NPV*) and intuitively increasing (*I*), will decrease (*NPV*). Second, a higher (*CF*) will have a positive effect on (*NPV*). Third and last, is the discount rate, will dampen the (*CF*)'s effect on (*NPV*). Figure (7) gives an example to illustrate the NPV calculation of an investment project.

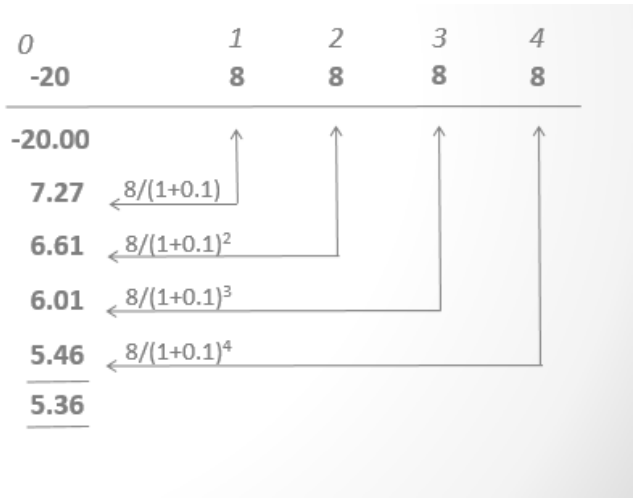


Figure 7: NPV calculation of a stylized investment project discounted at 10%

NPV decision rule:

When making an investment decision, take the alternative with the highest NPV. Choosing this alternative is equivalent to receiving it NPV in cash today. (Berk & De Marzo, 2011).

The NPV rule for stand-alone projects tells us to accept any project with a positive NPV and reject projects with a negative NPV. The implications here is that the management should in order to achieve NPV > 0, focus their attention at lowering the initial investment costs (*I*), in addition to efficiency and production level as explained in the previous section, as this will increase the net cash flows (*CF*)

2.1.3 Internal Rate of Return and the IRR rule

The discount rate that sets the NPV of an investment project equal to zero is called the *Internal Rate of Return* (IRR). The IRR gives information about the sensitivity of the NPV of a project to uncertainty in estimation of the projects cost of capital. The IRR is the average return gained by undertaking an investment. Investment decisions made based on IRR will accept a project as long as the discount rate is less than the IRR. The NPV will be negative for discount rates higher than the IRR.

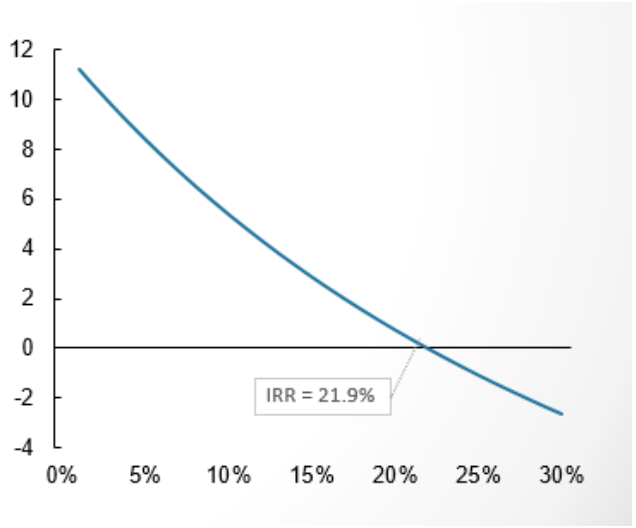


Figure 8: Identifying the IRR. Mapping of NPV and discount rate

The IRR rule:

Take any investment opportunity where the IRR exceeds the opportunity cost of capital. Turn down any opportunity whose IRR is less than the opportunity cost of capital. (Berk & De Marzo, 2011).

Identifying the IRR could be done by either using an iterative approach also known as trial-and-error. Calculate the NPV from a guessed discount rate. If the NPV is positive, increase the discount rate in the following iteration and continue the process until NPV is negative. Another way to calculate the IRR, is to set the NPV equal to zero and solve for the rate of return.

In resemblance to the NPV rule, the IRR rule applies to decision making regarding stand-alone project within the firm. Even though the IRR rule will give the right solution, hence coincide with the NPV rule, there are some cases where the IRR rule might fail. Four of these cases will be presented below.

First, the IRR method does not have the property of giving higher IRR to investments of a larger scale. In contrast to the NPV, where a project double in size the NPV will be double, the IRR will be unaffected by the scale of the investment project. This is because the IRR method measures the average return of an investment.

The second situation where IRR rule fails is when there is a delay in investment, that is, when payments are received upfront and the costs of a project occurs later, the IRR rule could provide an incorrect decision. This is because when the benefits of an investment occur before the cost will give an IRR that are higher than the opportunity cost. However, the cash flows in this situation has the same structure as borrowing money, thus a lower rate than opportunity cost of capital would be preferred. In the case of delayed investment only the NPV method should be applied. The IRR rule is only guaranteed to work if all the negative cash flows occur before the positive cash flows.

In some cases, multiple values of the IRR can set the NPV equal to zero or the IRR are non-existent and this is the third case where the IRR rule fails. Multiple IRRs can occur if there are fluctuations of positive and negative cash flow in the investment project period. Non-existent IRR is the case when NPV is positive for all discount rates. Having multiple IRRs or non-existent IRR, decisions should be made by applying the NPV rule, and the NPV should be calculated even when there is no IRR that will set NPV equal to zero, because the NPV of the investment project might also be negative.

The fourth and last case that will be presented in which the IRR might fail is in comparing and ranking investment project when choosing between projects. As mentioned in the description of the first case when IRR fails, choosing the project with the highest IRR can lead to mistakes. The fact that IRR does not capture the benefits of scale makes it impossible to compare projects that differ in scale. If the projects do not differ in scale the IRR method can still fail due to the fact that there is difference in timing of cash flows. As an example, receiving a high annual return has more value if it is received for several years, than only for a few days. Another timing difference is in the pattern of cash flows, a project with lower initial cash flows but higher long-run cash flow, might have a lower IRR, however the NPV might be higher because it is effectively a longer- term investment due to delayed cash flows. Another aspect of ranking or comparing investment project is the risk connected to them and the projects risk is reflected in the cost of capital. Choosing between projects by comparing the IRR to cost of capital ignores the fact that there is difference of risk connected to different projects. Earning an expected rate of return in a safe project might be more attractive than earning the same return in a riskier investment project.

The implications in the case of using IRR rule for investment decision is that even though management do not need to know the opportunity cost of capital to calculate the IRR, it is important when they intend to apply the IRR rule. Thus, for the purpose of IRR as a tool to measure the average return of an investment and to get an indication of the sensitivity of NPV to errors in the estimation of cost of capital, it is a valuable tool. However, in order to maximize firm value by investment decisions, NPV is the most reliable decision rule.

2.1.4 Payback Rule

The payback rule, in similarity to the decision rules mentioned previously, applies for decision making regarding single, stand-alone projects within a company. The projects cash flows should pay back the initial investment within a predetermined time period if the project should be accepted. Decisions are made by calculating the payback period, which is the time it takes to pay back the investment. Accept the project if the payback period is shorter than the predetermined time period, and reject otherwise. This is illustrated in figure (9).

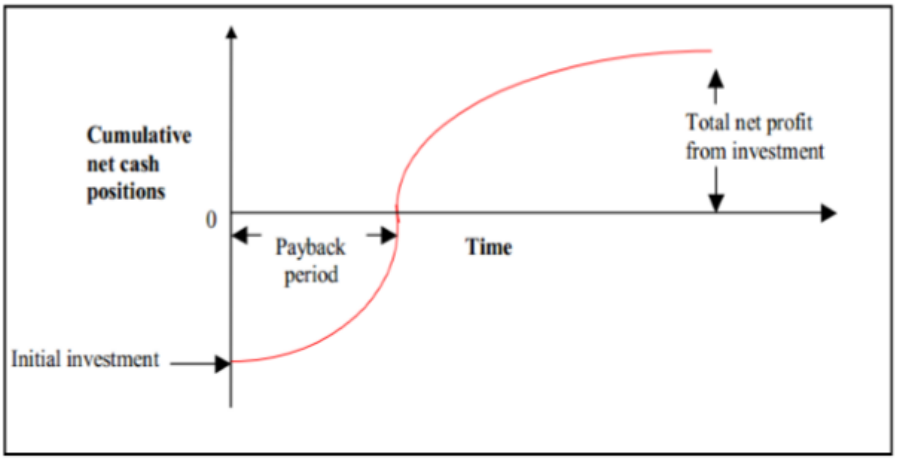


Figure 9: Graphic presentation of the Payback Rule

This method is simple and easy to use and can to some extend provide useful results. However, compared to the NPV, the lack of information about discount rate and the time value of money, makes it less reliable. The payback rule also ignores how the cash flow is distributed and the cash flows occurring after the payback period. Thus, this investment rule, due to its simplicity is most useful in decisions regarding smaller investments in a firm, where a wrong decision might not be as crucial.

Management who choose to use the payback rule can include the discount rate by calculating the payback period using discounted cash flows. The implications of using the payback rule is that the potential costs of making a mistake in investment decision when using the payback rule, should not exceed costs measured in time and effort spent on calculating NPV. Also, when the payback period is very short, it will usually have a positive NPV if it satisfies the payback rule, then management could increase the firm value by saving effort spent on calculating NPV.

Despite of its simplicity, surveys of capital budgeting practice show that the payback rule is popular among CFOs. Graham and Harvey (2001), surveyed the practice of 392 U.S CFOs about their practice of capital budgeting and found that over 50% always or almost always used the payback rule as a project evaluation technique. Brounen, de Jong, and Koedijk (2004), conducted a survey to extend these results for non-U. S firms. They found that among 313 CFOs in UK, the Netherlands, Germany and France respectively 69.2%, 64.7%, 50.0% and 50.9% use the payback period as their preferred tool.

This subsection has provided a presentation of a selection of commonly used investment decision rules and techniques. The key takeaway is that the NPV rule is the rule that maximizes the value of the firm. Presenting the IRR and Payback rule and the circumstances in which these rules are most likely to lead to bad investment decisions, illustrates that the NPV decision rule is the most accurate and reliable decision rule. The remaining of this thesis will therefore have a focus on the NPV rule as method for maximizing firm and shareholder value.

2.2 Systematic Risk and CAPM

Investors are averse to risk and do not want to be exposed to fluctuations in the value of their investments. Due to this fact, the return of an investment should reflect the level of risk the investors take on.

Systematic risk origins from the overall market influence that is affecting the economy as a whole. Unlike unsystematic risk, systematic risk can not be eliminated by portfolio diversification. Unsystematic risk is also known as the "firm- specific risk" and it will not be further discussed in this master thesis due to the fact that investors will not be compensated through risk premium for firm specific risk, this is because this source of risk is possible to eliminate through diversification. Systematic risk on the other hand can also be called "market risk" and the factors that will influence stocks or investment projects in this category, will affect all the stocks and projects in the market. Investors who take on the burden of carrying systematic risk want to be compensated in the form of earning a higher return. This additional return, the risk premium that investors claim to receive when investing in a project, can be determined after the systematic risk has been measured. Measuring how sensitive an investment is to systematic risk is followed by first considering the beta value (β). The beta reflects the sensitivity of a stock to risk factors that lays in the market conditions.

The beta (β) of a security is the expected percentage change in its return given a 1% change in the return of the market portfolio. (Berk & De Marzo, 2011)

As an example, determine how the oil price affect the return of a stock or an investment, is done by calculating the average change in return for each 1% change in oil prices.

Knowing the market risk (β) and the risk premium gives the opportunity to find the expected rate of return of an investment project. The method for this is the CAPM model, that was developed by William Sharpe in 1964, who received the Nobel Prize in 1990 for this development. CAPM is a method of measuring how much reward investment projects have to offer, in order to compensate investors of the project for their risk taking. Being able to judge the risk of new investment projects, gives the possibility to determine the appropriate cost of capital to apply when calculating the projects net present value (NPV). The cost of capital can also be referred to as the opportunity cost of capital for the investors, and shows the appropriate expected rate of return.

There are three underlying assumptions of the CAPM model regarding the investors behavior:

1. Investors can buy and sell all securities at competitive market prices (without incurring taxes or transactions costs) and can borrow and lend at the risk-free interest rate.
2. Investors hold only efficient portfolios of traded securities- portfolios that yield the maximum expected return for a given level of volatility.
3. Investors have homogeneous expectations regarding the volatilities, correlations and expected returns of securities.

Assumption number 2 states that investors only have expectations of return for the systematic risk they undertake, because the unsystematic risk is removed and hence not of significance. The underlying of this third assumption is that there are perfect capital markets, no tax and transaction costs, and that perfect information is available to all investors, thus they have the same expectations.

The CAPM Equation for the Expected return:

$$E[R_i] = r_i = r_f + \beta_i \times (E[R_m] - r_f), \qquad (4)$$

where the expected return on investment ($E[R_i]$ is the sum of the risk free interest rate r_f and the risk premium of investment i ($\beta_i \times (E[R_m] - r_f)$. The risk premium of investment i is given by the difference between the expected return on the overall market ($E[R_m]$) and the risk- free interest rate together with the investments sensitivity to market risk (β_i).

The risk premium is the difference between the market portfolios expected return and the risk-free interest rate. In a competitive market, the expected return of investments with the same level of risk should be equal, and measuring an investments risk with the market portfolios is reasonable.

The CAPM face some criticism due to its strong assumptions and that it does not give a realistic picture of the real world. For example, the capital market is not perfect, and lending and borrowing at a risk-free rate is not possible. Another limitation about the model is that the CAPM is a one period -model, but most investment projects tend to be over a number of years. Because some of these assumptions do not actually explain how investors behave it is not completely accurate. However, the model makes the decision makers to take risk into consideration in a correct way, and it does give a picture of the linear relationship between required return and systematic risk. Decision makers needs to be prepared to compensate their investors for the market risk in the financial decisions they make.

The CAPM model face some empirical challenges due to the fact that it is impossible to construct the true market portfolio of all risky investment, which makes the CAPM theory difficult to test. Also, the fact that when investigating the expected return, investors care about several factors than just the β alone and those are different among different managers. However, the CAPM model serve as an important benchmark model as it gives information about the economic risk of an investment and gives NPV a risk adjusted discount rate for evaluating projects, but fails to give a prediction about expected return.

3. Modern Investment Theory

While classical investment theory assumes investors and managers to be fully rational, modern investment theory is an area that has been developed in order to respond to the difficulty related to these strong assumptions. Broad assumptions on rationality, efficient markets where the value of assets to a firm and its investors are determined by market prices, and that perfect information is available to agents in the market, are in modern investment theory replaced with more evidence-driven behavioral foundations. Modern investment theory is based on assumptions of market failure and modified behavioral hypotheses. In this chapter, a number of theories concerning agency problems and managerial bias are presented to explain how irrational actors in the market behave. Irrationality is referred to behavior that deviates from the strong assumptions of classical investment theory, and show how human emotions are embedded in investment decisions.

3.1 Agency Theory

Agency theory is the analysis of the relationship between two parties that occurs when one part acts one behalf of the other. Corporate managers being the agents of shareholders can be a relationship filled with conflicting interests (Jensen, 1986), and the two parties do not always have the same information. Factors affecting the efficiency of corporate investments are, among others, the ones that emerge from agency problems and information asymmetries (Stein, 2003). Conflicts that can occur in the types of relationships described above are questions about cash payouts to shareholders. Payouts to shareholders imply a reduction of the resources the manager administrates, and hence, reduce the manager's power. Rozeff (1982) presents a model showing that a higher level of payouts to shareholders will lower agency costs. However, due to the decrease in internal resources, managers will have to turn to external capital as investment funding, and by that be exposed to monitoring of capital markets and to the possibilities of funding becoming unavailable or available at high prices.

3.1.1 Asymmetric Information

In a situation where managers have spent all internal funds they will need to raise external capital in order to invest in new attractive projects. External financing is, due to asymmetric information, related to some challenges, which can lead to underinvestment. For example, managers wish to issue shares if they possess superior information vis-a-vis investors, that imply that these shares are overvalued. However, issuing equity is perceived by the market as a negative signal about the firm's performance, and the result is that the firm's stock price will fall (Asquith & Mullins, 1986). Due to asymmetric information, it is difficult for external investors to separate good firms from bad ones, resulting in that all firms get valued at the average. Therefore, there is an implicit demand from new shareholders for a premium to buy shares of good quality firms to cancel out the loss arising if they fund bad ones (Fazzari, Hubbard, Petersen, Blinder, & Poterba, 1988). This premium can increase the manager's cost of issuing equity for financing investment to a higher level than the existing shareholders opportunity cost of internal finance.

This creates an adverse selection problem, and managers become reluctant to issue equity when their internal recourses are scarce, even if it means giving up good investment opportunities (Myers & Majluf, 1984).

Financing investments with debt is an alternative when there are challenges related to raising new equity. However, asymmetric information problems could also occur in the debt market. Managers have more information about the likelihood of repaying debt than the lenders have, and managers might have incentives to accept high risk of default. Because lenders are not able to fully monitor the borrowers' behavior, they use the terms of contracts as a control mechanism (Stiglitz & Andrew, 1981). Increasing interest rate as a mechanism can create an adverse selection problem, because borrowers who are willing to pay a high interest rate could have private information that suggest that they most likely will not be able to repay the loan (Stiglitz & Andrew, 1981). As a result, the credit market turns to credit rationing. *Credit rationing* is a situation where some of the loan applicants gets their applications granted and some do not, even if they offer to pay a higher interest rate. Thus, managers might be unable to raise debt financing for investment.

In addition to challenges of going in to the debt market, problems can occur after a firm has a borrowed money. Having a lot of debt has a negative effect on the willingness to invest in new projects, due to the obligations to existing lenders. Any increase in the earnings from new

projects has to be used to repay the existing lenders, thus there are no available cash to pay the new lenders. This situation, also called "debt overhang", makes firms prone to underinvestment, event tough the new investment opportunities are good projects with positive NPVs.

3.1.2 Empire- building

Another source of agency problem can be that managers think they can obtain a higher degree of power by running large firms, contrary to smaller profitable firms that would be more in the shareholders' interests. In agency theory, this tendency is referred to as "empire building" and can create a conflict of interest between managers and shareholders if the manager chooses to spend all of the firm's internal resources on investing in new projects instead of payouts to shareholders. Managers' incentives for empire building is gaining private benefits of control, and they perceive these benefits to increase proportionally with both the amount of investment and the output of investment. Managers' increased compensation through bonuses connected to growth also affects the inclination to empire building. The influence empire building tendencies have on investment behavior depend on the level of internal recourses being used for investments. Jensen (1986) argues that agency problems due to conflicting interests between managers and shareholders are particularly serious in firms where the degree of free cash flow generated is large. *Free cash flow,* is cash flows from operations that exceeds the amount of cash that is required to finance all the firm's projects with a positive net present value. Having excess cash flow increases the possibility of investing in projects with negative present value because the free cash flow becomes available for the manager to use at her discretion. Jensen (1986) argues that debt will enhance the firm value by both give managers incentives to operate the firm's assets in an efficient way and by committing managers to pay out cash to shareholders. Stulz (1990) also argues when the level of free cash flow is high there will be overinvestment. When investments are financed with debt, obligations of repaying debt will reduce the internal funds and there would be underinvestment.

3.2 Managerial Bias

Managerial bias is an area in behavioral finance that investigates the behavior of irrational managers who operate in efficient capital markets. Baker and Wurgler (2012) provide a definition of how irrational managers behave in their survey on behavioral corporate finance:

Behavior that departs from rational expectations and expected utility maximization of the manager. (Baker & Wurgler, 2012)

Where managers are convinced they are making decisions that increases firm value, but are in fact deviating from the ideal that classical investment theory has provided in the picture of fully rational managers. Thus, the manager has two conflicting goals associated with an investment decision. One is to maximize the perceived fundamental value, and the other is to minimize the perceived cost of capital. To make a point of departure for the presentation of this theory, following Baker and Wurgler (2012), the value of a project can be shown as

$$(1+\gamma)f(K,\cdot)-K, \qquad (5)$$

where γ is an optimism parameter that arguments fundamental value. (*f)* is increasing and concave in new investment *K*.

An optimistic manager never considers there to be a good time to issue equity. Because the capital market is efficient and values the firm at its actual fundamental value of *f-K*, the manager will think that the firm is undervalued by γ*f*, and then by selling a part of the firm *e*, the manager perceives that the existing long- run shareholders the manager is assumed to act on behalf of, will face a loss of

$$e\gamma f(K,\cdot). \qquad (6)$$

Putting the two goals together, the optimistic manager makes investment decisions to solve

$$\max_{K,e}\ (1+\gamma)f(K,\cdot)-K-e\gamma f(K,\cdot) \qquad (7)$$

Differentiation with respect to *K* and *e* gives

$$f_K(K,\cdot) = \frac{1}{1+(1-e)\gamma} \ , \qquad (8)$$

and

$$(1+\gamma)f_e(K,\cdot) = \gamma\big(f(K,\cdot) + ef_e(K,\cdot)\big). \qquad (9)$$

The first derivation *(8)* show the investment policy and show that managers overinvest to a point where the marginal value creation is less than one. Any increase in optimism (γ) and decrease in equity (*e*) the manager is forced to raise in financing investment, makes the problem bigger. Derivation *(9)* is about financing, and show that the marginal value lost from shifting capital structure away from equity is weighted against market timing losses.

3.2.1 Limited Governance

Baker and Wurgler (2012) presents an assumption that limited governance in a firm is present if the behavior of irrational managers could have an impact on the firm's value creation. Several studies provide evidence that the variability of a firm's performance is influenced by the power of the CEO. When the governance is weak it can give the CEO room for influent individual managerial decisions, affecting the potential negative impact an irrational manager can have on value creation in the firm, see for example Adams, Almeida & Ferreira (2005).

3.2.2 Bounded Rationality

In contrast to fully rational behavior, the term bounded rationality refers to human beings' limited ability of information-gathering and computing capacity is limited when dealing with complex formal models. Simon (1972) gives a description of rationality as an ability to gather information about all possible alternatives and outcomes in decision making. Conlisk (1996) present evidence showing that including the assumption of bounded rationality is important to successfully describe economic behavior beyond classical investment theory.

3.2.3 Managerial Overconfidence and Optimism

Compared to social and experimental psychology literature, where overconfidence and other personality biases have been studied for a long time, managerial biases have just recently received attention in economic and financial literature. Optimism and overconfidence is an overestimation of the average skills or outcome (Baker & Wurgler, 2012).

"Overconfidence is defined as the overestimation of the value a manager believes he or she can create" (Malmendier & Tate, Behavioral CEOs: The Role of Managerial Overconfidence, 2015).

This managerial bias is displayed in the form that an overconfident manager believes that the company's current assets are undervalued in the market. He or she also overestimates the value of future potential investments he or she might choose (Malmendier & Tate 2015).

In order to measure CEO overconfidence, decisions regarding the executive's personal portfolio of company stock options has been a common approach in behavioral finance literature. This approach is built on the fact that since the 1980s, US executives have received large grants of stock and options as a part of their compensation. This lead to a situation where the executives are under-diversified with respect to the company- specific risk. Thus, the CEOs human capital value is connected to the firm's success, and reinforces the under-diversification problem. As a measure of overconfidence, the "Longholder" measure was developed (Malmendier & Tate 2005). The idea behind this measure is that overestimation of own firm's future performance, makes overconfident executives take long-term bets on their company's stock event though they suffer from being under-diversified. The executives hold options longer and often all the way to expiration, with the expectation that they will profit from future stock price appreciation.

3.2.3.1 Effects on investment policy:

In finance behavior research literature about overconfidence and optimism, there is evidence that these types of managerial bias affect business investment decisions.

A study by Merrow, Phillips and Myers (1981) in the energy industry about forecasting costs for pioneer plants, reveals that there were cost-estimation errors when the actual costs where double the predicted costs of the plants. Over 50% of the plants included in the study, underperformed by failing in reaching their production goals after six months. They argue that based on experience and knowledge in the industry, both predictable and unpredictable costs should be easy to forecast. However, in many cases in the study managers rejected cost estimates as too high. Thus, revealing a strong optimism bias in the management.

Modelling the implications of overconfident CEOs, Malmendier and Tate (2015) make two testable predictions about the distinctions between an overconfident and rational CEO:

Prediction 1: The investment of overconfident CEOs is more sensitive to the availability of internal cash flow than the investment of CEOs who are not overconfident.

While rational CEOs do not have any preference in what sources they collect capital for investing in projects, an overconfident CEO believes the market sets the price of equity in the firm too low. This belief induces a pecking order of capital structure preferences where an overconfident manager rank the sources of financing where internal funds and debt are ranked first and second respectively and raising equity as a final course of action. Thus, they avoid risky external equity capital by using all internal sources of financing first. The result is that investment decisions are influenced by the availability of internal cash flow.

Prediction 2: The investment-cash flow sensitivity of overconfident CEOs is more pronounced in equity-dependent firms.

An additional level of investment-cash flow sensitivity appears in equity-dependent firms when the desired level of investment is held back by the internal funding limitation. In firms where they are able to use debt financing in investment projects, the investment-cash flow sensitivity is less evident. Malmendier and Tate (2005) show that the measure of overconfidence they call "Longholder" has a higher sensitivity to investment cash flow. Overconfident CEOs overestimate the return on their investment project. Thus, having plenty of cash flow available the overconfident manager will overinvest. It is a perceived undervaluation and reluctance to issue equity that is the mechanism driving overconfidence to increase the sensitivity to

investment cash flow. As a result, due to this unwillingness of issue new equity, if there are too little cash flow available overinvestment will decrease.

3.2.4 Managerial Miscalibration

Miscalibration is the systematic underestimation of the range of potential outcomes, and is a form of overconfidence. Miscalibration is defined as "excessive *confidence about having accurate information"* (Ben-David, Graham, & Harvey, 2013).

Miscalibration can influence corporate policies and there are theoretical reasons to believe that the miscalibration bias can be widespread among executives.

Individuals who are miscalibrated hold a subjective probability distribution that is too narrow. This has been shown in a survey by Ben-David et al., (2013) where U.S. CFOs where asked to give a prediction of one- and ten-year market-wide stock returns. The results show that they were to a great extent miscalibrated, because the actual realized marked returns only falls within their 80% confidence intervals 36.3% of the time. This miscalibration about market-wide returns is also reflected in the decisions and predictions about their own firm's projects, where CFOs in the state of miscalibration tends to provide IRR distributions where it seems that the volatility they expect is far too low. The prediction the CFOs made of market stock returns as over precision measure in the study, show that those predictions were significantly correlated with over precision in their own-firm investment returns expectations. Thus, miscalibration bias can lead to overinvestment.

3.2.5 Bounded rationality bias

Bounded rationality is as mentioned earlier managers and decisions makers' limitations of being fully rational. The boundedly- rational manager will replace the optimization criteria which involves the assumption of rationality, with a criterion of satisfactory performance. Managers with limited rationality will utilize financial rules of thumb to obtain satisfying results. This cognitive limitation can be a reason that explain why managers tend to deviate from the Net Present Value rule, which is stated to be the optimal capital budgeting rule. Surveys show that managers use the Internal Rate of Return more frequently than NPV, and by this dodge the cost of capital calculation. Graham and Harvey (2001) found, in addition to an overweight of IRR

utilization, that over 50% of the firms in their survey use the Payback period rule, despite the fact that the payback criterion also ignores the time value of money and by that has been criticized as a sufficient capital budgeting technique. However, Graham and Harvey (2001) show that the firms who do use techniques that require cost of capital use the Capital Asset Pricing Model. There is also a bounded rationality bias in the choice of discount rate to estimate the appropriate cost of capital. Managers tend to use a firm-wide discount rate for all investment projects instead of using project specific discount rate. A projects discount rate is a measure of risk given by the beta value, and failing to account for project- specific risk can make managers overestimate the value of risky projects, and underestimate the value of safer projects (Krueger, Landier, & Thesmar, 2011). This affects investment decisions whereas there will be overinvestment in projects in divisions within the firm that has a higher beta than the firms' average beta, or underinvestment in divisions that have a beta lower than the firm's average.

The bounded rationality bias is reflected in a firm's project selection because the value of projects that are riskier than the types of projects the firms usually invest in, will be overestimated when the firm use a firm-wide discount rate. Also, when managers rely on the IRR selecting investment projects, the IRR rule would make them choose the project with the highest IRR. As presented in the previous chapter in this thesis the IRR could fail because different investment projects have different characteristics and thus, if the minimum IRR required is the same for all investment project in a firm, it will be overinvestment in more risky projects.

Managers who fail to use a project- specific discount rate, fail in their risk assessment by incorrectly adjust for risk in their valuation of new projects. This leads to value destroying investment decisions because the wrong beta is used to value the NPV of new projects. If the managers cost of capital is underestimated, the investment project should have a comparatively lower return, reflecting comparatively lower value creation for the firm's shareholders.

Allocating internal funds among the firm's portfolio of divisions may be inefficient due to the fact that managers under bounded rationality tend to use a single discount rate for all the firm's divisions. Internal funds will move towards high-risk divisions in the firm, thus, investments are not only dependent on cash flows, but also on the single divisions beta.

For International Oil Companies (IOC), implications of bounded rationality bias are that they might invest more in for example complex exploration activity, that is an area of oil and gas production with most risk connected to it. On the other hand, safer areas such as infrastructure

and transportation might face underinvestment if the IOCs use on firm-wide discount rate for all investment projects. Another implication for IOCs is when choosing to make investment in risky areas or countries. Failing to use a project-specific discount rate might lead to overinvestment in risky areas, drawing a line towards investment in the Barents Sea or countries with high government involvement.

4 Analysis

Agency theory and managerial bias are widely documented in the world of scientific and theoretical articles. The purpose of this chapter is to analyze whether recent observations of the investment pattern in the oil and gas industry can be explained by modern investment theory.

The analysis is concerned around five peculiarities that are representative for several of the major oil companies' investment behavior; 1) Oil companies respond to short-term changes in oil price, 2) Dividend and debt as shareholder's control mechanism, 3) Preserving financial flexibility, 4) Investor Skepticism, and 5) Scrip dividend.

In order to answer the research question that was presented in the introduction chapter, this analysis will draw a line towards agency theory and managerial bias that with the objective to enlighten aspects of the development in the oil and gas investments that can not be explained by classical investment theory. Observations of the oil majors' investment pattern are based on available information from the companies and actualities presented in financial news articles and journals.

4.1 Oil companies respond to short- term changes in oil price

Investment projects in the oil and gas industry have a long- term time horizon, with a lifetime of 30-40 years, and if there is a short-term change in the oil price, following classical investment theory this would be included in the calculation of the cost of capital. Based on classical investment theory, the systematic risk (β) that measures the investment project's sensitivity to change in market conditions, including the oil price, is reflected in the discount rate used in the calculation of the present value of future net cash flows. Thus, the NPV of the long-term projects could, and should still be positive and the investments should not be affected. However, observations of the recent developments in oil and gas investment exhibit that investments have declined after the oil price fall in 2014, illustrated in figure (10).

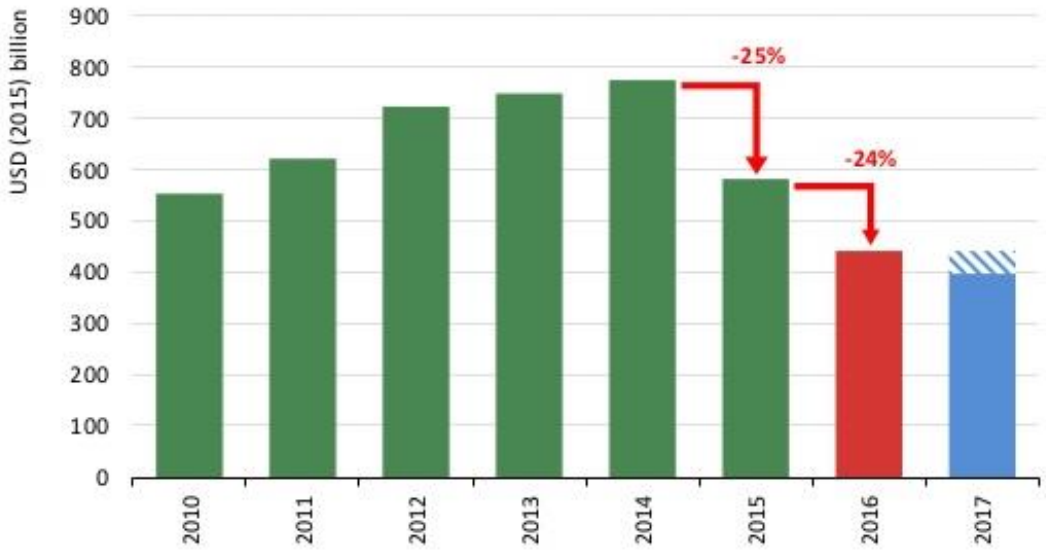


Figure 10: World Oil and Gas Investment. Source: IEA (World Energy Investment 2016)

According to IEA (International Energy Agency, 2017), as a consequence of reduced investment spending driven by low oil prices, global oil discoveries fell to a record low in 2016, and the number of new projects that received a final investment decision has not been lower since the 1940s. For example, in the North Sea, oil investments in 2016 fell to approximately half of the investment level in 2014. The red line in figure (11) show the effects of cut in investment spending, whereas the discovered resources has declined from an average of 9 billion barrels per year the last 15 years, down to 2,4 billion barrels in 2016. Subdued investment in new production raises doubts over longer-term growth (Crooks & Ward, 2017).

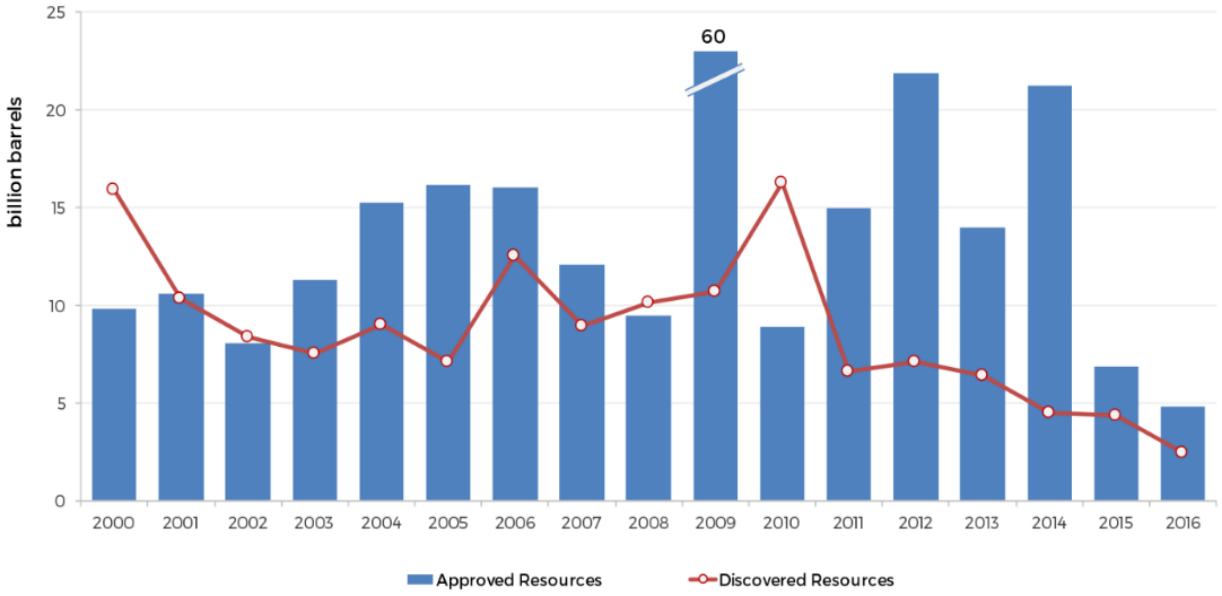


Figure 11: Conventional crude oil resourced discovered and approved (bn barrels) Source: IEA

The response to short- term changes is seemingly at stake with classical investment theory. Thus, in order to explain the fall in investments due to short term changes in oil price, classical investment theory accompanied with strong assumptions of rationality and perfect market conditions, is not sufficient.

Oil and gas companies have different sources to obtain funding in order to finance their investments and dividend payouts to investors. Their options are cash flow from operations, issuing debt, divestment or issuing shares. Statoil's cash flow in figure (12), exemplifies the cash inflows and outflows in an oil company. The cash flow from operating activity is not

sufficient to cover the investment plans, thus other options of funding is required, and if funding is not collected there will be underinvestment. Looking at Statoil's cash flows there are three options to obtain funding for investments. First option is to cut in dividend payouts as this would reduce the cash outflows, however this would not be well received by investors, thus is most likely not an option for the oil companies. The oil companies' dividend payouts are discussed in the next subsection of this chapter. Second would be to sell more assets in order to increase cash inflows, and third option is to raise more debt.

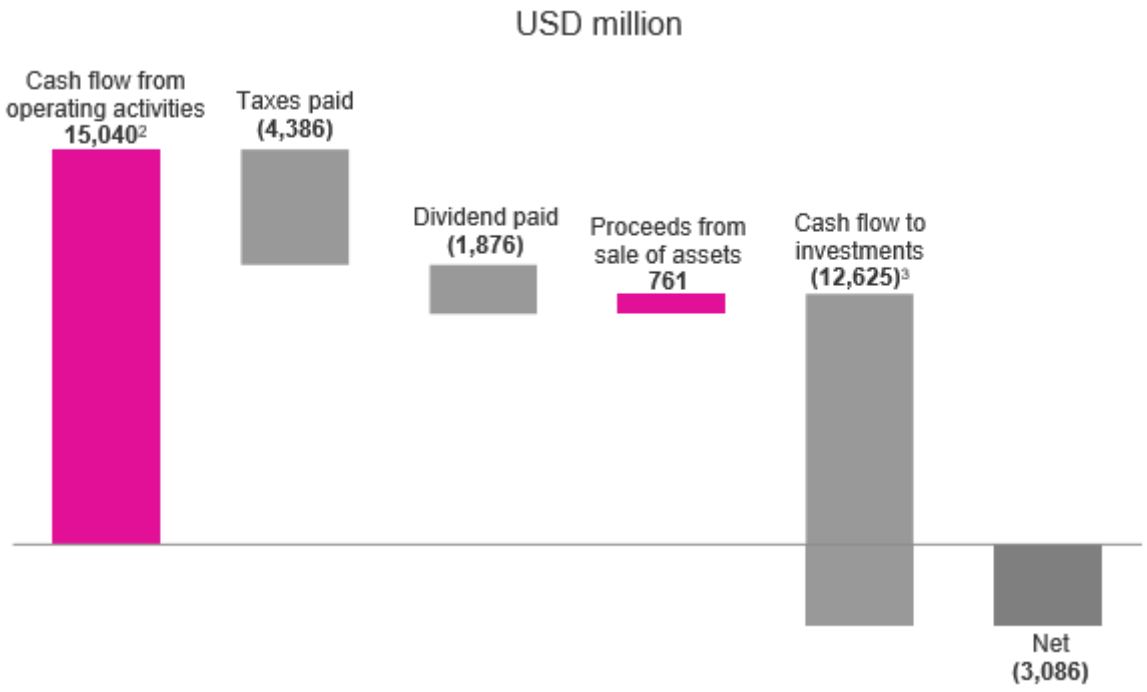


Figure 12: Statoil cash flow in 2016. Source: Statoil

After the sharp oil price drop in 2014, cash flow from operations has decreased, and as a result the oil companies are "forced" to employ alternative sources of capital to finance to new investments.

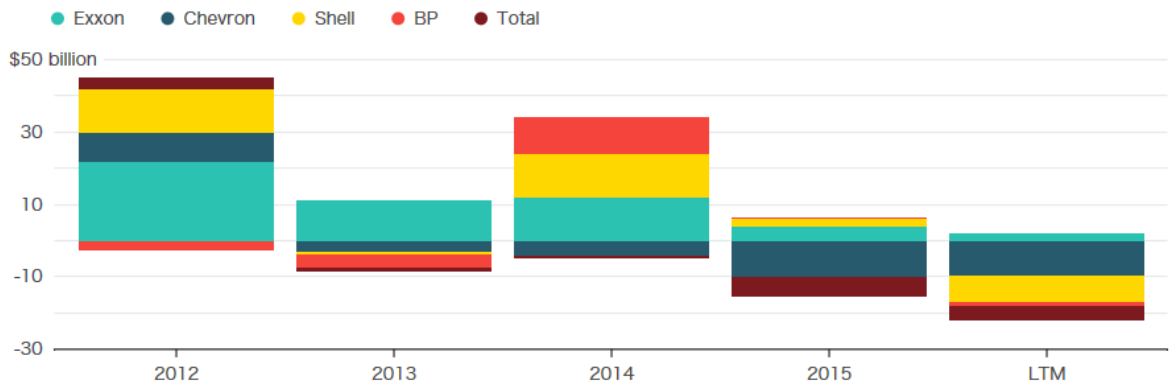


Figure 13: Free Cash Flow after Capital Expenditure 2012-215 and Last Twelve Months (LTM). Source: Bloomberg (2016)

Figure (13) illustrate how the big oil companies' free cash flow after covering their capital expenditure has decreased the recent years, and for all but Exxon, the free cash flow is negative. Oil companies do not only have to cover capital expenditure, but also pay out dividend to investors. In figure (14) the amount of free cash flow after covering both capital expenditure and dividend for the same selection of companies is pictured, and emphasize that none of the major companies are able to finance their capital expenditure and dividend with cash flow from operations.

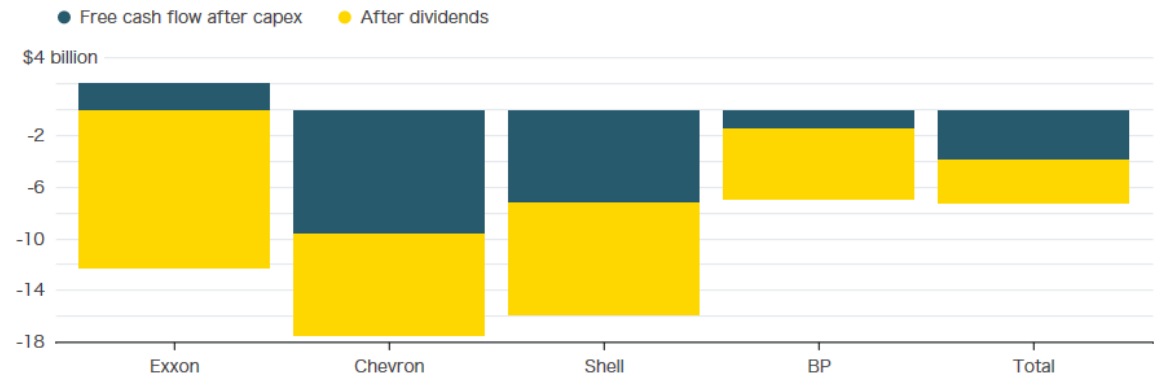


Figure 14: Free cash flow after capex and dividend. Source: Bloomberg (2016)

In the oil and gas industry, uncertainty about future reward is often related to the oil price, and the fact that investment has declined due to the fall in oil price that reduced the company's cash flow from operations, indicates that oil companies are not willing to utilize other alternatives than free cash flow to finance new investment plans[2]. This leaves a clear indication that the management in oil companies are sensitive to cash flow. Crooks and Ward (2017) disclose in their article in the Financial Times that analysts warn the big oil companies to get too focused on increasing cash flow, and express a worry that efforts to realign to lower oil prices are causing oil companies to underinvest in their future. The cash flow sensitivity in the management in the big oil companies are also described by Denning (2016) stating that,

"the majors"[3] main objective is simple to define and fiendishly difficult to reach: Cover their capex and dividend outlays with cash flow from operations. In other words, be self-funding and stop running up debt".

If the management are fully rational, they would be indifferent about sources from where they collect capital. Thus, their apparent reluctance to collect external capital through the option of selling more assets in order to maintain their investment level, is a sign of overconfidence. Recall from chapter three, an overconfident manager overestimates the value of their own firm, hence, believe that the market is under evaluating the value of their firm and as a result set the price of equity in the firm too low. Based on the observations of the oil and gas investments, it is implied that there exists a degree of overconfidence among the managers in the industry. Malmendier and Tate's (2015) prediction number one states that investment of overconfident managers is sensitive to the availability of internal cash flow.

The desired level of investment might be held back by limitation in internal funding. It appears, due to the sharp decline in investment, that oil companies have decided not to increase sale of assets nor raising debt further to finance new investment projects. According to Malmendier and Tate's (2015) second prediction of overconfidence, the cash flow sensitivity is even more pronounced in equity dependent firms. Thus, in the case of lack of cash flow from operations in the oil and gas industry there will be underinvestment, if the management are overconfident.

[2] The rapid response from oil companies to the increase in uncertainty which a shock in the oil price creates, could also be explained by real option theory. An overview of how the irreversible- and sequential nature of oil and gas investments, together with uncertainty affect the value of the real option of waiting is given in Appendix 1.

[3] The majors refer to five of the largest Western oil companies. Exxon Mobil Corp., Chevron Corp., Royal Dutch Shell Plc, BP plc, and Total SA. (Bloomberg 2016)

Subsection 4.3 in this chapter provides a further discussion about the option of taking on debt as investment financing, and reasons why oil companies could be reluctant to utilize this option.

Overconfident managers who cut investment because they are too sensitive to cash flow, make their decisions convinced that they are increasing the firm value. Investment cut in the oil and gas industry might lead to a halt in the damage to the companies' balance sheets right now. This might have implications for the oil companies reserve replacement, which is a very important aspect due to the non-renewable nature of the resources in the oil and gas industry. The oil companies create a long-term foundation of activity and value creation based on the access to producible reserves. However, it might actually be that the oil companies are failing to ensure future reserve replacement due to the historical low investment level, and jeopardize the company's future growth.

To summarize, the overall observations is that oil companies' investment levels are modified as a response to short-term changes in the oil price. According to classical investment theory, this would not be the case; investment levels would remain unchanged. Further, the revealed investment behavior by management in the oil companies have resemblance with modern investment theories of managerial overconfidence. As such, this implies that modern investment theory adds quality to the explanation, and prove more suitable to describe, the observed behavior.

4.2 Dividend and debt as shareholder's control mechanism

According to classical investment theory, all decisions being made affects a firm's value both in terms of costs and benefits. Thus, making a decision of paying dividend, should create value that exceeds the costs of such payments, as this will increase the value of the firm. Ben-David (2010) presents an overview of different theories to explain why firms pay dividend and why investors prefer them. The majority of the studies presented in his outline that researched theories based on rational assumptions, which yields for classical investment theory, finds that rational theories have low explanatory power of dividend policy. However, some findings suggest that one of the economic factors of dividend payments for rational agents are, accompanied by taxes and transaction costs, signaling firms performance. On the other hand, there are also theories that find that dividend do not predict future earnings growth or improvement in operating performance, thus contradicts the signaling theory. This is in line with the observations in the oil and gas sector, whereas stable and increasing dividend is being announced at the same time as earning and future growth has declined with the oil price. Figure (15) gives an illustration of the oil majors and how their dividend has increased even when earnings declined.

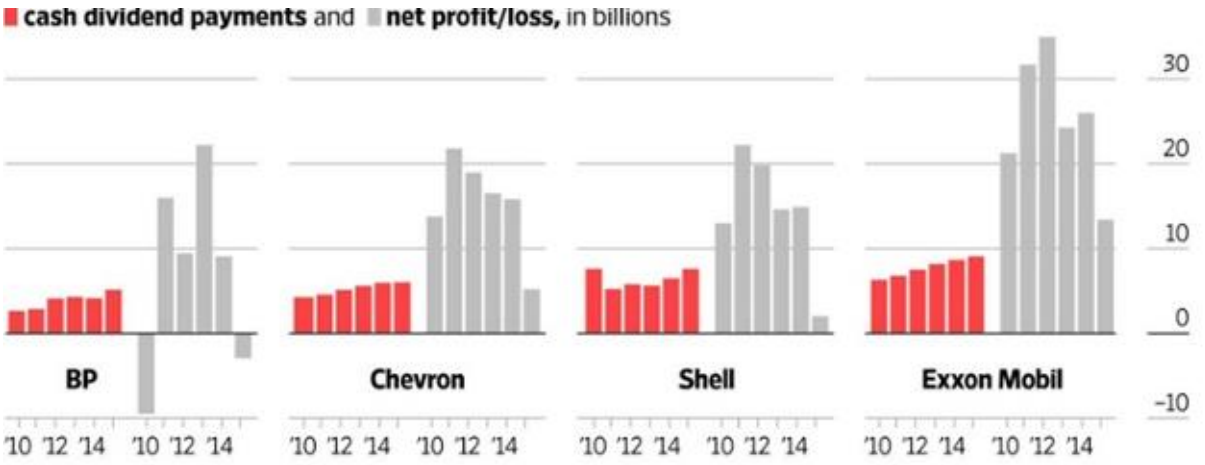


Figure 15: Cash dividend payments and earnings of the largest oil companies. Source: Oilprice.com

Oil companies are cutting capital investment when the oil price falls, putting a limit on their abilities to ensure future production, much because of commitments to maintain dividend payouts to their shareholders. Figure (14) in previous subsection shows how the oil companies fail to cover dividend with cash flow from operations. This means that they have to take on debt to make their payments to shareholders when the recent years low oil price created a slump in oil companies' revenue and decreased the amount of free cash flow

Dividend history of the major oil companies show that dividend has had a stable growth rate. One example is given by Katakey (2017), who writes in a news article that Royal Dutch Shell has not cut in their dividend to shareholders since the second world war, and together with BP consider the payouts sacrosanct. Exxon Mobil as another example, state in their summary annual report for 2016 (Figure 16), that 2016 was their 34th consecutive year with dividend growth.

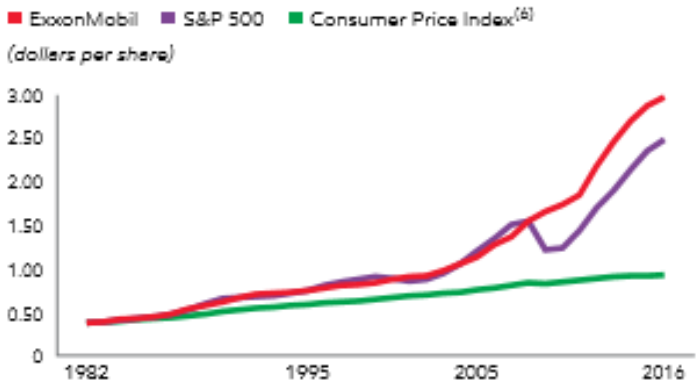


Figure 16: Exxon Mobil dividend growth. Source: Exxon Mobil Summary Annual Report 2016

Dividend payout is determined by the management in a firm, making decisions about the amount per share being paid out and at what time the payment will occur. In a perfect market, all information is available to all actors, but in fact the relationship between management and shareholders includes a number of conflicting interests. Managers might prefer to retain and maintain control over the company's cash, rather than pay it out to investors. Retained cash could be used to fund investment that are costly for shareholders, but could be beneficial for managers' flexibility and empire building. Shareholders might not be convinced that the management in oil and gas companies are making decisions that will increase the value of the

firm. Shareholders' lack of trust in the decisions that are made by the oil companies management, can be explained by figure (17).

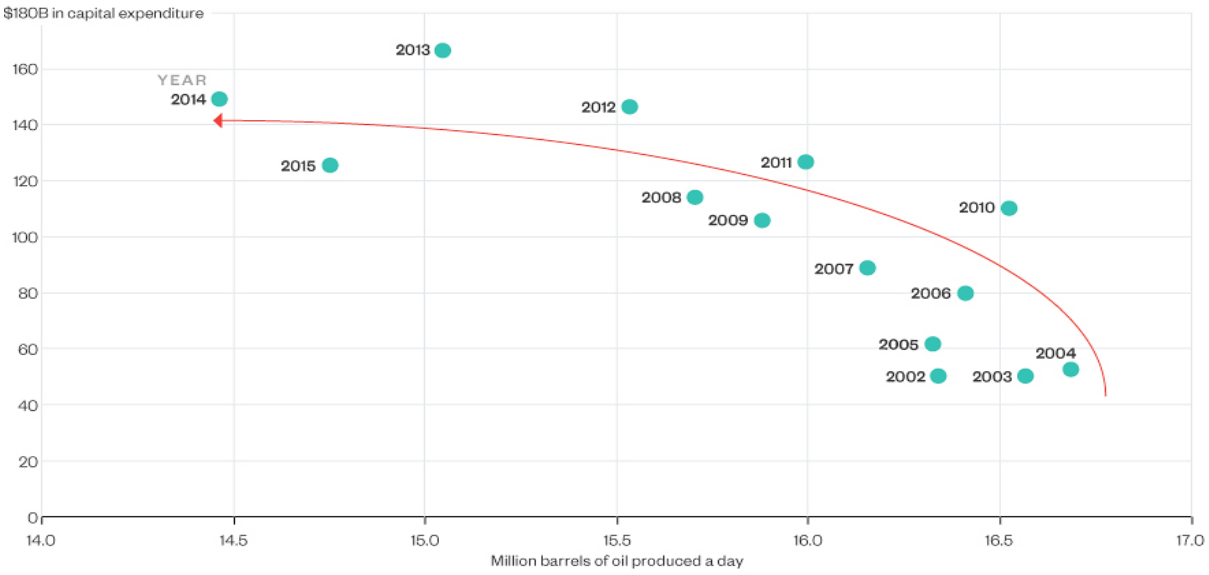


Figure 17: Big oil capex and production. Source: Bloomberg

It reveals how increasing capital expenditure over the last years has not been followed by the same increase in production. Since 2009 to 2015, Exxon Mobil increased their capex with 51% while their production only went up by 6%, Chevron increased capex with as much as 89%, while production actually decreased by 3% (Figure 18) (Fredriksen 2015).

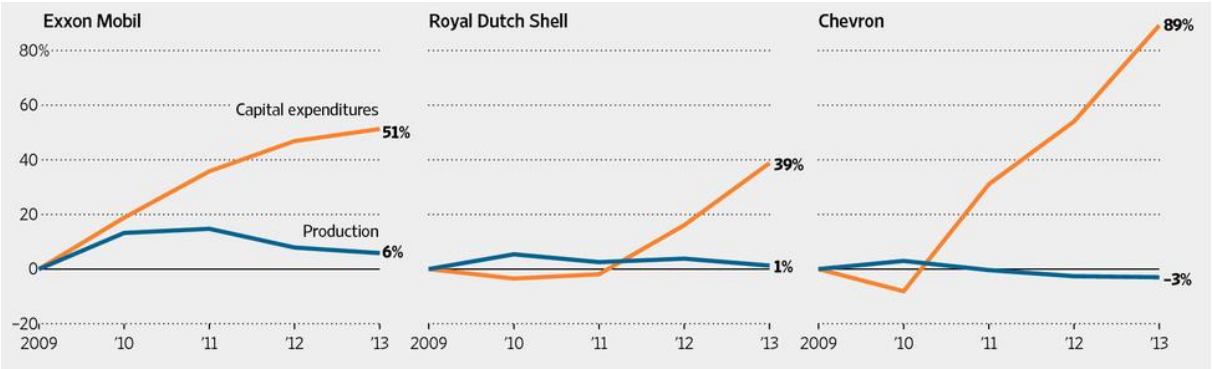


Figure 18: Capex and production from 2009-2013. Source: The Wall Street Journal

This can be interpreted as the management has focused too much on growth rather than profit, making investment that has not been profitable enough to meet their investors interests. Incentives that could have encouraged this mindset is that the managers in the oil and gas industry has received excess salaries and bonuses connected to growth and empire building, and according to Osmundsen (2002), empirical evidence show that top management salaries vary more with firm size than with results. This implies an agency problem, whereas managers have made investment decisions motivated by potential personal gain, at the expense of shareholders, rather than increasing firm value. The development of increasing capex has occurred in times with high oil prices, when the amount of free cash flow in the oil companies has been high and earnings came from the oil price. According to Jensen (1986) agency problems are more pronounced in firms with high amount of free cash flow. The fact that the companies' production has decreased while capex has increased has affected the oil companies' profits, and the result is that they have failed to create a positive yield for their shareholders (Mohn 2014). Demanding dividend would force cash out of the oil companies, and also out of the management control, thus reduce the potential agency costs of free cash flow.

Since the oil price started falling in 2014, the major oil companies were not planning on cutting dividend to shareholders, and Shell and BP state that they will protect dividend at all costs. The oil companies are raising cash elsewhere by selling assets, cutting spending and preserving cash flow to keep maintaining dividend, even though the oil price drop has since June 2014, resulted in half a trillion dollars of value being erased from the five biggest international oil companies (Katakey, 2015). The investors have held on to their demand for dividend, even after the oil price fall in 2014, and oil companies have dividend as their top priority, and would risk to lose investors if they cut it. The market has other investment possibilities, meaning that the oil share has several competitors, and without dividend some of the oil companies would represent a bad investment when earnings are down. The figure from BPs result presentation for 2016 show how their operational cash flows in both 2015 and 2016 fell short of dividend payouts (Figure 19).

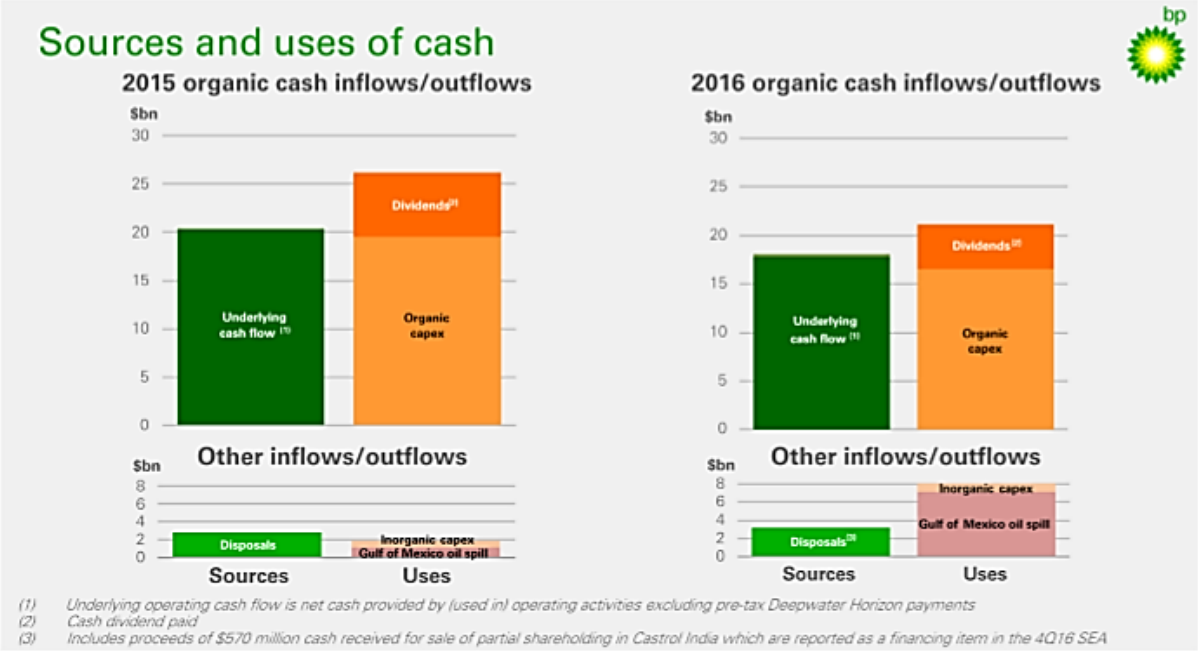


Figure 19: BP Sources and uses of cash. Source: BP.com

BPs situation is not unique among the major oil companies, a situation forcing oil companies to borrow in order to finance their payouts commitments. To exemplify how strong the pressure from investors are on the oil companies, Exxon Mobil increased their dividend payout the day after they lost their coveted triple A credit rating (Katakey 2016). An illustration of how the debt burden has increased for the oil companies the last years is depicted in figure (20).

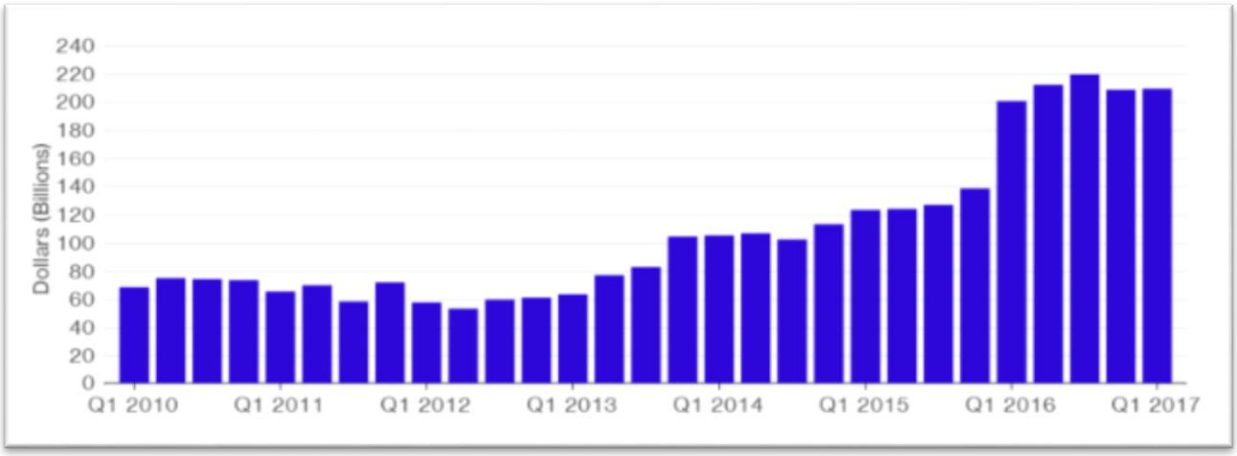


Figure 20: Net debt of Exxon, Shell, Chevron, Total and BP. Source: Bloomberg

Financing dividend with debt in times with low oil price and reduced earnings for the oil companies is facing some criticism. Butler (2016) argues that most oil and gas companies are being forced to borrow to meet their payout commitments and that is a dangerous thing to do. The reason for his statement is that borrowing against a strong balance sheet can only be justified when the money is for investment in new lucrative projects, not when there is no prospect for revenue increase. Other criticism of this practice focus on the fact that companies are borrowing money to pay dividend while they are not investing enough to maintain production. Implications of this criticism is that the value of the managers' decisions of paying out dividend using debt, might not exceed the costs of these dividend payments, thus are not made with a rational objective to increase the value of the firm.

If oil companies would cut in dividends, the investors will suspect this is done to buy additional flexibility to pursue dubious investments, and their response is therefore to send the share price down. Classical investment theory states that making investments with positive NPV creates value for the firm's investors, however once all the positive NPV projects are accepted, any additional project a firm takes on would be a zero- or negative NPV investment. The shareholders pressure on oil companies to maintain their dividend commitment might be because it would tie the hands of the mangers in the oil and gas industry. They suspect that the oil companies' managers desire for empire building would make them invest beyond the positive NPV projects available, whereas this would reduce the shareholder value, as the benefits of such investments does not exceed their costs.

According to Ben-David (2010), several researches done about the link between managerial bias and dividend, find that the market reacts strongly to dividend changes from optimistic or overconfident managers. This could be because mangers with these characteristics will overestimate the value of their investments, thus prefer to invest the firm's cash in firm projects rather than pay out to investors. It is the oil companies' investment pattern that shows a mismatch between capital spending and production over the recent years that keeps shareholders to hold on to their demand for dividend, whereas debt is being used as a mechanism to reduce the flexibility for management. Jensen (1986), state that debt will enhance the firm value by give mangers incentives to narrow their focus towards profitable investments and also securing commitment to cash payout in form of dividend to shareholders. According to a Financial Times news story by Crooks (2016), the pressure for dividend has been reflected in strategic shifts made by the oil companies. Oil companies are moving away from large, unsecure long-term expensive projects towards smaller more flexible projects, giving evidence

to Jensen (1986)'s theory, suggesting that debt prevent managers to waste resources on low-return projects.

The findings in this subsection imply that the oil companies are maintaining dividend to investors, even when the low oil price put their cash flows under pressure. Classical theory suggests that the decision of dividend payouts, should be made in order to increase firm value. However, the fact that they finance their dividend with debt might not create value that exceeds the costs of these payments. The investors demand for dividend share characteristics of a control mechanism to reduce agency costs of free cash flow, in line with modern investment theories of agency problems. Thus, modern investment theory can enhance the explanation of the observed behavior.

4.3 Preserving financial flexibility

When investors are demanding dividend, and forcing cash out of the hands of the oil companies' managers, an obvious alternative for the companies would be to borrow money for their investments. Classical investment theory assumes that there are perfect capital markets where all actors have the same information, and all actors can borrow and lend at a risk-free interest rate. It is also build on the assumption of rationality, where the implication is that rational managers are indifferent of the sources they collect capital.

The reality is different, in fact it is very likely that manager's information about the company and its future cash flows is superior to that of investors. Thus, there is asymmetric information between managers and investors. Oil companies usually argues that the quality of their project portfolio is high, however the fact that they are cutting their investment plans could be a signal of reluctance to use the option of financing their investment plans by raising more debt. Managers in oil companies are seemingly putting their growth at risk by cutting investments, rather than take on the burden of debt obligations.

The managers in the oil companies do have incentives to appear optimistic about their investment projects in order to convince investors that their new project will increase the firm- and shareholder value. Investors will suspect there is asymmetric information, thus, expect the manager to be biased, therefore, financing an investment with debt would serve as a credibility signal about the quality of the project. This is because committing the company to future debt payments signals that the revenue from the investment would place the company in a position where it has no problem making payments. The fact that the oil companies do not take on debt, could be a signal that their investment projects might not be as good as they claim. For example, figure (21) show how few of Chevron's oil and gas projects actually met production targets.

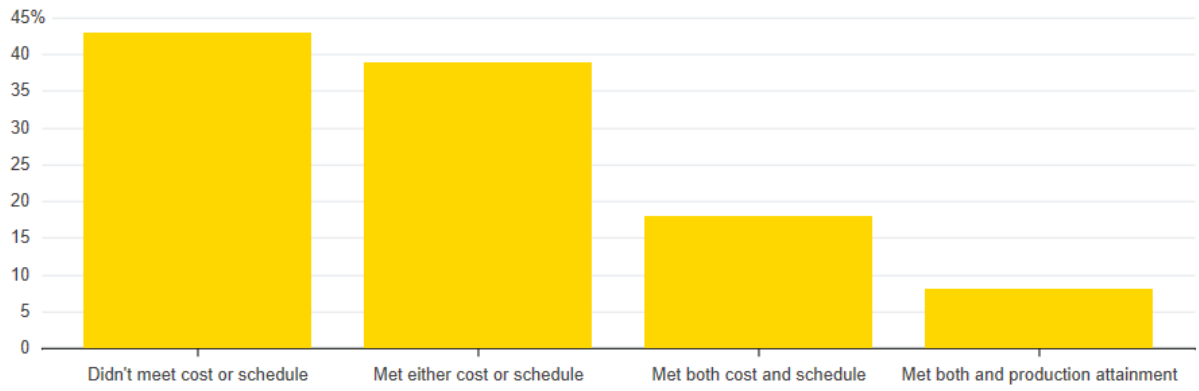


Figure 21: Chevron's industry projects that came on time, on budget, and met their production target. Source: Bloomberg

This example is representative for several of the oil companies' investment projects and reflects the quality of their investments. Having commitment to repay debt would reduce the manager's possibility to invest in projects where there is high risk of not meeting budgets and not being on time.

According to Berk and DeMarzo (2011), debt financing puts an obligation on a firm, because failing to make the required interest- or principal payments at the debt leads the firm to default. This payment obligation will reduce the oil company manager's financial flexibility. Financial flexibility is according to Graham and Harvey (2001), who surveyed CFO's practice of corporate finance including capital structure, the most important item affecting corporate debt decisions. Financial flexibility can be used to make further expansions and acquisitions, and based on the development of capital spending in the oil and gas sector, it might seem as the oil companies' managers are reluctant to constrain their internal funds to spend at their discretion, due to the fact that financing projects internally avoids monitoring by the capital market. According to Byoun (2007), financial flexibility can be described as the amount of resources available for the future, however many of the actions taken today for future financial flexibility can be very costly. If the oil companies financed their investment using debt, they would have incentives to operate their firm's assets in an efficient way, and securing reserve replacement, thus increasing firm value. If they are seeking to maximize their financial flexibility at the cost of maximizing firm value, there is a clear agency conflict between management and shareholders in the oil and gas industry.

The second most important factor affecting the debt policy of the firms surveyed in the study of Graham and Harvey (2001), was good credit rating. Credit rating is given by rating agency, and is an expression of the company's ability to meet the financial obligations in full and on time. Having a high credit rating is a part of the competition among the oil companies. If they do not wish to pursue their alleged high-quality investment plans due to the risk of losing credit rating, they may not actually expect the investment projects to be profitable enough to meet the financial obligations. Receiving a poorer credit rating would raise the cost of borrowing for the oil companies, thus make investors worried about the sustainability of the companies' profitability.

Worries about credit rating could imply that the oil companies are concerned about financial distress and the risk of bankruptcy. It seems as the oil companies minimize the level of debt used for investment projects, implying that they take high risk in their investment decisions. In the case of bankruptcy, the shareholders suffer, because distress and bankruptcy costs reduce the cash available to investors. When securities are fairly priced, the original shareholders of a firm pay the present value of the costs associated with bankruptcy and financial distress (Berk & De Marzo, 2011). Therefore, an overambitious investment level would be punished with poorer loan conditions and a low share price.

Due to the shareholders' strong demand for dividend payouts, the companies have piled up on debt when their cash flow did not cover these payouts. There could be a situation of "debt overhang" for the oil companies, whereas the obligation to repay existing lenders leaves no cash to pay off any potential new lenders. Therefore, taking additional debt would increase the risk of default and bankruptcy.

The key takeaways are that the decrease in investments might stem from managers reluctance to finance new investment projects with debt. This contradicts the assumption of rationality in classical investment theory, stating that rational managers are indifferent to the choice of capital structure. Modern investment theory can provide a more suitable explanation, whereas implications of asymmetric information and desire for financial flexibility to make investments with internal funds, might be factors that hinder the managers from raising debt as capital for project financing.

4.4 Investor skepticism

Benchmark models of investment behavior and corporate finance imply that acceptance of projects with positive NPV will add value to the company. Consequently, the announcement of new investment plans will be an increase in the price of equity and shareholder value. Over the last few years, however, the typical pattern among major oil and gas companies has been that cutbacks in investment have been met with an increase in the share price.

One example is Statoil, who on February 7, 2014 announced to cut their investment by $5 billion from 2014-2016 in their presentation of the fourth quarter 2013 results (Reitan, 2014). Figure (22) below shows Statoil's share price compared to the benchmark index of the Norwegian stock market (OSEBX), U.S oil and gas industry stock performance index (Dow Jones Oil & Gas) and the oil price (Brent Oil). The figure illustrates how Statoil's share price increased February 7, 2014, while the indices and the oil price remained fairly stable in comparison.

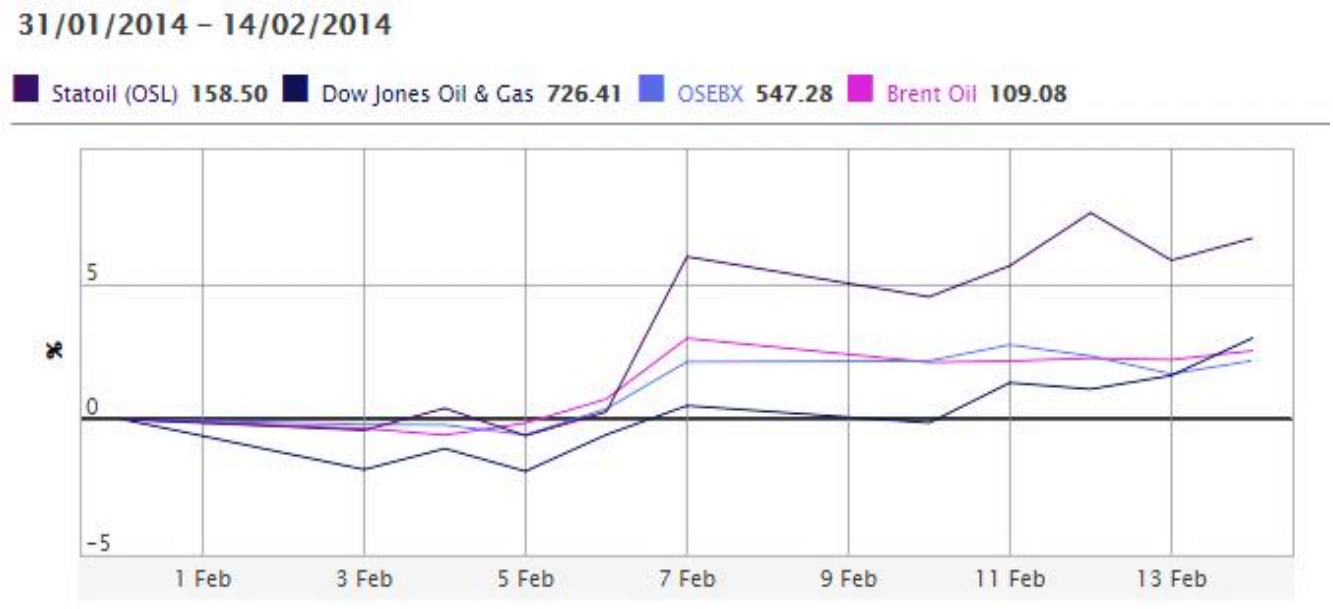


Figure 22: Percent change in Statoil share price, OSEBX, Dow Jones Oil & Gas and Brent Oil, February 1-13, 2014. Source: Statoil.com

Until recently, investors have insisted on maintaining dividend payouts, although falling oil prices have put downward pressure on the cash flows of oil and gas companies. As discussed in a preceding subsection, this dividend policy stem from the fact that investors do probably not share the views of management on project portfolio quality and profitability. Their view on the project portfolio could represents a skepticism to project capex estimates due to recent cost overruns, production shortfalls and lost returns. To illustrate, a study of 365 oil and gas "megaprojects" conducted by Ernst & Young, found that 64 % faced cost overruns, and 73 % were behind schedule. Another study by Edward W. Merrow for IPA (Independent Project Analysis) in 2011 investigated the same phenomenon in the oil and gas industry, he found that 78 % of "megaprojects" faced cost overruns or delays. Harry Benham, consultant and oil industry veteran gives a description to of "mega projects" as,

"highly complex one-offs, and demand very experienced teams to manage their unique difficulties. These intrinsic characteristics prevent conventional manufacturing mechanisms of cost improvements such as standardization at a distance and trial-and-error advances that lead to rapid sustainable technical learning and cost reductions." *(Denning, 2016)*

Following the reasoning of "bounded rationality bias" presented in subsection 3.2.4 in the previous chapter, the high investment in large complex projects with high risk connected to them could be explained by the manager's tendency to use firm-wide discount rate. Failing to account for project-specific risks connected to for example projects in deep-water drilling and artic exploration, could make oil companies overinvest in these risky projects on account of safer ones. However, the projects that succeeded was very successful, and due to the high oil price the successful projects generated high revenues. Baker and Wurgler, (2012) gives an overview of studies that provide empirical evidence that overconfidence and managerial bias have an impact on corporate investment decisions. Overconfidence is increasing following success but do not decrease to the same extent, or at all, following failure. Success tends to be attributed to managers own skill, while failure tends to be attributed to bad luck (Adam, Fernando, & Golubeva, 2015). The successful projects seem to have been more salient to the managers in oil companies, thus received more attention and fed the managers with additional overconfidence and optimism to keep spending money. The increases in spending has been justified as the managers were pointing out rich asset bases and approved projects (Farah & Mitchell, 2016). There is a possibility that the oil companies have invested in mega projects, with higher complexity, costs and risk, because they have emphasized growth over value. This

led them to underestimate the consequences of high project complexity, tighter supply chain, and uncertainty in the project schedule, not to mention the downside risk to the oil price.

In 2014, twenty major oil projects' forecasts were identified to a total cost of $90.7 billion, where most of them had a break-even price of at least $110/ barrel (Reuters, 2014). This is an example that may have made investors skeptical to oil companies estimates for oil and gas prices. Managers in the oil and gas industry seem to have had optimistic expectations about the oil price, and underestimated the probability of a decline. There have been many warnings about the increasing uncertainty connected to a high oil price. One example is analyst Torbjørn Kjos in DNB Markets who in 2012, presented a report predicting that increasing supply from U.S shale oil and decreasing demand would lead to a sharp decline in the oil price (Bjerke, 2012). However, the managers continued to increase their investments. Another example of how managers have been too optimistic about the oil price is that some of the highest cost projects of the Top 400 global oil and gas projects reviewed by Goldman Sachs in 2014, have complex ownership structure and government involvement. For example, the Kashagan field in Kazakhstan, stopping production if oil price would drop is almost impossible due to the producer country's need for export revenues (Livsey & Armstrong, 2015), implying that the choice of projects was decided based on a lasting high oil price.

Another factor that might shape the investors view on the oil companies project portfolio is a skepticism to oil companies estimates for reserves and production profits. Based on available information from the international oil companies[4], Farah and Mitchell (2016) found that the companies' exploration and drilling spending increased by 57% in the period between 2010 and 2014, however they were not able to increase their production, nor their reserves organically.[5]

[4] Chevron Corp., ConocoPhillips Inc., Eni SPA, ExxonMobil Corp., Royal Dutch Shell PLC, Total SA, and BP PLC.
[5] Organic reserve replacement refers to the reserves found by a company's exploration and production activity, rather than buying proven reserves.

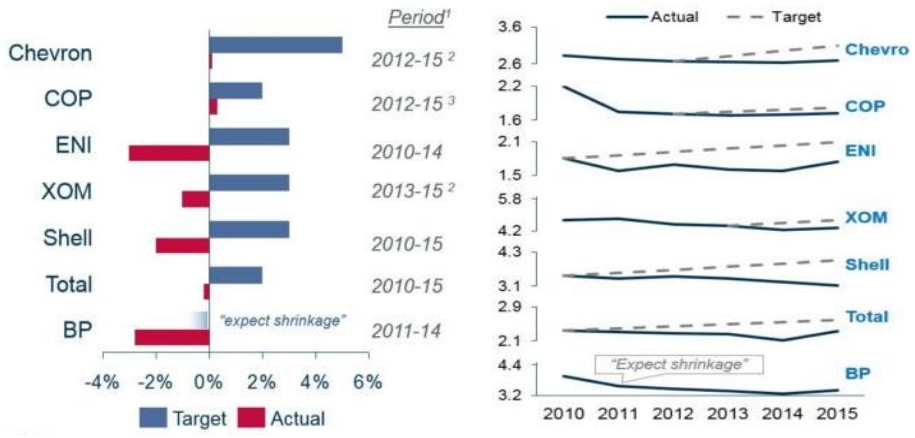


Figure 23: Production growth targets vs delivery and production vs growth target. Source: Oil & Gas Journal

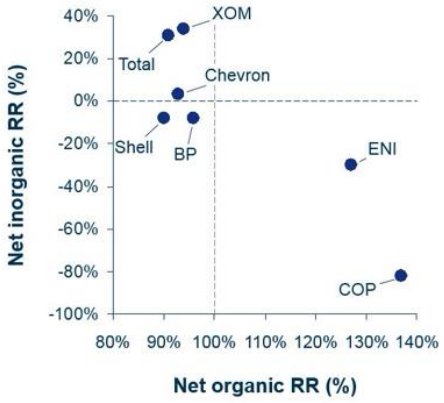


Figure 24: Reserve replacement rate, organic vs inorganic. Source: Oil & Gas Journal

The international oil companies' growth target suggested an increase in production of 1.9 mmboe/d crosswise the companies. Altogether they fell 2.4 mmboe/d short of their targets (Figure 23). Figure (24) illustrates how only two of the major oil companies managed to replace reserves organically. The revenues however, raised along with the oil price at that time, which led the oil companies to accept inefficiency. It could seem as the managers worried less about their inefficiency, and more about the revenues created due to the high oil price because the revenues were more observable than the potential threat of inefficient production. Focusing more on the observable rather than the possible is according to Rook and Caldecott (2015) a sign that there is bias in the management that increase the risk of *stranded assets*[6].

[6] Stranded assets include premature or unexpected write-downs, devaluation, or conversion to liability of assets (Rook & Caldecott, 2015)

Stranded assets are always a potential outcome when managerial cognitive bias result in improper management of the risks an investment project in the oil and gas industry are exposed to. According to Rook and Caldecott (2015) this especially yields for risks associated with climate change, such as environmental risks. Threats from this type of risks for an oil and gas investment project are, among others, new governmental regulation, such as carbon pricing, in order to reach the 2 °C global warming target (U.N, 2015). This could make it too costly to produce oil, and these investments would not be profitable. In addition, threats from developments in technology of producing energy from renewable resources that leads to lower costs in renewable energy could threaten the demand for oil and gas. Rock and Caldecott (2015), suggest that increasing capex into "megaprojects" is accompanied by managerial bias, whereas environmental threats has not yet been experienced by many, thus falls under the category of "possible", rather than "observable outcomes". Shareholders might be concerned that the oil companies' management fail to include environmental- related risk facing individual projects into their decision making. Thus, high capex projects could be a result of inefficient capital allocation by overinvesting in risky projects, rather than safer ones.

There seem to have been a miscalibration in the management of oil and gas companies, whereas their underestimation of the range of potential outcomes, led to overinvestment. The fact that many of the big oil companies are cutting their "mega projects" and shift to lower-cost projects when the oil price dropped, indicates that they failed to account for the risk of falling oil price. A big part of the uncertainty in the oil and gas industry is connected to the oil price, therefore the managers should have been better calibrated in their project evaluation and forecast on how lower prices and higher costs would affect their projects and future profits. Research on miscalibration finds that overconfidence and miscalibration bias are more pronounced when the actual risk is high. Thus, these mechanisms could be enhanced as the oil price increases the uncertainty in the industry.

Due to the mismatch between level of investment and production, whereas the increase in investments has been accompanied with reduced production, the capital market and investors seem to have reduced faith in oil companies' investment plans and profits. The fact that the share price increase when the oil companies are announcing cutbacks in their investments could be because investors seem to believe that the projects companies cut actually have negative NPV. In times with growth and high oil prices, the oil companies have had large amounts of free cash flow (figure 25).

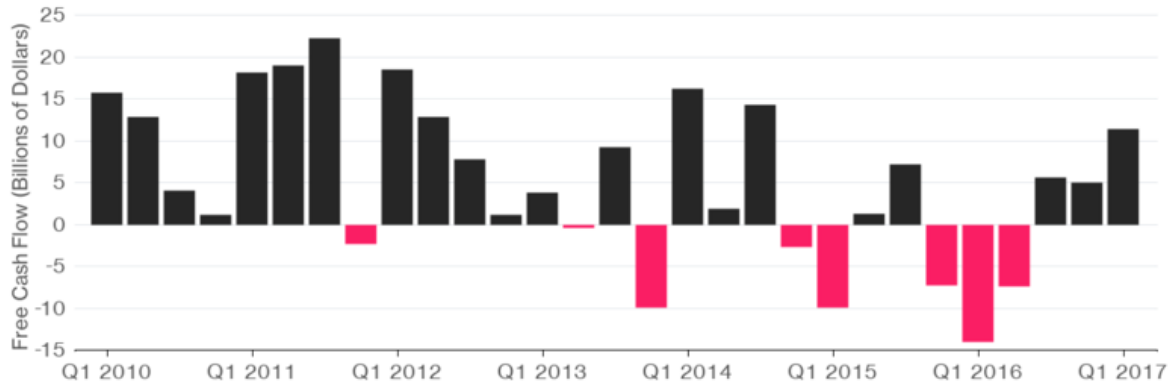


Figure 25: Oil Major's free cash flow. Source: Bloomberg

According to Jensen (1986) having excess cash flow increases the possibility for investing in projects with negative NPV, thus the investors' suspicions are in line with theory of agency problems of free cash flow.

Overall, the above discussion suggests that oil companies' managers might have incentives for empire building, seem to be miscalibrated in their project evaluation, overconfident in their own project's performance, or suffer from bounded rationality. This could be the reason why investors and capital markets now applaud cut in what they perceive to be bad investment projects, with goals to lead the oil companies to focus on profits and capital discipline. Thus, modern investment theories' assumptions may better explain recent observations in the pattern of oil and gas investment behavior, beyond classical investment theory.

4.5 Scrip dividend

Scrip dividend is additional shares given to shareholders relative to their existing shareholdings, and is offered to the shareholders in place of a cash dividend. The company expand their shareholdings, meaning that they increase the number of shares existing, and give them to whom of their shareholders choosing this as an alternative payment. This, however, does not increase the value of the firm, this practice actually dilutes earnings per share and future earnings might be spread more thinly.

In a low-price environment, which the oil industry finds it selves to be in, the oil companies' investors are holding on to their demand for dividend, and the companies are in urgent need for cash. Offering a scrip dividend would potentially preserve both. Distributing dividend in shares rather than cash gives the companies a possibility to retain more of its cash flow to invest in new projects or reduce their debt burden. Many of the big oil companies have offered their shareholders to participate in a scrip dividend program, for example in 2015 analysts said that Royal Dutch Shell Plc, Total SA, and BP Plc would retain $8 billion a year in cash by offering scrip dividend (Katakey, 2015). The CFOs stated that the purpose of introducing scrip dividend was to obtain flexibility.

In May 2016, Statoil's annual general meeting approved the introduction of a two-year scrip dividend program (Statoil ASA, 2016). Statoil have for several years had to borrow money in order to finance their dividend because their operating cash flows have not been sufficient to cover their expenses. Statoil's scrip dividend program could in resemblance to the other big oil companies, yield significant savings of cash for the company compared to cash dividend. In order to make their offer more appealing to shareholders, Statoil gives a 5% price discount per share for those who opt for the scrip dividend. According to Statoil, the scrip dividend program is expected to strengthen the company's financial robustness, and complements this with other measures such as financial discipline and efficiency improvements. Further, the program should work as a tool to strengthen Statoil's financial capacity to invest in profitable projects in a low, volatile and uncertain price environment (Statoil ASA, 2017). The scrip dividend is postponing the cash payouts for the future, in the hope that the oil price will recover.

Analysts predicted that a large proportion of Statoil's shareholders would choose a scrip dividend, and that as much as 70% of dividend would be chosen to take in shares (Lorentzen, 2016). The actual amount however, was much lower. In the fourth quarter of 2015, investors only took 43% of their net dividend in shares. A possible reason why so few chose the scrip dividend could be that the shareholders do not have faith in Statoil's future earnings, and that they would be better off investing the money themselves. However, the discount is still "money on the street" and more than half of the investors do not pick it up.

Offering shares as dividend, allows shareholders who take this option to obtain new shares without incurring transaction costs they would otherwise meet if they would buy these shares in the market. However, the managers transfer a price risk from the company to their shareholders, who might not wish to bear that price risk if they have reduced faith in the company. If there would be a reduction in Statoil's share price, converting shares into cash in the stock market would be unprofitable for the investors, even after the price discount on share price, whereas the discount would not offset the potential price risk, nor the transaction costs by converting the shares in to cash, in a satisfying way for shareholders. Therefore, cash would be a better alternative for those investors who depend on a stable cash flow. Another aspect is that if all the shareholders would sign up for the scrip dividend program, the discount on share price would effectively disappear. Thus, when some shareholders evaluate the costs of price risk and transaction costs to not exceed the value of the discount, they are all better off if some take it, and some do not.

The fact that less than half of Statoil's dividend that was paid out in shares, reduced the potential amount of cash flow preserved for new investments. The shareholders might suspect that given the oil companies' history of mismatch between capital spending and production, the new investment Statoil wish to pursue will not increase the firm and shareholder value. Thus, choosing cash dividend limits their cash flow for investments. Postponing cash payouts for the future could imply that the managers are optimistic about the oil price recovery and overconfident in their own potential new investments revenue. Statoil's shareholders could have recent history in mind, and suspect this managerial behavior and therefore, securing their own cash flows by taking dividend in cash rather than shares.

Scrip dividend preserve cash for now, however it dilutes the earnings per share and reduces the relative value of the pre-existing shares. Thus, reduces the value of shareholders' investment and their relative ownership in the company. Reduced ownership could also reduce the shareholders power, as a control contest whereas the management seek to dilute shareholdings

of certain shareholders (Graham & Harvey, 2001). The shareholder's choice to not participate in the scrip dividend program could be to avert a high degree of dilution. The company could choose to buy back their shares to offset the dilution issue, or allocate more cash for investor payouts. Statoil is including share buybacks as a part of their dividend policy. According to Jensen (1986) managers with free cash flow can repurchase stock to payout cash, leaving them with control over the use of future free cash flows. Shareholders might prefer that paying out cash dividend, force the company to maintain their debt burden in order to motivate management towards profitable, efficient investment decisions.

To sum up, a large percentage of the investors do not opt for the oil companies offer of scrip dividend with a price discount on the share price, in the place of cash dividend. Classical investment theory is underlaid assumptions of perfect capital markets and rational behavior. However, modern investment theories of market imperfections such as transaction costs, agency costs and asymmetric information are seemingly more representative of the companies' choice of offering scrip dividend, and the reasons at which investors emphasize whether to opt for this option or not.

5 Conclusion

By reviewing classical and modern investment theory, conjointly with occurring investment patterns in the oil and gas industry, this thesis has investigated to which degree certain actualities may be justified by established investment theory. Further, whether more recent contributions to the investment theory is more suitable, and adds value, to the explanation of current investment patterns observed in the market.

This study introduces the principles and financial tools of classical investment theory, followed by a systematic review of the available literature on modern investment theory. These two ideologies have been applied to, and discussed simultaneously, as noteworthy events, patterns, investor and managerial behavior, have been revised. The analysis provides useful insights. Firstly, the development in the oil and gas industry ahead of, and likely reinforced by, the ongoing recession, have induced investors to become more skeptical. The evident patterns for instance imply that investors have an increased focus on profits in the short-run, restrict their investments, and consider shares with dividend more attractive. Hence, investors are more concerned for receiving cash today. Secondly, this have implications for the investor relationship with managers. Managerial decisions are seemingly driven by underlying motivations such as personal gains, financing through internal capital, empire building, and securing future personal earnings, meaning, they prioritize ensuring future free cash flow. This has led to managers´ overconfidence and excess optimism. As a result, investors appear to have diminished trust in, and a greater need for control of, management. Thirdly, the companies have increased their proportion of debt, however they prefer to employ internal funding to avoid losing financial flexibility. Furthermore, increased debt reflects the firms' satisfying of investors' demand for dividend alternatively to new investments.

Overall, the analysis provides that the development in oil and gas industry moves in a direction whereas decisions and behavior to a larger degree coincides with, and is better explained by, the central assumptions of modern investment theory.

The review present valuable knowledge and acumen for policy makers and decision takers. Especially for oil nations, it is key to design strategies that are based on appropriate assumptions on investment behavior in order to implement measures that will safeguard the nation´s welfare. Awareness of potential market response to decisions made by biased motivation, is important insight for decision-makers at the firm level, and ought to be carefully considered towards a

final investment decision to ensure profitable investments. In the capital market, investors also benefit in the sense that this provides insight that enables them to recognize signs of managerial behavior that are potentially harmful for their profits.

This thesis has sought to enlighten several topics and peculiarities in consideration of classical and modern investment theory. Naturally, given the limitations of a master´s thesis, resulting in a high-level analysis and indicators of present relationships. This is not hard evidence that may form basis for future decisions, however it does provide several interesting paths for further research. The implied relationship between stock prices and investment is negatively correlated, however it is not addressed to which degree this is supported by empirical data. Will this also be supported by undergoing more extensive data analyzes? Firms decisions regarding debt and capital structure is an essential choice of strategy, and as such, what are in fact the firms' preferences in practice? What is favored between internal and external financing? Which of the internal sources of capital is most commonly chosen and preferred to finance new investments? Moreover, to which degree are firms in fact concerned about factors such as financial flexibility, credit rating and bankruptcy when determining their capital structure? Another intriguing observation is that firms continue to distribute dividend to shareholders by increasing debt. What is the long run consequence for the firm? Will continued dividend attract new investors so that the market value is maintained, or is the going concern altered by the continuous outflow of the firm´s value and increasing financial obligations?

6. Reference List

Adam, T. R., Fernando, C. S., & Golubeva, E. (2015). Managerial Overconfidence and Corporate Risk Managment. *Journal of Banking and Finance 60*, ss. 195-208.

Adams, R., Almeida, H., & Ferreira, D. (2005). Powerful CEOs and Their Impact on Corporate Performance. *The Review of Financial Studies*, ss. 1432-1443.

Asquith, P., & Mullins, D. W. (1986). Equity issues and offering dillution . *Journal of Financial Economics* , ss. 61-89.

Baker, M., & Wurgler, J. (2012). Behavioral Corporate Finance: A current study. *Handbook of the Economics of Finance: Volume 2*, s. Elsveier Press.

Ben-David, I. (2010). Dividen Policy Decisions. Hoboken: Wiley.

Ben-David, I., Graham, J. R., & Harvey, C. R. (2013). Managerial Miscalibration. *Quarterly Journal of Economics*, ss. 1547-1584.

Berk, J., & De Marzo, P. (2011). *Corporate Finance.* Pearson.

Bernanke, B. S. (1983, February). Irreversibility, Uncertainty and Cyclical Investment. *The Quarterly Journal of Economics, Vol 98*, ss. 85-106.

Bhattacharyya, S. C. (2011). *Energy Economics* . London: Springer.

Bjerke, E. (2012, August 22). *Spår at oljefesten snart er over*. Retrieved from Dagens Næringsliv: http://www.dn.no/nyheter/energi/2012/08/22/spar-at-oljefesten-snart-er-over

Bloom, N. (2000). *The Real Options Effect of Uncertainty on Investment and Labor Demand.* Institute for Fiscal Studies: Working Paper 00/15.

BP Plc. (2017, February 7). *BP Global.* Retrieved from http://www.bp.com/content/dam/bp/en/corporate/pdf/investors/bp-fourth-quarter-2016-results-presentation-slides-and-script.pdf

Brounen, D., de Jong, A., & Koedijk, K. (2004). *Corporate Finance In Europe Confronting Theory With Practice.* Rotterdam: Erasmus Research Institute of Managment.

Butler, N. (2016, Januar 13). *Financial Times.* Retrieved from http://blogs.ft.com/nick-butler/2016/01/13/big-oil-in-hard-times-the-case-for-cutting-dividends/

Byoun, S. (2007, October). *Financial Flexibility, Firm size, and Capital Structure.* Waco: Hankamer School of Business, Baylor University .

Carlsson, M. (2007, March 12). Investment and Uncertainty: A Theory- Based Empirical Approach. *Oxford Bulletin of Economics and Statistics 65 (5)*, ss. 603-617.

Colinsk, J. (1996, June). Why bounded rationality? *Journal of Economic Literature*, ss. 669-700.

Crooks, E. (2016, May 29). *The Financial Times.* Retrieved from https://www.ft.com/content/88a4d2d8-25ba-11e6-8b18-91555f2f4fde

Crooks, E., & Ward, A. (2017, May 6). Big Oil still nervous after profit rebound. *Financial Times*. Retrieved from: https://www.ft.com/content/a95fd5a6-30c0-11e7-9555-23ef563ecf9a

Denning, L. (2016, November 1). Big oil burned less cash. Yay. *Bloomberg*. Retrieved from: https://www.bloomberg.com/gadfly/articles/2016-11-01/big-oil-earnings-burning-less-cash-which-isn-t-saying-much

Denning, L. (2016, August 1). Big Oil's Ugly Second-Quarter Scorecard. *Bloomberg*. Retrieved from: https://www.bloomberg.com/gadfly/articles/2016-08-01/big-oil-earnings-cash-flow-crash

Denning, L. (2016, August 29). Big Oil's Yuge Problem. *Bloomberg*. Retrieved from: https://www.bloomberg.com/gadfly/articles/2016-08-29/big-oil-loses-love-for-big-projects

Dixit, A. K., & Pindyck, R. S. (1994). *Investment under uncertainty.* Princeton, New Jersey: Princeton University Press.

Ernst & Young. (2014). *Spotlight on oil and gas megaprojects.* Retrieved from http://www.ey.com/Publication/vwLUAssets/EY-spotlight-on-oil-and-gas-megaprojects/$FILE/EY-spotlight-on-oil-and-gas-megaprojects.pdf

Exxon Mobil. (2016). *Summary Annual Report.*

Farah, P., & Mitchell, A. (2016, August 1). Cost-cutting not enough to hit IOC growth target . *Oil & Gas Journal Vol 114, Issue 8*.

Fazzari, S. M., Hubbard, G. R., Petersen, B. C., Blinder, A. S., & Poterba, J. M. (1988). Financing Constraints and Corporate Investment. *Brookings Papers on Economic Activity*, ss. 141-206.

Fredriksen, A. W. (2015, February 25). *E24.* Retrieved from http://e24.no/energi/professor-om-oljebransjens-utsikter-aksjonaerene-vil-kreve-cash-eller-sende-aksjene-ned/23403072

Gitman, L. J., & Forrester, J. R. (1977). A survey of capital budgeting techniques used by major U.S firms. *Financial Management*, ss. 66-71.

Graham, J. R., & Harvey, C. R. (2001). The theory and pratctice of corpotate finance: evidence from the field. *Journal of Financial Economics*, ss. 187-243.

Hanesson, R. (1998). *Petroleum Economics, Issues and strategies of oil and natural gas production.* Praeger.

Heaton, J. B. (2002). Managerial Optimism and Corporate Finance. *Financial Managment* , ss. 33-45.

Hegge, H. J. (2017, February 7). *Statoil 4Q result.* Retrieved from https://www.statoil.com/content/dam/statoil/documents/quarterly-reports/2016/q4-2016/statoil-cfo-presentation-cmu-2017.pdf

International Energy Agency. (2017, April 27). *IEA.org*. Retrieved from News: https://www.iea.org/newsroom/news/2017/april/global-oil-discoveries-and-new-projects-fell-to-historic-lows-in-2016.html

International Monetary fund. (2015). *World Economic Outlook: Uneven Growth - Short- and Long- Term Factors.* Washington.

Iqbal, Z. (2015). CEO age, education, and introduction of hedging in the oil and gas industry. *Journal of Economics and Finance 39*, ss. 189-200.

Jensen, M. C. (1986). Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *American Economic Review*, ss. 323-329.

Kabeya, A. (2017). *Student Energy*. Retrieved from https://www.studentenergy.org/topics/tight-oil

Katakey, R. (2015, August 26). Investors Betting on dividend cuts ignores decades of history. *Bloomberg*. Retrieved from https://www.bloomberg.com/news/articles/2015-08-26/oil-investors-betting-on-dividend-cuts-ignore-decades-of-history

Katakey, R. (2015, April 11). European Oil's $8 billion plan to pay investors and retain cash. *Bloomberg*. Retrieved from: https://www.bloomberg.com/news/articles/2015-11-04/european-oil-s-8-billion-plan-to-pay-investors-and-retain-cash

Katakey, R. (2016, May 13). *Bloomberg.* Retrieved from https://www.bloomberg.com/news/articles/2016-05-13/big-oil-gobbles-up-record-levels-of-debt-as-borrowing-costs-fall

Kjus, T. (2012, November). *Oil Market Outlook - The fat lady has started to sing.* Oslo: DNB Markets.

Krueger, P., Landier, A., & Thesmar, D. (2011). The WACC fallacy: The Real Effects of Using a Unique Discount Rate. *Journal of Finance*, ss. 1253-1285.

Limperopoulos. (1995). *Usikkerhet i Oljeprosjekter* . Oslo-Kongsvinger: Statistisk Sentralbyrå.

Livsey, A., & Armstrong, R. (2015, January 27). Lex in-depth: Glut feeling. *Financial Times.* Retrieved from: https://www.ft.com/content/772c130c-a606-11e4-9bd3-00144feab7de

Lorentzen, M. (2016, June 23). *Overraskende lavt*. Retrieved from E24: http://e24.no/boers-og-finans/statoil/under-halvparten-gikk-for-statoils-utbytteaksjer-overraskende-lavt/23720374

Malmendier, U., & Tate, G. (2005). CEO Overconfidence and Corporate Investment . *Journal of Finance* .

Malmendier, U., & Tate, G. (2015, Fall). Behavioral CEOs: The Role of Managerial Overconfidence. *Journal of Economic Perspectives*, ss. 37-60.

Merrow, E. W. (2012, April). Oil and Gas Industry Megaprojects: Our Recent Track Record. *Society of Petroleum Engineers* , ss. 38-42.

Merrow, E. W., Phillips, K. E., & Myers, C. W. (1981). *Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants.* The Rand Corporation.

Mohn, K. (2007). Hva er det med oljeinvesteringene? *Magma*, ss. 83-95.

Mohn, K. (2008). *Investment Behaviour in the International Oil and Gas Industry, (Phd Thesis)*. Faculty of Science and Engineering Department of Industrial Economics, Univeristy of Stavanger, Stavanger.

Mohn, K. (2014). Kva skjer med oljeinvesteringane. *Samfunnsøkonomene,* ss. 10-14.

Mohn, K. (2015, December 14). *Bergens Tidende* . Retrieved from Meninger: http://www.uis.no/getfile.php/Forskning/Bilder/09%20%C3%98konomi/1209%20Utbytte%20gir%20meining%20%28Debatt-innlegg%20i%20Bergens%20Tidende%29.pdf

Mohn, K. (2015, January 7). *Dagens Næringsliv.* Retrieved from http://www.uis.no/getfile.php/Forskning/Bilder/09%20%C3%98konomi/Nye%20kutt%20i%20kj%C3%B8mda%20fr%C3%A5%20Statoil%20%28kronikk%20i%20Dagens%20N%C3%A6ringsliv%29.pdf

Mohn, K. (2015, July 2). Frå overmot til oppvask i oljebransjen. *SYSLA.* Retrieved from: http://sysla.no/meninger/fra-overmot-til-oppvask-i-oljebransjen/

Mohn, K., & Bård, M. (2009, March). Investment and uncertainty in the international oil and gas industry. *Energy Economics, Volume 31*, ss. 240-248.

Mohn, K., & Osmundsen, P. (2011). Asymmetry and uncertainty in capital formation: an application to oil investment. *Applied Economics, 43:28*, ss. 4387-4401.

MPE. (2016, June 3). *Regjeringen.no*. Retrieved from https://www.regjeringen.no/no/tema/energi/olje-og-gass/verdiskaping/id2001331/

MPE. (2017). Retrieved from http://www.norskpetroleum.no/okonomi/statens-inntekter/

Myers, S. C., & Majluf, N. S. (1984). Corporate Financing and Investment Decision when Firms have Information that Investors do not have. *Journal of Financial Economics* , ss. 187-221.

Norwegian Petroleum.(2017, February 2). *Norway's petroleums history* Retrieved from: http://www.norskpetroleum.no/en/framework/norways-petroleum-history/

NOU 2016:15. (2016). *Lønnsdannelsen i lys av nye økonimiske utviklingstrekk.* Oslo: Department of finance.

Oi, W. Y. (1961, January). The Desireability of Price Instability Under Perfect Competition. *Econometria vol 29*, ss. 58-64.

OPEC. (2017). *About us: OPEC*. Retrieved from http://www.opec.org/opec_web/en/about_us/24.htm

Osmundsen, P. (2002). *Verdsetting av oljeselskaper- implikasjoner for selskapsatferd.* Bergen: Samfunns- og næringslivsforskning AS.

Reitan, T. (2014, February 7). *Statoil 4Q results 2013: Balancing returns and growth.* Retrieved from Staoil.com: https://www.statoil.com/content/dam/statoil/documents/quarterly-reports/2013/Statoil%20-%20CFO%20presentation%204Q%202013.pdf

Reuters. (2014, August 15). *Billions in oil investments at risk from low crude prices, says Carbon Tracker*. Retrieved from Reuters Business News: http://uk.reuters.com/article/uk-oil-investment-risks-idUKKBN0GF05R20140815

Rook, D., & Caldecott, B. (2015). *Cognitive biases and Stranded Assets: Detecting psychological vulnerabilities within International Oil Companies. SME Working Paper.* University of Oxford.

Rozeff, M. (1982). Growth, Beta and Agency Costs as Determinants of Dividend Payout Ratios. *Journal of Financial Research* , ss. 249-259.

Scholtens, B., & Wang, L. (2008, January). Oil Risk in Oil Stocks. *Energy Journal Vol 29*, ss. 89-112.

Schulze, W. S., Lubatkin, M. H., & Chatterjee, S. (1999). Toward a strategic theory of risk premium: Moving beyond CAPM. *Academy of Management Review*, ss. 556-567.

Simon A, H. (1972). Theories of Bounded Rationality . I C. Radner, & R. Radner, *Decision and Organization* (ss. 162-176). North-Holland Publishing Company.

Smit, H. T., & Trigeorgis, L. (2004). *Strategic Investment: Real Options and Games.* New Jersey: Princeton Univeristy Press.

Smith, G. (2016, June 23). *Statoil Saves $292 Million Cash as Investors Take Scrip Dividend*. Retrieved from Bloomberg: https://www.bloomberg.com/news/articles/2016-06-23/statoil-saves-292-million-cash-as-investors-take-scrip-dividend

Stafford, J. (2015, March 18). *Can Big Oil Keep Paying High Dividends?* Retrieved from Oilprice.com: http://oilprice.com/Energy/Crude-Oil/Can-Big-Oil-Keep-Paying-High-Dividends.html

Statistisk sentralbyrå. (2017, Februar 23). *Investeringer i olje og gass, industri, bergverk og kraftforsyning* . Retrieved from https://www.ssb.no/energi-og-industri/statistikker/kis/kvartal

Statoil ASA. (2016, May 11). *Annual general meeting approves dividend of USD 0.2201 per share for fourth quarter 2015 and two-year scrip programme*. Retrieved from Statoil : https://www.statoil.com/en/news/annual-general-meeting-2016.html

Statoil ASA. (2017). *Investors: The Statoil Share*. Retrieved from Statoil.com: https://www.statoil.com/en/investors.html#the-statoil-share

Statoil ASA. (2017, May 6). *Our Dividend*. Retrieved from Statoil ASA: https://www.statoil.com/en/investors/our-dividend.html

Stein, J. C. (2003). Agency, Information and Corporate Investment . I G. Constantindies, M. Harris, & R. Stulz, *Handbook of the Economics of Finance* (ss. 111-124). Elsevier Science B.V.

Stiglitz, J. E., & Andrew, W. (1981, June). Credit Rationing in Markets with Imperfect Information. *The American Economic Review*, ss. 393-410.

Stulz, R. M. (1990). Managerial Discretion and Optimal Financing Policies . *Journal of Finacial Economics* , ss. 501-521.

Stulz, R. M. (1996). Rethinking Risk Managment . *Journal of Applied Corporate Finance 9*, ss. 8-25.

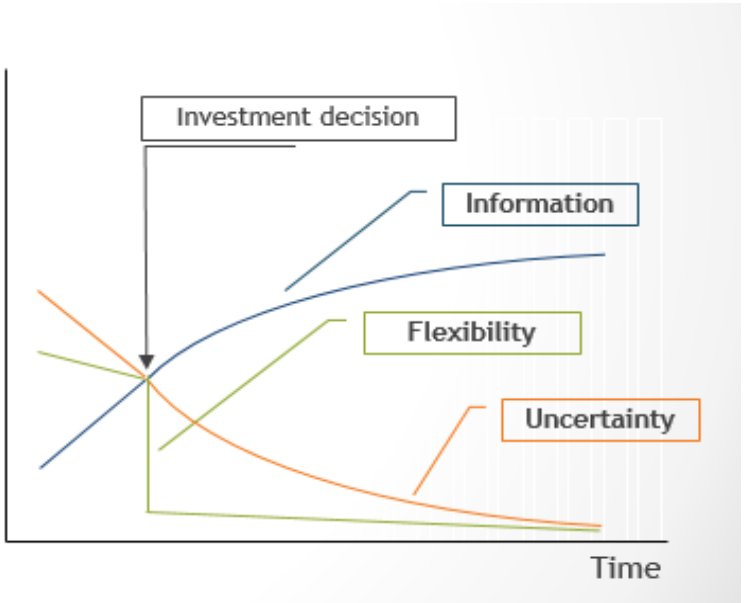
U.N. (2015, December 12). *Paris Agreement. art. 2, para . 1a.* Retrieved from http://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf

Appendix 1

The rapid response from oil companies to the increase in uncertainty which a shock in the oil price creates, could also be explained by real option theory. This appendix offers a brief review of how the irreversible- and sequential nature of oil and gas investments, together with uncertainty affect the value of the real option of waiting.

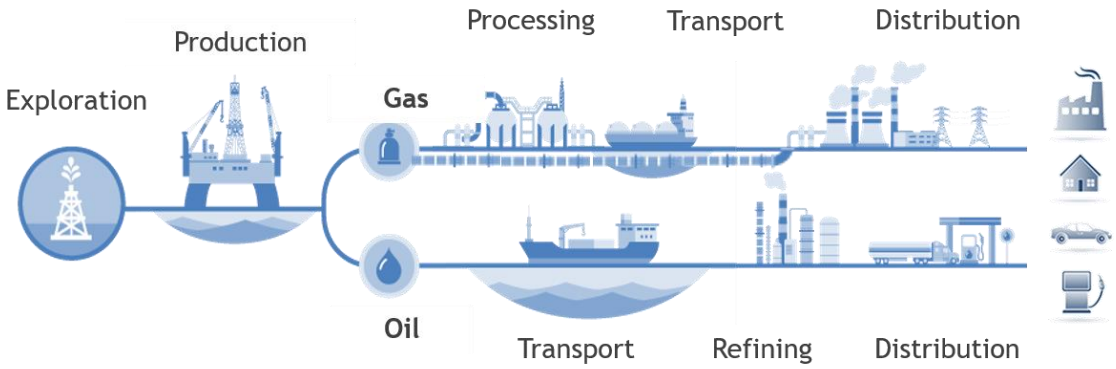
Irreversible investments

The exploration activity is a specific characteristic of the oil and gas industry. Exploration activity is very capital intensive by nature and necessary in order to ensure reserve replacement. Investments in exploration activity is also very firm-specific and thereby falls under Pindyck & Dixit (1994)'s classification of irreversible investments. An investment is irreversible when the whole or parts of the initial investment cost is sunk. The high degree of specificity of assets in the oil industry makes the investments irreversible because they usually serve no purpose in other industries. Assets can however be sold to other companies in the oil industry, but assets will have the same value for all competing companies, thus a bad investment for one company could be considered as bad also for others.



Sequential investment

Investment decisions about oil and gas projects are made sequentially. This means that in an investment process there is numerous decision points in oil and gas investment projects. First there is a decision to start exploration activity to obtain reserves, then about developing wells and pipelines in order to produce oil and gas from these reserves.



The sequentially nature of oil and gas investment projects gives room for flexibility, and by that fall under the Pindyck & Dixit (1994) third characteristic that classifies an investment decision, that there is some degree of leeway about the timing of investment. The sequentially of investment gives opportunity to wait and gather more information about the future. Oil companies might invest in the initial stage, but then decide to wait instead of immediately invest in the next stage. The key characteristic of sequential investments is that there is a possibility to temporarily or permanently stop investing if the value of the project falls, the costs rise or the prospectivity and degree of complexity in the reservoir change.

Uncertainty and real options

Investments are characterized by uncertainty over the future reward from the investment, and that it is important to assess the probabilities of alternative outcomes. In the oil and gas industry, uncertainty about future reward is often related to the oil price and its volatility. Due to the fact that oil and gas investments are characterized by long time horizons, the market conditions, and political regimes can change during long construction periods. A projects life-time is around 15-50 years, and it is almost at no point during this time possible to predict with certainty what the future and remaining cash flows will be. Uncertainty affecting the investments also stem from the financial markets, in the form of share price volatility. Thus, uncertainties that affects the investments are, among others, oil price volatility and general financial market uncertainty reflected in share price volatility. Other sources of uncertainty in the oil and gas industry can stem from technological and geological factors in addition to political risk.

The irreversibility of oil and gas investment projects supply the companies with a real option to postpone the investment. According to Pindyck and Dixit (1994) the irreversibility and possibility to delay can profoundly affect the decision to invest. For a company, this opportunity is much like a financial call option. The company has the right, but not the obligation to buy an asset at some future time. Making an irreversible investment expenditure, "kills" the companies option to invest, in a way that it gives up the possibility of waiting for new information that might affect the attractiveness or the timing of the expenditure. Thus, the lost option is an opportunity cost for the company. This opportunity cost is very sensitive to the uncertainty over the future value of the project, so that changing economic conditions that affect the future cash flows can potentially have a great impact on an investment decision.

For oil and gas investments, the concept of irreversible investments is highly relevant. The large size of capital commitments, long investment lags and field specific sequences of the investments decisions involves a series of waiting options. Once a well is spudded there is no way back (Mohn and Osmundsen 2011).

Pindyck and Dixit (1994) suggest a negative relationship between irreversible investment and real options. According to Mohn and Misund (2009), general financial market uncertainty is negatively related to investment, in accordance with theoretical results from the irreversibility literature. Increase in uncertainty regarding future profitability will add value to the waiting option, which implies a negative investment respond to increase in uncertainty. Deciding to

invest includes giving up a waiting option, however, in addition to be compensated through the NPV of the actual project, the company also get access to new growth options and potential reward from future development options. Smit and Trigeorgis (2004) point out that with these types of compound options there can also be a positive relation between investment and uncertainty.

Bloom (2000) show that real options and irreversibility play an important role in shaping the short run dynamics of investment. Carlsson (2007) also find that uncertainty has a negative effect on capital accumulation in both the short run and the long run, however the short run effect is large, whereas the long run effect is moderate. Mohn and Misund (2009) measure the effect of uncertainty on investment in the oil and gas industry. The sources of uncertainty in their study are extrinsic risk, measured as the volatility of overall stock market return, and intrinsic risk measured by volatility of the crude oil price. The study shows that a simultaneous increase in both uncertainty indicators produce an immediate reduction in investment.

A highly significant negative effect between oil and gas investment and extrinsic risk, is found by Mohn and Misund (2009). Together with results that shows that aggregate uncertainty is not fully reflected in the company valuation, this could be evidence that company managers are more sensitive to extrinsic risk than investors. This can be interpreted as a form of overconfidence in the management in the oil and gas industry. Malmendier and Tate (2005) argue that an important link between a company's investment level and cash flow, is the tension between the manager and the market about the value of the firm. They state that overconfident managers believe that the market is underestimating the present value of the return on investments, and that issuing shares will reduce the claims of current shareholders. This incorrectly perception of the market results in that the manager becomes reluctant to issue shares in order to finance investments. Thus, investment of overconfident managers is sensitive to cash flow. This implies that they restrain their investments if they do not have sufficient internal funds and are reluctant to issue new equity because they perceive the stock of their company to be undervalued by the market.

Mohn and Osmundsen (2011) test the relevance of uncertainty and asymmetry in investment behavior in the oil and gas industry. Testing the role of uncertainty, they show that both oil price volatility and underground risk has negative impact in oil and gas exploration activity, in line with the theories of irreversible investment. They introduce two types of effect uncertainty can have on investment, opportunity effect and risk effect. Opportunity effect refers to theories suggesting that any increase in uncertainty will increase the marginal valuation of investment.

Oi (1961) analyze behavior of firms facing uncertain demand in the form of price instability. Results from this analysis prove that instability in prices always result in greater total returns, thus, providing a positive link between investment and uncertainty. The risk effect of increased uncertainty is linked to theory of irreversible investments and the real option to defer an investment. Any increase in uncertainty will increase the value of the waiting option, thus, the risk effect suggests a negative link between uncertainty and investment. In the short run the risk effect dominates the opportunity effect, thus uncertainty plays a significant role in the short-term dynamics of exploration spending.

They also find that oil and gas companies are more convinced about a persistent change in oil price if the oil price decrease, than if there is an increase in oil price. In the short run, an increase in oil price does not stimulate the exploration drilling, on the other side, if the oil price decrease, the oil companies instantly drop activity in exploration. This show an asymmetric response to uncertainty regarding the oil price. Addressing implications of asymmetry, Bernanke (1983) introduced the "bad news principle" of irreversible investment:

That of possible future outcomes, only the unfavorable ones have a bearing on the current propensity to undertake a project (Bernanke, 1983).

Showing that given the current return of the most profitable investment, the desire to invest in one period, depends only on the average expected severity of bad news for the investment that may occur in the next period. Potential good news has no effect. Decisions to invest is made in order to expose the company to good outcomes, and reduce the exposure to bad outcomes. For investment in the oil and gas industry and exploration activity, the implications of the "bad news principle", is that news about increased oil price do not affect the value of the waiting option, however, news about oil price reduction increases the value of this option. Oil price reduction therefore dampens the ongoing exploration activities.