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Summary

Over the last decades, the energy industry has been exposed to significant changes within the world marked. The intention of this thesis has therefore been to measure and evaluate financial risk exposure for energy companies. Financial risk has been the primary subject of this thesis. This subject has further been divided into one prediction and two hypotheses encompassing the theoretical framework of this thesis; recession versus growth, financial risk and investments. The prediction and hypotheses have been evaluated by applying both quantitative and qualitative analysis. This thesis studies financial risk exposure and its influence on 16 major oil and gas companies during a 20 year time period, from February 1989 to February 2009.

World market changes may provoke several changes in financial risk exposure facing energy companies. These changes could provoke higher volatility, meaning significant changes in a company's stock price and could further revise future investment strategies. These considerations form the basis for the first prediction in this thesis; "economic recession and resulting changes in market risk factors increases the stock price volatility and changes the investment behavior for energy companies." The quantitative results points toward the highest volatility measurements in periods of recession. This corresponds to the qualitative analysis, as the overall responses from the depth interviews presumed the highest volatility measures in periods of recession. Based on the quantitative and qualitative results the prediction stating that "economic recession and resulting changes in the market risk factors increases the stock price volatility for energy companies" is accepted. The investment behavior was further analyzed by evaluating the reserves replacement rate and finding and development costs of each of the company represented. Neither the quantitative nor the qualitative analysis points towards periods of recession causing changes in the investment behavior for the companies analyzed, so the predicting stating changes in a company's investment behavior as the results of periods of recession is rejected.

Periods of recession and growth caused by world market changes could have dissimilar influence on an energy company's stock price, depending on size and value of company. The subsequent hypothesis analyzed in this thesis therefore claimed that "the stock price is more influenced by market risk in periods of recession than in periods of growth". The quantitative results show a

higher relation between the market risk factors in periods of recession compared to periods of growth. From the results of the t-test, oil and gas frequently proves a significant correlation at given significance levels. This is similar to the qualitative analysis, as the financial personnel ranked oil and gas price to provide the highest influence on a company's stock price when asked to compare this to other financial risk factors. Based on these results the hypothesis "the stock price is more influenced by market risk factors in periods of recession than in periods of growth" was accepted.

The financial risk exposure facing the energy companies can be viewed by evaluating the stock price fluctuation, and further to apply models to calculate the historical expected stock return based on included risk factors. These models are used to price risk and are therefore applied to evaluate which of the presented models provides the most accurate measure of historical expected stock return compared to the actual historic stock return. These models represent the final hypothesis stated in this thesis, "increased number of financial risk factors included in a model for pricing risk, gives a more accurate predicted historical stock return". The results show that Brent oil price, market cap and book-to-market ratio each have a significant impact on the historic stock price return for the energy industry. Considering the calculation of expected historical stock return based on the included systematic and unsystematic risk factors, the APT multifactor model provides the most accurate model to explain historical expected stock return. The APT model incorporated the following systematic risk factors: interest rate, market index, exchange rate, oil price and gas price. These could therefore be considered as the most important risk factors for predicting historical stock return. Based on the yearly analysis, increased number of financial risk factors does not necessarily give more accurate predicted stock return. However, if considering the monthly analysis, increased number of financial risk factors did actually give a more accurate predicted stock return.

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1 Preface

This master thesis represents the final work of my Masters degree in Economic and Administration at the University of Stavanger. The process of completing this thesis has been both challenging and time-consuming, but has also been both instructive and educational. This assignment gave me the opportunity to expand the knowledge on several subjects of interest, namely financial risk and its exposure to major energy companies.

I would like to thank my professor at the University in Stavanger, Bård Misund, for his role in this thesis. He has contributed with both data and valuable guidance throughout this semester. I would also like to thank Trond Todnem in StatoilHydro for providing me with the market data required to complete the analysis in this thesis. Further I would like to thank the financial and leadership personnel who agreed to complete depth interviews for my qualitative analysis. Both the qualitative and quantitative data has provided me with valuable information and would hopefully encourage to further research within this subject in the future. Last, but not least, I would like to thank my friends and family for all their encouragement and support throughout this challenging process.

2 Introduction

The purpose of this chapter was to give an introduction to the motive for selecting financial risk exposure in the energy industry as the main subject of this thesis. The background and history of this thesis are followed by the subject, providing an introduction to the main theme of this thesis. The problems for discussion are further presented in order to illustrate the main problems of this study. This chapter was completed by illustrating the structure of this thesis by presenting a model giving the reader an introduction to the main stages of this thesis.

2.1 Background and History

The last decade has proven how single events can have major impact for international and national economics. The energy companies are exposed to financial risks within changing stock prices, interest rates, currency rates and oil and gas prices in their everyday life, to both deliver short term profits and return to shareholders, and when taking decisions on major future capital investments. This assignment has given a brief introduction to financial risk and has differentiated between systematic, market specific, and unsystematic, firm specific, risk. Systematic risk can be referred to as changes in the market which are hard to resist and since this risk affects the market as a whole, it cannot be avoided by diversification. Systematic risk is often known as market risk because of the economy wide influence (Brealey, Myers, & Allen, 2008). Market risk can further be defined as the experienced risk from an *adverse movement in the price or value of a commodity, currency or asset* (Horcher, 2005, p. 206). The unsystematic risk is the company specific risk which the companies can affect in a larger extent by diversifying their risk exposure in contrast to systematic risk (Brealey et al., 2008).

The late nineties and early years of this century saw a global recession following the IT-meltdown, the 9-11 attack and low commodity prices. This recession period was followed by seven years of enormous world growth, mainly powered by high investments in the Far East countries as China and India, as well as other developing countries such as Brazil, Nigeria, Angola and the Middle East. The seven years of growth found in 2008 what seemed to be the start of a new global recession period. This time the recession comes from a financial “crises”; subprime loans, collapse of major financial institutions and a shaking American car industry. These turns from recession to growth to recession has had a significant impact on prices of

commodities such as crude oil price, natural gas price and so forth, as well as on the demand for services and raw material. These significant changes can have a major impact for energy companies where income has a direct correlation with the commodity price (example: an upstream oil and gas company will deliver very different results if crude price is $145 per barrel, than if the crude price is $35 per barrel).

So the changes in world "temperature" (growth, recession) would represent a source of financial risk for an energy company depending on commodity prices, interest rates and exchange rates. Example: a low crude price could stop oil and gas exploration, put large projects on hold and even mean bankruptcy for an oil and gas company which is cash stripped and depending on a high crude oil price to keep a positive cash flow. These changes in world markets may further represent an influence concerning the investment behavior for oil and gas companies. These concerns could again lead to different investment behavior in periods of growth versus periods of recession.

We are now in what many refers as the "financial crisis" which will be an interesting supplement for this assignment. According to NBER (2008), the financial crisis kicked off in December 2007 and has caused changes in the world growth ("Determination of the December 2007 Peak in Economic Activity," 2008). This financial crisis is still ongoing with significant changes in the world market trends and with national and international banks lowering the interest rate to almost zero, to allow for new investments to re-create economical growth.

2.2 Subject

The main subject of this thesis is "measuring and evaluating financial risk exposure for energy companies". The financial risk we here refer to, can be defined as the possibility for experiencing loss or profit through the exposure for changes in market conditions (Horcher, 2005). The purpose of this chapter is to introduce the subject of financial risk exposure and which theoretical approaches this thesis has applied to illustrate financial risk. This chapter will also include the foundation for choosing the main problems to be addressed in this thesis.

The goals and objectives of this thesis was to evaluate and measure financial risk exposure for energy companies and further how this could affect the energy company's stock price and

investment behavior. This chapter will therefore introduce three important theoretical approaches chosen for this thesis by illustrating how these concepts relates to evaluating and measuring of the financial risk exposure for the energy industry.

Financial risk arises as a result of exposure to changes and uncertainties in world market conditions and supplies. The first theoretical approach chosen in this thesis was therefore how periods of recession and growth, also referred to as business cycles, could influence the energy industry by changes within world market activities. Growth periods are often characterized by a significant increase in world energy demand, while a recession tends to decline the energy demand growth on worldwide bases (Marion, 2001). In rapidly changing market conditions, understanding the connection between financial risk arising from periods of financial recession or growth and significant changes to stock prices are vital to understand how companies will change investment profiles during these changes. An example on how unanticipated changes have affected stock fluctuations and possible future oil and gas supplies, is how radical decline in oil and gas price have caused uncertainties on future capital investments causing a possible decline in the replacement of reserve rate for energy companies (Osmundsen, 2008).

These periods of changing world market activity caused by periods of recession and growth could therefore cause a significant influence on the energy company's stock prices. The second theoretical approach chosen for this thesis has therefore been the concept of financial risk. This thesis has further chosen to differentiate between systematic and unsystematic risk which comprises the total risk affecting the energy industry. Systematic risk refers to the overall market influence affecting the economy as a whole, and unsystematic risk refers to company specific risk factors present for each company (Brealey et al., 2008). This thesis has given a presentation to several both systematic and unsystematic risk factors further applied for the quantitative and qualitative analysis. The systematic risk factors were applied to evaluate the extent of financial risk exposure caused by changes in stock prices. Further, the unsystematic risk factors were applied to consider possible changes in the investment behavior in periods of recession compared to periods of growth.

An important part of this thesis has been to measure financial risk exposure facing the energy industry. This thesis has applied different models trying to capture the energy company's

exposure to both systematic and unsystematic risk and this comprises the last theoretical approach chosen for this thesis. The intention of these risk pricing models was to determine what models were the most accurate to measure the financial risk exposure due to changes in systematic risk and/or unsystematic risk by giving the most accurate historical expected stock return compared to the actual stock return. The number of financial risk factors included in the model that best predicts historical stock return, would indicate whether an increased number of financial risk factors included in the models gives a more accurate historical stock return.

Eliminating financial risk should be considered as neither possible nor desirable, but attaining knowledge on the exposure to risk in order to manage it, should still be considered as essential. Stock fluctuation caused by financial risk may reduce revenues, increase costs and may make it difficult to allocate capital expenditures. So, management's ability to identify exposure to financial risk could therefore be considered as crucial in order to attain an appropriate financial risk strategy. The process of financial risk management comprises strategies that enable an organization to manage the risk associated with financial markets. Financial risk management involves evaluating the financial risk facing an organization and further to develop strategies consistent with internal priorities and policies (Horcher, 2005).

2.3 Main Problem to be Addressed

The subject chosen for this thesis was "measuring and evaluating financial risk exposure for energy companies". The main goal of this thesis was to evaluate financial risk exposure for comparable energy companies and how they are exposed to systematic and unsystematic risk. The three main problems to be addressed and tested in this master thesis are:

- Economic recession, and resulting changes in market risk factors, increases the stock price volatility and changes the investment behavior for energy companies;
- The stock price is more influenced by market risk in periods of recession than in periods of growth;
- Increased number of financial risk factors included in a model for pricing risk, gives a more accurate predicted historical stock return

2.4 Purpose

The purpose of this study was to provide an insight to financial risk factors affecting the energy industry in periods of recession versus periods of growth. There could be mentioned several reasons for selecting this topic. The primary reason was the curiosity within financial changes and subsequent developments within the energy sector. Financial risk provides several possibilities and limitations, and it was therefore interesting to view how the energy industry was affected by these changes. It was interesting to consider the underlying motives behind important financial decision and investments. Further, it has been interesting to discover which financial risk factors are most important for predicting historical stock return.

The current financial crisis has dominated the news headlines for the last months, discussing possible implications, influences and consequences from the meltdown in world economy. Throughout the last decades there has been several recession and growth periods influencing the companies within the energy sector. But unfortunately, it is difficult to predict when they arise and their full risk dimension. These circumstances provoked additional interest for evaluating the energy companies risk exposure to changing market conditions.

The energy sector is a critical industry providing energy for world supplies. The 16 companies selected for this thesis represent some of the world's major oil and gas companies. They are all ranked on the Petroleum Intelligence Weekly world's top 50 oil companies ("Petroleum Intelligence Weekly Ranks World's Top 50 Oil Companies (2009) ", 2008). This implies that this thesis considered oil and gas companies providing energy to drive our cars, heat or homes and provide materials for nearly everything we have. It is therefore essential to evaluate how this industry is exposed to changing marked condition. The companies are further dependent on oil and gas prices to provide revenue for their stakeholders.

As the world picture changes, a company may reconsider possible future investments and future expenditures to prevent future decline in the stock price. The long term investment can be considered as relatively unpredictable compared to short term investment because of uncertainties regarding future developments. The short term investment will provide rather immediately result causing the stock price to increase or decline respectively. A short term investment could for

example be drilling an additional well at a current oil field. In contrast to long term investment, the outcome will be known immediately. The long investments could for example be developing new fields, and if oil and gas is discovered, the investment has succeeded and the company can continue in providing additional supplies.

The purpose and desire of this thesis was to present relevant theory on financial risk, and perform empirical research giving valuable information required to evaluate the relation between risk factors and stock return. This thesis has further explored these possible risk factors in relation to periods of recession compared to periods of growth in order to evaluate when the energy companies are considered as most volatile. We have further considered different risk pricing models to evaluate which of the models is the most accurate in predicting expected historical stock return. The most accurate model would therefore contain the most essential financial risk factors to explain former stock price fluctuations.

In order to answer these questions, there has been implemented both quantitative and qualitative analysis. These analyses have been used to evaluate the connection between significant changes in the market conditions and its influence on market risk factors and company specific risk factors in relation to fluctuating stock prices and possible changes in the investment behavior.

2.5 Goals and Objectives

We have mentioned several essential underlying reasons for choosing the subject financial risk exposure for this master thesis. We would now like to summarize the purpose and motivation for this study by presenting the goals and objectives.

2.5.1 Goals

Theme 1: Recession versus Expansion

- Determine when the world's financial market are characterized by recession or growth

Theme 2: Financial Risk

- Evaluate if comparable energy companies are more volatile in periods of recession than in periods of growth

- Evaluate whether periods of recession increases the correlation between stock return and market risk factors than periods of growth
- Determine what/which risk factors (systematic/unsystematic) are most important for predicting historical stock return and explaining a company's financial risk exposure by evaluating single and multifactor models

Theme 3: Investments

- Determine the possible changes in investment behavior in periods of recession versus periods of growth

Theme 4: Recommendations

- Establish recommendations and provide a possible foundation for further research

2.5.2 Objectives

Theme 1: Recession versus Expansion

- Determine a set of variables describing the world marked trends

Theme 2: Financial Risk

- Identify a set of systematic and unsystematic risk factors and evaluate their importance to stock price fluctuations in periods of recession compared to periods of growth.
- Evaluate the relation between changes in financial market risk factors and the possible influence on stock price movements
- Evaluate the stock price return by applying single and multifactor models for systematic and unsystematic risk factors; and estimate differences between predicted and actual stock return

Theme 3: Investment Behavior

- Consider the changes in reserves replacement rate and finding and development costs in periods of recession versus periods of growth

2.6 Structure

Having a structured approach (following the progress from start to finish) providing the goals and objectives from start to finish is critical to accomplish success when analyzing and discussing difficult and complex hypotheses. In this sub-chapter we have introduced the overall structure of this thesis, presenting the different analysis and evaluations conducted and discussed prior to reaching a conclusion from this master thesis. The structure of this thesis has been presented in Figure 1 - Structure of Master Thesis.

The first step conducted in this thesis was the theoretical research providing information for the subject of this thesis. This theoretical framework included relevant theory, previous conducted research and models used for analysis. These theories, models and former research were further used to identify independent variables describing possible financial risk exposure parameters for major energy companies.

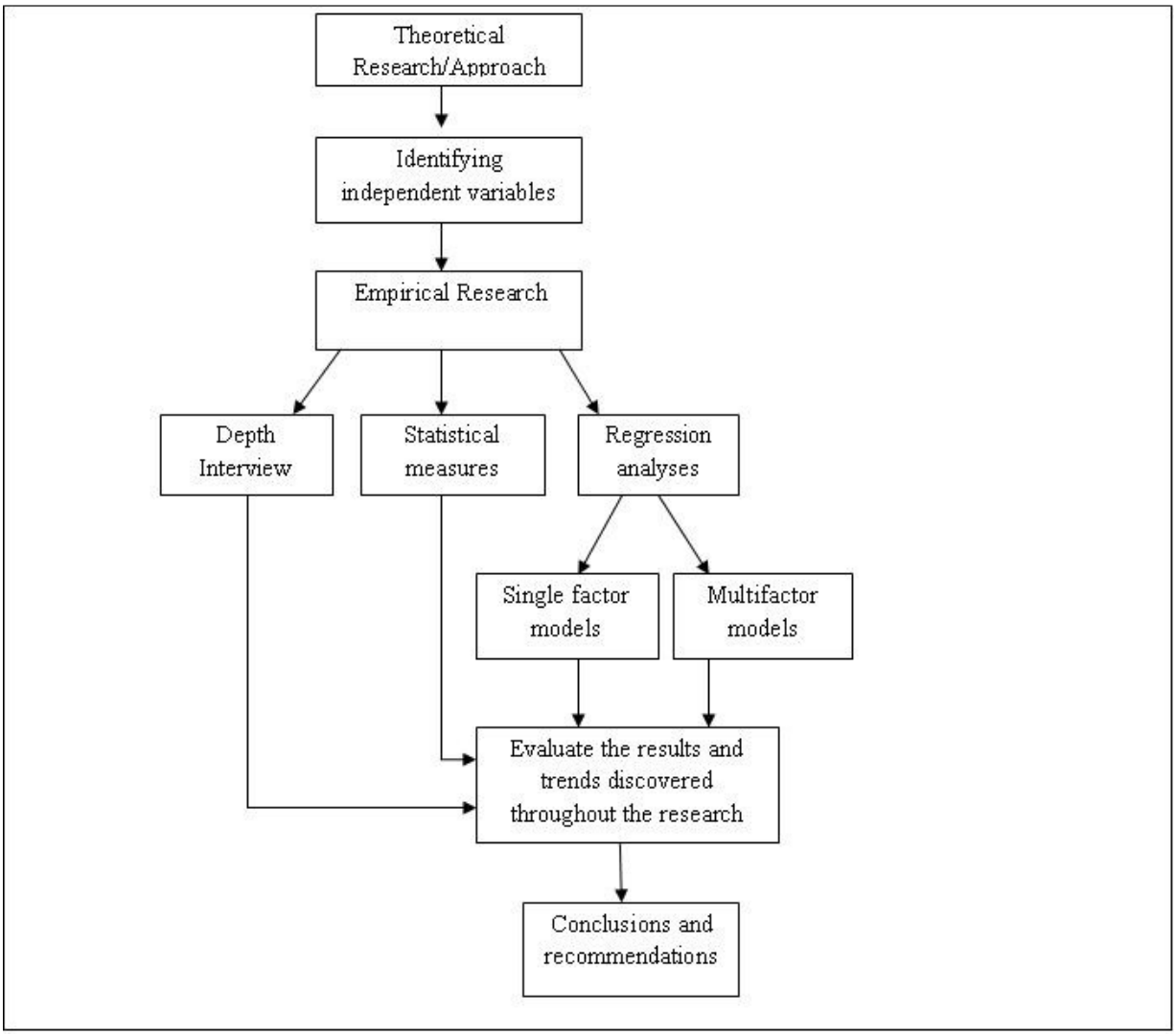

Figure 1 - Structure of Master Thesis

After identifying and concluding on a set of variables, the empirical research was conducted. The empirical research included:

- Depth interviews with expertise and leadership personnel within research, finance and oil and gas companies;
- Descriptive statistics and correlations analysis of the identified variables;
- Regression analysis including single and multifactor models.

Upon completion of the analysis, the results were discussed and evaluated to present our conclusions and recommendation to the identified hypotheses.

The chronographic chapters of this thesis have been presented below:

Chapter 1: Introduction: gives a presentation to the thesis by introducing the subject, background and history for the selected theme. The main problem to be addressed was presented to give an overview of the main purpose of this thesis. The first chapter was completed by illustrating a figure representing the overall structure of this thesis.

Chapter 2: Theoretical framework: gives an overview of the concepts applied in this thesis. This includes recession versus growth, financial risk and investment behavior. The chapter also presents the impact from the ongoing financial crisis as it has caused a significant influence on the world market's present financial situation. Towards the end of the chapter we introduced former empirical evidence and literature review.

Chapter 3: Conducting the regression analysis: gives an explanation on how we have proceeded when conduction the regression analysis required for estimating the historical expected stock return in the quantitative analysis.

Chapter 4: Statistical measurements: describes the statistical measurements required to perform the quantitative analysis in this thesis.

Chapter 5: Method: gives an introduction to the method used to analyze and illustrate the results obtained from the assembled data. The chapter describes the procedure for how this research has handled the primary and secondary data collected and how these have been applied.

Chapter 6: Data selection and results: describes the selection of data and further how it has been collected. The selection of data has been presented in tables giving a summary statistics for the companies and variables applied in this thesis.

Chapter 7: Qualitative analysis: describes the results conducted from the depth interviews with key economical and leadership personnel in the oil and gas, research and banking industry.

Chapter 8: Hypothesis discussion and results: summarizes the qualitative and quantitative results required to conclude on the prediction and hypothesis. The chapter concludes on accepting or rejecting the defined prediction and hypothesis.

Chapter 9: Conclusions and further work: Summarizes the results from the quantitative and qualitative analysis before introducing possibilities for further research.

Chapter 10: Bibliography: Lists all references applied throughout the thesis.

3 Theoretical Framework

The purpose of the following chapter was to introduce three important theoretical financial approaches selected in this thesis and its importance for evaluating and measuring financial risk exposure facing the energy industry. The purpose of the theoretical framework was to give an overview of important financial topics within business cycles; recession and growth, financial risk and investment behavior. The subsequent chapters intended to describe the importance of these financial concepts and further to relate them to the energy industry. The financial topics are then followed by introducing the statistical measurements and regression models applied in this thesis preliminary to the method, data selection and results.

3.1 Recession versus Growth

The purpose of this chapter was to describe the characteristics of significant world market changes, also known as periods of recession and periods of growth. This chapter intended to explain the possible consequences of these changes by presenting former changes within business cycles. This chapter provided a good foundation for further theoretical aspects to understand the importance of the extended effects of recession or growth periods when presenting financial risk factors and investment behavior.

Economic cycles are often referred to as either periods of recession or periods of growth. There are several economic indicators providing information regarding the business cycles. These refer to observable movements in GDP (Gross Domestic Product), real income, employment or industrial production. The world economy has proven several changes throughout the last 20 years, hence providing several changes within the world economy. There is however several opinions on how to determine whether we are experiencing periods of recession or periods of growth. The National Bureau of Economic Research (NBER) proposes GDP as one of the best measures of economic activity ("Business Cycle Dating Committee, National Bureau of Economic Research," 2003). GDP provides an estimate on the total value of all goods and services produced in a country in a specific time period (Amadeo, 2009). The term recession is often interpreted as a persistent decline in economic growth and is often referred to as a decrease in GDP in more than two quarters of a year. This could be considered as a rather vague explanation as the world economy has experienced several fluctuations within the economic

activity (Marion, 2001; Sjølie, 2008). We choose to employ NBER definition of recession as a *significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in GDP, real income, employment, industrial production, and wholesale-retail sales* (Hall et al., 2003).

Increased production and economic activity symbolizes expansion. Expansion is present whenever the economy is experiencing growth and the businesses are doing well. Periods of growth may therefore provide increased GDP and production causing possible new investments enabling the energy companies to acquire increased return (Marion, 2001). We choose to further apply NBER's characterization of expansion as the period *between trough and peak* (Hall et al., 2003). The period of expansion implies the ascending level of economic activity until it reaches its highest point.

Periods of recession are therefore present when the world economy has reached its highest level. These periods of reduced economic activity continues until the economic activity has reached its trough. When the trough period is reached, economic expansion is present. The time frame studied in this thesis is a 20 year period, from February 1989 to February 2009. There have been several periods of recession and growth the last 20 years affecting the economic activity. We have presented former and present changes in the economic activity to illustrate when these recessions and growth periods occurred based on NBER's declarations. The recession and expansion periods mentioned below were used in further analyses to evaluate possible changes within stock prices and investment behavior.

According to NBER there have been two periods of recession and two periods of growth the last 20 years. The first expansion period to be considered in this thesis began in March 1991. The period of increased economic activity reached its peak level 10 years later (Hall et al., 2001). The following recession period lasted for 8 month before the second period of growing economic activity occurred in November 2001 (Hall et al., 2003). Unfortunately this period of expansion was not persistent and reached its highest level of growth in December 2007. The subsequent period of recession has shown to cause significant changes within the world economy and as we move into the second quarter of 2009, we do not know when this period of recession will reach

its trough ("Determination of the December 2007 Peak in Economic Activity," 2008). These periods of recession and growth were applied in later analysis in order to evaluate how these changes in the economic activity has influenced the world economy and major energy companies.

Before presenting the concept of risk and how systematic and unsystematic risk factors could be influenced in periods of changing economic activity, we would like to illustrate how the crude oil price has been affected from changes within the world economy. The graph underneath illustrates how key world events have influenced the increase or decrease of crude oil price. We are aware that these changes within the crude oil price may deviate from the recession and growth periods mentioned above, but will however provide an indication on the effect of global supply and demand affecting the energy industry.

Let us look at some examples on how single events have changed the oil price over the last decades:

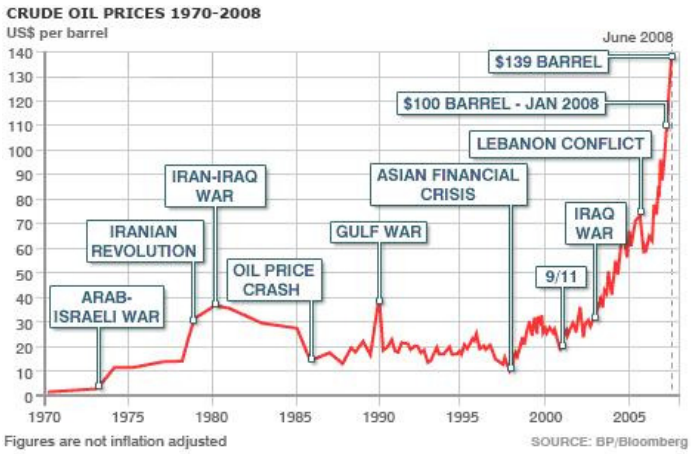

Figure 2 - Historical Oil Price

("Why the oil price keeps rising ", 2008)

The crude oil has been influenced by several market risk factors which mean that significant world key events like the Gulf War in 1990, Asia crisis in 1997, 9/11 in 2001 and recently the financial crisis in 2008 have caused several changes in the crude oil price.

- Gulf War: Low oil price provoked the Iraq invasion of Kuwait which led to uncertain oil production and supply. The intention behind this invasion was to gain control over Kuwait, which at the time was the third largest oil producer, in order to achieve control

over the majority of the market for oil supply. Followed by this invasion the crude oil price followed a stable decline and attained its lowest level in 1994 ("Why the oil price keeps rising ", 2008).

- Asian Financial crisis: Followed by Asian economic growth OPEC increased its oil production. This economic growth reached its ground level followed by a significant decline in consumption for oil which provoked the Asian economy to collapse in 1997 ("Why the oil price keeps rising ", 2008).
- 9/11 2001: As the production of oil in Russia kept on rising, the US economy experienced a decline. OPEC tried to solve this decline by cutting its production but the terror attacks experienced in November in 2001 provoked further decline in oil price ("Why the oil price keeps rising ", 2008).
- Iraq War 2003: Access to oil provoked the American invasion of Iraq and caused a decline in oil production in the Gulf State. The excess production capacity of oil fell remarkably, from producing six million barrels per day in 2002 to beneath two million barrels per day in 2003. The production capacity continued dropping in 2004 and 2005 which caused an increased oil price (Moran, 2008; "Why the oil price keeps rising ", 2008)
- Lebanon Conflict 2006: The oil price reached a new peak after Israel initiated attack on Lebanon. The conflict caused increased tension in Middle East leading to new peaks in oil prices ("Why the oil price keeps rising ", 2008).
- $100 per barrel in January 2008: Ongoing tensions in Kenya, Algeria and Pakistan, increased demand after oil from China, India and US, suspicions of a cold winter in the US and Europe, in addition to threats of US sanctions against Iran provoked several increases in the price of oil. The US dollar decreased, encouraging oil prices to rise in order to compensate for a depreciating US currency ("Why the oil price keeps rising ", 2008).
- $139 per barrel in June 2008: After the peak in January 2008 the oil prices continued to rise and reached a new peak of $139 per barrel 6 June 2008. The Asian economy continued to expand and as the supply of crude oil kept on growing, it went beyond the demand for crude oil which provoked the oil price reaching new peak levels. The increasing oil price was followed by investments in confidence of further increases in the

oil price. At the same time the production capability struggled to keep track with these presumptions. These reflections could be some of the explanations to why the oil price reached peak levels ("Why the oil price keeps rising ", 2008).

- Oil price today: The present financial situation could be considered as descending. The contemporary financial crises have caused a significant decrease in oil price and uncertainties regarding new investments. As the oil price reached its highest level the companies were concerned regarding their capability to produce enough oil to accommodate economic expansion. The focus has now shifted into reluctance on how to defend future investments in order to take advantage of excess capacity. This reluctance and descending economy has caused companies to reject several projects because the expected return is no longer sufficient. The uncertainties are substantial whether to commit or remain reluctant until new indicators reveal the financial risk dimension and possible reasons for the risk exposure.

We have now presented how world events have caused tremendous changes in the crude oil price. We will not turn over to present the concept of financial risk and its influence on the energy industry.

3.2 Financial Risk

The purpose of the following chapters was to introduce the concept of financial risk and its influence on the economic activity and stock prices in the energy industry. The concept of financial risk was further divided into two risk dimensions, systematic and unsystematic risk. These two dimensions comprises the total risk exposure facing the energy industry (Brealey et al., 2008).

3.2.1 Introduction

Let us start by introducing the general terms of financial risk. Risk can be regarded as future uncertainties; these uncertainties could provide both limitations and opportunities for a company. Financial risk could further be defined as the *likelihood of losses resulting from events such as changes in the market price* (Horcher, 2005, p. 16). This financial risk is the product of two factors:

- Conceiving the potential loss from changes in a particular rate or price
- Estimating the probability of the change occurring (Horcher, 2005)

In order to reduce risk it is necessary to first manage the risk exposure and provide an adequate answer to the following questions:

- What financial risk is the company exposed to?
- How sensitive is the company to the financial risk exposure?
- What is the possible loss or gain for the company as a result of this risk? (Horcher, 2005)

Managing financial risk can be considered as an economical priority for energy companies. The motive behind managing financial risk is creating economic value through applying financial instruments in order to control its risk exposure.

The total financial risk exposure and the resulting influence on the energy company's stock prices, or other companies in general, can further be characterized as equity risk. Equity risk relates to the risk behind fluctuating stock prices and would therefore refer to the exposure to changes within a stock price value. Equity risk can encompass one stock, several stocks, an industry or the market as a whole (Armitage, 2005; Goetzmann & Ibbotson, 2004; Horcher, 2005).

Variation in a company's stock price could represent a significant risk for the energy companies and for the investors and shareholders within a specific energy company. Significant stock price fluctuations signals a high degree of risk exposure but does also provide the possibility to either experience a great return when the stock price increases, or a large loss when the stock price deteriorates.

The total risk exposure or equity risk of a stock price can be measured by the volatility of a stock. Volatility can be described as *a measurement of how uncertain we are about future stock price movements* (Hull, 2009, p. 202). The volatility of a stock will therefore provide a measure of the uncertainty of a stock caused by possible financial risk factors (systematic and unsystematic risk). This implies uncertainties of a stock providing additional return. The volatility of a stock can be

measured by the standard deviation of the log return of a single stock in a given period and can be illustrated by the following equation:

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(u_i - \bar{u})^2}$$

Equation 1 - Volatility

Where $u_i$is the log stock return and is calculated by the following equation:

$$u_i = \ln\left(\frac{S_i}{S_{i-1}}\right)$$

Equation 2 - Log Stock Return

s= volatility

u_i= log return of stock

$\bar{u}$= average log return of stock

ln= natural logarithm

n = number of observations

S_i= current stock price

S_{i-1}= former stock price

(Stock & Watson, 2007)

The above equation helps to indicate the extent of former stock price fluctuations caused by former changes within the world economy. A high volatility would indicate that the stock has experienced several significant movements, while a low volatility would indicate a rather stable stock price (Hull, 2009). The volatility measurement of a stock could therefore provide us with valuable information on a stock's previous movements, and indicate the extent of financial risk exposure in periods of recession compared to periods of growth.

As earlier mentioned, the equity risk has been divided into two risk dimensions, systematic and unsystematic (Brealey et al., 2008). The following chapters will further introduce possible systematic, meaning market specific, and unsystematic, meaning company specific, risk factors.

The systematic and unsystematic risk provided us with fundamental concept within this thesis and will remain as an underlying framework when discussing further theories and models.

3.2.2 Systematic and Unsystematic Risk

This sub-chapter provides us with an understanding on why and how companies might be exposed to financial risk by introducing systematic and unsystematic risk. The purpose of the following sub-chapters was therefore to present possible systematic and unsystematic risk factors and its influence on the energy industry.

3.2.2.1 Systematic Risk

Systematic risk refers to the overall market influence affecting the economy as a whole. The systematic risk dimension will refer to the industries interdependence to a market or a system, effecting the entire market index or industry rather than individual companies as a single unit (Horcher, 2005; James, 2008).

3.2.2.2 Beta

When evaluating the systematic risk exposure of a company we would have to consider the beta value. The beta value describes the sensitivity of a single stock to changes in the marked conditions, here defined as systematic risk. If we would like to consider how a stock is exposed to systematic risk we could further use models as CAPM (Capital Asset Pricing Model) to assess the systematic risk exposure by predicting the estimated stock return. The beta value representing the systematic risk factor in CAPM is measured by calculating the covariance between the return on a stock and the market index. The market index would therefore represent the systematic risk (T. E. Copeland, Weston, & Shastri, 2005). The formula for calculating beta in CAPM can be illustrated by the following equation:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2}$$

Equation 3 - CAPM Beta Value

- β_i represents the sensitivity of stock i to the market risk

- σ_{im} represents the covariance between the return on stock i and the marked index; how the company stock deviates from the market index. This is caused by changes in the particular stock; unsystematic risk
- σ_m^2 represents the variance of the market index. This is caused by changes in the marked index and is therefore common for every stock; systematic risk (Brealey et al., 2008; T. E. Copeland et al., 2005; Cuthbertson & Nitzsche, 2004)

The beta value in CAPM indicates how the stock return varies in relative to the overall market index. The market index is supposed to capture the systematic risk exposure. The market index is further supposed to provide a beta value of 1. By calculating the beta value of a stock we could therefore determine whether a stock moves in the same or opposite extent as the market index. A stock with a beta value less than one indicates the stock price changing in a smaller frequency than the market index, whereas the opposite is true for a beta above 1. A stock representing a high beta value is therefore expected to provide supplementary return because of the additional systematic risk not captured by the market index (Brealey et al., 2008; T. E. Copeland et al., 2005; Hull, 2009).

The CAPM is only one of several models incorporating financial risk factors to assess the financial risk exposure from changes in a company's stock price. There is however several possible systematic and unsystematic risk factors that could have influenced the stock price fluctuation. The CAPM model could therefore be regarded as insufficient, as it only includes the market index to explain the total risk exposure. This thesis has chosen to consider several models including both systematic and unsystematic risk factors in order to measure a company's financial risk exposure from former stock price changes. The following sub-chapters will therefore introduce possible systematic and unsystematic risk factors before proceeding to the models incorporating these risk factors for measuring the energy company's exposure to financial risk when considering former stock price fluctuations.

3.2.2.3 Systematic Risk Factors

This chapter intends to introduce three possible systematic risk factors and their possible influence on a company's stock price. The three risk factors selected to represent an energy companies exposure to systematic risk were interest rates, exchange rates and commodity prices.

The purpose of the next sub-chapters were to provide an explanation to how these systematic risk factors could influence the energy industry, and how periods of recession and periods of growth may provoke additional changes in the stock return. The intention of this chapter was therefore to provide a sufficient perspective of the possible determinants of expected stock return.

3.2.2.3.1 Interest Rate Risk

Interest rate risk is the first systematic risk factor presented that could have caused changes in the stock price values. Interest rate risk can be defined as *the possibility of an adverse impact on profitability or asset value as a result of interest rate changes* (Horcher, 2005, p. 24). Interest rates can be regarded as a key factor within market prices, and as an important economic indicator. Energy companies are exposed to interest rate risk when borrowing money to perform new investments and when performing monthly repayment. In periods of recession it might be more difficult for the bank sector to achieve access to enough capital, hence increasing the requirement to loan money. This provides the energy companies with limited access to capital when planning future investments, and may therefore reduce the ability to explore new strategic developments to secure future growth.

The US Treasury bill is often referred to when considering the risk free interest rate. The Treasury bill can be considered as an instrument used by the government to borrow in its own currency. This is a non-interest bearing obligation or debt issued by the US Treasury with a maturity of less than one year. The US Treasury could therefore be considered as the safest securities available for the investors, and the yield provided by these securities appear to be the Treasury bill or the risk-free rate of return. For that reason, these securities would appear a good possibility for companies to obtain risk free investments and at the same time provide a less extent of credit risk. This is followed by the high liquidity of US government/Treasury obligations. The low maturity provides less sensitivity to changes within interest rates (Brealey et al., 2008; Hull, 2009; Van Horne & Wachowicz, 2005).

The interest rate risk is particularly important for the energy companies, because it could affect both profitability and the asset value causing the stock price to increase or decline. In periods of recession and periods of growth followed by respectively a low or high interest rate, it is therefore important to incorporate the possible changes to prevent possible influence on the

company's profitability. A high interest rate indicates increased cost of capital which may cause changes within strategic and financial plans (Horcher, 2005). The cost of capital we refer to here, is the companies expected return on an investment (Brealey et al., 2008). The companies will therefore have to increase their effort additionally to sustain required growth. Increased interest rate does not only influence investment behavior, it also affects the amount of debt held by the company. Higher interest rates could increase the monthly obligations and for that reason decrease the capital available for investments and operations expenditures. The interest rate is often settled over a given time period and can therefore remain unchanged for months. This enables the energy company to make the necessary preparation and management in order to maintain economic growth and possibly mitigate the cost of capital (Horcher, 2005).

3.2.2.3.2 Exchange Rate Risk

When performing transactions related to export or import, or when performing international investments the companies are exposed to exchange rate risk. International investments and transactions often require transactions in foreign currencies providing possible risk exposure when converting from national to foreign currency. Exchange risk can therefore be defined as *the price of a unit of foreign currency, measured in units of domestic currency* (L. S. Copeland, 2005, p. 53).

Oil and gas are usually traded internationally in U.S. dollars. This implicates a higher risk exposure for non U.S. energy companies. Trading supplies involves exposure to other currencies and arises through transaction of commodities. When trading oil and gas supplies, the supplier will have to sell oil and gas in U.S. dollars then convert the sale income into the national currency. This trade could provide a strong or weak exchange rate for the supplier. The exchange rate risk can be illustrated by the following example. If oil supplies are traded in U.S. dollars and the supplier converts its domestic currency into U.S. dollars, it is exposed to exchange rate risk. For example, if StatoilHydro were selling oil at an exchange rate 7 NOK/$ it would have significant higher income then if oil was sold at an exchange rate of 5 NOK/$. In periods of recession there will be currencies that are more attractive and safer than others. The company decides how to utilize their financial holdings which allows them to seek safe return on their investments (Horcher, 2005).

The company's exposure to exchange rate risk can be reduced by only doing business in their own country or by entering into fixed rate contracts. The first option is rather unlikely because performing investments exclusively in their own country can diminish their growth possibilities. A fixed rate contract can be defined as a *customized contract that locks in an exchange rate for the purchase or sale of a predetermined amount of currency for future delivery date* (Horcher, 2005, p. 80). The contract involves an obligation to buy one currency and sell the other currency at a future delivery date. Fixed rate contracts can provide beneficial protection if the exchange rate moves adversely. Entering these contracts can also give up potential profit if the exchange rate moves favorably. Instead of facing exposure to exchange rates, the company now faces exposure to the performance of the contractual counterpart (Horcher, 2005).

3.2.2.3.3 Commodity Price Risk

Organization producing or purchasing commodities are exposed to commodity risk. Commodity risk can be defined as *the exposure to absolute price changes in the risk of commodity prices rising or falling* (Horcher, 2005, p. 34). Both producers of commodities and those who use commodities as intermediate supplies would experience exposure to commodity price risk. The commodity price fluctuation may therefore cause the energy companies to experience uncertainties regarding future market values and future income from commodities not yet produced.

Financial risk associated with commodity prices relates to uncertainties regarding various unpredictable factors like exchange rates, interest rate, economic conditions and production costs. The value of the commodity could also be affected by physical quality, delivery location and storability unlike other financial assets. For an energy company to maximize their return they need to take these risk factors into consideration. An unexpected decline in the exchange rate or reduced product quality may cause significant financial loss. The commodity prices are further influenced by market demand and supply. Commodity supply is a function of production which may deteriorate if the production system fails or if the company experience difficulties regarding delivery. Demand will also experience increased cost as the commodity prices goes up, possible causing reduced profit (Horcher, 2005).

Fluctuating commodity prices will not only affect production revenues and conceivable strategies, it may also affect quantity produced. When the commodity prices are low, it could be less enticing to maintain the same production intensity or establish new production since the conceivable return is no longer obtainable. Conversely when the commodity prices are high, producing (oil and gas) becomes more attractive causing additional production levels (Horcher, 2005).

Periods of recession and periods of growth may cause additional commodity price fluctuation in contrast to rather stable commodity price levels. These periods may cause additional uncertainties when considering long term investments. Long term investments are intended to provide income on the long term basis, and it is therefore important to consider possible movements based on former historical movements. It is however difficult to predict how the oil price would be 1 year from now, and even more difficult in 5 years from now. Who would for example have guessed the oil price reaching a peak level above 130 $/bbl by July 2008, and who would have guessed the oil price dropping over 65% as we move into March 2009? These periods of growth and recession makes is rather difficult for an energy company to predict future conditions when considering developing new fields. This provides superior exposure to commodity risk and could therefore provide as an important indicator when evaluating previous stock price movements.

The systematic risk factors presented could appear as possible reasons for former stock price changes within the energy industry. The following chapter will now present unsystematic risk as the other important component within equity risk.

3.2.2.4 Unsystematic Risk

The unsystematic risk relates to the company specific risk. Companies can influence these risk factors in a larger extent by diversifying their risk exposure in contrast to systematic risk (T. E. Copeland et al., 2005; Downes & Goodman, 2006). This thesis has evaluated stocks individually and not as a portfolio, this implies that we will not explore the term diversification further in our quantitative or qualitative analysis.

If we would have considered several portfolios of stocks then diversification could have removed a large extent of the unsystematic risk. The concept of diversification is to spread the risk by investing in several stocks in order to be prepared for uncertain market conditions if a stock sudden deteriorates. Diversification will not be further evaluated since we are considering single stocks rather than several stocks in one portfolio. In this thesis there is only one portfolio, the market index. In this context the portfolio referred to in this thesis will be the world market index consisting of all the stocks in one portfolio.

The unique risk is related to revenues and activities within the company. The unique risk discussed and evaluated in this thesis is exploration and production related risk; exploration and development cost, and reserve replacement rate. These company specific or unsystematic risk factors were further presented in chapter 3.3 Investment Behavior, as these unsystematic risk factors could be related to a company's investment behavior.

3.2.3 Systematic and Unsystematic Risk Summary

We have now evaluated systematic and unsystematic risk that comprises the equity risk or the overall financial exposure facing the energy industry. These factors could all provide significant financial risk exposure in periods of recession or periods of growth, causing fluctuating stock prices and return alterations for an energy company. In order for a company to succeed they are depending on managing financial risk and succeeding within financial investments, to increase revenue and hence increase the stock price (Horcher, 2005). The first task in any management function is to identify the risk exposure facing a company. Once the risk has been identified, it must be assessed, evaluated and mitigated. This implies to determine the impact of risk exposure and evaluate what influence risk management can have on limiting the risk. These procedures are present for all the different market risk factors and are essential in order to provide higher returns and dividends for the shareholders. These systematic and unsystematic risk factors were further applied in the quantitative and qualitative analysis in order to explain their possible influence to former stock price changes.

We will now continue to present the models selected in this thesis used to measure the company's financial risk exposure from former stock price changes.

3.2.4 Historical Stock Return

As mentioned in the previous sub-chapters, the energy companies are vulnerable to both systematic and unsystematic risk. In order to determine the market price of risk and the appropriate measure of risk for a single stock, we can employ different models. The purpose of this chapter was to present the single and multifactor models applied in this thesis for the explanation of oil and gas companies' excess stock return over the last 20 years. The excess return of a stock represents the required risk premium from investing in a single stock rather than in a risk free investment (Bodie, Kane, & Marcus, 2005). The excess return is required to calculate the beta values indicating the systematic and unsystematic risk factor for a stock. The risk premium indicating the excess stock return has further been presented in chapter 3.2.5 Risk Premium and Excess Stock Return. These models intend to capture the energy company's exposure to both systematic and unsystematic risk factors by including certain risk factors within the model to help explain historical stock return. The next sub-chapters will provide an introduction to these models applied in this thesis by explaining the fundamentals of each model selected.

3.2.4.1 CAPM

A well recognized method for calculating the required rate of return is CAPM; Capital Asset Pricing Model. The theory of CAPM was developed by Black, Lintner, and Sharpe (Black, 1972; Lintner, 1965; Sharpe, 1964). The idea behind the CAPM theory started with how investors could construct efficient stock portfolios based on a single factor, the market index. CAPM was included in this thesis as it assesses the financial risk exposure by considering the changes in the return of the world market index compared to stock return. This relationship is indicated by the beta value of a stock and was presented in chapter 3.2.2.2 Beta. This model provides information of the historical stock price as a function of the covariance with the market index.

When investing in a company or when purchasing company stocks, one would require a compensation for the exposure to financial risk. When an investment is considered as risky, the expected return (r) will have to exceed the return on a risk-free investment (r_f); here described as the market risk premium. Market risk premium is referred to *the difference between the return from the market and the interest rate* (Brealey et al., 2008, p. 214). This risk free return is often considered to be the interest rate.

The formula illustrating the relationship between risk and expected stock return, CAPM, is:

$$Er_i = r_f + \beta_i\left[E(r_m) - r_f\right] + e_i$$

Equation 4 - CAPM Expected Stock Return

Er_j: expected return on stock i

r_f: risk free interest rate often referred to as the US Treasury bill

r_m: expected return on the market index

$\left[E(r_m) - r_f\right]$: equity risk premium; the excess return of the market index beyond the risk free interest rate

β_i: systematic risk

e_i: other risk factors that might have influenced the former stock return

(Reilly & Brown, 2003)

The CAPM formula provides the relation between the expected risk premium of a stock and their systematic risk factor represented by the market index. The CAPM model can further be explained by illustrating a few examples. Consider an example where the market index provides several fluctuation during a given time period, like for example in recession or growth periods. The stock price however, remains at a rather stable level providing a small volatility measure. The stock return does therefore not vary in accordance to the market and would therefore provide a beta around 0. This implies a risk free investment and would provide an expected return similar to the return provided by the risk free interest rate. Another example would be a stock providing similar movement as the market index implying a beta value around 1. The stock's relation with the market would therefore provide the stock return to be similar as the return provided by the market index (Womack & Zhang, 2003).

The CAPM formula divides risk into two dimensions, systematic and unsystematic risk. The systematic risk stems from market risk factors and unsystematic from company specific factors. CAPM further implies that investors are compensated for systematic risk exposure but not for unsystematic risk exposure. The possible unsystematic risk factors are therefore excluded in the CAPM model. The reason being that investors could avoid unsystematic risk by diversifying

which involves investing in a portfolio consisting of several stocks (Brealey et al., 2008; Reilly & Brown, 2003).

The CAPM model assumes that a stock should provide a return similar to the risk free rate in addition to a risk premium from holding the stock, measured by the beta value of the stock. The beta value of a stock representing the systematic risk would therefore provide valuable information indicating the variance of the stock price which can't be reduced trough diversification. The relation between the beta of a stock and the following expected stock return can be illustrated by the following figure:

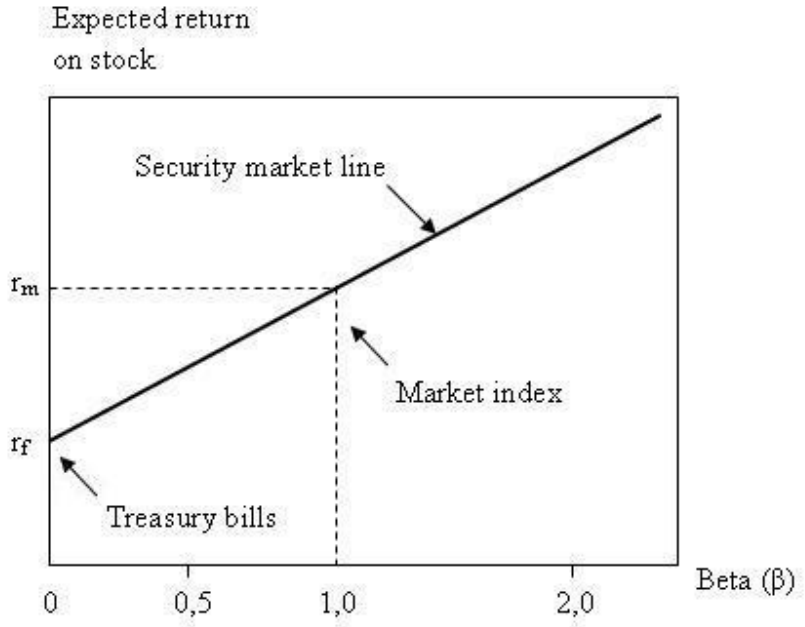

Figure 3 - CAPM: Security Market Line (SML)

(Brealey et al., 2008, p. 214)

The security market line illustrates the relation between the expected return and the market risk, where the market risk referred to here is the beta value. In a competitive market, the expected risk premium varies in proportion to beta which implies that all stocks should be on the security market line (Armitage, 2005).

As earlier mentioned, this thesis has selected to apply several models including both systematic and unsystematic risk factors as the CAPM model only captures financial risk in one systematic

risk factor; the market index, and could therefore be regarded as insufficient. We have explored several models trying to explain a company's financial risk exposure considering the relation between the stock return and several systematic and unsystematic risk factors. The following chapters will therefore provide an introduction to some of the multifactor models explored, as they have been applied to assess and measure the financial risk exposure of the energy companies selected.

3.2.4.2 Multifactor Models

When measuring financial risk exposure and predicting former stock return there could be several different risk factors contributing to changes in a stock price. If we open for multiple risk factors to be included in a model we would refer to multifactor models. These multifactor models would evaluate the sensitivity of a stock to several financial risk factors (Armitage, 2005).

The opinion of CAPM not being sufficient to explain the financial risk exposure due to former stock price changes corresponds to the research of Fama and French (1992). This research discovered that the CAPM model provided a good indicator for expected stock return during the periods 1926-1968 but during the period 1963-1990 the results from their research showed the CAPM model no longer was sufficient to explain the financial risk exposure as a result of changes in the stock return (Fama & French, 1992).

In order to better understand what determined the expected return of a stock there has been developed several multifactor models including additional factors within the model. We can start by mentioning APT (Arbitrage Pricing Model) introduced by Stephen A. Ross (Ross, 1976).

3.2.4.2.1 APT

The resemblance between the CAPM and APT is the comprehension of systematic and unsystematic risk. Both CAPM and APT determines that systematic risk is non diversifiable. The systematic risk relates to unexpected economic activity or market events affecting the entire industry; not just one particular company. There are however certain factors initiated by the company itself relating to the unsystematic risk. These factors relates to one particular company or for a small group of companies making it easier for an investor to avoid risk by diversification.

These unsystematic risk factors are therefore excluded or not "priced" when calculating the expected stock return in both CAPM and APT (Brealey et al., 2008; Cuthbertson & Nitzsche, 2004).

APT provides a broader range than CAPM, stating that the stock return could be affected by several systematic risk factors in addition to the marked index. The relation between the expected risk premiums of a stock should depend on several economy wide market risk factors when estimating the expected historical stock return. However, the theory of APT does not state which underlying systematic market risk factors that could be important, unlike CAPM which incorporates the systematic risk into a well defined single factor; the return of the market index. The number or the identity of risk factors are therefore unknown and could provide a challenge when aiming to determine expected stock return by applying APT (Reilly & Brown, 2003). The formula illustrating the relationship between systematic risk and expected stock return, APT, is:

$$R_i = r_f + b_1(r_{factor\,1}) + b_2(r_{factor\,2}) + b_3(r_{factor\,3}) + \cdots + noise$$

Equation 5 - APT Expected Stock Return

R_i= expected return on the stock

r_f= the risk free interest rate

b_1,b_2, b_3= the stocks sensitivity to the included systematic risk factors

$r_{factor\,1}$,$r_{factor\,2}$, $r_{factor\,3}$ = the chosen risk factors included in the APT model

$noise$ = representing the error term, other factors that might explain the changes in the stock return and could therefore be regarded as noise

(Brealey et al., 2008).

The APT model does not provide which systematic risk factors they are referring to. This enables us to choose among several market risk factors that could influence the return provided by the stock. When estimating the historical stock return it was therefore important to consider the possibility for other systematic risk factors that could relate to the changes in stock return.

Some stocks would be more sensitive to a particular factor than others; this was analyzed at a later stage of this thesis. APT utilizes several market risk factors to explain expected stock return,

and as it includes several factors we can consider APT as a multifactor model. This model could therefore provide useful information in order to evaluate whether other systematic risk factors than the market index could contribute to the calculation of historical stock return (Brealey et al., 2008).

3.2.4.2.2 Fama and French

This chapter provides an example of a multifactor model developed by Fama and French (Fama & French, 1993). Fama and French performed further research on possible financial risk factors affecting the stock return, and discovered that the beta value provided by the market index in CAPM, no longer was sufficient to explain excess stock return. In addition to market risk measured by beta, they discovered that the unsystematic risk factors describing a company's value and size were important to provide a good indicator for estimating the variance in expected historic stock return. This implied that Fama and French included both systematic and unsystematic risk when estimating the expected historical stock return.

The three factor model developed by Fama and French described the expected stock return as a result of the relationship between the following risk factors: market, size and value. The market index is considered to represent the overall market or systematic risk, similar to the CAPM model. The market cap indicating the size of a company is further included to represent the first unsystematic risk factor in the Fama and French three factor model. The market cap can be estimated by multiplying the number of shares with the current stock price. The procedure for evaluating the size risk is by subtracting stock return from companies with a relatively large market capitalization from stock returns from companies with relatively small market capitalization. The book-to-market ratio is the last unsystematic risk factor included representing the value of a company. The book-to-market ratio can be calculated by dividing the book-value of a company by its market value. The value risk is further estimated by subtracting return on low book-to-market stock returns from high book-to-market stock returns (Fama & French, 1993). Fama and French discovered that stocks in smaller companies and those with higher book-to-market ratio provided above-average stock returns (Fama & French, 1993, 1995).

The vulnerability caused by financial risk differs between energy companies; this implies differences within required additional compensation for exposure to market, size (market cap) and value (book-to-market ratio) risk. The three factor model developed by Fama and French is represented by the following equation:

$$R_i = r_f + b_1\left[E(r_m) - r_f\right] + b_2 * SMB + b_3 * HML + e_i$$

Equation 6 - Fama and French Expected Stock Return

R_i: expected stock return of company i
r_f: risk free interest rate
b_1: the stocks sensitivity to market risk (market index)
$\left[E(r_m) - r_f\right]$: the risk premium or excess return required from investing in the market index rather than in a risk free investment
b_2: the stocks sensitivity to size or market cap
SMB: the return from small company stocks subtracted by the return from large company stocks.
b_3: the stocks sensitivity to value or book-to-market ratio
HML: the return from companies with a high book-to-market subtracted by the return from companies with a low book-to-market ratio
e_i: the error term representing other factors that might explain the expected stock return (Brealey et al., 2008; Fama & French, 1993)

This equation could be regarded as similar to CAPM considering the beta value indicating the stocks exposure to systematic risk. Even though the three factor model includes the same market index variable, the beta value representing the systematic risk will change by adding two additional variables. The additional explanatory variables, size and value, could therefore result in a more accurate measure of financial risk exposure when predicting the former changes in a company's historical stock return (Womack & Zhang, 2003).

3.2.4.3 Historical Stock Return Summary

We have now presented the selection of models chosen in this thesis to assess financial risk exposure of each of the company's selected. As earlier explained, this thesis has selected to apply

several models in order to determine what model gives the most accurate measure of historical expected stock return. As the CAPM model incorporates systematic risk in one factor, market index, it is likely to believe that multifactor models including several possible financial risk factors would improve the explanation of former changes in a stock price. The predicted stock return is therefore assumed to be more accurate as the multifactor model allows for a stock price to be exposed to several financial risk factors.

Measuring financial risk was one of the primary purposes of this thesis. The models presented enable us to measure the financial risk exposure by considering changes within systematic and unsystematic risk factors. These models further enable us to calculate the predicted stock return by applying historical data to consider whether increased numbers of financial risk factors would give a more accurate measurement of historical stock return.

The intention of applying these models was to determine which of these models minimizes the difference between the predicted and the actual historical stock return. The presented models have different characteristics that are important when determining expected stock return. This implies including various risk factors to calculate the expected stock return.

3.2.5 Risk Premium and Excess Stock Return

The former chapter presented the models for calculating expected stock return. These models are intended to estimate the historical expected stock return based on systematic and unsystematic risk factors, or risk premium. When estimating the beta values representing the systematic and unsystematic risk factors, the excess returns have been presented as the dependent variable, and further the other factor's risk premium or change in return as the independent variables. Since we have selected to apply different models, we will present a general equation for calculating the excess return and the beta values valid for the CAPM, APT, Fama & French and the self explored multifactor model.

CAPM, APT, Fama and French and the multifactor model selected have indicated several market and company specific risk factors providing information on a certain risk premium required to perform an investment. The risk premium of investing in a stock indicates the excess return and was calculated by subtracting the risk free interest rate from the stock return. The risk premium

refers to the additional required return for making an uncertain rather than a safe investment (Brealey et al., 2008). The previous presented model further requires estimating certain systematic and unsystematic beta values. The beta values representing the systematic and unsystematic risk factors have been estimated by performing a regression analyses.

The general formula for calculating the beta values factors required to perform the single and multifactor models can be illustrated by the following equation:

$$r - r_f = \alpha + b_1(r_{factor1} - r_f) + b_2(r_{factor2} - r_f) + \cdots + b_i(r_{factori} - r_f)$$

Equation 7 - Excess Stock Return

r: stock return

$r - r_f$: excess stock return

r_f: risk free interest rate

b_1,b_2: the stocks sensitivity to the included systematic and unsystematic risk factors

$r_{factor\ 1}$,$r_{factor\ 2}$: the chosen risk factors included in the model

$(r_{factor1} - r_f)$: the expected or historic risk premium indicating the difference between the risky and risk averse alternative.

(Brealey et al., 2008)

However, it is important to emphasize that this is a general formula where $(r_{factor1} - r_f)$ should be replaced by an alternative when referring to the size and value factor of a company. There are also other financial risk factors like for example oil and gas price, but these would be included as a change factor and not as a risk premium.

The excess return is an important estimate and explains the required risk premium of investing in a single stock rather than in a safe investment. The excess stock return provides the dependent variable in the regression analysis and is therefore important to provide the necessary beta values required to estimate the expected stock return when applying the relevant models.

3.3 Investment Behavior

The purpose of this chapter was to present the importance of investment behavior. The intention was further to present two important company specific factors providing information about an energy company's investment behavior.

Future investments are essential to provide future growth and production. An investment can be defined as *the current commitment of money or other resources in the expectation of reaping future benefits* (Bodie et al., 2005, p. 1). An important intention for the energy industry is to provide a production capacity that is sufficient to meet the market demand. The demand for commodities will however change in periods of growth compared to periods of recession. Periods of growth may often provide additional demand for oil and gas while periods of recession may provide less demand.

The last 20 years has proven periods with changing economic activity providing both possibilities and limitations for both short and long term investments. These periods has proven several changes within the financial market risk factors influencing the stock return and investment behavior of a company. In these periods the energy companies are required to make critical decisions that could affect the future of a company. Wrong or risky investments could cause major losses over a longer time period. We can consider two important company specific measures that could reflect a company's investment behavior; reserves replacement rate and finding and development costs. These factors can be considered to represent two unsystematic risk factors reflecting industry specific information.

3.3.1 Reserves Replacement Rate

The reserve replacement rate (RRR) can be considered a key performance indicator on explaining an oil and gas company's ability to grow or maintain existing production profile. The RRR can be expressed as the extent of proved reserves added each year as a result of exploration and development activities ("Performance Profiles of Major Energy Producers 2007," 2008).

Let us start by looking at the formula for calculating the reserve replacement rate:
RRR= (Booked Reserves in year XX / Produced Reserves in year XX) * 100%

Each year an oil and gas company depletes their reservoirs by producing the amount of oil and gas reservoirs and topsides facility (wells, process equipment and storage and transportation facilities) enables them to. If no exploration activities are conducted, the company will deplete the reservoirs year in and year out until there are no more producible oil and gas. Reducing the amount of producible oil and gas will affect the company's production profile (daily production rate), and a reduced daily production rate could not be seen as positive in the stock market.

To retain or grow the current production profile, oil and gas companies explore for oil and gas. This can be done through seismic surveys, exploration activities in new frontiers or platform drilling in mature areas. Discovered oil and gas can be booked and replace the produced reserves. Having a RRR of over 100% can be regarded as a healthy indicator for a business, as this will be seen as positive by stock stakeholders and proves the plans for long term growth for an energy company.

3.3.2 Finding and Development Costs

The finding and development costs can be divided into two segments:

- Cost of exploration activities;
- Cost of development activities.

The cost of exploration activities will include all costs related to exploration and booking of reserves as described in the previous chapter. This will include the cost of exploration licenses, seismic surveys, interpretation of geological models, drilling and booking of reserves.

Once the reserves have been booked, topsides facilities and equipment is required to safely and efficiently produce the reserves. The requirement and cost for topsides facility will depend heavily on geographical location and environment. The finding and development cost really sums up all the cost from applying for an exploration license to having a full topside facility in place ready to produce.

The formula for estimating F&D costs is illustrated below:

F&D Cost = Total $ used for exploration and development / Barrels to be produced

The F&D cost will be another key performance indicator for an oil and gas company. Maintaining a low and stable F&D cost will be essential to find and develop new reserves within reasonably economical constrains, proving an economical control over investments.

3.3.2.1 Investment Behavior Summary

The preceding sub-chapters has introduces the importance of reserves replacement ratio and the finding and development costs representing information on the investment behavior of a single company. These factors relate to industry specific risk factors were applied in the quantitative analysis in chapter 7 Data Selection and Results, as they might contribute to the explanation of former changes in the stock return.

3.4 Financial Crisis 2008

The ongoing financial crisis could be an important feature encompassing the prevailing financial situation. The goal in this chapter was to present the dimensions behind a financial crisis and to present the influence from the current financial crisis.

A financial crisis is often characterized by its low predictability. Even though financial crises have occurred regularly, they are unfortunately not predictable. The world has experienced several former crises, like the Gulf War or the Asian financial crisis which provoked surprising influence on the world economy, see for example its influence on the crude oil price in chapter 3.1 Recession versus Growth shown in Figure 2 - Historical Oil Price. Changes within interest rates, exchange rates, commodity prices and stock prices are all factors which could influence the worldwide financial situation. The major concern for regulators or for financial institutions is when an industry or the market as a whole is experiencing deterioration. This is often referred to as systematic risk and may occur if an industry or the market as a whole are dependent on large investments or systems in order to succeed (Geman, 2005; Horcher, 2005).

The current financial condition could be explored from several dimensions. First of all, the financial crisis can be regarded as confidence violations between the financial institutes. Further, it has caused the stock exchange to crack, provoking significant fluctuations in the stock market.

It has also affected the commodity prices, like for example the oil and gas price, which in turn has caused significant decline in returns. This might stem from a decline in the supply and demand for commodities. A decline in demand could results in declining commodity prices and may further cause less willingness to maintain the production level (Vactor, 2009; Vennemo, 2008). The figure below illustrates the radical changes in the oil price $/bbl between 2006 and 2009.

Figure 4 – ICE Brent Crude Oil Price: 2006-2009

("ICE Brent Crude Oil Front Month ", 2009)

Paolo Scaroni, the top executive in the Italian oil company, Eni, claims that the worst enemy facing future production capability is the unstable oil price. He states that the ideal oil price to be around 60-70 U.S. dollars. At this price we would see sufficient return on invested capital emphasizing further investment (Rosenberg, 2009).

The ongoing financial crisis requires additional effort in order to maintain return for stockholders. Managing financial crisis requires additional effort by management to ensure that an adequate financial risk management framework is in place. This emphasizes the importance of understanding the current risk exposure and the ability to avoid overconfidence in case of exposure to systematic risk. The financial crisis makes it more difficult to decide on future investments, as the market future movements could be considered as very uncertain. This might

cause higher cost when initiating or closing out transactions which in return might induce higher volatility (Horcher, 2005).

3.5 Empirical Evidence and Literature Review

Previous work and former articles has been written about financial risk exposure for energy companies. This chapter intends to introduce the results and possible explanations provided by former research and articles. The empirical evidence has been further used when presenting and discussing the results provided in this thesis in chapter 9 Hypothesis Discussion and Results, to evaluate possible resemblances and differences.

One of the first prediction presented in this thesis stated that "economic recession, and resulting changes in market risk factors, increases the stock price volatility and changes the investment behavior for energy companies".

Several articles considering whether periods of recession change the stock price volatility due to changes in the world market activity have been identified. The first two articles selected considered the volatility in periods of recession during 1834-1987 and discovered that the overall stock price volatility increases in periods of recession. These articles indicated that the stock market volatility is considered to provide the highest volatility measure when the uncertainty and panics is at its highest level in periods of recession. It is however further mentioned that these periods of recession has not caused long-term effect on stock price volatility, the volatility measure will therefore diminish gradually (Schwert, 1989a, 1989b).

The articles do not include the selected periods of recession and growth in this thesis, however we have therefore considered a third article considering the stock price volatility. The article referring to here was developed by Lugvigson and Ng (2007) and considered the stock price volatility during 1960-2001. This article stated that in most periods of recession the stock price volatility intends to increase compared to periods of growth, similar to the result of Schwert (1989). Despite the overall increased stock price volatility in periods of recession, they further discovered two exceptions, the recession in early 1960 and 2001 (Ludvigson & Ng, 2007).

Former articles have further stated that despite periods of recession and lower oil prices, the oil and gas investments has kept an ascending or stable level. This was further explained by former periods of economic growth as these have provoked several long term investments (Langum, 2009). There has also been discussed the importance of an ascending oil price to maintain increasing future investments in former articles. Abdalla Salem el-Badri, the general secretary in OPEC, further stated that today's oil price is not sufficient to secure future investments and developments of new fields (Øklend, 2009). The main responsibility of OPEC, the organization of petroleum exporting countries, is to ensure stabilization of oil markets and secure an efficient supply of petroleum to consumers ("The Organization of the Petroleum Exporting Countries (OPEC)," n.d.). The oil price would require an increase in order to increase investments in new capacities and further to secure long-term stability in the oil markets (Øklend, 2009).

The first prediction was followed by a hypothesis stating that "the stock price is more influenced by market risk in periods of recession than in periods of growth". We could not identity research considering the relation between a company's stock return and market risk factors in periods of recession and growth. We would however like to present the positive and negative relation discovered between a stock return and different market risk factors in general from previous research. Sadorsky (2001) discovered a positive correlation between the stock return and the return from the market index and crude oil price changes. The other market risk factors, exchange rate returns and the interest rate risk premium; *the risk premium between the annual yield on the 90-day Canadian Treasury bill and the yield on the 30-day Canadian Treasury bill* (Sadorsky, 2001, p. 21), represents a negative relation with the stock return. The exchange rate returns represents the exchange rate between $CAN/$US. Boyer and Filion (2007) showed a positive correlation between the stock return and the following financial risk factors; market index return, interest rate return, crude oil and natural gas price changes. The stock return was further negative correlated with the exchange rate return. As similar to Sadorsky (2001), the exchange rate return is between $CAN/$US. The overall results from both Sadorsky (2001) and Boyer and Filion (2007) illustrates the changes within oil price to be the most important factors for former stock price changes as the oil price shows the highest correlation with the stock price compared to the other financial risk factors included.

Finally we would like to consider the former empirical review on the last hypothesis stated in this thesis “Increased number of financial risk factors included in a model for pricing risk, gives a more accurate predicted historical stock return”. Several studies have conducted empirical evidence on possible financial risk factors that could have influenced the historical stock return by applying both single and multifactor models. This implies to find the possible risk factors contributing to the explanation of former stock price changes. The former research shows mixed results regarding the included variables ability to explain the former changes in stock return. This implies that previous research have discovered several different variables that have contributed significantly, either positive or negative, to the explanation of former excess stock return.

Previous and recent studies have discovered that both market risk factors, in addition to company specific factors, to contribute significantly to the explanation of predicted stock return. The models used for estimating the historical stock return based on former data were applied in several industries. We would now like to illustrate some examples within the energy industry by presenting some of the factors that has contributed significantly to the explanation of changes in energy company stocks.

Recent studies have incorporated both systematic and unsystematic risk when estimating former predicted stock return. Boyer and Fillion (2007) presented a recently progressed research considering the determinants of Canadian oil and gas stock returns. They provided a multifactor model consisting of a sample of 105 Canadian oil and gas corporations on a quarterly basis from 1995-1998 and from 2000-2002. The companies selected were further divided into two portfolios, one consisting of producers and the other consisting of integrated oil and gas companies. The regression results from the multifactor model on the complete sample, meaning all the 105 companies selected, provided evidence of several financial risk factors that has contributed significantly to the explanation of excess stock return. The return of the market index, the crude oil price and the natural gas price were considered to contribute significantly by showing a positive impact on the Canadian oil and gas stock return. The interest rate and exchange rate return did also provide a significant influence but did however indicate a negative influence on the stock return. The multifactor model was further expanded to include several unsystematic risk factors on the entire sample by including for example variation in proven

reserves and production volume. Each of these variables contributed significantly to the explanation of stock return, but as the variance in proven reserves showed a positive influence, the variation in production volume showed a negative influence (Boyer & Filion, 2007).

Scholtens and Wang (2008) performed a study on 96 oil and gas companies listed on NYSE (New York Stock Exchange) on a weekly basis from January 1. 2002 to December 31. 2005. This research applied both an APT multifactor model including systematic risk factors and an integrated multifactor model including the unsystematic risk factors size and value introduced by Fama and French three factor model in addition to the systematic risk factors from the APT model. The analysis was performed on each of the companies selected in order to evaluate whether the selected financial risk factors contributed significantly, either positive or negative, to the explanation of excess stock return. The overall results from the regression analysis showed that the crude oil price, the market index and the size risk premium; representing the market cap of large companies less the market cap of small companies, showed a positive influence and contributed significantly to the explanation of former excess stock return. There was however also discovered that 12 of the companies from the entire sample did not prove the oil price to be significant for stock price movements. Further, the value risk premium; representing the book-to-market ratio on companies with high book-to-market ratio less the book-to-market ratio of companies with a low book-to-market ratio, was only identified to provide a significant positive influence on one third of the companies selected. The interest rate risk premium; indicating the *difference between the weekly return of a 7 year US Treasury note less the 1 month US Treasury bill rate* (Scholtens & Wang, 2008, p. 111), showed insignificant estimates and could therefore be regarded to be less important when trying to explain the changes in the former stock return (Scholtens & Wang, 2008).

We have now presented the results from former research and how they contribute with valuable information regarding comparable studies. These results have been further discussed when presenting the results from the analysis conducted in this thesis in chapter 9 Hypothesis Discussion and Results, to evaluate whether there is a resemblance between the results in this thesis and former studies.

The next chapter will give an introduction to how we have proceeded in conducting the regression analysis. These risk pricing models are essential to help explain and measure financial risk exposure due to both systematic and unsystematic risk factors that might help explain oil and gas companies excess stock return.

4 Conducting the Regression Analysis

In chapter 3.2.4 Historical Stock Return we provided the theory behind three models for estimating historical stock returns. These models included both systematic and unsystematic risk factors that could help explain oil and gas companies financial risk exposure when estimating the excess stock return. In this chapter we will present how we have proceeded in conducting the analyses for estimating the historical stock returns. The single and multifactor analysis has been performed on a monthly basis from February 28th 1989 to February 27th 2009 except for the final multifactor model chosen as this has been analyzed on a yearly basis from 1990 to 2008.

4.1 Single Factor Models

The first analysis performed in this thesis was CAPM, trying to capture the systematic market risk factor in one variable, the changes within the market index.

4.1.1 CAPM

We started by presenting CAPM for estimating each company's historical expected stock return by examining the relationship between the stock return and variation in the market index. Before implementing the CAPM model and calculating the predicted stock return, a regression analysis was conducted to give the beta values required for the model. The beta values were estimated by performing a single factor time-series regression. A time series regression is a model collecting several observations representing different points of time (Stock & Watson, 2007). The model for calculating the beta value has been presented below.

$$R_{i,t} = \alpha_i + r_f + \beta_i\left[E(r_{m,t}) - r_{f,t}\right] + e_{i,t}$$

Equation 8 - CAPM Expected Stock Return

$R_{i,t}$= stock return for company *i* in month *t*

α_i= constant term

r_f= the monthly change in the risk free interest rate; US Treasury bill

β_i = represents as earlier mentioned the systematic market risk factor; describing the sensitivity of a stock to changes within the market index

$[E(r_{m,t}) - r_{f,t}]$= risk premium in month *t*; the required premium of investing in the market index rather than in the US Treasury bill

$e_{i,t}$= error term in month *t*; other factors that could have influenced the stock return

(Reilly & Brown, 2003)

The beta value in this analysis represents the percentage change in stock return for a 1% increase in the market index.

4.2 Multifactor Models

Further we have introduced two multifactor models throughout this thesis; the arbitrage pricing model (APT) and Fama and French three factor model. These models include additional risk factors that could allow for a more specific characteristic of each of the included risk factors to which a company might be exposed to. The three-factor model considers the relation between stock return and three risk factors, both systematic and unsystematic factors. The APT model considers systematic risk, but does not determine which variables the model is referring to. In addition to these models we have also performed a fourth multifactor model including both systematic and unsystematic risk. The models and the following multi-factor regression equations are presented below.

4.2.1 APT

APT is the first multifactor model applied in this thesis. As earlier mentioned, APT does not provide what systematic risk factors that requires to be included in the model. This thesis has therefore selected several variables representing the systematic risk factors in the model. The market risk factors included in this model are the market index, the risk free interest rate, the oil price, the gas price and the exchange rate. The APT model views the relation between the stock return of each company and variation in the market risk factors. The beta values representing the systematic risk factors are estimated by using a multifactor time-series regression and are calculated by the following formula:

$$R_{i,t} = \alpha_i + r_f + \beta_1\left[E(r_{m,t}) - r_{f,t}\right] + \beta_2\left[E(r_{f,t1}) - r_{f,t2}\right] + \beta_3 * r_{oil,t} + \beta_4 * r_{gas,t} + \beta_5 * r_{exchange\ rate,t} + e_{i,t}$$

Equation 9 - APT Expected Stock Return

$R_{i,t}$= stock return for company *i* in month *t* based on the variation in the included market risk factors

α_i= constant term

r_f= the monthly change in the risk free interest rate; US Treasury bill

β_i = market index beta, representing the systematic risk factor as mentioned in the CAPM equation

$\left[E(r_{m,t}) - r_{f,t}\right]$= risk premium in month *t*; the required premium of investing in the market index rather than in the US Treasury bill

β_2= interest rate beta

$\left[E(r_{f,t1}) - r_{f,t2}\right]$= interest rate risk premium in month t; the required premium of investing in a 10 year Treasury note rather than in the US Treasury bill

β_3= crude oil beta

$r_{oil,t}$= s the monthly change in the oil price in month *t*

β_4= natural gas beta

$r_{gas,t}$= the monthly change in the gas price in month *t*

β_5= exchange rate beta

$r_{exchange\ rate,t}$= the monthly change in exchange rate in month *t*

$e_{i,t}$= error term in month *t*; estimating other factors that could have explained the changes in the stock return

(Brealey et al., 2008)

The betas estimated gives us the percentage change in stock prices for a 1 % increase in the market index, interest rate, oil price, gas price and exchange rate. It is however important to emphasize that for some of the companies the exchange rate risk variable were absent, this refers to American operated companies. The exchange rate risk relates to non-American companies that are required to perform currency exchange when performing transaction with other international companies or when selling oil and gas or purchasing goods or services.

4.2.2 Fama and French

In comparison to APT developed by Ross (1976), Fama and French discovered that the market index presenting the systematic risk in CAPM was not sufficient to estimate the stock return. They discovered that the unsystematic risk factors representing the size and the value of a company were predicative of the stock return (Fama & French, 1992, 1993). Similar to CAPM, the market index represents the systematic risk within the three factor model. The beta values indicating the percentage change in stock prices for both systematic and unsystematic risk was further calculated by the following equation:

$$R_{i,t} = \alpha_i + r_f + \beta_1\left[E(r_{m,t}) - r_{f,t}\right] + \beta_2 * SMB_t + \beta_3 * HML_t + e_i$$

Equation 10 - Fama and French Expected Stock Return

$R_{i,t}$= stock return for company *i* in month *t*

α_i= constant term

r_f= the monthly change in the risk free interest rate; US Treasury bill

β_i = represents the systematic market risk as similar to CAPM

$\left[E(r_{m,t}) - r_{f,t}\right]$= risk premium in month *t*; the required premium of investing in the market index rather than in the US Treasury bill

β_2= market cap or size beta; representing the first unsystematic risk factor

SMB_t= size risk premium; the required premium of investing in a small market cap company stock rather than in a large market cap company stock in month *t* (Brealey et al., 2008)

β_3= book-to-market ratio or value beta; representing the second unsystematic risk factor

HML_t= value risk premium; the required premium of investing in a low book-to-market ratio company stock rather than in a high book-to-market ratio company stock in month *t*

$e_{i,t}$= error term in month *t*; other factors that could have influenced the monthly stock return (Brealey et al., 2008; Fama & French, 1993)

The beta value conducted for each company in this analysis is the percentage change in stock return for a 1% increase in the market index, risk free interest rate, market cap and book-to-market ratio.

4.2.3 Multifactor Model

In addition to the other variables analyzed, there has also been conducted a third multifactor model in this thesis incorporating both systematic and unsystematic risk. The multifactor model is therefore similar to the APT model by including several possible risk factors. However, as the APT model only includes systematic risk factors, a generic multifactor model could incorporate multiple both systematic and unsystematic risk factors when predicting former stock return due to these possible risk factors. This analysis has utilized data on a yearly basis in contrast to the other model applied, as the unsystematic risk factors included, the reserves replacement rate and finding and development costs, are only provided on a yearly basis. The market risk factors included in this model are the market index, risk free rate, oil and gas price and exchange rate as similar to the APT model. The unsystematic risk factors selected were the reserves replacement rate and the finding and development cost for each company. This multifactor model would therefore examine the relationship between the stock return of a single company and the following variation in these systematic and unsystematic risk factors. The betas estimating the systematic and unsystematic risk for this multifactor model is provided by using the following multifactor time series equation:

$$R_{i,t} = \alpha_i + r_f + \beta_1\left[E(r_{m,t}) - r_{f,t}\right] + \beta_2\left[E(r_{f,t1}) - r_{f,t2}\right] + \beta_3 * r_{oil,t} + \beta_4 * r_{gas,t} + \beta_5 * r_{exchange\ rate,t} + \beta_6 * r_{RRR,t} + \beta_7 * r_{F\&D,t} + e_{i,t}$$

Equation 11 - Multifactor Expected Stock Return

$R_{i,t}$= stock return for company *i* in month *t* based on the variation in the included systematic and unsystematic risk factors

α_i= constant term

r_f= yearly change in the risk free interest rate; US Treasury bill

β_i = market index beta, representing the systematic risk factor similar to CAPM, APT and Fama and French

$\left[E(r_{m,t}) - r_{f,t}\right]$= risk premium in year *t*; the required premium of investing in the market index rather than in the US Treasury

β_2= interest rate beta

$[E(r_{f,t1}) - r_{f,t2}]$= interest rate risk premium in year *t*; the required premium of investing in a 10 year Treasury note rather than in the 1 year Treasury bill

β_3= crude oil beta

$r_{oil,t}$= the yearly change in the oil price in year *t*

β_4= natural gas beta

$r_{gas,t}$= the yearly change in the gas price in year *t*

β_5= exchange rate beta

$r_{exchange\ rate,t}$= the yearly change in exchange rate in year *t*

β_6= reserves replacement rate beta

$r_{RRR,t}$= the yearly change in the reserves replacement rate provided by each company

β_7= finding and development cost beta

$r_{F\&D,t}$= the yearly change of finding and development costs employed by each company

$e_{i,t}$= error term in year *t*; estimating other factors that could have explained the yearly changes in the stock return

(Armitage, 2005)

Similar to the APT model, some companies are not exposed to changes within the exchange rates. This risk factor has therefore been excluded when calculating the stock return for the selected companies with US dollars as national currency.

This multifactor model provided us with the relationship between the stock return and variation within several systematic and unsystematic risk factors on a yearly basis. The beta values would further indicate the percentage change in stock prices for a 1 % increase in interest rate, market index, oil and gas price, exchange rate, reserves replacement rate and finding and development cost.

The previous presented sub-chapter has presented the process for conducting regression analysis required to estimate historical stock return. To provide a conclusion on which of the presented model indicates the best explanation of historical stock return, the predicted stock return calculated from the model is subtracted from the actual stock return of each company stock. The difference was further used to estimate the mean, variance and standard deviation for each model.

In prior to these calculation, the absolute value was calculated to remove any negative values. After completing these measurements we could be able to reach a conclusion of which of the presented models were the most accurate model to predict historical stock return by choosing the model with the lowest mean, variance and standard deviation. The results for these calculations, estimating the most accurate model, were based on the ability to predict historical stock return, has been presented in chapter 9.4 Hypothesis 3 – Single and Multifactor Models.

This chapter has given an insight in the process of conducting the regression analysis for the models chosen to evaluate a company's financial risk exposure. The next chapter will further introduce the statistical measurements required to perform the quantitative analysis.

5 Statistical Measurements

We have applied several statistical measures in the quantitative analysis. The purpose of this chapter is therefore to present a brief introduction to the statistical measurements applied in this thesis for completing the analysis described in chapter 7 Data Selection and Results and 9 Hypothesis Discussion and Results.

5.1 Mean

The mean is a commonly used to measure the trend within a specific population. It estimates the average value for a set of data over a given time period (Stock & Watson, 2007). In this thesis we have collected a sample from the population of selected oil and gas companies, defined as our peer group. This peer group represents major companies and corporations with similar characteristics in the oil and gas sector. The data collected for this thesis has given us access to historical data from a sample of the population studied. The historical data for the independent variables applied in this thesis has given us the opportunity to estimate the mean value, representing our best estimate of the "true" mean value. The mean was calculated by using the following equation:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} X_i$$

Equation 12 - Mean

$\bar{x}$ = mean (average value) of x

n = number of observations

X_i = value of observation X_i

(Stock & Watson, 2007)

5.2 Standard Deviation

The standard deviation indicates the observations deviation from the mean. If the standard deviation has a high value, there is high dispersion between the observations, either positive or negative (Stock & Watson, 2007). For example, if the stock price within a single company proves several fluctuations there will be a high standard deviation. On the other hand, if the stock price keeps a stable price, the standard deviation will be at a lower level. Before presenting the

equation applied for calculating the standard deviation we will first present the variance measure. The variance indicates the extent of variation between the data or observations and is used prior to the standard deviation calculation. The variance and standard deviation has been calculated by the following two equations:

$$\sigma_x^2 = Var(x) = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

Equation 13 - Variance

$$\sigma_x = \sqrt{\sigma_x^2} = \sqrt{Var(x)}$$

Equation 14 - Standard Deviation

$\bar{x}$ = mean (average value) of x

n = number of observations

x_i = value of observation x_i

σ_x = standard deviation of x

σ_x^2 = variance of x

(Stock & Watson, 2007)

5.3 Correlation

The correlation refers to the dependence between two variables and measures how two variables move or vary together. The correlation ranges between 1 and -1 and indicates either a positive or negative relationship between two variables. A positive correlation refers to the variables moving in the same direction over a given time period. This means that if one variable increases the other variable will increase respectively. If on the other hand two variables indicate different trends, the variables can be regarded as uncorrelated, hence giving a zero in correlation (Stock & Watson, 2007). Before presenting the equation used for calculating the correlation we will first present the covariance measurement. The covariance indicates the linear dependence between two variables. This statistical measure is used when calculating the correlation. The covariance and correlation is calculated by the following two equations:

$$\sigma_{xy} = cov(x,y) = \frac{1}{n-1}\sum_{i=1}^{n}[(x-\bar{x})(y-\bar{y})$$

Equation 15 - Covariance

$$r_{xy} = corr(x,y) = \frac{cov(x,y)}{\sqrt{Var(x)Var(y)}} = \frac{\sigma_{xy}}{\sigma_x \sigma_y}$$

Equation 16 - Correlation

$\bar{x}$ = mean (average value) of *x*

$\bar{y}$ = mean (average value) of *y*

n = number of observations

x = value of observation *x*

y= value of observation *y*

$\sigma_{xy} = cov(x,y)$= covariance of values x and y

$r_{xy} = corr(x,y)$ = correlation between values x and y

σ_x = standard deviation of *x*

σ_y = standard deviation of *y*

$\sigma_x^2 = Var(x)$ = variance of *x*

$\sigma_y^2 = Var(y)$ = variance of *y*

(Stock & Watson, 2007)

5.4 R-square

After the regression has been conducted, an important parameter to consider is how well does the included variables account for the changes in the dependent variables. This refers to a models ability to explain the variance of the dependent variable, and is known as R-square (Stock & Watson, 2007).Consider for example a company's stock return as the dependent variable providing several changes during the last year. After performing the regression analysis and calculating the R-square, we can state if changes in the oil price had a significant impact for the changes in stock returns. The R-square can be calculated by the following equation:

$$R^2 = \frac{ESS}{TSS}$$

Equation 17 - R-Square

R^2: R-square

ESS= Explained Sum of Squares; this implies the difference between the predicted value of Y and the mean value of Y, shown in the formula below

TSS= Total Sum of Squares, this implies the difference between the dependent variable Y and the mean value of Y, shown in the formula below

(Stock & Watson, 2007)

Where ESS is calculated by

$$ESS = \sum_{i=1}^{n} (\hat{Y}_i - \bar{Y})^2$$

Equation 18 - Explained Sum of Squares

$\hat{Y}_i$= predicted value Y_i

$\bar{Y}$= mean (average value) of Y

(Stock & Watson, 2007)

And TSS is calculated by

$$TSS = \sum_{i=1}^{n} = (Y_i - \bar{Y})^2$$

Equation 19 - Total Sum of Squares

$\hat{Y}_i$= predicted value Y_i

$\bar{Y}$= mean (average value) of Y

(Stock & Watson, 2007)

However, there might be other variables that could account for the changes in the dependent variable. This does however not necessarily imply an increased fit of the regression model. When performing regression analysis with several independent variables we need to consider another important variable, namely the adjusted R-square. The adjusted R-square corrects for including several variables and provides an estimate of how well all the included variables describes the dependent variable (Stock & Watson, 2007). The adjusted R-square can be calculated by the following equation:

$$\bar{R}^2 = \frac{n-1}{n-k-1} * \frac{ESS}{TSS}$$

Equation 20 - Adjusted R-Square

$\bar{R}^2$: adjusted R-square

n: number of observations

k: number of independent variables included in the regression analysis

ESS= Explained Sum of Squares

TSS= Total Sum of Squares

(Stock & Watson, 2007)

5.5 t-Test

The t-test is a statistical test used to consider whether an included variable contributes significantly to explaining the dependent variable. The t-test could further be applied to evaluate if the correlation coefficient could be considered as statistical significant. The t-value in the t-test can be calculated by the following equation:

$$t = \frac{Corr(X,Y)}{\sqrt{\frac{1-Corr(X,Y)^2}{n-2}}}$$

Equation 21 - t-Test

$Corr(X,Y)$= correlation between values x and y

n = number of observations

(Gripsrud & Olsson, 1999)

5.6 Hypothesis Testing

The purpose of this sub-chapter is to introduce the basics of hypothesis testing and the p-value used to consider whether a variable can be considers as statistically significant before introducing the objective and importance of regression analysis.

Hypothesis can be regarded as assumptions or predictions about the characteristics of the population studied. A hypothesis could therefore be formulated as a *statement that specifies how two or more measureable variables are related* (Churchill, 1995, p. 147).

Hypothesis testing involves stating a null and an alternative hypothesis, where H_0 indicates the null hypotheses and H_1 indicates the alternative hypothesis:

$$H_0: \beta = 0$$

Equation 22 - Null Hypothesis

Vs.

$$H_1: \beta \neq 0$$

Equation 23 - Alternative Hypothesis

H_0: presents the hypotheses showing no significant relations between the factors measured
H_1: presents the hypothesis showing a significant relation between the factors measured
(Stock & Watson, 2007)

Hypothesis testing has been an important part of this thesis to examine whether the information and data obtained provides a sufficient foundation to reject or accept the hypothesis. This requires the model to present sufficient proof for either maintaining or rejecting the hypothesis.

The p-test is further used to consider the statistical significance of a certain explanatory variable on a dependent variable. Prior to the analysis we have selected a critical p-value representing the limit of acceptance or rejection. The commonly used p-values are at a 1, 5 and 10 % significance level. If the p-value calculated is larger than these values, then there is no evidence of a certain explanatory variable being statistical significant for explaining the dependent variable. This implies that the p-values or level of statistical significance can be applied to either accept or reject a certain hypothesis of whether a certain variable contributes significantly to the explanation of a dependent variable.

The p-value further indicates the probability of type 1 error in the statistical analyses. Type 1 error consists of rejecting the zero hypotheses when it is actually true. The p-value chosen will indicate the probability of type 1 error (Stock & Watson, 2007).

The hypothesis test and the p-value indicating the level of significance will enable us to draw conclusions on our hypothesis based on the results obtained in the analyses.

5.7 Regression Analyses

The regression analysis is a quantitative analyses used to discover the possible relation between two or several variables. This thesis applies both single and multifactor regression models, where single factor refers to including one variable in the model and multifactor refers to including several independent variables in the model. A frequently used regression model is the linear model and can be presented by the following equation;

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i + e_i$$

Equation 24 - Regression Equation

Y_i= dependent variable
X_i= value of X (independent variable)
β_0= intercept
β_i= beta value for X_i
e_i= error term; variables effecting Y not included in model
(Stock & Watson, 2007)

5.8 OLS (Ordinary Least Square)

A well known method used for calculating the regression equation is the OLS (ordinary least squares) method. This could be regarded as a linear regression method that intends to minimize the sum of squared residuals. The OLS regression model will therefore provide estimated coefficients as close as the true values as possible. The squared residuals refer to the residuals conducted when trying to explain the dependent variable. When trying to explain the changes in the dependent variables we have considered changes in one or several independent variables. It is however not certain that these models will be able to provide an accurate cause and effect relation

between the variables included in the regression analysis. There could also be other variables not included in the model that might explain changes within the dependent variables, these are called residuals (Stock & Watson, 2007).

The OLS regression model was the basic statistical tool used in this thesis. The estimated regression equation can be illustrated by the following equation:

$$\bar{Y}_i = \hat{\beta}_o + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \cdots + \hat{\beta}_i X_i + \hat{e}_i$$

Equation 25 - Ordinary Least Square Regression Equation

$\bar{Y}_i$= estimated dependent variable

X_i= value of *X* (independent variable)

$\hat{\beta}_o$= estimated intercept

$\hat{\beta}_i$= estimated beta value for X_i

$\hat{e}_i$= estimated variables effecting Y not included in model

(Stock & Watson, 2007)

Where the ”hat” indicates the estimated factors within the regression model. The estimated error term provides the difference between the true and the estimated value, and can be described as:

$$\hat{e}_i = Y_i - \hat{Y}_i$$

Equation 26 - Estimated Error Equation

$\hat{e}_i$: estimated error term

Y_i: the realized dependent variable

$\hat{Y}_i$: the predicted dependent variable

(Stock & Watson, 2007)

The preceding chapters have introduced the statistical measurements applied in the quantitative analysis. The following chapter will introduce the method used to analyze the assembled data before the statistical results is presented in chapter 7 Data Selection and Results and in 9 Hypothesis Discussion and Results.

6 Method

The purpose of this chapter was to give an insight to the method used to analyze and illustrate the results obtained from the assembled data. This includes:

- The design applied when collecting information
- The sample used in order to collect relevant data on the population studied
- The process used for analyzing the data in order to provide valid results
- The type of data analysis applied required to provide essential explanations to the obtained data information

The method can be characterized as the process on how to obtain increased knowledge of a specific subject or how to verify the knowledge obtained within the study of social science (Dalland, 2007). The following sections will provide information regarding important stages within the research process. This means to present how this thesis has applied relevant theories and methods to perform the analysis required to reach a conclusion on the problem discussed.

6.1 Research Design

The preceding chapters have focused on determining several hypotheses evaluated and tested throughout the thesis, explaining several variables of importance within this thesis. In order to test the hypotheses, a research design has been selected. It is important to choose a research design that makes hypothesis testing possible. A research design can be characterized as a guideline when collecting, analyzing and observing data and information. The research design selected in this thesis has helped us to determine what types of questions needs to be answered and what kind of study is appropriate in order to address the research questions (Churchill, 1995; Frankfort-Nachmias & Nachmias, 1996).

There are several important questions that need to be addressed in order to find the appropriate research design. First, who is the target group within the research? In which time period should the observation be made? How should the data be collected? Answering these question has enabled us the collect important information that has been valuable through the various stages of the research process (Frankfort-Nachmias & Nachmias, 1996).

We can distinguish among three main research designs: exploratory, descriptive and causal design. While exploratory research tries to attain insight and discover ideas within a specific subject, descriptive research attends to describe certain characteristics of the population or phenomenon described. Thus, neither exploratory nor descriptive designs are sufficient to provide causal relationships between several variables. The causal design attempts to account for the cause of an event or the effect from a change in one variable on another. The relationships between the research designs can be illustrated by the following model (Churchill, 1995):

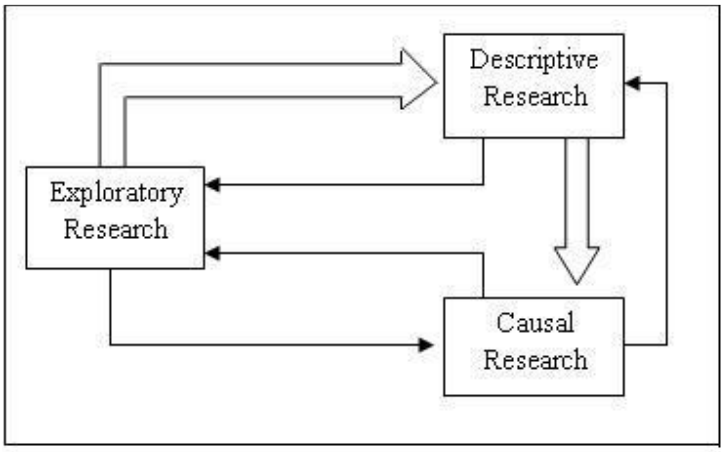

Figure 5 - Research Design

(Churchill, 1995, p. 146)

The figure above presents the interrelations between different types of research designs. Exploratory research is often considered as the initial step in order to acquire knowledge about a specific population or phenomenon. This research design is prominent if the researcher has minor knowledge about a specific phenomenon or population. While exploratory research tries to record the motive behind a problem, descriptive research tries to determine which of these motives are decisive in order to accept or reject a certain hypothesis. When these terms are clarified the next step would be to prove the cause and effect between two or several variables. The choice of research design will therefore depend on the intention of the study (Churchill, 1995).

This thesis has applied both descriptive and causal research design. The intention has been describe the essential concepts when evaluating and measuring financial risk exposure for oil and gas companies. Hypotheses were developed in order to accept or reject several predefined

predictions. We are now going to discuss how this thesis has applied descriptive and causal research design.

The descriptive design was used to attain knowledge about the subject being studied. In order to present this design we are now going to present the answers to questions within this design, namely who, what, when, where, why and how:

- Who: the population studied in thesis was a selected peer group representing major energy companies and a selection of key personnel assigned to the questionnaires. The companies are presented in chapter 7.1 Company Information.
- What: a selection of market and company specific risk factors were selected to provide a possible relation with the stock return. The variables are presented in chapter 7.2 Selection of Variables.
- When: The time-period analyzed in this research is from the end in February 1989 until the end of February 2009, a 20 years period.
- Where: The companies selected are major oil and gas companies from the following countries: Norway, USA, Canada, Italy, Spain, Brasil, France, United Kingdom and Russia. The selection of key personnel is experienced staff within the oil and gas, banking and research industry.
- Why: The motive behind this research was to evaluate and measure an energy company's financial risk exposure and to discover how the world changes from periods of growth to periods of recession, and to discover how systematic and unsystematic risk factors has influenced the expected stock return of each company selected.
- How: The data and information needed to perform the analysis were received from a database in StatoilHydro and from the Internet. For further data collection description see chapter 7 Data Selection and Results.

The intention of applying descriptive design in this thesis was to describe the characteristics, estimate the proportions and make the necessary predictions about the selection of companies and the individuals within the study. By applying the descriptive design, this thesis would attempt to describe the characteristics and relation between the variables mentioned earlier, required to accept or reject the hypothesis and predictions defined in chapter 2.3 Main Problem to be

Addressed. The descriptive research can be divided into cross-sectional and longitudinal studies. Cross-sectional studies involve studying a selection of companies or individuals from a given population at one particular time period, while the longitudinal studies perform continuous measurements of the same variables over time (Churchill, 1995). This study has applied longitudinal studies by analyzing the same 16 companies over a 20 year time period. The cross-sectional descriptive design was used for the qualitative analysis. This refers to the depth interviews with the selection of financial and leadership personnel at a given time period. The results from the descriptive analysis (both qualitative and quantitative research) explored have further been presented in chapter 8 Qualitative Analysis and chapter 9 Hypothesis Discussion and Results.

As mentioned earlier, causal design is also an important part of this research. The intention of causal design was to prove causal connection between different variables. Choosing the causal design implies to determine what variables are causing another variable to change. The variable(s) causing another variable to change were regarded as the independent variables. The variable affected by other variables is further regarded as the dependent variable (Churchill, 1995; Malhotra, 1996). This study has identified several independent variables, such as interest rate, exchange rate, world market index, oil and gas price, reserves replacement rate and finding and development costs. These variables were selected in order to prove the exposure of the dependent variable identified; stock return. This cause and effect relationship has been explored through quantitative analysis, as presented in chapter 9 Hypothesis Discussion and Results.

6.2 Secondary and Primary Data

The previous chapter focused on the characteristics from the different research designs. After selecting the appropriate research design the next step was to evaluate the different data collection forms. We can distinguish between primary and secondary data. Primary data refers to information collected by the researcher for the purpose of the current research. Secondary data refers to available data already collected by other researchers for other purposes (Churchill, 1995). This thesis has applied both secondary and primary data. The secondary applied in this thesis are the data obtained from the database in StatoilHydro and data obtained from the

Internet. The primary data applied is the in-depth questionnaires performed among key personnel in financial or leadership positions.

Collecting primary data requires time and resources and for the purpose of this thesis it was only needed to acquire supplementary information for the quantitative results. Secondary data has been applied both when evaluating former research and when obtaining the necessary data and information. The secondary data has provided us with important information to solve the hypothesis studied. The combination of secondary and primary data has proved to be both informative and consenting when presenting the results obtained. For further information about the results obtained reference is made to chapter 7 Data Selection and Results and 8 Qualitative Analysis.

6.3 Qualitative and Quantitative Method

After having chosen the appropriate research design and form of data and information collection, the next step was to consider using qualitative or quantitative data or a combination of these two methods. Quantitative method involves structuring the gathered information into measureable units. This implies the possibility of describing the subject of current interest into measurable numbers to discover comparable or dissimilar patterns. Qualitative method involves capturing observations that are not measurable. This means discovering specific characteristics of a certain group of companies or individuals (Dalland, 2007).

This thesis has applied both quantitative and qualitative data. The quantitative data refers to the statistical results presented in chapter 7 Data Selection and Results. The qualitative data was obtained through the depth interviews employed on a small sample of key financial and leadership personnel within the research, oil and gas and banking industries presented in chapter 8 Qualitative Analysis. The intention of collecting these qualitative data was to provide supplementary information on the analysis conducted and hypothesis tested through the quantitative data.

Followed by the presentation of important characteristic within the method applied for this thesis we would now like to present the data selection and results. The following chapters will therefore

introduce summary statistics for the sample and variables selected, before introducing the results from the qualitative and quantitative data.

7 Data Selection and Results

The purpose of this chapter was to present how the data has been collected and how the companies and variables have been chosen for the analysis. This chapter further introduces summary statistics providing information on the number of observation, mean, variance, standard deviation and percentile from the companies and the variables chosen.

The data collected in this thesis are historical values from international oil and gas companies and important market and company specific factors possibly affecting stock returns. The data sample in this thesis contains 16 international oil and gas companies within the time period 1989 to 2009. The companies are chosen to present the major energy companies within the oil and gas sector. These companies are descended from a peer group used by StatoilHydro. This implies comparable companies with similar characteristics as StatoilHydro.

Table 1 - Summary Statistics for the Selected Companies presents the selection of companies in this thesis. It provides information on the historical stock price changes provided on a monthly basis during the last 20 years.

Company	Number of observations	Mean [US$]	Variance	Standard deviation	5 % percentile [US$]	95 % percentile [US$]
StatoilHydro	91	17.4927	91.2343	9.5517	6.3581	32.9461
Occidential	240	21.2575	345.8997	18.5984	8.9375	64.0800
ConocoPhillips	240	30.6583	444.5200	21.0836	11.8125	80.0400
Total SA	231	33.1773	471.4986	21.7141	7.6412	75.3191
Exxon Mobil	240	36.1387	494.7911	22.2439	11.7474	83.8800
BP Plc	240	6.9780	9.9270	3.1507	2.2960	12.0474
BG Group Plc	240	5.3046	29.4560	5.4273	1.3950	17.2626
Encana Corporation	240	18.5432	390.9724	19.7730	4.9372	61.7502
ENI SPA	158	18.5777	81.3737	9.0207	9.3298	35.3876

Devon Energy Corporation	240	27.2244	657.2743	25.6374	4.5000	82.8100
Repsol YPF	231	17.1284	75.514211	8.6898913	7.6522	35.2652
Chevron Coporation	240	39.4930	424.4967	20.6033	16.4688	84.5600
Anadarko Petroleum Corporation	240	22.8049	248.3139	15.7580	6.4375	53.7500
Lukoil	156	31.6287	820.8492	28.6505	5.1000	86.5400
Petrobras	180	5.1747	34.6450	5.8860	1.1727	20.7401
Royal Dutch Shell	240	21.4648	88.8716	9.4272	8.6989	35.9554

Table 1 - Summary Statistics for the Selected Companies

It is important to emphasize that the number of observations varies due to specific reasons. For example StatoilHydro was not listed on the stock exchange before 2001. Table 1 - Summary Statistics for the Selected Companies provides essential information in order to evaluate the stock price changes of each of the selected companies during the last 20 years.

7.1 Company Information

Before we present the selection of variables conducted for this thesis we wish to present each of the company analyzed in this thesis. The information presented is only a short introduction to each of the company indicating its main function and the size of the company.

StatoilHydro ASA (STL)

StatoilHydro is a Norwegian integrated energy company. StatoilHydro operates over 80% of the oil and gas production of the Norwegian Continental Shelf (NCS) as well as increasing international production. StatoilHydro operates in the upstream, downstream, natural gas and alternative energy businesses. This Stavanger (Norway) based corporation has a marked cap of over 60 billion US dollars ("StatoilHydro ASA," 2009).

ExxonMobil Corporation (XOM)

ExxonMobil Corporation consists of many divisions and affiliates under the ExxonMobil, Esso, Exxon and Mobil brands. ExxonMobil engages in the upstream, downstream, chemicals and power generation businesses. This Irving, Texas (USA) based supermajor posted the largest ever profit in American history in 4th quarter 2008 and has a marked cap of over 325 billion US dollars ("Exxon Mobil Corporation," 2009).

ConocoPhillips Corporation (COP)

ConocoPhillips is an international integrated energy company. ConocoPhillips operates in five business segments; upstream, midstream, refining and marketing, chemicals and emerging businesses. This Houston (USA) based corporation holds a marked cap of over 60 billion US dollars ("ConocoPhillips," 2009).

Chevron Corporation (CVX)

Chevron Corporation and its US and international affiliates operate in the upstream, downstream, chemicals, mining, power generation and services throughout the world. This California (USA) based US supermajor has a market cap of over 130 billion US dollars ("Chevron Corporation," 2009).

Total S. A. (TOT)

Total S. A. together with its subsidies and affiliates is an integrated international oil and gas company. Total operates in upstream, downstream, chemicals, mining and power generation businesses. This Paris (France) based supermajor has a marked cap of over 110 billion US dollars ("TOTAL S.A.," 2009).

Eni S. P. A (ENI)

Eni is an integrated Italian energy company. Eni operates in the oil and gas industry, power generation and marketing, and oilfield services, construction and engineering. This Rome (Italy) based company has a marked cap of almost 80 billion US dollars ("Eni S.p.A.," 2009).

BP PLC (BP)

BP PLC is an integrated energy company, operated through its subsidies and affiliates around the world. BP operated in three business segments, upstream, downstream and alternative energy. This London (UK) based supermajor has a marked cap of over 130 billion US dollars ("BP plc," 2009).

BG Group PLC (BG)

BG Group PLC with international affiliates is engaged in exploration, development, transmission, distribution and supply of oil and natural gas. This Reading (UK) based corporation has a marked cap of over 50 billion US dollars ("BG Group plc ", 2009).

Lukoil (LUKOY)

Lukoil is integrated oil and gas company, focusing on exploration, production and refining of oil and gas products. Lukoil operates mainly in Russia and Easter Europe, Colombia and Africa. This company is based in Moscow (Russia) and has a marked cap of over 38 billion US dollars ("LUKOIL," 2009).

Encana Corporation (ECA)

Encana is a major North American natural gas producer. In addition Encana operates in the downstream segment of the oil and gas industry. This Calgary (Canada) based company has a marked cap of over 40 billion US dollars ("EnCana Corporation," 2009).

Occidental Petroleum Group (OXY)

Occidental is an international oil and gas company operating in the oil and gas, chemical and downstream business segments. This Los Angeles (USA) based company has a market cap of over 45 billion US dollars ("Occidental Petroleum Corporation," 2009).

Devon Energy Corporation (DVN)

Devon is an independent oil and gas company, mainly focusing on exploration, production and transpiration of oil and natural gas. Devon holds its majority of assets in the United States and Canada. This Oklahoma (USA) run company has a marked cap just below 25 billion US dollars ("Devon Energy Corporation," 2009).

Repsol YPF, S. A. (REP)

Repsol is a Spanish based integrated oil and gas company who participates in all segments of the oil and gas industry. Repsol is based in Madrid (Spain) and has a marked cap of approximately 23 billion US dollars ("Repsol YPF, S.A.," 2009).

Royal Dutch Shell plc (RDS)

Shell is an international oil and gas company engaged globally in the principal activities of oil and natural gas. Shell operates in five business segments; upstream, oil sands, chemicals, oil products and power generation. Shell is run from the head office in The Hague (Netherlands) and has a marked cap of over 150 billion US dollars ("Royal Dutch Shell plc ", 2009).

Petrobras Brasileiro SA (BPR)

Petrobras is a Brazilian oil and gas company operating in all segments of the industry. From exploration, through production, refining and marketing oil and gas products, focusing mainly on the Brazilin marked and territory. This Rio de Janeiro (Brazil) based company has a marked cap of over 150 billion US dollars ("Petroleo Brasileiro SA ", 2009).

Anadarko Petroleum Group (APC)

Anadarko is a US independent oil and gas company, operating in all segments of the oil and gas industry. Anadarko is run out of Houston (USA) and has a marked cap of approximately 21 billion US dollars ("Anadarko Petroleum Corporation," 2009).

7.2 Selection of Variables

This thesis started by presenting relevant theories and models used throughout the thesis. These variables were further required to perform the quantitative analyses to solve the hypotheses and prediction previous stated. These variables were shared from StatoilHydro, and supplied from quantitative records and databases used in StatoilHydro. The data collected from StatoilHydro are acquired from Bloomberg and Reuters EcoWin, providing important financial information and data for businesses and professionals ("About Bloomberg," n.d.; "About us," n.d.). The historical values obtained from Bloomberg and Reuters EcoWin acquired from StatoilHydro were:

- MSCI, Morgan Stanley Capital International, 1 month; representing the world market index. This world market index can be characterized as a *free float-adjusted market capitalization weighted index designed to measure the equity market performance of developed markets* ("MSCI Regional Equity Indices," n.d.).
- US Treasury bill, 1 year; representing the risk free interest rate. This US Treasury bill is as earlier referred to, the non-interest bearing obligation or debt issued by the US Treasury with a maturity of less than one year (Brealey et al., 2008; Hull, 2009).
- ICE (Intercontinental Petroleum Exchange) Brent 1 month $/bbl; representing the oil price. ICE is known as the second-biggest future market for trading oil located in London, whereas NYMEX represents the biggest future market for trading the price of oil (James, 2008). The ICE Brent is a future contract based on Exchange of Futures for Physical (EFP) delivery ("ICE Brent Crude Futures," n.d.).
- NYMEX Henry Hub (New York Mercantile Exchange) 1 month $/mmtbu (million British thermal units); representing the natural gas price. NYMEX represents the world's largest regulated energy-futures exchange. Henry Hub is a natural gas pipeline located near Erath Louisiana in the United States. Henry Hub also prices the natural gas futures on NYMEX (James, 2008).
- RRR, Reserves Replacement Ratio 1 year %; indicating the company's ability to maintain the production sustainability
- F&D, Finding and Development cost 1 year $/bbl; indicating the company's ability to maintain cost levels at a reasonable level

The US Treasury bill selected represents the rate obtained at 1 year maturity, and is updated each month. This thesis has however chosen to divide the 1 year Treasury bill by 12 to indicate the 1 month return from the risk free investment.

The crude oil and natural gas price are included by using future prices instead of spot prices. The reasons for having selected future oil and gas price rather than the spot price is because this thesis has provided analysis based on monthly and yearly changes and that the spot price could be considered as less predictable than the future oil and gas price. The spot price could be considered as less predictable as the spot price is settled based on the short run price fluctuations.

A spot price is the given quote for oil and gas due to short-run price fluctuations and is usually settled immediately by paying the current price. The future oil and gas price is based on a contract, for example 1 month, by entering into an obligation to buy oil and gas in 1 month for a price that is settled when the contract is entered. By entering into a fixed rate contract the oil and gas price is more predictable as it is not exposed to short run price fluctuation (Brealey et al., 2008; Hull, 2009).The choice of future oil and gas price corresponds to Sadorsky (2001) as he chooses to apply future oil price for the reason that spot price is considered to be more affected by short-run price fluctuations due to temporary shortages or surpluses.

There are as earlier mentioned multifactor models trying to measure the financial risk exposure by estimating changes in historical stock return. This thesis has applied both single and multifactor models and has therefore chosen to collect additional historical values to perform the multifactor models. The additional variables required to perform these analyzes were conducted from the Internet. The variables referring to here are:

- Exchange rates, 1 month: representing the currency exposure from converting ones national currency into US dollars. The peer group selected for this thesis contains several companies operation with other currencies than U.S. dollars. The historical exchange rates required for this thesis was GBP, EUR, NOK, BRL and CAD converted into USD. The currency rates analyzed in this thesis were provided by MSN money ("Currency Rates," 2009).
- 10 year Treasury note representing the debt issued by the US government. The maturity is 10 years and would be further used to illustrate the risk premium between the US Treasury Note and the US Treasury bill. The 10 year Treasury note analyzed in this thesis were provided by Yahoo Finance ("10-YEAR TREASURY NOTE ", 2009).
- U.S. GDP (Gross Domestic Product), Quarterly; representing the changes within the US national income. This has been selected as a reference for the world GDP, as US has a broad and diverse economy influenced by changes throughout the world. The historical GDP values analyzed in this thesis were provided by Bureau of Economic Analyses U.S. Department of Commerce ("Gross Domestic Product (GDP)," 2009).
- Fama and French factors:
    - Market capitalization, 1 month: indicating the size risk premium

- Book-to-market ratio, 1 month: indicating the value risk premium

The Fama and French factors collected were US research return data based on a portfolio of stock and were collected from the data library from Kenneth French (French, 2009). The market cap and book-to-market ratio represents the size and value risk premium required from investing in a company stock with a small market cap or with a low book-to-market ratio. The market cap portfolio is constructed based on the size of the market cap and denotes the difference between the three portfolios with the smallest average return less the three portfolios with the largest average return. The procedure used for estimating the size risk premium is presented in the article from Fama and French (1993) and on the data library from Kenneth French (2009) and can be illustrated by the following formula:

$$SMB = 1/3(Small\ Value + Small\ neutral + Small\ Growth) - 1/3(Big\ value + Big\ neutral + Big\ Growth)$$

Equation 27 - Small Minus Big (SMB)

(Fama & French, 1993; French, n.d.)

The book-to-market ratio is further constructed based on the value of the book-to-market ratio and denotes the difference between the two portfolios with the highest average return less the two portfolios with the lowest average return. The procedure for estimating the value risk premium is also presented in the article from Fama and French (1993) and on the data library from Kenneth French and can be illustrated by the following formula:

$$HML = 1/2(Small\ Value + Big\ value) - 1/2(Small\ Growth + Big\ Growth)$$

Equation 28 - High Minus Low (HML)

(Fama & French, 1993; French, n.d.)

Table 2 - Summary of Independent Variables presents the selection of variables representing the market and company specific risk factors applied for thesis. The market specific factors are provided on a monthly basis between February 1989 and the end of February 2009. The data for historical gas prices were limited, hence this variable has fewer observations than the other variables provided. Another important consideration is that the Euro currency was inserted in the

latter years for some of the companies studied. We have therefore presumed that the euro reflects similar fluctuation as the former national currency. These market specific factors provide essential information of former changes due to changes in the world economy.

Variable	Number of observations	Mean	Variance	Standard deviation	5 % percentile	95 % percentile
US Treasury bill (interest rate) [Monthly %]	240	0.3473	0.0003	0.1674	0.0777	0.6605
MSCI world market index [US$]	240	2486.1073	1257071.0126	1121.1918	1070.9473	4520.6715
Crude oil price [US$/bbl]	240	32.0790	558.5222	23.6331	13.6700	76.9600
Natural Gas price [US$/mmtbu]	225	4.0267	7.1743	2.6785	1.4300	8.6488
Exchange rates:						
[EUR/USD]	240	1.1836	0.0236	0.1535	0.8904	1.4149
[NOK/USD]	240	0.1463	0.0004	0.0189	0.112	0.1799
[GBP/USD]	240	1.6721	0.0283	0.1683	1.4325	1.9847
CAD/USD	240	0.7740	0.0093	0.0965	0.6387	0.9403
BRL/USD	195	5.3553	543.5396	23.3139	0.3282	17.2131
Size, SMB	240	0.1220	12.1210	3.4815	-4.9100	5.0800
Value, HML	240	0.2255	10.7861	3.2842	-4.6200	5.1500

Table 2 - Summary of Independent Variables

Table 3 - Summary of Selected Company Variables presents the selection of company specific factors chosen for this thesis. The reserves replacement rate and the finding and development costs can be considered as important indicators regarding the investment behavior of a company, and provides essential information required to perform the multifactor models, and to evaluate

investment behavior in periods of recession versus periods of growth. The company specific data are provided on a yearly basis during the time period 1991 to 2007. The reserves replacement rate and finding and development costs have not been provided in the period 1989-1991 and 2008 and for some of the companies these variables have not been obtained in some of the years studied due to limited availability.

Company	Item	Number of observations	Mean	Variance	Standard deviation	5 % percentile	95 % percentile
Statoil Hydro	RRR [%]	10	104.1544	1112.6067	33.3558	59.8690	153.8596
	F&D [US$]	10	13.8085	61.1909	7.8225	4.6062	23.9912
Occi-dential	RRR [%]	16	203.2186	22250.3658	149.1656	97.7943	457.6470
	F&D [US$]	16	9.2355	67.5075	8.2163	3.4338	23.3823
Conoco Phillips	RRR [%]	16	262.1720	86459.5162	294.0400	74.6123	903.6228
	F&D [US$]	16	12.2281	235.4583	15.3447	2.7365	44.8633
Total SA	RRR [%]	16	142.7492	1854.8688	43.0682	78.3063	212.0085
	F&D [US$]	16	6.2311	18.0283	4.2460	3.0763	13.1410
Exxon Mobil	RRR [%]	16	114.8304	441.5947	21.0142	88.8150	143.4500
	F&D [US$]	16	5.3844	3.3442	1.8287	3.3815	8.5275
BP Plc	RRR [%]	16	162.6389	5767.4371	75.9436	95.1640	293.0785
	F&D [US$]	16	5.4184	3.3467	1.8294	3.5733	8.2638
BG Group Plc	RRR [%]	16	201.3628	27794.5809	166.7171	-38.9498	479.9035
	F&D [US$]	16	4.2863	298.6088	17.2803	-23.1178	25.6095
Encana Corp.	RRR [%]	16	225.3539	6375.2029	79.8449	138.4993	356.6920
	F&D [US$]	16	8.5569	49.2858	7.0204	3.3730	17.5020
ENI SPA	RRR [%]	16	144.2582	3837.0549	61.9440	59.3725	230.4358
	F&D [US$]	16	18.5568	1293.1134	35.9599	4.3928	67.8365
Devon	RRR [%]	16	271.0153	23340.8713	152.7772	154.5275	556.8448

Energy Corp.	F&D [US$]	16	11.4078	84.6478	9.2004	4.0265	25.4563
Repsol YPF	RRR [%]	16	218.6073	160979.593	401.2226	-115.8698	755.0343
	F&D [US$]	16	5.7770	123.6569	11.1201	-15.2635	22.2658
Chevron Corp.	RRR [%]	16	132.0272	2748.7612	52.4286	58.7228	213.8515
	F&D [US$]	16	17.9666	1017.4676	31.8978	3.6685	89.0830
Anadarko Petroleum Corp.	RRR [%]	16	325.2944	56924.6480	238.5889	128.4600	701.2273
	F&D [US$]	16	8.0577	22.9096	4.7864	2.6443	15.2470
Lukoil	RRR [%]	10	270.3118	50468.7624	224.6525	76.9479	617.1586
	F&D [US$]	10	-5.0560	578.3455	24.0488	-46.1879	9.4161
Petrobras	RRR [%]	11	164.5359	20731.9918	143.9861	-36.7660	357.6795
	F&D [US$]	11	6.6192	64.4566	8.0285	-2.8495	18.8260
Royal Dutch Shell	RRR [%]	16	110.4732	2622.8827	51.2141	59.5788	200.2663
	F&D [US$]	16	8.6953	33.7410	5.8087	2.7245	18.3740

Table 3 - Summary of Selected Company Variables

The summary statistics regarding the changing stock prices, the market and company risk factors are used to illustrate the range of the data sample provided in this thesis. It indicates how these variables have changed during the last years, and could therefore provide essential information on how world market changes have caused changes within a stock price and certain systematic and unsystematic risk factors.

This chapter has only presented the summary statistics for each of the companies and variables selected. For a more profound insight we have presented several graphs illustrating the world market and company trends during the sample period 1989 to 2009 in appendix A. This appendix illustrates graphs providing information on how each company has been exposed to financial risk by illustrating former stock price changes and further how systematic and unsystematic risk factors has changed throughout the last two decades.

8 Qualitative Analysis

In the previous chapters we have presented the selection of variables and the procedure for conducting the analyses for estimating the historical stock returns. In this chapter we will explore the hypotheses by presenting the qualitative analysis and results obtained from the depth interviews with key economical and leadership personnel in the oil and gas, research and banking industry. The purpose of the qualitative study was to complement the results from the quantitative study and provide supplementary information when answering the prediction and hypothesis presented in this thesis.

The qualitative depth interviews in this thesis were employed on a small sample of key financial and leadership personnel in relevant industries to attain a broad extent of the information acquired from the analysis. The oil and gas industry is represented by key personnel from ConocoPhillips, StatoilHydro and ExxonMobil. The research industry is further represented by University in Stavanger and the banking industry represented by Sparebank 1 SR-Bank. We have chosen one representative from each of these companies to attain an insight to different points of view from different companies and different industries.

The questions included in the survey represent essential information required to answer the hypothesis and predictions, and opens for the financial and leadership personnel to emphasize own opinions regarding the topics discussed in the survey. The survey incorporated topics from the theoretical framework of this thesis, giving us the opportunity to attain valuable information about the interviewed personnel's perspective and opinions on the various topics. The survey is enclosed in appendix B.

We will now introduce the answers obtained from the survey, and discuss possible trends and differences in the results from the interviews. These answers have been further used to enhance the discussion of the predictions and hypothesis in chapter 9 Hypothesis Discussion and Results.

Let us start by presenting what market risk factor was assumed to have the highest degree of influence on strategic planning for a company. The respondents highlighted several important market risk factors that could influence the strategic planning within a company. For an energy

company, the oil and gas price was seen as the most important market risk factor as it provides guidance for future investment opportunities. The justification for the oil price being an important indicator could be the difficulties of predicting future movements, and the significant impact the price will have for income on new and existing investments.

If considering the market as a whole, the interest rate and the consumer market were further mentioned to provide an influence on a company's strategic planning, this was considered as valid for both the energy as well as other industries. Changes in the consumer demand or access to commodities relates to changes in the consumer market and may further influence how a company performs future strategic planning. Several industries are exposed to changes within the interest rate both when considering future investments or repayment of company debt.

Let us further present the importance of macroeconomic factors for stock price changes. The oil price is mentioned by each respondent as one of the most important factors influencing the stock price within the energy industry. The long-term world economic growth, GDP, was also identified as an essential factor for stock price changes for several industries.

The next result of interest required the respondents to evaluate both market and company specific risk factors and its/their influence on stock price changes. We asked them to weigh the possible risk factors after how important they are for the stock price changes for a (energy) company. The possible risk factors included were the interest rate, exchange rate, oil price, gas price, finding and development cost and reserves replacement rate. The variables were ranked on a scale from 1 to 4, where 1 indicated high importance and 4 indicated less importance.

The interest rate is the first variable presented and appears to have some importance for stock price changes, like for example the cost of debt increasing or decreasing respectively. The exchange rate is however indicated to have less importance for stock price changes, but could provide some importance if considering long-term fluctuations.

The oil and gas price was further assumed to have the highest importance for a changing stock price in the energy industry in accordance to the respondents. The overall tendency is however

that the oil price is the most important commodity factor affecting the stock price compared to gas price.

The finding and development costs and reserves replacement rate are energy industry specific factors and is considered to provoke possible changes in an energy company's stock price. Two of the respondents claimed that it depends on each individual company. The claim here being that companies with a solid daily production rate will be less affected by changes in the finding and development cost compared to companies with limited or no daily production. The reserves replacement rate is further considered as important by the interviewed personnel, as it indicates the company's ability to maintain its company value. This includes the company's ability to discover enough reserves to maintain the daily production level.

Further the respondents were asked to evaluate the importance of systematic and unsystematic risk for a company's stock return. The overall conclusion here was that the systematic risk is the most important factor for an energy company's stock return. Some of the respondents emphasized that it could depend on the investment philosophy within a company. For companies who operate with a "fixed model" or investment behavior, the systematic risk will provide the highest influence on a company's stock return. However, for those companies who alter their investment behavior in accordance to market changes, the unsystematic risk will provide the highest influence. If a stock price declines, this does not necessarily imply actions caused by a particular company, as this could be the results of systematic risk factors like an oil price decline.

Periods of recession, periods of growth and its influence on volatility, risk exposure and changes within a company's investment behavior is an important aspect of this thesis. These theoretical approaches were therefore further included as important questions within the questionnaire. The respondents were first asked to evaluate if an (energy) company could be considered as most volatile in periods of recession or in periods of growth. In four of the five interviews the opinion was that periods of recession caused the highest volatility (stock price fluctuations), within a company. One indicated however that the transition phase caused the highest volatility as this phase could provide uncertain future market expectation and therefore effect the stock price movements.

The next question asked the respondents to consider how energy companies could reduce risk exposure in periods of recession versus periods of growth. This question emphasized several proposals on how energy companies could reduce risk exposure in periods of recession. Long-term investment behavior and a well defined business philosophy appear as key elements in both periods of growth and recession for the personnel interviewed. Hedging is also introduced as a proposed alternative for reducing risk exposure in periods of recession, but for many of the major oil and gas companies this is not an alternative as the stakeholders prefers the risk exposure in periods of growth. The overall opinion regardless of energy or other companies in general, was to maintain a stable and effective operation to reduce financial risk exposure. The further opportunities for reduction of risk exposure identified were being aware of the risk exposure when conducting investments in periods of recession, and maintaining a reasonable cost level independent of recession or growth periods.

The final question regarding recession and growth evaluated the investment behavior for energy companies. We asked the interviewed personnel to express their expectation on changes within an energy companies finding and development costs and reserves replacement rate in periods of recession compared to periods of growth. Trough the interviews several of the financial and leadership personnel expressed that periods of recession would demand a higher commitment on budgets and efficiency compared to periods of growth. Periods of growth were further assumed to involve a higher exploration and production activity and reserves replacement rate compared to periods of recession. Despite of changing focus, the overall respondents did not consider periods of recession to cause significant changes in the investment behavior for the energy companies.

We further asked the personnel if they would change their investment behavior in periods of recession compared to periods of growth. The interviewed personnel underlined several important considerations. The common belief of the respondents was to maintain a stable long-term investment profile, independent of world market changes. Two of the respondents expressed however that it was important to be more restrictive and conscious about future investment in periods of recession. When a long-term investment first is approved for implementation, it would

be difficult to slow down or cut off the project because of already made obligations and commitments to partners and or the government.

We completed the interview by asking the financial personnel to reflect on what kind of experiences oil and gas companies could gain from the ongoing financial crises. The interviewed personnel mentioned several proposals for how an energy company and other companies in general could gain knowledge and experience from the financial crisis. In two of the five interviews the proposal was to employ historical data and be conscious when considering long-term investments. The overall opinion whether considering the energy industry, or other industries was to maintain a stable finance structure, and be aware in periods of growth as these conditions are not persistent. Maintaining long-term investments was still considered as important by the interviewed personnel, as this was expressed to secure long term growth.

Periods of significant recession, like for example the ongoing financial crises, should remind companies that a growth period does not last forever. This should make them aware that investments made with small margins in periods of growth could end up not delivering any profit in periods of recession.

We have now presented the qualitative analysis results received from depth interview with key financial and leadership personnel. The quantitative and qualitative data and results may provide both similarities and differences, and will therefore be essential for either accepting or rejecting the predictions and hypothesis in this thesis, as presented in chapter 9 Hypothesis Discussion and Results.

9 Hypothesis Discussion and Results

We have conducted several statistical analyzes in this thesis. The intention of this chapter was to present and discuss the results obtained from the analysis. This thesis started by presenting one key prediction and two main hypotheses in chapter 2.3 Main Problem to be Addressed. The hypothesis and predictions presented in this thesis were:

1. Economic recession, and resulting changes in market risk factors, increases the stock price volatility and changes the investment behavior for energy companies compared to periods of growth (prediction);
2. The stock price is more influenced by market risk in periods of recession than in periods of growth (hypothesis);
3. Increased number of financial risk factors included in a model for pricing risk, gives a more accurate predicted historical stock return (hypothesis).

The intention of this chapter was to evaluate if the results obtained from the qualitative and quantitative analysis supports or rejects the above stated prediction and hypotheses and further to discuss the resemblance to results from previous research. This chapter presents the results for each hypothesis and predictions separately before providing a more general summary of the results at the end. We have started by presenting the first prediction regarding the volatility and investment behavior in period of recession versus periods of growth.

9.1 Prediction 1 – Volatility

The first prediction presented in this thesis was the prediction that periods of recession caused higher stock volatility than periods of growth. Volatility indicates, as earlier mentioned in chapter 3.2.1 Introduction, the historical stock price movements or the uncertainties regarding future stock returns provided by the changes within the stock price (Hull, 2009). The volatility of a stock is often a result of changes within several market risk factors. As earlier mentioned, we have employed NBER's declaration of recession and growth periods to illustrate the volatility measures within the growth and recession periods. As presented in chapter 3.1 Recession versus Growth, there have been two periods of growth and two periods of recession during the period from February 1989 to February 2009. It is further important to notice that this thesis has only chosen a selection of the two growth periods identified, as they extended over a 10 and 6 year's

period. The second recession period selected started in December 2007, but has still not reached its trough. Therefore, this thesis wished to illustrate a selection of this recession period as well.

The volatility of each stock has been calculated by estimating the standard deviation of the log return, the formula for completing this analysis was presented in chapter 3.2.1Introduction in Equation 1 - Volatility. Table 4 - Volatility in Periods of Recession and Periods of Growth presents the summary of the results obtained from the volatility measures in periods of recession and periods of growth.

	Recession period 01.03.01 - 01.12.01	**Recession period 27.02.08 – 27.02.09**	**Growth period 01.04.99 – 01.04.00**	**Growth period 01.04.03 – 01.04.04**
Company	Volatility	Volatility	Volatility	Volatility
StatoilHydro	no available data	0.1430	no available data	0.0443
Occidential	0.0938	0.1164	0.1014	0.0493
ConocoPhillips	0.0702	0.1188	0.0805	0.0552
Total SA	0.0564	0.0843	0.0727	0.0549
Exxon Mobil	0.0391	0.0541	0.0665	0.0406
BP Plc	0.0454	0.0840	0.0911	0.0460
BG Group Plc	0.0320	0.0901	0.1064	0.0580
Encana Corporation	0.0909	0.1183	0.0684	0.0645
ENI SPA	0.0512	0.0969	0.0631	0.0651
Devon Energy Corporation	0.1194	0.1119	0.0919	0.0708
Repsol YPF	0.0677	0.1538	0.0848	0.0391
Chevron Corporation	0.0480	0.0773	0.0715	0.0505
Anadarko Petroleum Corporation	0.1173	0.1501	0.1114	0.0601
Lukoil	0.1161	0.1783	0.2064	0.0805
Petrobras	0.1079	0.1981	0.1872	0.0835
Royal Dutch Shell	0.0511	0.0952	0.0884	0.0672

Table 4 - Volatility in Periods of Recession and Periods of Growth

These volatility measures provide important observations indicating the historical stock price movements of each stock. Before deciding for accepting or rejecting the prediction stated above, the results from the volatility analysis will be discussed. It is important to underline that a high volatility doesn't necessary need to be negative. The volatility measure indicates both ascending and descending stock price movements. As earlier mentioned, in chapter 3.2.1 Introduction, a high volatility measure indicates several significant stock price movements, while a low volatility represents a rather stable stock price.

The second or ongoing recession period provides generally the most significant stock price volatility. This indicates that the stock return has provided several changes provoked by the stock price changing during these last 12 months. This presumption is however not applicable for ExxonMobil, BP, BG and Lukoil. The analysis indicated these companies to have the highest stock price fluctuation in the first growth period. There could be different reasons for these four companies differencing from the rest. ExxonMobil, BP and BG are large corporations with both upstream and downstream business segments, reducing the exposure for volatility in recession periods. For Lukoil, the reason could be different. As Lukoil was first listed on the stock exchange in February 1994, and could therefore have a larger volatility as a newly listed stock.

Based on the calculations provided in the table above, the first growth period seems to exceed the stock price fluctuation in the second growth period and surprisingly also the first recession period. This observation corresponds to former research results, as the recession period in 2001 was mentioned as an exception to higher volatility compared to the other recession periods (Ludvigson & Ng, 2007). We can therefore presume that this growth period provided more significant changes within the world economy than the former recession period did. Encana, Devon and Anadarko do however provide a higher volatility in the first recession period. But, in general the last recession period analyzed, February 2008 to February 2009, provided the most significant stock return volatility.

9.1.1 Prediction Discussion

Based on the quantitative and qualitative analysis we have evaluated to accept the prediction that periods of recession increases the stock price volatility compared to periods of growth. This is mainly driven by volatility in the second and ongoing recession period. The result that comprises these conclusions is similar to previous empirical research. Previous studies indicates that periods of recession caused higher volatility measure, meaning more significant stock price changes, compared to periods of growth (Ludvigson & Ng, 2007; Schwert, 1989a, 1989b). The former empirical research does however consider the period between 1834 and 2001, and the second recession period identified has therefore not been taken into consideration in this former research.

The overall tendency illustrated by the quantitative analysis shows that the second period of recession caused the highest volatility in stock return. The overall impression of the interviewed personnel corresponds to this conclusion as they express the recession period to provide the highest volatility measure. However, one of the respondents emphasized the transition phase as having the highest influence on a stock price, as this was considered to provide several uncertainties in the marked conditions. Schwert (1989a) mentioned in his study that the highest volatility measure is present when there was considered to be high uncertainty in the market conditions. The response from the qualitative analysis could therefore be seen in resemblance with the results from previous research, as transition phase could imply higher uncertainties and therefore provoke the highest volatility measures.

The remark from the qualitative and former research has made us think of whether it is uncertainties in recession and growth periods that cause the high volatility and not the period itself. Hence, based on the uncertain market condition both the transition phase; meaning in the early stage of a recession or growth, or during recession and growth periods that could have caused the highest stock price fluctuations. These reflections could therefore imply that both periods of recession, periods of growth and also the transition phase could provide a high volatility measure because of the uncertainties that it causes. This could be a sign that it is not necessarily the recession period that causes a high volatility measure, as seen in Table 4 - Volatility in Periods of Recession and Periods of Growth above, but rather the uncertainty in the market conditions. This could therefore be an explanation to why the growth period selected showed a

higher volatility measure than the recession period in 2001, as the underlying reason could be that the future prospects were more uncertain in this growth period than in the former recession period.

The overall conclusion on the presented hypothesis was however to accept the hypothesis stating that periods of recession increases the stock price volatility compared to periods of growth. It is however important to emphasize that the conclusion could have changed if we had limited our analysis to only one of the periods presented. The justification for this was that the second period of recession and the first period of growth provided the highest volatility of the stocks represented. However, if the second period of recession was not taken into account, the first period of growth would have represented the highest volatility measure compared to the first recession period. This observation corresponds to the exception discovered by Ludvigson and Ng (2007), stating that the recession period in 2001 did not increase the overall stock price volatility. The former study could therefore strengthen the exception discovered for four of the companies selected in this thesis, where the growth period exceeded the recession period. This remark could have changed the conclusion by rejecting the hypothesis instead of accepting it as in this case.

9.2 Prediction 1 – Investment Behavior

The second part of the prediction was to consider whether periods of recession caused further changes within the investment behavior compared to periods of growth. Earlier in this thesis we presented several market risk factors affecting the world economic activity and the stock price of a single company. These changes may further change the company's apprehension about the value of stock and future market expectations. The intention of this analysis was therefore to evaluate if periods with changing world market activity could have caused the companies to revise their investment behavior for reserves replacement rate and finding and developments costs. We have divided this discussion into two parts, one part for the reserve replacement rate and one part for finding and development costs.

9.2.1 Reserve Replacement Rate

We have presented the historical yearly reserve replacement rate for our selected oil and gas companies in Figure 6 - Historical RRR%. From theory presented in chapter 3.1 Recession versus

Growth, we know that recession had been identified for the two periods, March 2001 to December 2001 and from December 2007 until today's date. If we start by reviewing the first recession period in Figure 6 - Historical RRR%, we see that six of the companies increased the RRR% from 2000 to 2001, seven companies decreased the RRR% and three companies had virtually no change in the RRR% (less than 10%). If we compare the 2001 RRR% for the companies to their average RRR% in the period from 1992 to 2007, we see that seven companies has a lager RRR% in 2001 compared to their average, while nine companies has a smaller RRR% compared to their average. For the second recession period that started in December 2007, we do unfortunately not have the data available this period, so we do not have the opportunity of comparing this year with historical data. But we see from the graph in the figure below that the RRR% for 2007 is relatively stable compared to previous years.

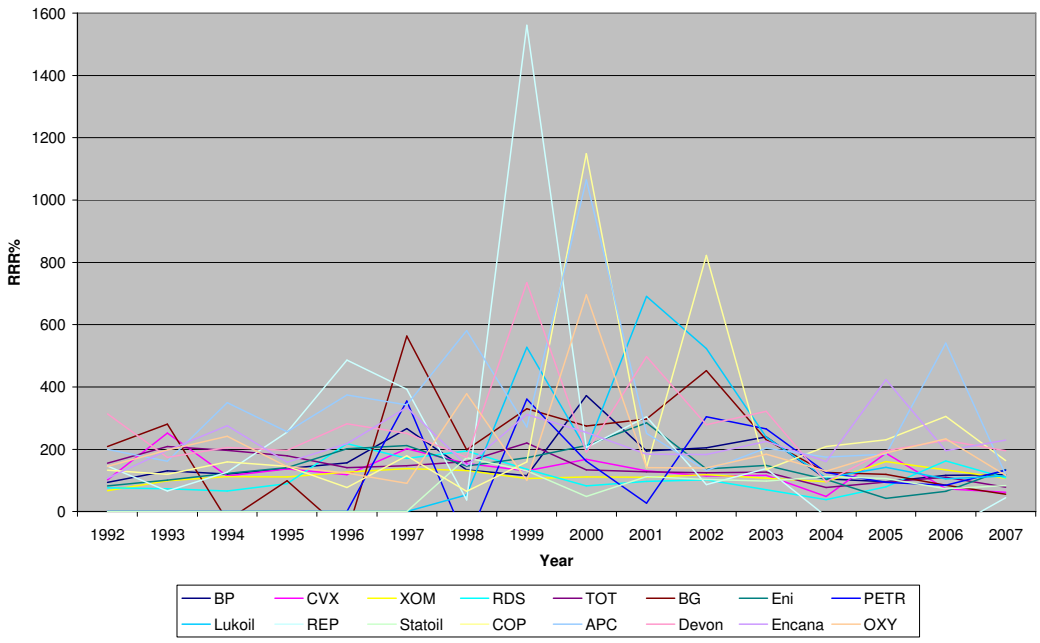

Figure 6 - Historical RRR%

9.2.2 Finding & Development Costs

We have presented the historical finding and development cost per barrel in Figure 7 - Historical F&D Costs illustrated in the following figure. This graph shows how the cost for finding and developing one barrel has developed from 1992 to 2007. As mentioned in the previous sub chapter, our first recession period has been defined as the period from March 2001 to December

2001, so we started by reviewing this period. We can see from the graph that nine of the analyzed companies have increased their finding and development costs from 2000 to 2001, five companies have decreased their costs, while two does not have a significant change in finding and development cost from 2000 to 2001. As earlier mentioned, this data for the second recession period was not yet available, but we can see from the graph that a several of the companies have an increased finding and development cost from 2006 to 2007.

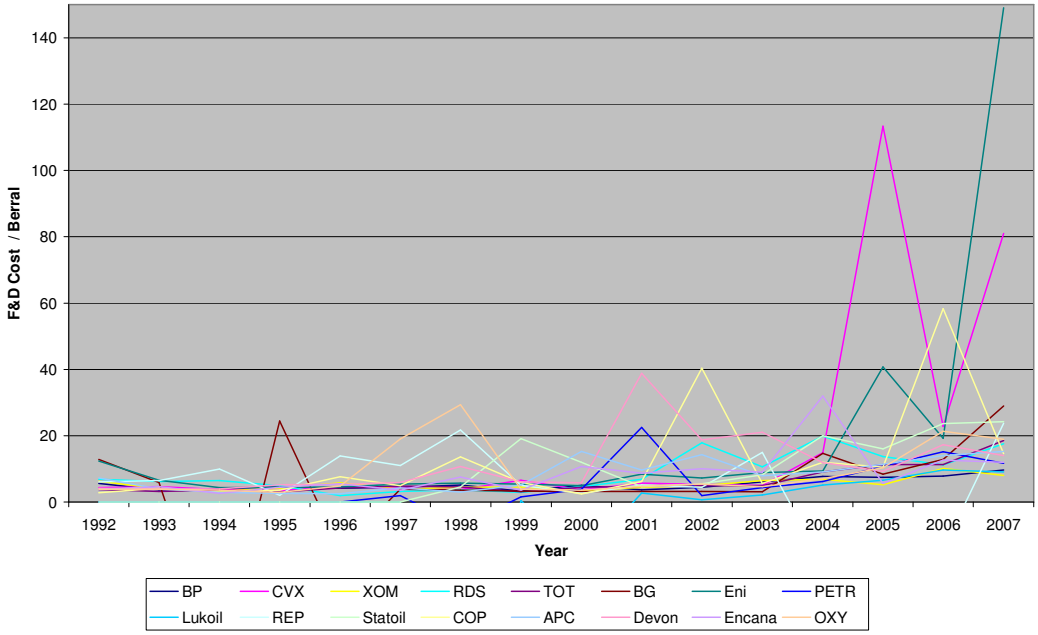

Figure 7 - Historical F&D Costs

9.2.3 Prediction Discussion

Based on the results above we would have to reject our prediction that a recession period changes the investment behavior for oil and gas companies. Nothing in the data available points towards energy companies doing significant changes to their investment plans in periods of recession versus periods of growth. This conclusion is consistent with the results from the qualitative analysis, as several of the personnel interviewed indicated that it was important to maintain a stable long-term investment profile independent of world market changes. Furthermore, the qualitative analysis expressed that periods of recession would imply commitments on cost and efficiency while periods of growth would imply increased exploration, production and project activities.

The conclusions presented are similar to the presumptions stated in former articles presented in chapter 3.5 Empirical Evidence and Literature Review. Former periods of growth have been mentioned as an explanation to why a company's investment behavior still keeps a stable level during periods of recession. The reason for this being that in periods of growth there have often been done long term investment commitments that are persistent despite periods of recession (Langum, 2009). However, former articles have also stated that the ongoing period of recession and the prevailing oil price is not sufficient to secure future investments and developments of new fields (Øklend, 2009). We do not have available data on reserves replacement rate and finding and development cost from the year of 2008. Because of this it was difficult to evaluate whether the previous year caused more changes in the investment behavior than the former recession period.

This conclusion may change over the next years when data for 2008 and 2009 becomes available, and our second recession period can be fully analyzed.

9.3 Hypothesis 2 – Market Risk Influence in Recession and Growth Periods

In order to conclude on the second hypothesis, the relationship between stock price movements and market risk factors in periods of growth versus periods of recession, were discussed. The main hypothesis was that periods of recession caused a higher relation between the stock price movements and market risk factors than periods of growth. The hypothesis can be illustrated by presenting the null and alternative hypothesis:

H_0: Corr. (stock price, market risk factors) = 0

H_1: Corr. (stock price, market risk factors) $\neq 0$

The null hypothesis indicates no relation between the stock price movements and the market risk factors while the alternative hypothesis indicates a possible relationship. The hypothesis was tested through a correlation analysis and a statistical t-test. We have earlier presented the equations for calculating the correlation and t-test in chapter 5 Statistical Measurements in Equation 16 - Correlation and Equation 21 - t-Test. The correlation analysis presents the positive or negative

relation between the stock price and the market risk factors movement and has been presented the following tables.

The correlation analysis and the t-test enable us to either accept or reject the hypothesis stated. The correlation analysis shows the possible relation between two variables and the t-test indicates whether the correlation between the stock price and each market risk factor is statistically significant from zero. In this chapter we have presented four tables indicating the relationship between changes in the stock price and changes in each market risk factor in the recession versus growth periods.

The main results are presented after each table before discussing the overall results and providing acceptance or rejection of the hypothesis. The tables presenting the relation between stock price and each market risk factor is further market by *** representing significance at 1 % significance level, ** representing significance at 5 % significance level and * representing significance at the 10 % significance level. We start by presenting the first recession period in Table 5 – Recession Period: 01.03.01 - 01.12.01.

9.3.1 Recession Period 1

In Table 5 – Recession Period: 01.03.01 - 01.12.01 we have illustrated the possible correlations between marked risk factor changes and changes to the stock price return for the first identified recession period.

Correlations in Recession Period: 01.03.01 – 01.12.01					
Company	Stock price return r_j correlation with:				
	Risk free interest rate, r_f	World market index, r_m	Exchange rate, $r_{exchange}$	NYMEX Brent Oil price, r_{oil}	ICE Gas price, r_{gas}
StatoilHydro ASA	n/a	n/a	n/a	n/a	n/a
Occidental Petroleum Group	0.1292	0.0656	n/a	0.5435	-0.1640
ConocoPhillips Corporation	0.1074	0.0519	n/a	0.6826 (**)	-0.2273
Total S. A.	-0.1132	-0.1475	-0.0113	0.5631 (*)	-0.4517
ExxonMobil Corporation	0.0030	0.3735	n/a	0.3005	-0.0282

BP PLC	0.2882	-0.2991	-0.4967	0.8149 (***)	-0.5096
BG Group PLC	0.2140	-0.2676	0.3097	0.5114	-0.6223 (*)
Encana Corporation	-0.2457	0.3334	0.6006 (*)	-0.3496	0.3431
Eni S. P. A	-0.0464	-0.2899	-0.4177	0.5998	-0.5093
Devon Energy Corporation	0.1855	0.2639	n/a	0.2806	-0.0018
Repsol YPF, S. A.	0.4665	-0.2256	-0.5557 (*)	0.8549 (***)	-0.6190 (*)
Chevron Corporation	-0.0623	0.4094	n/a	0.1932	0.1842
Anadarko Petroleum Group	-0.3325	0.4319	n/a	-0.1834	0.4939
LukOil	0.0683	0.0803	n/a	0.3952	-0.2984
Petrobras Brasileiro SA	0.3437	-0.5138	0.0426	0.4689	-0.5998
Royal Dutch Shell Plc	0.3236	-0.3800	n/a	0.5243	-0.5229
(*): Correlation different from zero at a 10% significance level (**): Correlation different from zero at a 5% significance level (***): Correlation different from zero at a 1% significance level					

Table 5 – Recession Period: 01.03.01 - 01.12.01

The first recession period from March 2001 to December 2001 illustrated several possible relations that could have influenced the stock price movements. The monthly changes within oil price are overall an important factor showing a relative high correlation with the stock return for several of the companies analyzed. ConocoPhillips, BP and Repsol shows a positive correlation relationship of over 0.68 indicating that for each percent the oil price increases, the stock return will increase subsequently by over 0.68 percent. Encana and Anadarko are the only two companies providing a minor negative relation with the monthly oil price changes. Analysis has indicated that four of the 16 energy companies have a correlation different from zero between stock price return changes and oil price changes at a 10% significance level. BP and Repsol actually prove a correlation between stock price return and oil price changes at a 1% significance level. This implies that we can conclude on the oil price having a significant impact on the stock price return in the first period of recession.

Considering the gas price, the correlation analysis provides a negative tendency for the overall stocks. This negative relation could therefore imply that the stock price and gas price could be considered to move in the opposite direction in the period of recession. This negative trend

provides a possible tendency for declining stock price as the gas prices increases in the first period of recession. Anadarko, Chevron and Encana are the only three companies providing a slight positive relation with the gas price changes. This could be a result of Anadarko, Chevron and Encana being more dependent on gas production and sale, compared to the remaining companies. Overall, this is an interesting observation as the oil prices proved the opposite pattern for the majority of the analyzed companies. The only two companies having a correlation significant different from zero considering the former gas price changes are BG Group and Repsol, both at a 10% significance level.

If we review the results from the correlation analysis between stock return changes and changes in the respective national currency, we can see a large spread in the results depending on what currency the stock is traded in. The exchange rate indicates a significant positive relation with Encana, traded in Canadian dollars, providing a correlation of 0.6. The other companies provide negative or minor positive relation with the exchange rate.

The risk free interest rate shows a fairly positive relation to stock prices changes for some of the companies presented, as for example Repsol, Petrobras and Shell. This implies a small related trend between the interest rate changes and stock return changes for these companies. For the remaining companies there is a variation from a minor negative to a minor positive correlation. The minor relation would therefore indicate dissimilar tendencies in the first recession period.

9.3.2 Recession Period 2

The second recession period is often characterized as the “financial crisis”. NBER stated that world market deterioration began in December 2007 ("Determination of the December 2007 Peak in Economic Activity," 2008). Since the world market still operates in this recession period, we evaluated the possible market risk relations from the end of February 2008 until the last observations acquired in the end of February 2009. In Table 6 – Recession Period: 27.02.08 - 27.02.09 we have illustrated the possible correlations between marked risk factor changes and changes to the stock price return for the second recession period.

Correlations in Recession Period: 27.02.08 – 27.02.09					
Company	Stock price return r_j correlation with:				
	Risk free interest rate, r_f	World market index, r_m	Exchange rate, $r_{exchange}$	NYMEX Brent Oil price, r_{oil}	ICE Gas price, r_{gas}
StatoilHydro ASA	0.3878	0.2700	0.2434	0.7579 (***)	0.4931 (*)
Occidental Petroleum Group	0.3142	0.1468	n/a	0.7075 (***)	0.4013
ConocoPhillips Corporation	0.4472	0.1994	n/a	0.6404 (***)	0.3089
Total S. A.	0.3242	0.4079	-0.0990	0.7464 (***)	0.4674
ExxonMobil Corporation	-0.1028	0.3027	n/a	0.1566	0.1508
BP PLC	0.2134	0.4013	0.2589	0.4354	0.4713
BG Group PLC	0.4733	0.4153	0.2571	0.8464 (***)	0.4319
Encana Corporation	0.4319	0.2108	-0.1744	0.7496 (***)	0.6194 (**)
Eni S. P. A	0.3094	0.3946	-0.1176	0.7198 (***)	0.5129 (*)
Devon Energy Corporation	0.4077	0.1883	n/a	0.6253 (**)	0.6574 (***)
Repsol YPF, S. A.	0.3282	0.2578	-0.4289	0.6425 (***)	0.3123
Chevron Corporation	0.1632	0.2297	n/a	0.3705	0.4325
Anadarko Petroleum Group	0.2029	0.3375	n/a	0.4930 (*)	0.3390
LukOil	0.3787	0.1645	n/a	0.7884 (***)	0.4697
Petrobas Brasileiro SA	0.3520	-0.0721	0.3869	0.7801 (***)	0.3412
Royal Dutch Shell Plc	0.2424	0.3570	n/a	0.5279 (*)	0.4526

(*): Correlation different from zero at a 10% significance level
(**): Correlation different from zero at a 5% significance level
(***): Correlation different from zero at a 1% significance level

Table 6 – Recession Period: 27.02.08 - 27.02.09

The correlation matrix illustrated above, shows a tremendous increased relationship between the oil price changes and the stock return. This indicates that the oil price could now be regarded as a more significant indicator for the overall companies selected. The oil price could therefore be considered to have a more significant effect on the stock price changes than in the former recession period indicated. The general tendency shows that when the oil price decreases by one

percent, the stock price decreases respectively between 0.5 and 0.9 percent. ExxonMobil provides different results than several of the other companies studied. The stock price could therefore be considered to be less influenced by changes in the oil price factor for ExxonMobil. 13 of the 16 companies prove a correlation between the stock price return and the oil price changes at a significant level; two companies at a 10% significance level, one at 5% and ten at a 1% significance level. Three companies have not proven a significant correlation between oil price changes and stock price return, an interesting observation is that these three companies are 3 of the 4 companies with the highest market cap, as presented in chapter 7.1 Company Information. This could indicate that larger supermajors are not exposed to oil price decreases in the same extent as smaller national or independent energy companies.

Changes within the gas price have become more important in the second recession period compared to the previous period. The company stocks show a rather small or a more considerable positive relation with the gas price. Four of the analyzed companies have shown a correlation between gas price changes and stock price return different from zero at a 10% significance level. The high relation between the stock price and the gas price changes could therefore imply similar tendencies. This could therefore imply that a decline in the gas price could imply less return for the oil and gas company stocks.

The second recession period also provided a higher relation between the stock price and the changes within both world market index and the risk free interest rate than the former recession period. The former recession period presented several negative relations between the stock return and the market risk factors. However, the second recession period indicated a more considerable relation between the stock return and the marker risk factors for several of the company stocks presented. The relation could therefore indicate that when the interest rate and market index declines by one percentage, the stock price will decline respectively shown by the value in Table 6 – Recession Period: 27.02.08 - 27.02.09. One explanation for this co-movement might be that the world market is experiencing the effect from the financial “crisis”. The exchange rates still provides a less important factor and were therefore not further discussed.

9.3.3 Growth Period 1

A growth period starts when the recession period has reached its lowest point (Hall et al., 2003). The first growth period present was for the time period between March 1991 and March 2001, where it reached its peak level (Hall et al., 2001). This expansion period lasted for 10 years but we have only chosen to provide a selection of this period, from 01.04.1999 until 01.04.2000 to illustrate the general effects caused by periods of growth. The first growth period is illustrated in Table 7 - Growth Period: 01.04.99-01.04.00.

Correlations in Growth period: 01.04.99–01.04.00					
Company	Stock price return r_j correlation with:				
	Risk free interest rate, r_f	World market index, r_m	Exchange rate, $r_{exchange}$	NYMEX Brent Oil price, r_{oil}	ICE Gas price, r_{gas}
StatoilHydro ASA	n/a	n/a	n/a	n/a	n/a
Occidental Petroleum Group	-0.7221 (***)	-0.2173	n/a	0.2782	0.0586
ConocoPhillips Corporation	-0.6595 (***)	0.0522	n/a	0.3563	0.3643
Total S. A.	-0.2899	-0.0571	-0.2799	0.4079	0.1306
ExxonMobil Corporation	-0.2409	-0.4093	n/a	-0.0776	0.1604
BP PLC	-0.6458 (***)	-0.0827	0.1176	0.4323	0.2326
BG Group PLC	-0.2066	-0.5245 (*)	-0.2023	0.0612	-0.2576
Encana Corporation	-0.4580	-0.3502	-0.0806	0.4193	0.2683
Eni S. P. A	-0.4092	-0.0391	-0.1022	0.0624	0.5226 (*)
Devon Energy Corporation	-0.2375	-0.1864	n/a	-0.0776	0.5592 (**)
Repsol YPF, S. A.	-0.2309	0.0531	0.2715	0.0345	-0.4303
Chevron Corporation	-0.6292 (**)	-0.3097	n/a	0.5512 (*)	0.0866
Anadarko Petroleum Group	-0.2501	-0.1420	n/a	0.4259	0.4208
LukOil	-0.2871	-0.2851	n/a	0.3660	-0.1715
Petrobas Brasileiro SA	-0.1953	0.1486	-0.1603	0.2621	0.2667
Royal Dutch Shell Plc	-0.5923 (**)	-0.2286	n/a	0.5300 (*)	0.2453
(*): Correlation different from zero at a 10% significance level					

(**): Correlation different from zero at a 5% significance level
(***): Correlation different from zero at a 1% significance level

Table 7 - Growth Period: 01.04.99-01.04.00

The growth period illustrated above represents several interesting observations. There are now a negative relationship between changes in the risk free interest rate and changes in the company stock prices. This implies that as the risk free interest rate increases by one percent the stock price will fall by for example 0.65 % as indicated from ConocoPhillips. A possible explanation to several of the market risk factors now proving a negative relation with the overall company stocks could be that in periods of growth an increase in these market risk factors could lead to a decline in the stock return. An explanation to these findings could be that increased interest rate increases the monthly obligations and could therefore limit the capital available for future investments that could have increased the stock return.

However, if considering the foregoing recession period, the overall tendency was a minor or rather positive correlation between the stock price changes and changes within the risk free interest rate and changes in the return of the market index. One explanation could be that in periods of recession there could be a certain linkage between the decline in certain market risk factors and decline in the overall stock price, while in periods of growth an increase in these market risk factors doesn't necessarily have a positive effect on stock prices. The analysis shown in Table 7 - Growth Period: 01.04.99-01.04.00 has proven a significant negative correlation between the interest rate changes and the stock return for five different companies at a 5% significance level. This seems like a logic correlation, as increases in the interest rate would limit investment possibilities for both investors and for the energy company; hence decreasing the demand for company stocks.

The world market index provides a negative or minor relationship with the stock price in the respective growth period. This implies either a weak relation or a decline in the stock price if the world market index increases.

When considering the stock price changes correlation to the oil and gas price changes, the correlation tendency has weakened compared to the recession periods earlier presented. The

correlation between the stock prices movements as the result of a changing oil price is no longer as prominent as earlier. In the previous chapter we identified 13 companies to have a significant correlation between oil price changes and stock returns in the second recession period. While in this growth period the results indicated that only two companies have a significant correlation with oil price changes. One reason could be that in periods of recession, when the oil price is at an descending order, it would be more decisive for a company if the oil price declines additional, for example from 70 to 50 $/bbl than if the oil price declines from 150 to 120 $/bbl in periods of growth. The reason for this being that a company probably wants to maintain a high production level and perform future investments even if the oil price declines to 120 $/bbl as this is still considered to be a high commodity price, but as the oil price declines in periods of recession where it already could have a low oil price, it could be more difficult to secure long-term investment to maintain a stable growth in the future.

9.3.4 Growth Period 2

The second growth period as illustrated below in Table 8 - Growth Period: 01.04.03-01.04.04, provides us with both similar tendencies as the previous growth period, but does also provide (has also provided) some differences within the relationship between the stock return and the changes within the market risk factors.

Correlations in Growth Period: 01.04.03–01.04.04					
Company	Stock price return r_j correlation with:				
	Risk free interest rate, r_f	World market index, r_m	Exchange rate, $r_{exchange}$	NYMEX Brent Oil price, r_{oil}	ICE Gas price, r_{gas}
StatoilHydro ASA	-0.4554	-0.1635	-0.1274	0.4339	0.4164
Occidental Petroleum Group	-0.5198 (*)	-0.1995	n/a	0.1817	0.0316
ConocoPhillips Corporation	-0.2817	-0.3597	n/a	-0.2302	-0.3343
Total S. A.	-0.5524 (*)	-0.2608	-0.4906 (*)	0.4563	0.2399
ExxonMobil Corporation	-0.2028	-0.2449	n/a	-0.1017	-0.1278
BP PLC	-0.3846	-0.1485	-0.1396	0.3412	0.0569
BG Group PLC	-0.3639	-0.3598	-0.4579	0.4849 (*)	0.2386

Encana Corporation	-0.3165	-0.3183	-0.6157 (**)	0.1062	0.1233
Eni S. P. A	-0.5359 (*)	-0.2367	-0.5078 (*)	0.5839 (**)	0.5138 (*)
Devon Energy Corporation	-0.2678	-0.3541	n/a	-0.1568	-0.1627
Repsol YPF, S. A.	-0.5049 (*)	-0.2408	-0.3147	0.0083	-0.2290
Chevron Corporation	-0.5760 (**)	-0.2981	n/a	0.2458	-0.0832
Anadarko Petroleum Group	-0.4133	-0.2244	n/a	0.1763	0.2080
LukOil	0.0249	-0.1728	n/a	0.2728	0.1290
Petrobas Brasileiro SA	0.2159	0.4681	-0.3051	-0.0551	0.2318
Royal Dutch Shell Plc	-0.3121	0.0366	n/a	0.1811	0.1730

(*): Correlation different from zero at a 10% significance level
(**): Correlation different from zero at a 5% significance level
(***): Correlation different from zero at a 1% significance level

Table 8 - Growth Period: 01.04.03-01.04.04

The similarities between this and the previous growth period was the negative relation between stock return provided and the risk free interest rate, the return provided by the market index and the changes within the exchange rates.

If we should consider any differences between this and the former growth period we could mention some examples. ConocoPhillips for example; the former growth period provided a rather positive relation of 0.36 for both oil and gas price. This growth period shows a rather negative relation for respectively oil of 0.23 and 0.33 for gas. Another example is BG Group, providing a minor or negative relation with oil and gas price changes in the former growth period to proving a rather positive relation of about 0.49 with oil and 0.24 with gas price in this period.

9.3.5 Hypothesis Discussion

Based on the overall quantitative analysis and results presented in the four earlier sub chapters we can accept the hypothesis indicating that the stock price is more influenced by market risk factors in periods of recession compared to period of growth. The tables presented have provided us with analysis on stock return relations to various market risk factors. The overall tendency from the quantitative analysis indicates that there is a higher relation between the stock return and the overall market risk factors in periods of recession compared to periods of growth. It is particular

the second and ongoing recession period that indicated the highest and significant correlation between the stock return and changes within oil and gas prices. This corresponds to the qualitative analysis, were the oil and gas prices was considered to have the highest influence on an energy company's stock price. The other market risk factors applied in the quantitative analyses; interest rate, market index and exchange rate, displayed less influence on a company's stock price than changes within the oil and gas price. Similar tendencies were seen in the qualitative analyses, where these market risk factors were considered to provide minor influence on the stock price.

The results from the quantitative and qualitative analysis indicated the oil and price changes as prominent factors and was found similar to former results from comparable research. When referring for former empirical results presented in chapter 3.5 Empirical Evidence and Literature Review, both Sadosky (2001) and Boyer and Filion (2007) illustrated the oil price to have the highest correlation with former stock price changes compared to the other financial risk factors selected. In the correlation analysis from Boyer and Filion (2007) the gas price changes were also presented to have a considerable relation with the former stock price compared to the other financial risk factors, but the oil price indicated the highest correlation measure. Even if these articles do not differentiate between periods of recession and periods of growth, the analysis from earlier comparable studies strengthen our results obtained in these analyses that oil and gas price proves to have a significant influence or relationship with a company's stock return.

There is no doubt that the second period of recession has provoked the highest relationship between changes in stock return and changes in the market risk factors as illustrated in Table 6 – Recession Period: 27.02.08 - 27.02.09. Furthermore, the answers from the questionnaire presented in the in chapter 8 Qualitative Analysis, has not differentiated between the relation of stock price and market risk factors in various business cycles. The conclusions on the hypothesis could therefore have changed (or have been reinforced) if the qualitative analysis would have differentiated between period of recession and periods of growth, when evaluating the influence from market risk factors on a company's stock return.

9.4 Hypothesis 3 – Single and Multifactor Models

The final hypothesis considered the estimation of historical stock returns based on the application of single and multifactor models. This thesis has applied models including both systematic and unsystematic risk factors for explaining the excess stock return of each energy company studied. These models represent the following hypothesis:

> H_0: Increased number of financial risk factors included in a model for pricing risk, gives a more accurate predicted historical stock return
>
> H_1: Increased number of financial risk factors included in a model for pricing risk, does not give a more accurate predicted historical stock return

The intention of these models were to calculate the stock return based on historical data and further to minimize the difference between the actual stock return and the predicted stock return, as indicated in chapter 3.2.4.3 Historical Stock Return Summary, estimated from the single and multifactor models. The difference between the actual and predicted stock return can be further considered as the estimated error term as earlier presented in chapter 5.8 OLS (Ordinary Least Square) from Equation 26 - Estimated Error Equation.

The hypothesis has been tested by running a regression analysis to obtain the beta values representing the systematic and unsystematic risk factors and their influence on the respective company as presented in chapter 4 Conducting the Regression Analysis. Then, the historical stock return was calculated based on the return and changes within the market and company specific financial risk factors included.

The purpose of this chapter was to present and discuss the results obtained. There are two important considerations within these models and statistical analyzes:

- Are the beta values statistically significant?
- Which of these models provides the most accurate stock return value based on the historical data?

The results are provided in tables representing each model, to provide a schematic and organized presentation. The results were further discussed after each model presented, before the overall results for providing acceptance or rejection of the hypotheses was discussed. The tables presenting the results were further marked by *** representing significant at a 1 % significance level, ** representing significant at a 5 % significance level and * representing significant at a 10 % significance level. A significant variable indicates that the systematic or unsystematic risk factor is statistically significant for explaining the historical stock price movements.

9.4.1 CAPM

Let us start by presenting the results from the single factor model CAPM in Table 9 – CAPM.

Company	β_0	β_1	R^2	Mean	Variance	Standard deviation
StatoilHydro	0.0131	0.3221	0.0174	0.0687	0.0028	0.0530
Occidential	0.0057	-0.0443	-0.0036	0.0595	0.0026	0.0507
ConocoPhillips	0.0057	-0.0335	-0.0038	0.0540	0.0021	0.0462
Total SA	0.0091 (**)	0.1736 (*)	0.0076	0.0519	0.0020	0.0449
Exxon Mobil	0.0056 (*)	0.0363	-0.0030	0.0356	0.0009	0.0294
BP Plc	0.0034	0.0015	-0.0042	0.0515	0.0016	0.0396
BG Group Plc	0.0093 (*)	-0.0660	-0.0027	0.0556	0.0023	0.0478
Encana Corporation	0.0088 (*)	0.0743	-0.0026	0.0621	0.0025	0.0503
ENI SPA	0.0069	0.0974	-0.0023	0.0537	0.0018	0.0422
Devon Energy Corporation	0.0153 (**)	0.2018	0.0027	0.0810	0.0045	0.0673
Repsol YPF	0.0035	0.0130	-0.0044	0.0558	0.0023	0.0477
Chevron Corporation	0.0056	-0.0047	-0.0042	0.0427	0.0013	0.0357
Anadarko Petroleum Corporation	0.0082	0.1413	-0.0001	0.0727	0.0039	0.0628
Lukoil	0.0226 (*)	-0.0710	-0.0061	0.1202	0.0118	0.1086
Petrobras	0.0205 (*)	-0.0696	-0.0053	0.1172	0.0117	0.1080
Royal Dutch Shell	0.0037	0.0067	-0.0042	0.0493	0.0017	0.0410
(*):different from zero at a 10% significance level						

(**):different from zero at a 5% significance level
(***):different from zero at a 1% significance level

Table 9 – CAPM: Systematic Risk

The CAPM model included the market index as the only factor capturing the systematic risk in the world market, represented by β_1. β_0 is the intercept of the regression equation illustrating the stock return when there is no market risk influencing the stock price. Seven of the analyzed companies have shown a significant β_0 value. This could point toward the risk free interest rate having an influence on the predicted stock price. Total is the only company providing a 10 % significance level indicating that changes within the world market index could represent the financial risk exposure based on former stock price changes.

The R-square indicates how well the changes within the market index accounts for changes in historical stock returns. The formula for estimating R-square was earlier presented in chapter 5 Statistical Measurements in Equation 17 - R-Square. This model indicates a rather small R-square. This could be explained by the lack of significant variables describing the predicted historical stock return, or simply that the world market index was not sufficient to explain the former changes or the financial risk exposure of the respective energy companies stocks selected.

The mean, variance and standard deviation in this model indicates the difference between the predicted stock return estimated by CAPM and the actual stock return calculated from historical stock price changes. The results from these calculations are discussed later, after having presented all the models applied to consider the accuracy of each model.

9.4.2 APT

APT is the first multifactor model studied in this thesis and this model has included several systematic risk factors, as illustrated in the table below Table 10 – APT: Systematic Risk Factors. This model have represented five different risk factors that comprises the systematic risk exposure indicated by each beta value where;

- β_0 intercept
- β_1 market risk premium, the return of the market index less the risk free interest rate
- β_2 interest rate risk premium, the rate from 10 year US Treasury note less the 1 year US Treasury bill

- β_3 oil price changes
- β_4 the gas price changes
- β_5 the exchange rate changes.

Company	β_0	β_1	β_2	β_3	β_4	β_5	Adjusted R^2	Mean	Variance	Standard deviation
StatoilHydro	-0.0313	0.2270	0.9565	0.4988 (***)	0.0142	-0.1285	0.2634	0.0598	0.0018	0.0426
Occidential	0.0402 (*)	-0.0256	-0.6972	0.1704 (***)	0.0350	n/a	0.0371	0.0597	0.0024	0.0494
ConocoPhillips	0.0066	0.0160	-0.0705	0.2340 (***)	0.0322	n/a	0.0824	0.0529	0.0017	0.0417
Total SA	-0.0083	0.1917 (*)	0.2545	0.1388 (***)	0.0356	-0.0056	0.0421	0.0496	0.0017	0.0416
Exxon Mobil	0.0024	0.0275	0.0589	0.0464	0.0358	n/a	0.0071	0.0351	0.0009	0.0301
BP Plc	-0.0067	0.0605	0.1524	0.2239 (***)	0.0220	-0.0748	0.0830	0.0474	0.0015	0.0392
BG Group Plc	0.0148	-0.0287	-0.1094	0.0955 (*)	0.0027	0.0167	-0.0074	0.0534	0.0022	0.0471
Encana Corporation	0.0310	0.0309	-0.4619	0.1444 (**)	0.1235 (***)	-0.3060	0.0686	0.0598	0.0025	0.0495
ENI SPA	-0.0073	0.0102	0.2517	0.1233 (*)	0.1080 (***)	-0.2354	0.07050	0.0507	0.0016	0.0405
Devon Energy Corporation	0.0132	0.1770	-0.0964	0.1421 (*)	0.2187 (***)	n/a	0.1068	0.0740	0.0040	0.0630
Repsol YPF	0.0076	0.0091	-0.0903	0.1354 (**)	-0.0021	-0.3173 (*)	0.0183	0.0549	0.0022	0.0471
Chevron Corporation	0.0092	-0.0020	-0.1140	0.1280 (***)	0.0462	n/a	0.0480	0.0419	0.0012	0.0347
Anadarko Petroleum Corporation	0.0236	0.0793	-0.3791	0.2433 (***)	0.1871 (***)	n/a	0.1337	0.0686	0.0034	0.0583
Lukoil	-0.0981	-0.1009	2.5457 (*)	0.2888 (*)	-0.0785	n/a	0.0194	0.1177	0.0112	0.1059
Petrobras	0.0219	-0.0883	-0.0647	0.3212 (**)	-0.0313	0.1331	0.0033	0.1137	0.0117	0.1082
Royal Dutch Shell	-0.0148	0.0454	0.3246	0.1357 (***)	0.0155	0.0481	0.0260	0.0069	0.0002	0.0146

(*):different from zero at a 10% significance level
(**):different from zero at a 5% significance level
(***):different from zero at a 1% significance level

Table 10 – APT: Systematic Risk Factors

The APT model included several market risk factors to explain the determinants of oil and gas stock return. The selection of market risk factors included in the selected APT model was the interest rate, market index, oil price, gas price and exchange rate. 15 of the 16 companies selected have indicated a significant oil price beta value, represented by β_3. This indicates that oil price has a significant influence for the predicted stock price. ExxonMobil is the only company providing a different trend when evaluating the oil price movements compared to the historical stock prices. The reason could be that ExxonMobil is, as earlier mentioned in chapter 7.1 Company Information, a major oil and gas company with the largest market cap compared to the other oil and gas companies, and could therefore not be exposed in the same extent as smaller energy companies.

Encana, Eni, Devon and Anadarko indicate a 1% significant gas price beta, represented by β_4, indicating the gas price movements to have a considerable effect on the stock price. We saw earlier in the correlation analysis in chapter 9.3 Hypothesis 2 – Market Risk Influence in Recession and Growth Periods, that Anadarko and Encana provided a positive correlation with the gas price and this is also shown by the significant gas price in the above table. The significant beta values for gas represented in Encana, Eni, Devon and Anadarko may therefore indicate higher dependence of the gas commodity than the other represented energy companies.

This table refers to adjusted R-square as this model has included several market risk factors. StatoilHydro and Anadarko provided us with the highest adjusted R-square, indicating the included variables to account for some effect of the financial risk exposure on the predicted stock return. The formula for calculating adjusted R-square is presented in Equation 20 - Adjusted R-Square.

9.4.3 Fama and French

The next model incorporated the market index as the systematic risk factor in resemblance to the CAPM model, and the value and size of a company indicating company specific factors. The beta values represent:

- β_0 intercept
- β_1 market risk premium; the return of the market index less the risk free interest rate
- β_2 the size premium; the supplementary return required from investing in a small rather than a large market cap company
- β_3 the value premium; the supplementary return required from investing in a low book-to-market ratio company rather than in a high book-to-market ratio company.

The statistical results from the Fama and French model are illustrated in Table 11 - Fama and French below.

Company	β_0	β_1	β_2	β_3	Adjusted R^2	Mean	Variance	Standard deviation
StatoilHydro	0.0119	0.2939	0.0551	0.4773	0.0147	0.0684	0.0027	0.0520
Occidential	0.0045	-0.0011	0.3163 (**)	0.3433 (**)	0.0128	0.0594	0.0024	0.0493
ConocoPhillips	0.0042	0.0163	0.3917 (***)	0.4057 (***)	0.0319	0.0530	0.0020	0.0450
Total SA	0.0091 (**)	0.2067 (*)	-0.1615	0.1077	0.0114	0.0518	0.0020	0.0445
Exxon Mobil	0.0050 (*)	0.0442	0.2447 (***)	0.1306	0.0184	0.0351	0.0008	0.0289
BP Plc	0.0026	0.0355	0.1778	0.2443 (*)	0.0024	0.0508	0.0016	0.0397
BG Group Plc	0.0081 (*)	0.0006	0.1938	0.4226 (***)	0.0186	0.0553	0.0022	0.0465
Encana Corporation	0.0078	0.1268	0.1250	0.3235 (*)	0.0034	0.0613	0.0025	0.0503
ENI SPA	0.0056	0.2041	-0.0074	0.4677 (***)	0.0466	0.0523	0.0016	0.0406
Devon Energy Corporation	0.0142 (**)	0.2660	0.1468	0.3931 (*)	0.0065	0.0800	0.0045	0.0674
Repsol YPF	0.0026	0.0495	0.1382	0.2533	-0.0018	0.0557	0.0022	0.0472
Chevron Corporation	0.0047	0.0341	0.2182 (**)	0.2845 (**)	0.0161	0.0422	0.0012	0.0350

Anadarko Petroleum Corporation	0.0069	0.1964	0.2734	0.3910 (*)	0.0085	0.0718	0.0039	0.0626
Lukoil	0.0198	0.0300	0.4072	0.6477	-0.0003	0.1194	0.0115	0.1072
Petrobras	0.0173	0.0548	0.7462 (**)	0.9012 (**)	0.0238	0.1173	0.0106	0.1031
Royal Dutch Shell	0.0026	0.0630	0.2077	0.3739 (***)	0.0192	0.0490	0.0016	0.0398
(*):different from zero at a 10% significance level (**):different from zero at a 5% significance level (***):different from zero at a 1% significance level								

Table 11 - Fama and French: Systematic and Unsystematic Risk Factors

The table above illustrates some resemblances with the CAPM analysis when evaluating the significance level of the β_0 value of Total, ExxonMobil, BG Group and Devon. These companies provide us with a 10 % significance value, indicating that the risk free interest rate could influence the predicted stock price movements. The same resemblances apply (applied) for the market index value represented by a significant β_1 provided for Total, indicating the changes in the market index having an influence on predicted historical stock price movements.

This model incorporated the size; β_2, and the value; β_3, of a company as two possible unsystematic, company specific, risk factors that could have an influence of historical stock return when measuring financial risk exposure. These company specific risk factors has provided us with an overall contribution explaining the determinants of historical oil and gas stock returns, by indicating several significant values shown in Table 11 - Fama and French: Systematic and Unsystematic Risk Factors. Five of the selected companies have beta values significant at a 5 and 10 % significance level. The market cap could therefore be a risk factor that actually influences the historical stock return for a company. The value of a company representing the book-to-market ratio does however appear as the prominent risk factor indicating a 1, 5 or 10 % significance level for eleven of the selected companies. The book-to-market ratio therefore provide an important financial risk factor for explaining the financial risk exposure when determining changes in historical stock return with the Fama and French model. This indicated the book-to-market ratio to be an important factor when predicting historical stock return based on the changes within company value.

9.4.4 Multifactor Model

The former models have provided analysis based on monthly data incorporating either systematic risk or both systematic and unsystematic risk factors, to measure financial risk exposure. The Table 12 - Multifactor Model: Systematic and Unsystematic Risk Factors illustrates analysis provided on a yearly basis, including both systematic and unsystematic risk factors, and could therefore be regarded as an attempt to measure the equity risk from historic stock price changes. The following multifactor models included seven financial risk factors and represents:

- β_0 intercept
- β_1 market risk premium; the return of the market index less the risk free interest rate
- β_2 interest rate risk premium, the rate from 10 year US Treasury note less the 1 year US Treasury bill
- β_3 the oil price changes
- β_4 the gas price changes
- β_5 the exchange rate changes
- β_6 the reserve replacement rate changes
- β_7 the finding and development costs changes

Company	β_0	β_1	β_2	β_3	β_4	β_5	β_6	β_7	Adj. R^2	Mean	Vari.	Standard deviation
Statoil-Hydro	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Occi-dential	0.1199	0.0289	-0.8558	0.0159	0.1244	n/a	-0.1011	0.0540	-0.0764	0.1421	0.0088	0.0936
Conoco-Phillips	0.1536	-0.3619	-5.7664	0.1542	0.0539	n/a	-0.0656	-0.0222	-0.1331	0.1060	0.0113	0.1064
Total SA	0.0453	0.3307	-2.3524	-0.0183	-0.0331	0.1143	0.1668	0.3343 (*)	0.3677	0.0540	0.0017	0.0407
Exxon Mobil	0.1057 (**)	-0.3466	-7.4923 (**)	0.0117	-0.0879	n/a	-0.1708	0.0334	0.3748	0.1091	0.0056	0.0745
BP Plc	0.1041	0.4567	-3.9981	0.0428	-0.0294	-0.0018	-0.0800	-0.2561	0.0770	0.1077	0.0074	0.0861
BG Group Plc	0.2065	-0.0594	-5.6657	-0.1847	-0.0830	0.4256	-0.0356	0.0518	-0.0964	0.1727	0.0213	0.1459
Encana Corp.	0.0122	-0.2741	4.0909	-0.0758	0.0724	1.5098	0.3243 (*)	0.2413 (*)	0.3422	0.1187	0.0070	0.0838
ENI SPA	0.1375	-0.0288	-4.3072	-0.0022	-0.0150	0.5282	0.0795	-0.0224	-1.1396	0.1189	0.0160	0.1266
Devon Energy Corp.	0.0306	0.2724	-9.1977	0.5448 (*)	0.0536	n/a	-0.2032	0.0920	0.4089	0.1204	0.0064	0.0799

Repsol YPF	0.0235	0.9339 (**)	-1.7496	0.0062	-0.0500	0.1776	-0.0000	0.0004	0.5806	0.0696	0.0024	0.0490
Chevron Corp.	0.0541	0.5543	-1.1372	-0.0849	-0.0359	n/a	-0.0788	0.0416	0.0382	0.0992	0.0054	0.0732
Anadarko Petroleum Corp.	0.0609	0.1529	-2.5108	-0.0511	0.2352	n/a	0.0128	0.0463	0.2160	0.1592	0.0132	0.1151
Lukoil	0.5436 (***)	-0.3540 (*)	-20.7853 (***)	-0.7773 (***)	0.2070 (**)	n/a	0.1646 (***)	0.0293 (***)	0.9831	0.0142	0.0001	0.0107
Petrobras	0.4026 (**)	-0.0378	5.2251	-0.3991 (**)	0.0966	2.7835 (**)	0.0116	-0.0734	0.9707	0.0259	0.0008	0.0282
Royal Dutch Shell	0.0346	0.1896	-3.4914	0.1673	-0.0451	-0.2369	0.0007	-0.0088	-0.1801	0.0889	0.0039	0.0624

(*):different from zero at a 10% significance level
(**):different from zero at a 5% significance level
(***):different from zero at a 1% significance level

Table 12 - Multifactor Model: Systematic and Unsystematic Risk Factors

The analysis illustrates interesting differences compared to the previous presented models. The oil and gas price changes does no longer provide the same number of significant values compared to the former presented APT model. Devon, Lukoil and Petrobras have a beta values significant at a 10 % significance level, indicating that the oil price might provide an influence on the predicted stock price movements. Lukoil was the only company proving the same possible trend for the gas price. The reserves replacement rate and finding and development costs, represented by β_6 and β_7 do not indicate to have an overall contribution to the explanation of historical stock price return. However, there were some exceptions. Total, Encana and Lukoil were the only companies with significant contributions, indicating that the finding and development cost provided an influence on the predicted stock return. The same applies for the reserves replacement rate where Encana and Lukoil are the only companies significant having a 10 % significance level.

The table above provides an interesting characteristic when observing Lukoil in contrast to the other companies. All of the included risk factors, both market and company specific factors, are significant at a 10 % significance level, indicating that these financial risk factors could provide an significant influence on the predicted historical stock price movements in Lukoil.

A reason for less significant financial risk factors in this model compared to APT could be that this analysis has been implemented on a yearly basis. The financial risk exposure provoking stock price changes could therefore have weakened when considering yearly changes. During a prospective year there could have been several fluctuations causing either a significant impact or less impact on the stock return. By exploring yearly changes, valuable information could be lost when trying to measure a company's financial risk exposure.

The adjusted R-square has also increased compared to other models presented. Lukoil and Petrobras illustrate a rather prominent R-square, indicating that the included market and company specific risk factors account for a significant effect on the predicted historical stock return. These market and company specific risk factors could therefore account for a significant proportion of the financial risk exposure for Lukoil and Petrobras.

9.4.5 Former Research Resemblances

Previous research has performed similar studies, including several financial risk factors required to measure a company's financial risk exposure and to assess the financial determinants of a company's historical stock return. In chapter 3.5 Empirical Evidence and Literature Review, we referred to two comparable studies, Boyer and Filion (2007) exploring the Canadian stock market and Scholtens and Wang (2008) exploring NYSE listed oil and gas companies. Despite different samples and results based on weekly, monthly, quarterly and yearly analysis and despite considering portfolios of stocks rather than one single company, the intention was only to provide a brief insight to general resemblances and differences between the results in this thesis and the results from similar research.

In resemblance to Fama and French (1992), CAPM was not sufficient to explain the financial risk exposure for changes in the world market index. From the results presented in Table 9 – CAPM: Systematic Risk, Total was the only company indicating that the changes within the world market index could have represented a certain extent of financial risk exposure due to former stock price changes, indicated by the 10 % significant level.

When considering the results regarding the APT multifactor model, as the article from Boyer and Filion (2007), presented in chapter 3.5 Empirical Evidence and Literature Review, each of the

included systematic market risk factors were discovered to have a significant influence, both positive and negative, on the total sample of Canadian oil and gas companies selected. The article included the same financial systematic risk factors as this research, meaning the market risk premium, interest rate risk premium, the oil price changes, the gas price changes and the exchange rate changes to assess the financial risk exposure due to former changes in historical stock return. From the results of this previous research, the crude oil price changes appeared to have the highest extent of financial risk exposure, meaning a higher beta value, on the Canadian stock market compared to the natural gas price. This result corresponds to the results in this study, except for one company, Devon, where the natural gas beta indicated a higher beta value compared to the crude oil beta. The oil beta was further presented to be twice as big as the market index beta. This is also similar to the research results in this thesis, except for Total and Devon where the market index beta was higher than the market index return coefficient. The exchange rate beta was further mentioned to provide an interesting observation as it was highly negative and close to one in absolute terms. In this study, the exchange rate changes showed a certain negative influence, except from BG, Petrobras and Shell, but in a much small extent than the former research referring to.

Proceeding to former comparable empirical research regarding the Fama and French risk factors, like Scholtens and Wang (2008) as referred to in chapter 3.5 Empirical Evidence and Literature Review, there could also be mentioned some resemblances and differences despite that the former article being based on weekly data and this thesis being based on monthly data. The market cap and book-to-market ratio were discovered to have a significant influence on the stock price, meaning a significant contribution when explaining the changes in the historical stock price. The article did however include a fourth factor in addition to the three factor model developed by Fama and French, the default premium. The beta values could therefore differ as the former article referring to included one additional risk factor. The default premium included in the analysis constitutes the weekly return of U.S. corporate bonds less the yield of 7 year U.S. Treasury note. The results indicated the market cap to have the most significant contribution for the overall company's studies, but only one third of the respective companies had significant coefficients considering the book-to-market ratio. These findings from the Scholtens and Wang (2007) differs from the analysis in this study, as presented in Table 11 - Fama and French:

Systematic and Unsystematic Risk Factors, whereas the book-to-market ratio is considered as the most significant coefficient to explain the historical expected stock return if compared to the results from the market cap.

Finally, when considering the multifactor model, including the unsystematic risk factors, reserves replacement rate and finding and development cost, there could be mentioned one similar research including the reserves replacement rate to assess its influence on former stock price changes. The former comparable research referring to here is the article from Boyer and Filion (2007) where they performed multifactor models with several financial risk variables in order to assess the financial risk exposure due to changes in the Canadian oil and gas company stock return. The beta value representing the unsystematic risk factor, meaning the changes within reserves replacement rate, was discovered to have a significant explanation to changes in the stock return. As earlier mentioned, Boyer and Filion (2007) considered one and two portfolios that constituted the selection of oil and gas companies and were further based on a quarterly basis, while this research considered each of the respective companies and were further performed on a yearly basis. The reserves replacement rate was one of several financial risk factors included within the multifactor model presented in this former research article. The beta values could therefore differ from other multifactor models including fewer coefficients. This could be an explanation to why Encana and Lukoil are the only two companies showing a significant beta value considering the reserves replacement rate.

9.4.6 Hypothesis Discussion

The previous chapters has presented and discussed the results from the single and multifactor models applied for measuring financial risk. The purpose of these previous chapters has been to discuss whether the systematic and unsystematic risk factors included contributed significantly in explaining the changes in stock return for each of the respective companies.

However, there still remains one important consideration for the statistical analyzes regarding the accuracy of each model, as presented in chapter 9.4 Hypothesis 3 – Single and Multifactor Models. The purpose of this chapter was therefore to evaluate and conclude on which of the presented models provided the most accurate stock return prediction compared to the historical actual stock

return. Based on the hypothesis presented, this involves considering if increased number of financial risk factors included in the model for pricing risk has given a more accurate predicted stock return.

The statistical analyses were performed on a monthly and yearly basis, this was therefore an important consideration when answering the hypothesis stated. We have therefore stated two conclusions on the hypothesis. The reason for this being that the CAPM, APT and Fama and French were based on a monthly data and the multifactor model was based on yearly data. If considering the last multifactor model applying yearly data, the answer to the hypothesis would be that increased number of financial risk factors does not necessarily give a more accurate predicted stock return. From the results presented in Table 12 - Multifactor Model: Systematic and Unsystematic Risk Factors, there were however to exceptions, Lukoil and Petrobras, were increased number of financial risk factors did improve the explanation of historical stock return. Lukoil and Petrobras were also presented as two exceptions in the preceding chapter shown in Table 12 - Multifactor Model: Systematic and Unsystematic Risk Factors, providing several significant beta values compared to the other company stocks.

As emphasized in the previous chapter, the disadvantage of this multifactor model was the fact that we could lose valuable information concerning former fluctuations in a given a year. The price of a single stock or the oil price could have fluctuated several times during the year, and could therefore have contributed with essential information when considering the financial risk exposure of a single stock.

As the CAPM, APT and Fama and French models were based on monthly data, with the limited possibility for loosing valuable information, there has been formed a second conclusion based on the monthly analysis. These models included systematic risk factors or both systematic and unsystematic risk factors when estimating the historical stock return. It is important to emphasize that two of the models, CAPM and APT, has only considered one part of the equity risk, the systematic risk, when considering the hypothesis. Except from these considerations and based on the overall result, the APT model gave us the best estimate on historical stock return despite of not including unsystematic risk factors. The APT model considered several systematic risk

factors that could have influenced a company's stock return. The APT model does not specify what market risk factors that should be included, only that the factors included should be systematic risk factors. The APT model in this thesis included changes in interest rate, market index, oil price, gas price and exchange rate, as these were the systematic risk factors we identified as significant contributors for the analyzed companies.

Based on the overall monthly analysis and results, the APT multifactor model indicated the least difference between the actual and predicted historical stock return, by showing the smallest mean, variance and standard deviation compared to the other models as seen in table Table 10 – APT: Systematic Risk Factors. The least difference between the actual and the predicted stock return refers to the smallest estimated error term as presented in chapter 5.8 OLS (Ordinary Least Square). This makes APT the most accurate model for predicting the historical stock return. Since the APT model has given us the best prediction of historical stock return, this could imply that the financial risk factors included in the model were the most important risk factors for predicting historical stock returns. Since these factors could be considered as most important for predicting historical stock return, it could indicate that these financial risk factors could represent the most significant financial risk exposure for the analyzed companies.

The APT model did further include the most financial risk factors considering the monthly analysis compared to the other models analyzed. The conclusion would therefore be to accept the hypothesis stating that increased number of financial risk factors included in a model for pricing risk, have given a more accurate predicted stock return considering monthly data.

10 Conclusion

Periods of recession and growth has over the last decades provoked significant changes within the world economic markets. These changes have caused the stock price to fluctuate and required major oil and gas companies to evaluate and reconsider investment behaviors to reduce financial risk exposure.

The purpose of this thesis has been to evaluate financial risk exposure for comparable energy companies and how they have been exposed to systematic and unsystematic risk. This thesis studied a sample of 16 major oil and gas companies and their sensitivities and relation to several financial risk factors over a 20 year time period, from 28 February 1989 to 27 February 2009.

The first prediction in this thesis stated that "economic recession, and resulting changes in market risk factors, increases the stock price volatility and changes the investment behavior for energy companies". We have explored this prediction by using both quantitative and qualitative analysis.

If we start by reviewing the first part of this prediction "economic recession, and resulting changes in market risk factors, increases the stock price volatility… for energy companies". Our quantitative analysis points towards recession periods in general increasing the stock volatility for energy companies. Further, our qualitative analysis has supported the results, as periods of recession were considered to provide the highest volatility by the overall respondents. These results were also confirmed by previous comparable research indicating that periods of recession increased the stock price volatility (Schwert, 1989a, 1989b). Economic recession, and resulting changes in market risk factors does increase stock price volatility for energy companies. Based on these reflections and the results from the quantitative and qualitative analysis we have decided to maintain the prediction stating that economic recession, and resulting changes in the market risk factors, increases the stock price volatility for energy companies.

The second part of this prediction expressed that "economic recession and resulting changes in market risk factors… changes the investment behavior for energy companies". The descriptive statistics results presented in chapter 9.2 Prediction 1 – Investment Behavior, did not give us any evidence on recession periods provoking a change in investment behavior for the analyzed

companies. The experts interviewed supported this by expressing the importance of having a long term and stable investment philosophy regardless of recession or growth periods. These reflections from the results of the quantitative and qualitative analysis were further confirmed by recent articles. These articles indicated that periods of growth prior to the recession periods would help to maintain a stable investment behavior. The explanation behind this statement was that periods of growth often results in several long-term investments and because of prospective commitments, the investments are maintained through periods of recession (Langum, 2009). For further information, reference is made to chapter 3.5 Empirical Evidence and Literature Review. Based on this, we have decided to reject this part of the prediction. Recession periods, and resulting changes in market risk factors does not necessary change investment behavior for energy companies.

The prediction was followed by a hypothesis stating that "the stock price is more influenced by market risk in periods of recession than in periods of growth". This hypothesis was explored by employing quantitative analysis and was further complemented by qualitative analysis.

The quantitative analysis was performed by implementing a correlation analysis indicating the relation between the market risk factors and the respective stock prices. The overall results from the correlation analysis indicated the stock price being more influenced by market risk factors in periods of recession than in periods of growth. The general tendency in the analyses proves the oil and gas price as the prominent market risk factors with the highest influence or relation on an oil and gas company's stock return. The qualitative analysis corresponds to the importance of oil and gas prices, as shown in the quantitative analysis. The personnel interviewed designated changes in oil and gas price to have the highest importance on stock price changes for an energy company. With the exception of differences within periods of recession versus growth, these results were emphasized by previous comparable research, illustrating that oil and gas price changes indicated the highest correlation with the stock price changes compared to the other market risk factors (Boyer & Filion, 2007; Sadorsky, 2001). Based on the results from the quantitative analysis and the supplementary results from the qualitative analysis, we have decided to accept the hypothesis of the stock price being more influenced by market risk factors in periods of recession than in periods of growth.

The final hypothesis presented in this thesis stated that "increased number of financial risk factors included in a model for pricing risk, gives a more accurate predicted historical stock return". The final hypothesis was explored by measuring the financial exposure through single and multifactor models required to predict historical stock return based on financial risk factors.

The quantitative analysis and results denoted the APT model as the most accurate model to predict historical expected stock return as this model indicates the lowest mean, variance and standard deviation illustrating the least difference between the realized and predicted stock return. The APT model incorporated interest rate, market index, oil price, gas price and exchange rate as the systematic risk factors.

Considering the yearly analysis, increased number of financial risk factors did not necessarily give a more accurate predicted stock return. Analysis on a yearly basis would however forego valuable information regarding financial risk exposure due to changes during a specific year. Based on this reasoning we have therefore chosen to present a conclusion on the hypothesis stated on a monthly basis. Despite of the APT multifactor model only considering one part of the equity risk; the systematic risk, increased number of financial risk factors included in a model for pricing risk, gave a more accurate prediction of historical stock return.

Based on the overall conclusions on the predictions and hypothesis stated we will briefly summarize the results obtained in this thesis. To begin with, the overall results indicated that periods of recession increased the overall stock price volatility but did not necessarily imply changed investment behavior. Further, periods of recession denoted a higher influence on the stock price than periods of growth for the respective business cycles studied in this thesis. Finally, based on the monthly analysis, increased number of financial risk factors explaining the financial risk exposure by considering changes in a company's stock price gave a more accurate prediction of historical stock return compared to other models selected.

10.1 Further research

The main contribution to previous research and literature was to evaluate the extent and influence from financial risk factors, both systematic and unsystematic, for a company's stock price and investment behavior in periods of recession versus periods of growth. We have applied several models trying to measure a company's financial risk exposure required to predict the historical stock return based on one or several included systematic and unsystematic risk factors. These models could therefore have contributed to former research by including market, company and industry specific risk factors when explaining former stock price changes.

Financial risk is a comprehensive and multidimensional topic, but is also very interesting and informative. Through this thesis we have had the opportunity to explore some of the dimensions within financial risk, but there are still multiple areas not yet explored or developed. The possibilities for further research are therefore numerous. We have the opinion that financial risk and the influence on the energy industry could have a significant importance for the energy companies in the future, as managing financial risk will secure future growth and profitability.

Hopefully, this thesis would have contributed with valuable information for the energy industry, and also for investors and analysts who would like to evaluate and measure financial risk exposure.

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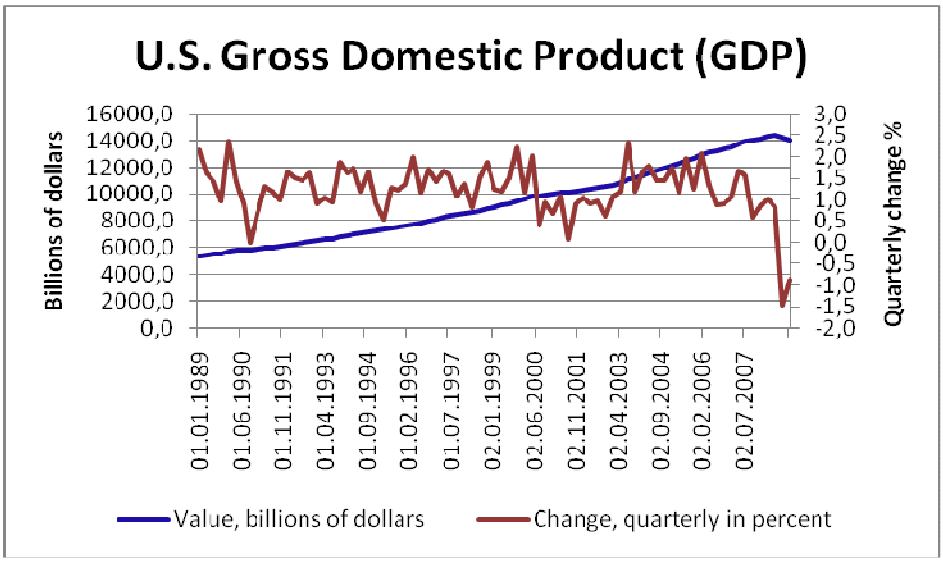
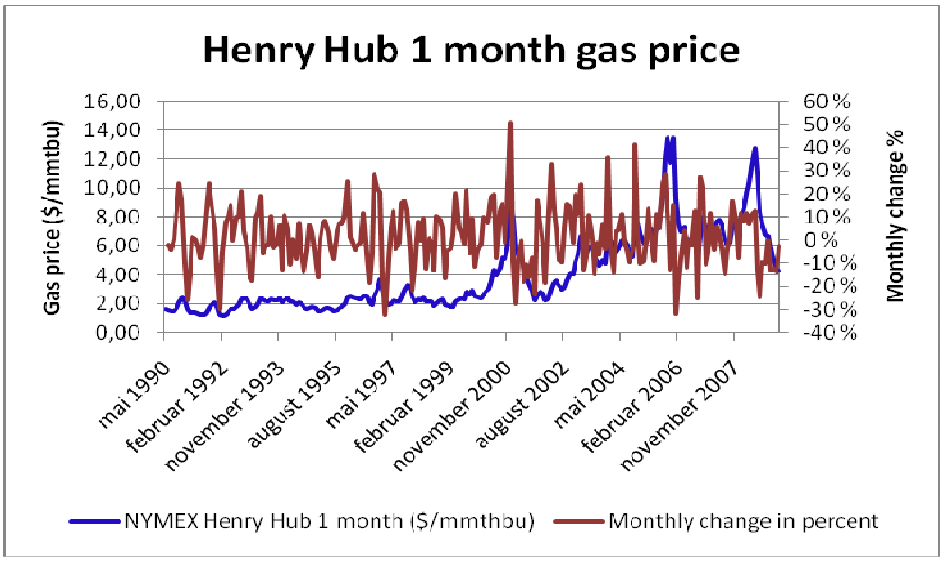
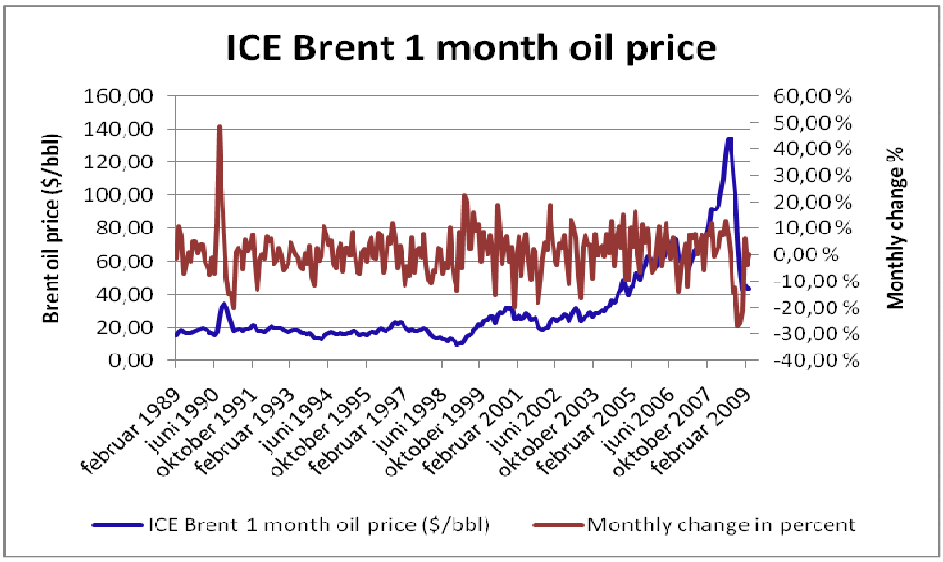
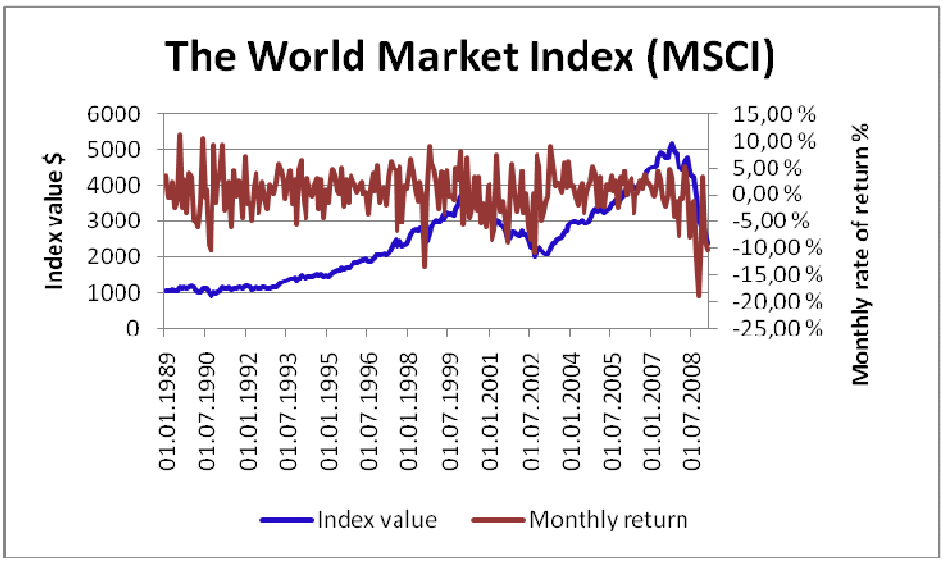
Appendix A – World market trends

Market Trends

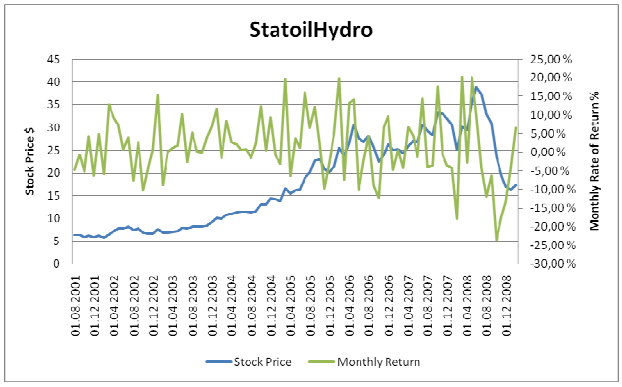


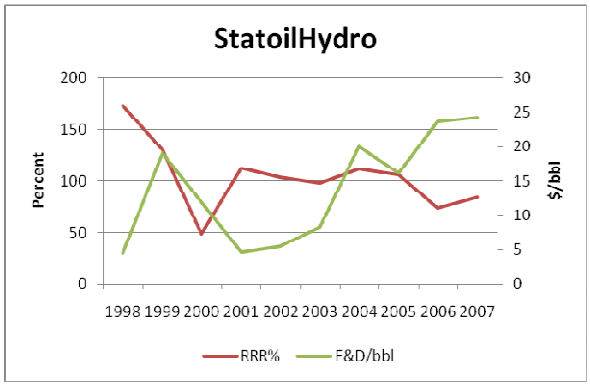


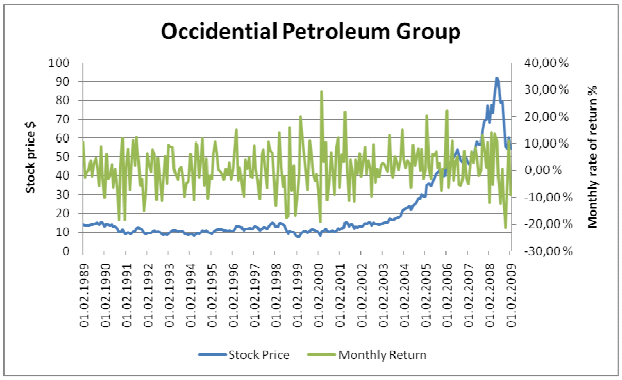

ICE Brent 1 month oil price
Brent oil price ($/bbl)
Monthly change %
160,00
140,00
120,00
100,00
80,00
60,00
40,00
20,00
0,00
60,00 %
50,00 %
40,00 %
30,00 %
20,00 %
10,00 %
0,00 %
-10,00 %
-20,00 %
-30,00 %
-40,00 %
februar 1989
juni 1990
oktober 1991
februar 1993
juni 1994
oktober 1995
februar 1997
juni 1998
oktober 1999
februar 2001
juni 2002
oktober 2003
februar 2005
juni 2006
oktober 2007
februar 2009
ICE Brent 1 month oil price ($/bbl)
Monthly change in percent

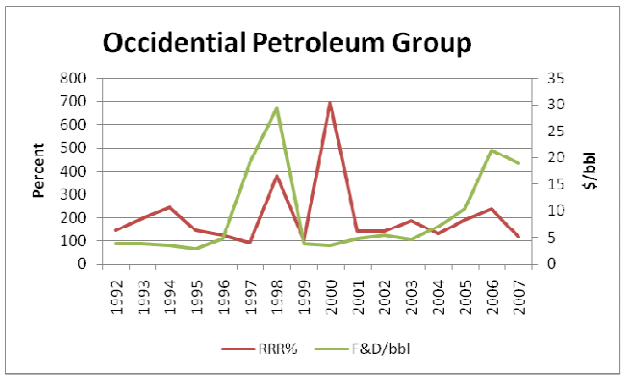

The World Market Index (MSCI)
Index value $
Monthly rate of return %
6000
5000
4000
3000
2000
1000
0
15,00 %
10,00 %
5,00 %
0,00 %
-5,00 %
-10,00 %
-15,00 %
-20,00 %
-25,00 %
01.01.1989
01.07.1990
01.01.1992
01.07.1993
01.01.1995
01.07.1996
01.01.1998
01.07.1999
01.01.2001
01.07.2002
01.01.2004
01.07.2005
01.01.2007
01.07.2008
Index value
Monthly return

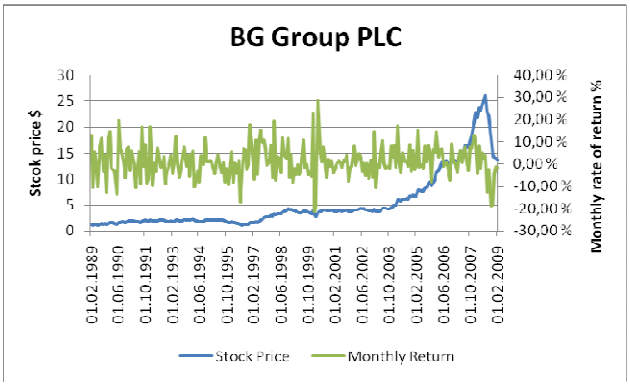
Company trends

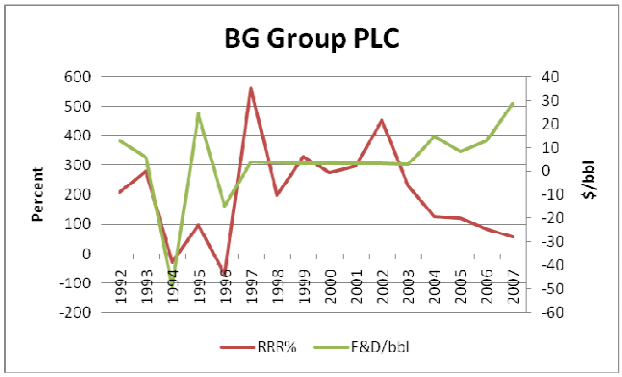


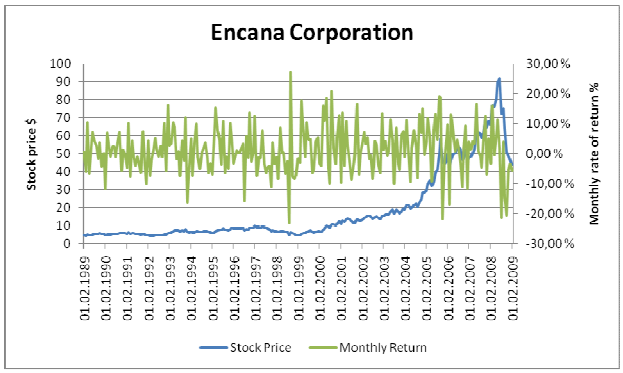


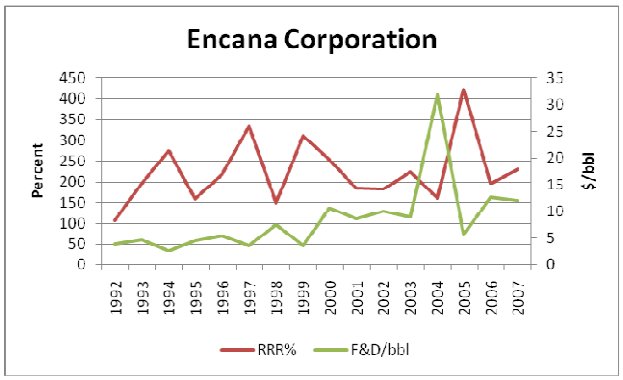


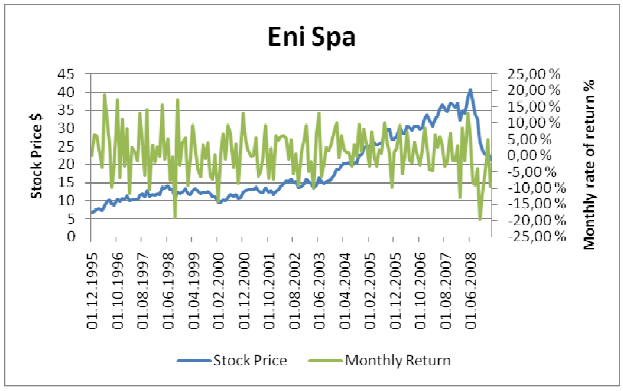


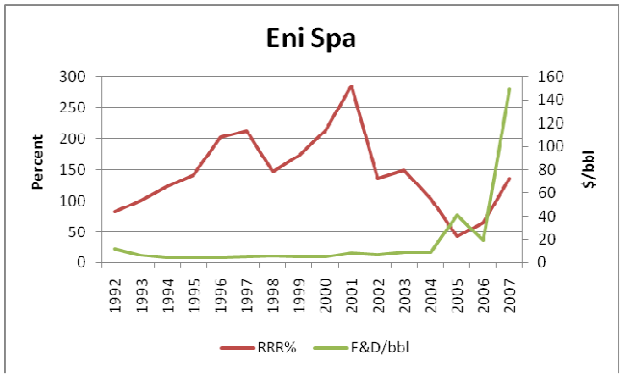


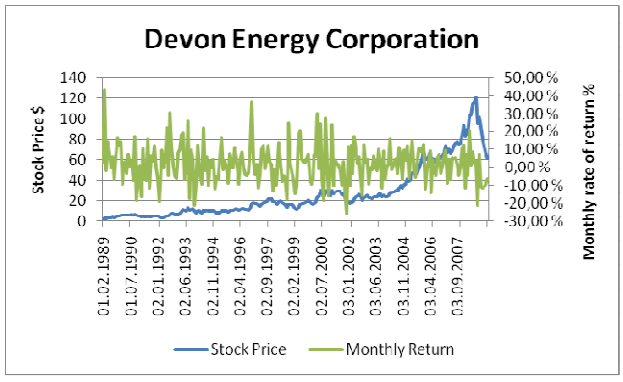


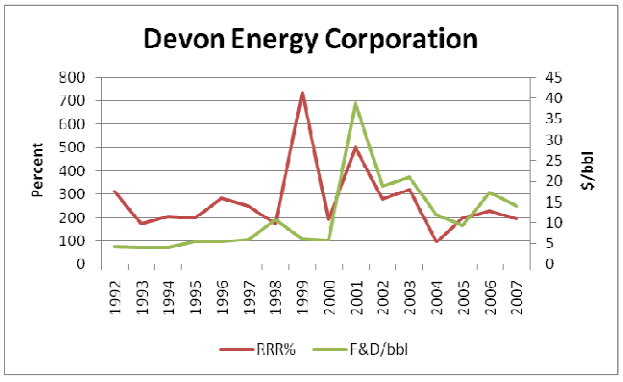

Encana Corporation
Stock price $
Monthly rate of return %
Stock Price
Monthly Return

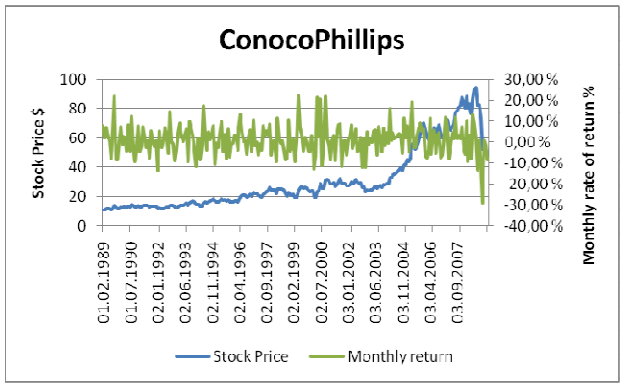

Encana Corporation
Percent
$/bbl
RRR%
F&D/bbl

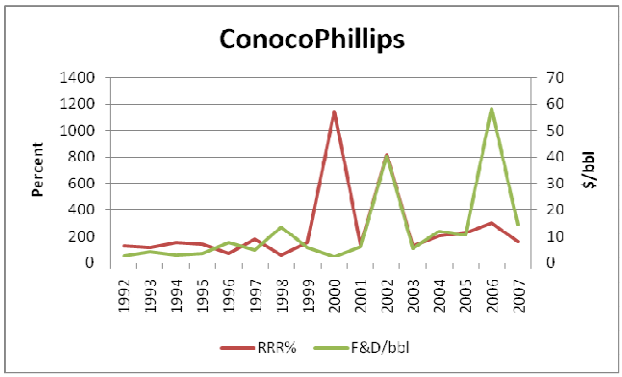

Eni Spa
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

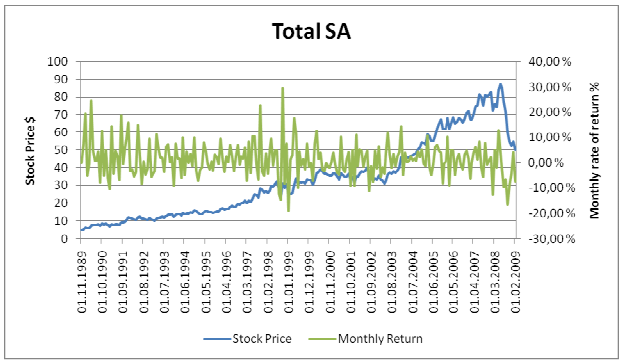

Eni Spa
Percent
$/bbl
RRR%
F&D/bbl

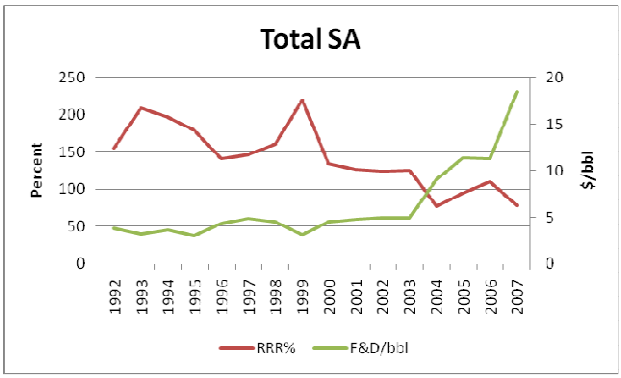

Devon Energy Corporation
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

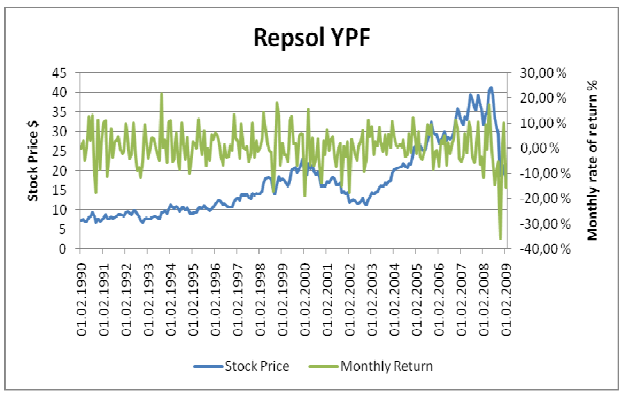

Devon Energy Corporation
Percent
$/bbl
RRR%
F&D/bbl

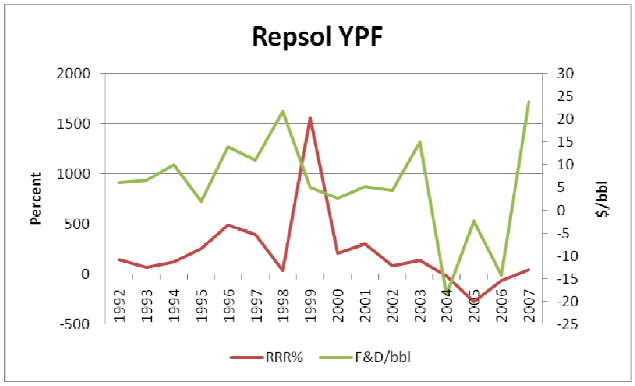

ConocoPhillips
Stock Price $
Monthly rate of return %
Stock Price
Monthly return

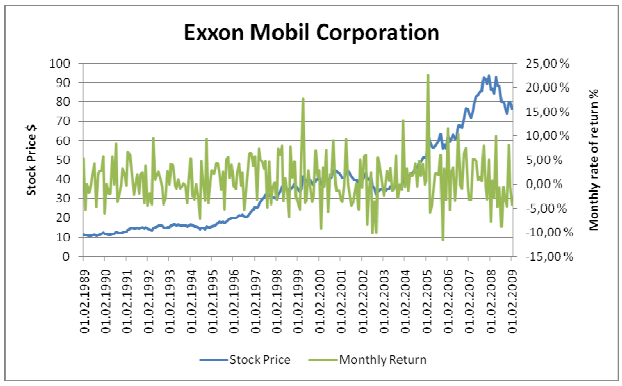

ConocoPhillips
Percent
$/bbl
RRR%
F&D/bbl

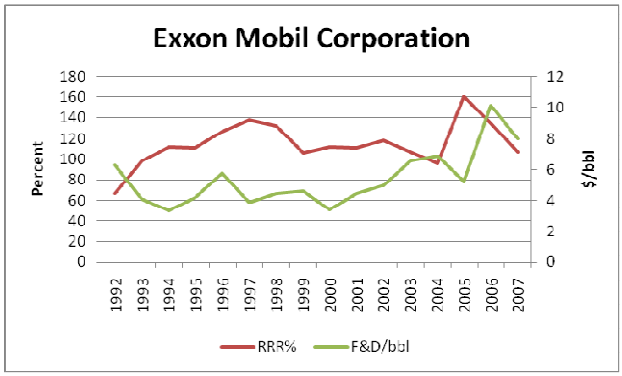

Total SA
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

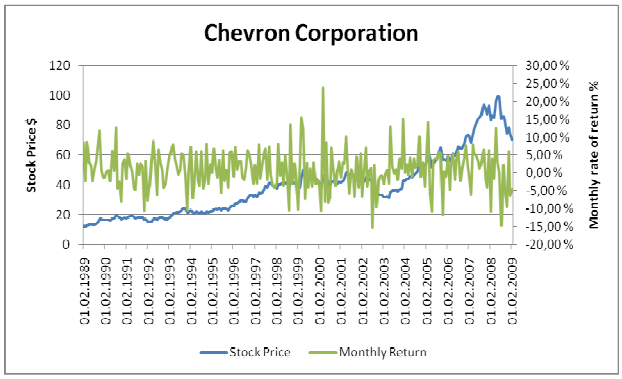

Total SA
Percent
$/bbl
RRR%
F&D/bbl

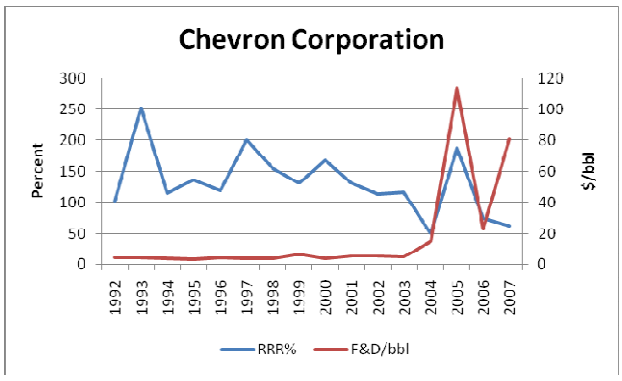

Repsol YPF
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

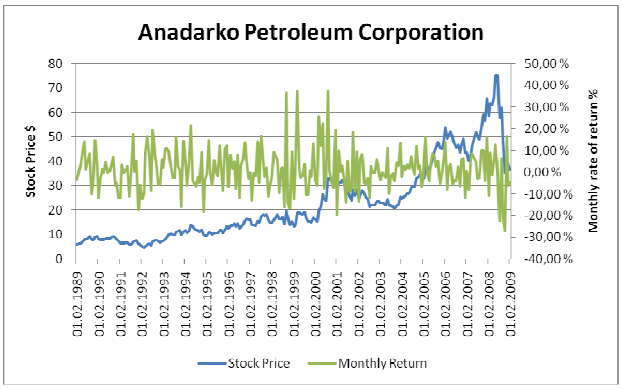

Repsol YPF
Percent
$/bbl
RRR%
F&D/bbl

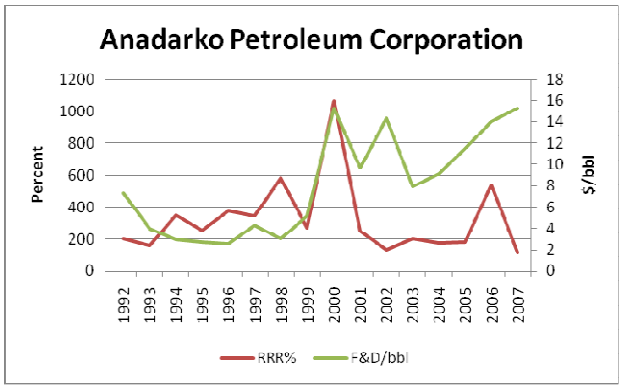

Exxon Mobil Corporation
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

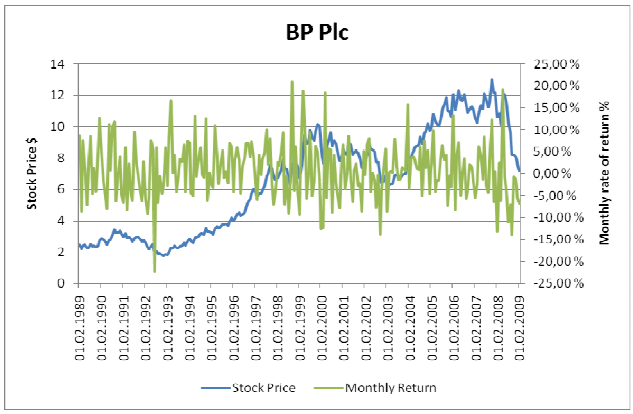

Exxon Mobil Corporation
Percent
$/bbl
RRR%
F&D/bbl

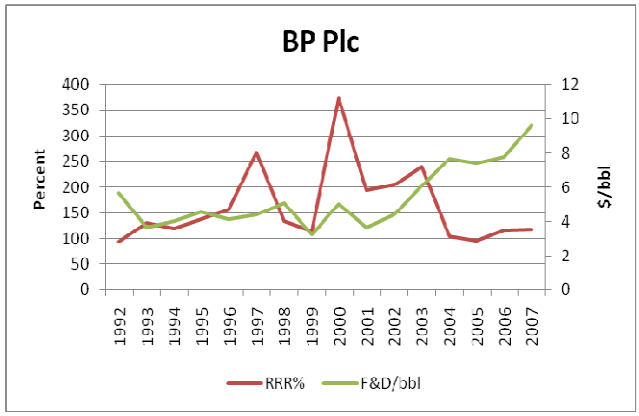

Chevron Corporation
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

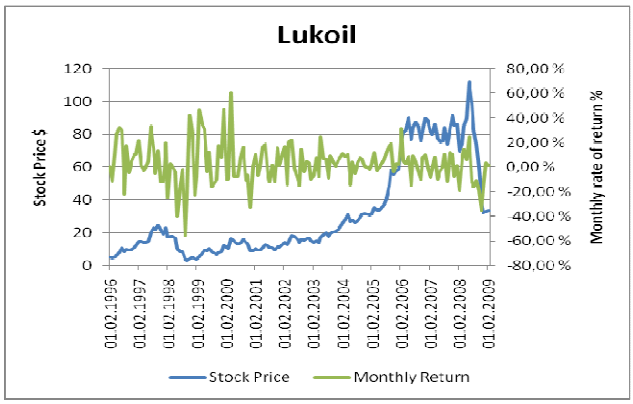

Chevron Corporation
Percent
$/bbl
RRR%
F&D/bbl

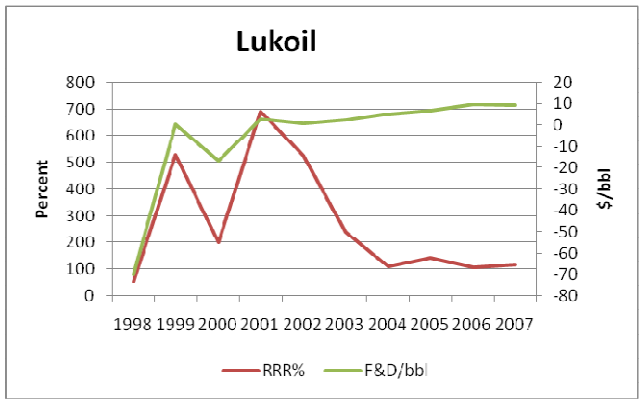

Anadarko Petroleum Corporation
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

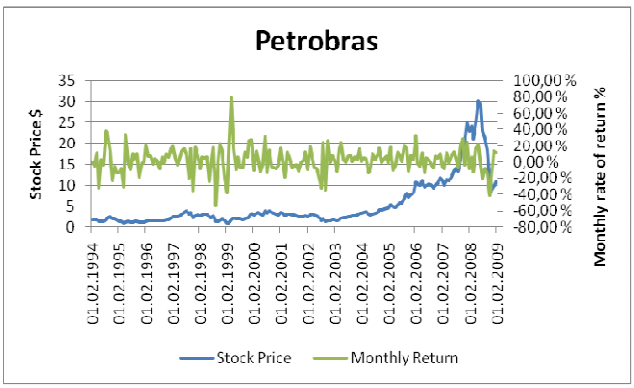

Anadarko Petroleum Corporation
Percent
$/bbl
RRR%
F&D/bbl

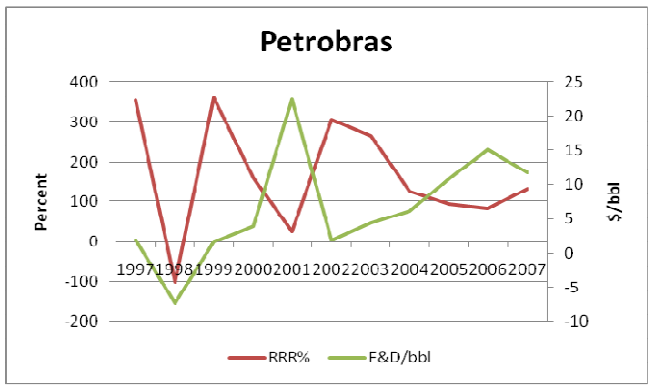

BP Plc
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return

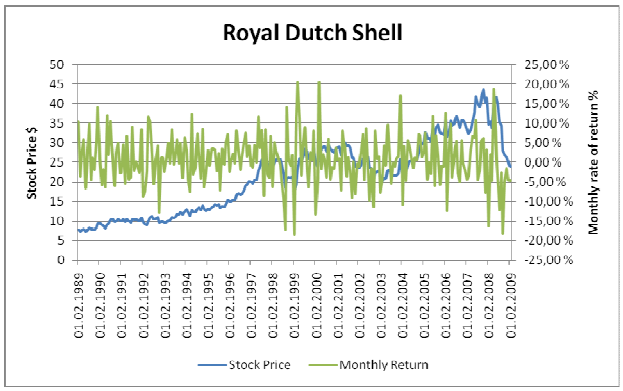

BP Plc
Percent
$/bbl
RRR%
F&D/bbl

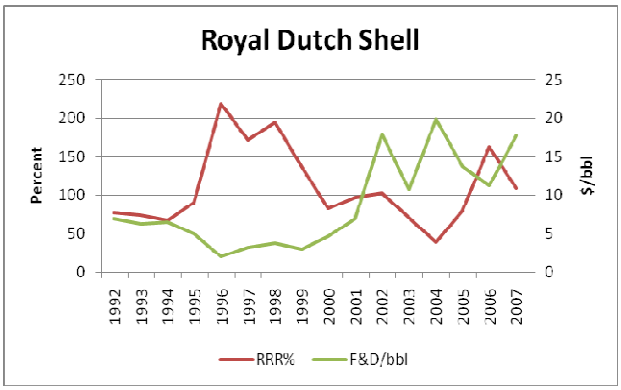

Lukoil
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return


Lukoil
Percent
$/bbl
RRR%
F&D/bbl


Petrobras
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return


Petrobras
Percent
$/bbl
RRR%
F&D/bbl


Royal Dutch Shell
Stock Price $
Monthly rate of return %
Stock Price
Monthly Return


Royal Dutch Shell
Percent
$/bbl
RRR%
F&D/bbl

Appendix B – Questionnaire

1. In your opinion, which market risk factors has the highest degree of influence on the strategic planning for a company? (Market risk; the risk indicating the possibility for a decline in investments caused by changes in one or several market risk factors)

2. What macro variable is the most important for changes within stock prices? (Macro, how the economy changes as a whole)

3. Please range the following macro and micro variables from one to four on their importance for changes in the stock price. 1 indicating high importance and 4 indicating less importance.

	Ranking			
a. Interest rate	1	2	3	4
b. Exchange rate	1	2	3	4
c. Oil price	1	2	3	4
d. Gas price	1	2	3	4
e. Finding and development costs	1	2	3	4
f. Reserves replacement rate	1	2	3	4

4. In your opinion, is systematic (market specific) or unsystematic (company specific) risk most important for the return on stock price?

5. In your opinion, when are companies considered as the most volatile, in periods of recession or in periods of growth?

6. In your opinion, what is the optimal oil price and why?

7. How can energy companies reduce risk exposure in periods of recession versus periods of growth?

8. What expectations do you have for changes in the finding and development costs and reserves replacement rate in periods of growth versus periods of recession?

9. Would you change investments in periods of growth compared to periods of recession?

10. What experience should oil and gas companies gain following the ongoing “financial crisis”?