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The influence of macroeconomic variables on stock performance

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Abstract

This study investigates the influence of four macroeconomic variables: crude oil, interest rate, exchange rate and gold, on stock returns of ten U.S. industries. The study uses monthly data from January 1997 to September 2014 and the ordinary least squares approach. The observation period is divided into a pre-crisis and post-crisis period; the period as a whole is also analysed.

The findings of this paper demonstrate that the impact of some macroeconomic variables differs between industries, whereas other macroeconomic variables have a homogenous impact. The negative impact of crude oil on stock returns is confirmed for four industries, namely consumer goods, consumer services, financials and healthcare. Due to their nature, the oil and gas sector and the industrials sector are positively influenced by increases in crude oil returns. Not only industries which are oil sensitive, also industries which do not use oil at all are influenced by movements in the crude oil returns. There is no evidence found in this study which suggests that the interest rate affect stock returns. The rise of enhanced tools for managing interest rate risk could be an explanation for this. The third variable, the exchange rate, has a heterogeneous effect on the industries that depend on imports or exports of goods. The technology, consumer goods, consumer services and telecommunication sectors exhibit an increase in stock returns when the domestic currency depreciates. The other industries all present insignificant results for the exchange rate variable. During the pre-crisis period, no relation between gold and stock performance was found for any industry. During the post-crisis period, significantly negative results were found for the consumer services, financials and industrials sectors, which could be a result of a substitution effect from shares to gold.

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Macroeconomics has attracted my particular interest since the start of my study at the University of Twente. After completing my master courses I realized that my knowledge in this area is still too limited and decided to strive for a deeper understanding of some macroeconomic variables. This master thesis has given me a great opportunity to explore this area. Working on a subject which I was not familiar with was a challenging and overwhelming experience, which would not have been possible without the support and guidance of several people. I would like to give special thanks to these individuals, without whom I may not have gotten to where I am today, at least not whilst retaining my sanity.

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1. Introduction

The stock market is an important area of economics and finance. Efforts to predict its performance have attracted significant attention of financial analysts and represent a popular area of financial research. In essence, the price of a stock is determined by supply and demand (Al-Shubiri, 2010). The supply of stock is created by the number of shares a firm issues, the demand is based on people who want to buy shares from shareholders who already own them. In this context, buyers and sellers weigh information about the firm, industry information, the general environment and their own investment goals (Palepu, Healy and Peek, 2008; NYSE, 2006).

When deciding to buy or sell a stock the financial health of the firm is considered first. Strategy analysis, ratio analysis with key profitability ratios and cash flow analysis to examine the company's liquidity are important tools to assess the financial health of the company (Palepu et al., 2008). The firm's past, present and future performance are considered. The health of the entire industry is another important factor when evaluating the firm (Palepu et al., 2008). In a declining industry investors might question the ability of the firm to keep growing, even when it is doing well financially. In addition to the specific firm or industry, investors may carefully follow general trends that signal fluctuations in the general economic and political environment. These signs can indicate whether the economy is healthy or not (NYSE, 2006). The performance of the economic environment is measured through macroeconomic variables. There is much literature which examines the relationship between these variables and stock performance over a range of different time horizons (e.g. Asprem, 1989; Abugri, 2006; Mollick and Assefa, 2013). This study focuses on the relationship between macroeconomic variables and stock performance in the spirit of these earlier studies.

1.1 Background

The theoretical underpinning of the relationship between macroeconomic variables and stock performance is explained by models such as the capital asset pricing model developed by Sharpe (1964) and Lintner (1965) and the arbitrage pricing theory developed by Ross (1976). These models clarify how fluctuations in the macro economy can influence stock performance. Investors hold risky assets only if the expected return compensates its risk (Hiller, Ross, Westerfield, Jaffe and Jordan, 2010). According to Sharpe (1964) it is possible to escape from all risk, except the risk resulting from changes in economic activity. This risk remains even in the most efficient portfolios and cannot be avoided by diversification. Chen, Roll and Ross (1986) add to this statement that the biggest part of stock returns is from unexpected events from the general economic environment. To elucidate, these models clarify how any new information about macroeconomic factors will influence stock performance through its effect on the expected future dividends, discount rate, or both.

Chen et al. (1986) continued to use the APT framework and provide evidence that macroeconomic variables are significantly influencing stock returns by using the arbitrage pricing theory. They argue that five macroeconomic variables significantly influence stock performance. Industrial production, changes in default risk premium and changes in the yield curve between long and short term interest rates are considered to be highly significant. The unanticipated inflation and changes in expected inflation are also significant, but have a smaller statistical significance when explaining stock returns.

1.2 Research question

Knowing how the market will behave as a response to macroeconomic changes is essential for those who are looking for returns on their investments and policy makers. Frequently, research in this area has found statistical proof to support the theory that macroeconomic factors affect the stock market, however there are also studies that found no causal relationship between some of the variables (Nasseh and Strauss, 2000; Tangjitprom, 2012). A common feature of these studies is that they focus on the whole market and examine the aggregate market of countries (Rapach, Wohar and Rangvid, 2005; Pierdzioch, Döpke and Hartmann, 2008). They assume that the firms are homogenous. This current paper takes a different approach to this subject and will make a distinction, because it is assumed that different sectors have different market structures and macroeconomic factors will affect stock returns in various sectors differently (Narayan and Sharma, 2011; Bartram, 2007). The purpose of this research is to analyse macroeconomic factors that drive stock performance and to examine the variables that have the largest explanatory power in each industry. To address this issue, the following research question is formulated:

What is the influence of macroeconomic variables on the stock performance of various industries?

To give an answer to the research question four macroeconomic variables have been selected, namely crude oil, interest rate, exchange rate and gold. These macroeconomic factors can be considered as important determinants of stock performance, since each of them features prominently in the stock market. Furthermore, these four macroeconomic variables have been investigated in numerous prior studies (Driesprong, Jacobsen and Maat, 2008; Alam and Uddin, 2009; Sharma and Mahendru, 2010; Ratner and Klein, 2008).

1.3 Contribution

Various studies focus on the influences of macroeconomic variables on stock performance. As mentioned before, a common characteristic of these studies is that they focus on the whole market. Although this study is not unique in its assessment of several industries within the market, it tries to provide a deeper understanding into the way macroeconomic variables influence stock performance of various industries by using recent data. Empirical studies on this linkage have been using data till the recent financial crisis, however, few studies were done after this crisis. Moreover, the capital asset pricing model and arbitrage pricing theory support insight into the macroeconomic variables as valuable for both investors and policy makers. An accurate understanding of the macroeconomic determinants can benefit investors to proactively control risk in the face of macroeconomic fluctuations. With this in mind, investors could adjust their portfolios to mitigate risk as a consequence of the possible influences the macro economy can have on industries' equity. An understanding of the linkage between macroeconomic variables and the stock market is also useful for policy makers, given that this linkage is a useful contribution in developing policies in order to support economic growth.

1.4 Outline

This study is organized as follows. Chapter two presents the literature review concerning the linkage between macroeconomic variables and stock performance. This chapter first presents two asset pricing theories and thereafter documents the relation between each of the four macroeconomic variables and stock performance. Chapter three describes the hypotheses that will be tested. Chapter four presents the methodology and introduces the data that will be used. The results of this research will be presented in chapter five. The discussion and conclusion are provided in chapter six and seven respectively.

2. Literature review

In this chapter the theories and empirical studies concerning the relationship between macroeconomic variables and stock performance will presented. First, the concept risk and two asset pricing theories will be explained. Thereafter, four macroeconomic variables will be analysed. Each of the four macroeconomic variables will first start with a theoretical linkage investigation followed by a discussion of the empirical evidence.

2.1 Asset pricing theories

The stock market is affected by a wide variety of expected and unexpected events. Some of these events have a more pervasive effect than others (Chen et al., 1986). The link between the stock market, and macroeconomic variables and financial variables plays a crucial role. Asset pricing theories describe this relation between the risk and expected return that is used in the pricing of assets. There are various models based on economic theory that provide a framework for this linkage. The one-factor capital asset pricing model of Sharpe (1964) and Lintner (1965) and the multi-factor arbitrage pricing theory developed by Ross (1976) are two of them. This paragraph will explain these two models, but before doing this, the concept of risk will be explained.

2.1.1 Risk

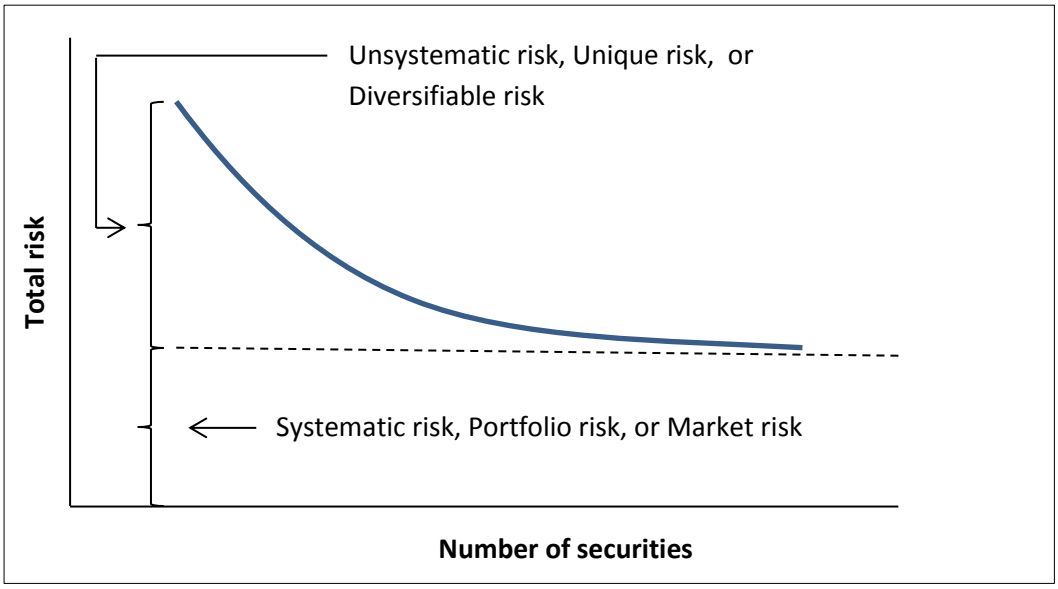
The expected return on an asset is positively linked to its risk, because investors hold risky assets only if the expected return is compensating its risk (Hillier et al., 2010). The expected return on any equity traded in financial markets varies. Some of the determinants are the country in which the firm is located or the industry in which the firm operates. To see why returns vary so much, and to understand the asset pricing models, it is important to see how and which components of the asset pricing formulas are influenced by outside factors such as macroeconomic variables. In this context, a deeper understanding of risk is needed.

According to Hillier et al. (2010), the return on a stock consists of two parts, the expected return and the unexpected or risky return. The expected return is the portion of the return that investors predict and consists of all the information that the investors have about the company; it is the known part. The second part is the unexpected or risky return and is the part of information that is influenced by surprises within the coming period. Since the investors have already accounted for the expected part, the uncertain portion of the return is the true risk for shareholders (Hillier et al. 2010).

The part resulting from surprises is the true risk of any return. There are several sources of risk which can be divided into two types, systematic risk and unsystematic risk. The systematic risk is any risk that influences a large number of assets, while the unsystematic risk is a risk that specifically influences a single or a small group of assets (Hillier et al. 2010). Systematic risk is about the general economic situation. Macroeconomic factors such as interest rates and exchange rates are examples of systematic risk; these factors influence all companies to some degree. In contrast, a management change or a product recall only affect one company or a few companies, and are examples of unsystematic risk.

Systematic risk is risk that still appears after full diversification in the portfolio. Systematic risk is also called portfolio risk or market risk. Unsystematic risk is risk that is effectively diversified away in large portfolios. Unsystematic risk is also called unique risk and diversifiable risk. This is illustrated in figure 1.

Figure 1
Diversification and portfolio risk



This figure presents the unsystematic and systematic risk in equally weighted portfolios (Hillier et al., 2010, p.274).

It is worth mentioning that this graph does not imply that portfolios do not have unsystematic risk. Shares have unsystematic risk, and unsystematic risk will influence returns. Diversifiable risk in this case means that investors can ignore the unsystematic risk when adding shares to their portfolio, because the unsystematic risks offset each other and therefore only the systematic risk will be linked to its expected return. It can be seen that diversification eliminates some, but not all, of the risk (Hillier et al., 2010). Investors will care only about the part that cannot be diversified away. Therefore, the expected return on equity is positively related to its systematic risk.

With a deeper knowledge of some risk concepts, the next paragraphs will introduce the capital asset pricing model and the arbitrage pricing theory.

2.1.2 Capital asset pricing model

The Capital Asset Pricing Model (hereafter CAPM) was developed in the 1960s by Sharpe (1964) and Lintner (1965) and builds on the theory of portfolio choice introduced by Markowitz (1952). The CAPM is one of the first asset pricing theories and is a traditional approach to calculate stock returns. Sharpe (1964) argued in his frequently cited article that diversification enables shareholders to escape from all risk, except the risk resulting from fluctuations in general economic activity. Each individual stock adds an amount of risk, which is the systematic risk, and depends on the response to the economic and political environment. As seen before, systematic risk remains even in the most efficient portfolios and cannot be avoided by diversification. Since the unsystematic risk can be diversified away, the CAPM only measures the response to the degree of economic activity when assessing the risk of an asset's rate of return.

2.1.2.1 Assumptions of the CAPM

Since the CAPM is often criticized due to the unrealistic assumptions, it is important to first mention these assumptions before going further. The CAPM has many assumptions, but the assumptions underlying CAPM can be combined into the following three sets (Bailey, 2005, p.144): (1) Asset markets are in equilibrium. Some of the characteristics of market equilibrium are no transaction

costs and institutional restrictions, stock is selling at the equilibrium price, the investors are price takers, all assets are divisible into units and the taxes are neutral for all investors; (2) Investors have a mean-variance criterion behaviour and are all risk averse. That is, they use the Markowitz (1952) portfolio selection approach, which is the market portfolio. And the investors focus on a value at a specific time in the future and ignore everything after the one-period investment horizon; and (3) The investors base their decisions on homogeneous probability distributions, they have the same views and forecasts in analysing securities (Bailey, 2005; Perold, 2004).

However, it is not possible to satisfy some of these assumptions. Some of the problematic assumptions are that transaction costs do exist and the market portfolio is unobservable. The Markowitz portfolio selection approach is not real, since all risky assets need to be included and investors have different preferences. Despite these unrealistic assumptions, CAPM is still frequently used and often the only asset pricing model taught in finance courses (Fama and French, 2004).

2.1.2.2 Capital Asset Pricing Model equation

The CAPM exhibits the linear linkage between systematic risk and return and indicates that it is not possible to increase returns without increasing risk. The CAPM can be represented as a function of the risk free rate and the beta of the asset and results in the following equation (Hillier et al., 2010, p.282):

$R_i = R_f + \beta_i * (R_m - R_f)$

Where:

R_i = Expected return on security i

R_f = Risk-free rate

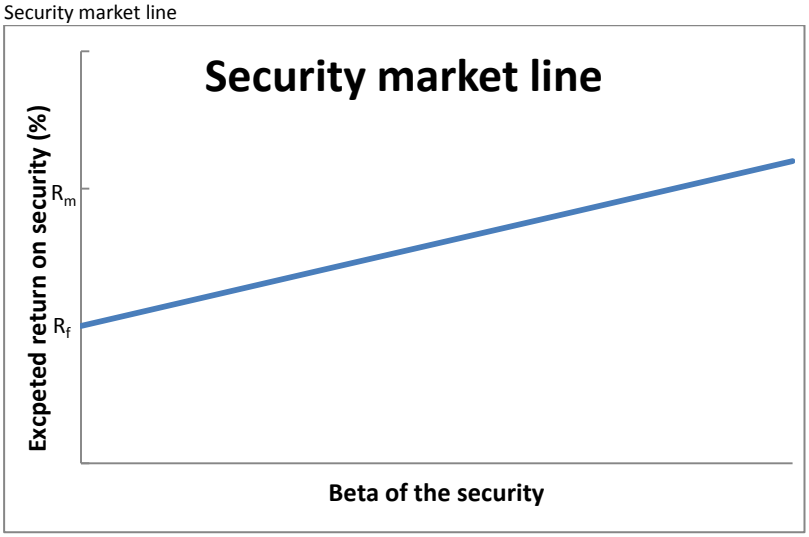
β_i = Beta of security i

R_m = Expected return on the market

The risk-free rate is defined as an asset from which the shareholder knows the expected return with certainty. Usually government bonds or notes are used for this purpose (Hillier et al., 2010). The expected return on the market is the return for the whole market, a broad index such as a country or industry index is often used as a proxy (Hillier et al., 2010). β represents the systematic risk. Assets that are riskier than the market, i.e. riskier than average, will have betas higher than 1 and implies that the asset is more sensitive to economic variables than the market. Assets that are less risky than average will have security betas lower than 1. Assets with no risk will have a security beta of 0 and are uncorrelated with the market (Hillier et al., 2010).

The difference between the expected return on the market and risk-free rate is likely positive, since over long periods the average return on the market is higher than the average risk-free rate (Hillier et al., 2010). The relation between the expected return and its systematic risk can be represented graphically and is called the security market line. The security market line is the graph of CAPM and provides a benchmark for assessing the investment performance. It provides the expected rate of return that is needed to compensate the investors for risk. The security market line is illustrated in figure 2.

Figure 2
Security market line



This figure presents the linkage between the expected return and the beta of the security (Hillier et al., 2010, p.283).

Given the aforementioned assumptions of the CAPM, in the security market line the returns are in proportion with their risk in market equilibrium. All stock need to lie on the security market line, any security below or above the security market line is mispriced.

2.1.3 Arbitrage pricing theory

The Arbitrage Pricing Theory (hereafter APT) was introduced in 1976 by Ross and also assumes a positive relationship between risk and expected return. This model is an expansion of the CAPM and describes returns as a linear function of several rather than of one variable. Some of these variables are macroeconomic factors and others are market indices. In the CAPM, beta is the only factor which compares the equity with the whole market, while the APT uses multiple variables and is a multi-beta model. The sensitivity of movements in each variable is represented with a beta coefficient which is factor specific, and indicates the unique sensitivity of each particular variable. The APT also distinguishes between systematic risk and unsystematic risk, but advocates, as is also the case for CAPM, that large portfolios are mainly affected by systematic risk since the unique risk is cancelled out through diversification.

2.1.3.1 Assumptions of the APT

The law of one price is the starting point in the APT. It implies that similar securities must have the same price, regardless of how the security is bundled or packaged. The APT assumes that arbitrage profit opportunities are eliminated. The idea behind this is that the forces of supply and demand drive the prices to the same point. It is argued that the return on a stock can be broken down into an expected return part and unexpected return part. The APT predicts that the biggest part of the returns is from unexpected events which are linked to the general economic environment.

Predicting the security market line in the APT is very similar to the CAPM. The APT only takes a different approach to reach the security market line. The APT has three underlying assumptions, which are fewer than those of the CAPM (Ross, 1976). First, in the APT the security returns are derived from a factor model in which a linear linkage exists between the returns and factors. Second, there are sufficient securities to diversify away idiosyncratic risk. Third, given the market equilibrium, well-developed and functioning security markets do not allow for arbitrage opportunities and

arbitrage opportunities do not exist. These three assumptions are in accordance with the aforementioned law of one price.

2.1.3.2 Arbitrage pricing theory equation

The APT assumes that the return on a stock is linearly linked to a set of various macroeconomic variables and/or market indices, in which the beta represents the sensitivity for each factor. The APT can be presented in equation as follows (Hillier et al., 2010, p.311):

$R_i = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_x X_x + \varepsilon$

Where:

R_i = Expected return on security i

β = The response to a systematic risk

X = Systematic risk

ε = Unsystematic risk

The beta coefficient represents the reaction of the return of equity to a systematic risk. As seen in the previous paragraph about the CAPM, the beta in the CAPM captures the response of the return of equity to a specific risk factor, the return on the market portfolio. In the APT the beta shows the responsiveness to a chosen macroeconomic factor. ε is the random error term and associated with unsystematic risk.

The APT does not offer guidance or rules to select the variables, the variables in the APT are not clearly defined and are open. The variables and their number can be chosen freely. Both macroeconomic variables and market indices can be used. The choice of variables is usually done with respect to the relevance of what is being tested, whereby the variables which are most likely to influence the returns are chosen (Bailey, 2005). Due to the openness of the model, the APT is an explanatory rather than an empirical model.

2.1.4 CAPM versus APT

The previous paragraphs explored two theoretical models that have been developed to ascertain stock prices and hence returns. A deeper understanding of risk is given, and following this, the CAPM and the APT are explained. Both models have some weaknesses and strengths.

The major weaknesses of the CAPM are the unrealistic assumptions and the use of only one beta. This results in poor explanatory power, as well as an underestimation or overestimation of stock returns (Groenewold and Fraser, 1997). These weaknesses have led to inconsistent empirical results, as mentioned by Fama and French (2004) and Perold (2004). Due to the strict and unrealistic assumptions, the CAPM as an early asset pricing model was questioned and led to the development of the APT. Yet, despite these shortcomings, the CAPM received 2-3 times more attention in financial research and textbooks compared to the APT (Groenewold and Fraser, 1997).

The APT views risk in a more general way than only the beta of a security in a market portfolio. A reason why the APT is preferred over the CAPM is the ability of APT to use multiple sources of risk. The APT does not specify the systematic risk factors. However, this has both advantages and

disadvantages. This could be an advantage, as researchers are free to choose each systematic risk factor they want and this consequently provides motivation for researchers to detect particular factors for specific situations (Groenewold and Fraser, 1997). This could also be a disadvantage, as the APT does not state a theoretical foundation for the risk factors, nor the number of risk factors to include (Dhrymes, Friend and Gültekin, 1984). As a result, researchers may define different risk factors. Moreover, even when they do select the most frequently used risk factors, the degree of responsiveness to each of the risk factors could vary and could cause comparison problems (Dhrymes et al., 1984). Dhrymes et al. (1984) and Rasiah and Kim (2011) also point out that the APT is sensitive to the number of factors included in the model.

As can be seen, both models have some weaknesses and drawbacks. However, from a theoretical point of view, the CAPM and APT present a theoretical foundation on which stock market fluctuations may be attributed to changes in the macro economy. The next paragraphs will investigate the macroeconomic variables.

2.2 Macroeconomic variables and stock performance

Tangjitprom (2012) mentions that macroeconomic variables used in empirical research can be classified into four groups: variables concerning general economic conditions, variables involving the interest rate and monetary policy, variables reflecting price levels and variables related to international activities. There are a lot of variables which can be categorised within this classification, some of them are presented in table 1.

Table 1
Classification macroeconomic variables

General economic conditions	Interest rate and monetary policy	Price levels	International activities
Industrial production	Interest rate	Consumer price index	Exchange rate
Gross domestic savings	Term spread	Price of key assets: crude oil	Foreign direct investment
Consumption	Default spread	Price of key assets: gold	Foreign exchange reserves
Employment level	Money supply		

This table presents the classification for some macroeconomic variables into four groups according to Tangjitprom (2012).

Among the variables, crude oil, interest rate, exchange rate and gold are used. As mentioned before in the introduction section, these four macroeconomic have been investigated in prior studies and can be considered as important determinants of stock performance. Therefore, this study focuses on these four macroeconomic variables and next paragraphs will give a deeper understanding of these variables in relation with the stock performance.

2.2.1 Crude oil

On July 11th 2008, the crude oil price reached its highest price ever (Hamilton, 2009; Worldbank, 2014a). In the second half of 2008 there was a sharply decrease in oil prices. The increasing OPEC supply, political issues between Iran and the United States and the financial crisis exacerbated this decrease (Hamilton, 2009). Other determinants of the oil prices are the structure of the oil market and speculation (Fattouh, 2007). In May 2010 prices fell more than 10 Dollar per barrel in less than a fortnight (OPEC, 2014; Worldbank, 2014a). The prices have recovered since then and are currently

hovering around 100 Dollar per barrel for the main crude oil benchmarks (OPEC, 2014; Worldbank, 2014a).

One might ask what consequences such events would have for the stock markets. The linkage between oil prices and financial performance has been investigated by researchers. This relation traces its origins back to the work of the frequently cited study in this field, Hamilton (1983). He analyses the relation between oil prices and economic output and advocates that all recessions since World War II can be explained, at least to some extent, by a sharp increase in the oil price. It is clearheaded to draw the same conclusions about the relationship between oil prices and stock markets. If an increase in oil prices influences economic output negatively, this results in diminished expected earnings and should influence stock performance. Nevertheless, there is no common agreement about this linkage and the previous studies are limited and have not included data from recent years. Therefore, this relation need to be further investigated.

The aim of this paragraph is to analyse the linkage between crude oil and stock performance. First the theoretical linkage between the change in crude oil prices, which is the return, and stock returns will be explored. Thereafter, the empirical evidence about this issue will be discussed.

2.2.1.1 Crude oil and stock; a theoretical review

Mussa (2000) presented a variety of channels through which higher oil prices affect the global economy. First, there will be some decrease in demand and therefore a swift of income from energy consumers to energy producers. Second, there will be an increase in the cost of production and a pressure on yield margins. Third, a higher oil price will influence the price levels and the level of inflation. This will vary with the degree of monetary tightening. The expected duration of the rise in price levels will create incentives for oil suppliers to expand the production and investments. Furthermore, this all will have both direct and indirect influence on the financial markets.

Huang, Masulis and Stoll (1996) describe the theoretical linkage between crude oil and stock returns using economic linkages at a general level. The stock valuation of a company is based on the discounted values of expected future cash flows. Movements in oil prices can influence these parameters for different reasons. Oil is a real resource and an essential material to the production of a lot of goods, and could be compared to other variables like labour and capital. Higher oil prices cause movements in expected costs and would depress stock performance. Oil price movements also influence stock performance through the discount rate. The discount rate that is used to value the company originate from the expected inflation rate and interest rate, which may depend on expected oil prices. For instance, for an oil importing country a rise in oil prices may influence the balance of payments negatively, put a pressure on the exchange rate and an upward pressure on the inflation rate. Therefore, a higher inflation rate is positively linked to the discount rate and consequently negatively linked to the stock performance. Going one step further, since oil is a commodity, expected oil prices can be used as proxy for the expected inflation rate. The interest rate is also closely related to the oil price. As mentioned before, oil is a major resource and therefore higher oil prices comparative to the general inflation level could drive the interest rate upwards. A higher interest rate will make bonds more attractive and motivates investors to change their portfolios by buying bonds and selling stock, and lead to falling stock prices.

As also noted in Kilian (2007), higher oil prices may be transmitted to changes in stock prices through increases in the cost of production and will cause a swift in the expected future cash flows. This will

depend on the level of the costs of oil. He also add another view and argue that oil prices affect the performance of firms through the change in consumer expenditures and firm expenditures. In this view, there will be both a reduction in demand from the consumers and firms. There will be a reduced demand for the company's output, because consumer spending will increase as a response to increasing oil prices, since this is an important energy resource for householders. The negative effect of higher oil prices on consumption, investments and stock prices is also documented by Lardic and Mignon (2008). They argue in the same context, consumption is affected through the relation with the disposable income and the investments are influenced due to higher costs of the company. Higher costs will cause a reduction in the profits and the discounted sum of expected future dividends, which are key drivers of stock prices (Lescaroux and Mignon, 2008). Filis (2010) mentions that oil prices affect the overall stock market performance on a direct and indirect way. The direct negative influence can be justified by the fact that oil price increases creates uncertainty in financial markets, which in turns decreases stock prices. The indirect negative effect can be explained due to the aforementioned reasons, namely the increase in production level and the increase in inflation rates, as a result of increasing oil prices.

However, the linkage between oil prices and stock performance is more complicated and cannot only explained by higher costs or higher revenues and the demand and supply curves for this major resource. As mentioned before, oil price fluctuations happens for various reasons and do not influence the economy each time in the same way. Considering a rise in the demand for oil due to a growing economy or firms that are well performing, there could be a positive linkage between oil prices and stock returns. Another reason is speculation, reserves may be filled up with oil so that oil is becoming a more scarce resource. Besides that, they can believe that the cost of production in the future is higher than nowadays and decide to speculate with the supply and prices. Furthermore, the oil prices can change due to natural disasters and conflicts between governments, so that the linkage between the oil price and stock returns only depends on the costs and revenues for the firm, which in turn are adapted by the fluctuations in oil prices.

As can be seen, it is not clearheaded to find direct influences from movements in the oil price on stock performance. Therefore, the empirical framework in the next paragraph will provide empirical evidence about this issue.

2.2.1.2 Crude oil and stock; an empirical review

Early empirical research by Burbidge and Harrison (1984) and Bruno and Sachs (1979) documented in cross country analysis a linkage between oil prices and the performance of the whole economy. The aforementioned study by Hamilton (1983) made a major contribution to this context and argued that the most recessions after World War II was preceded by increasing oil prices. Various explanations are mentioned as the reason of the relationship between oil prices and economic activity. Between these explanations, temporizing GDP growth and inflation due to higher oil prices appears to be most preferred.

More interesting for the aim of this paper are studies focused on the relation between oil prices and stock performance. In contrast with studies on effects of oil prices on the economy, there are relatively few studies focused on the influence of oil prices on stock performance.

Basher and Sadorsky (2006) investigate the influence of oil price movements on 21 emerging stock market returns. They use daily, weekly and monthly data between 1992 and 2005 and find strong

evidence between oil returns and stock returns in emerging markets. Driesprong et al. (2008) investigate price series of various types of oil and conclude that oil prices forecast stock market returns in both developed and emerging markets. They advocate that an increase in oil prices dramatically decreases future stock returns. Using monthly data between 1986 and 2005, Park and Ratti (2008) investigate the influences of oil price shocks on stock returns in the United States and thirteen European countries. They conclude that oil price shocks have a statistically significant negative effect on stock returns. Filis (2010) conclude in the same way with using monthly data for Greece.

At the industry level, Nandha and Faff (2008) analyse 35 industries for the period from April 1983 till September 2005 and conclude that oil price increases have a negative influence on equity returns for all sectors, with the exception for the mining, oil and gas sector. Liao and Chen (2008) believe that prices should have different degrees of impacts on different industries and analyse 20 industries instead of the whole market. They conclude that changes in oil prices affect both the electronic and the rubber sector. Gogineni (2010) use a much narrower classification for the industries and use 61 industry groups. He presents that sectors that to a great extent depend on oil are sensitive to oil price fluctuations, but also conclude that non-oil intensive sectors are influenced by changes in oil prices. He gives the explanation for this through an indirect relation, that is, the customers of these sectors could be affected by the oil price fluctuations. The findings of Narayan and Sharma (2011) suggest that the energy and transportation sector experience an increase in returns when oil prices increases, while the other 12 sectors experience lower returns in reaction to an increase in the oil price. They mention no further explanations or arguments for the differences between the industries.

2.2.2 Interest rate

Governments or monetary authorities have several tools of monetary policy. The interest rate is one of them and is used in order to influence the economy. A high interest rate is an indication of a tight monetary policy. In times with high interest rates, it is more costly for firms to borrow which makes it more unattractive to invest. Not only firms, but also individuals are affected by high interest rates, since the repayments of their loans and mortgages will be cost more. Therefore, high interest rates tend to decrease demand, while low interest rates stimulate demand in the economy (Lipsey and Chrystal, 2007).

Interest rate fluctuations are worldwide acknowledged as an important source of uncertainty for firms. Graham and Harvey (2001) provide evidence that fluctuations in the interest rate are the second most significant risk factor for companies. They mention the maturity match between assets and liabilities as ‘important or very important’. The influence of the interest rate on the stock performance of firms has received big attention in empirical studies, yet a lot of these studies focused on financial institutions due to the particularly interest rate sensitivity of these sector Kasman et al., 2011; Memmel, 2011). However, interest rate fluctuations may also affect nonfinancial companies through their influence on the financing costs and the value of the assets and liabilities held by these companies (Bartram, 2002).

2.2.2.1 Interest rates and stock; a theoretical review

In fact, the interest rate is the cost that is charged to someone to use money of someone else. This could be money from the bank for a mortgage, for a credit card or something else. But the relation

between the interest rate and the stock market is more than that, while all these forms of credit have an influence as well (Lipsey and Chrystal, 2007). The interest rate that affects the investors is the interest rate from the bank, which are the costs that the bank needs to pay for using money from the central bank. The interest rate is important because it is the way the central bank is controlling, as mentioned before, over the inflation. In fact, it is a way to lower or bring up the money supply (Saborowski and Weber, 2013).

From a basic and practical view, an increase in the interest rate by monetary authorities, will not result in a direct effect on the stock market. Rather, it will become more expensive for banks to borrow money from the central bank. In turn, this will influence both individuals and businesses. Individuals need to pay more for their credit cards and mortgages, especially when they have a variable interest rate. In turn this will lead to a decrease in the amount of discretionary money. This will influence the bottom lines, such as the revenues, for companies. This is one of the ways how companies are influenced, however the influence on companies due to higher interest rate is twofold. The companies borrow also money from the banks, when borrowing is becoming more expensive they need to pay higher rates on their borrowings. Higher expenses and less revenues slow down their operations and result in decreasing growth and profits. Since the value of the company is based on the expected future cash flows, fluctuations in the interest rate and a drop in the expected cash flows will lower the price of shares and influence the value of the company.

Financial theories mention that changes in interest rates influence both the expected future cash flows for firms and the discount rate to value these cash flows, and therefore the value of the company (Martinez-Moya, Ferrer-Lapena and Escribano-Sotos, 2013). As mentioned before, the bulk of the research in this area focused on the financial industry, due to the structure of this business. However, interest rate changes have also a significant effect on the value of nonfinancial companies through three channels. First, an increase in the interest rate, increase the interest expenses of a highly indebted firm, and therefore decrease dividends and have a negative consequence on future cash flows and share prices. A higher interest rate will also negatively influence the investment behaviour, which is also mentioned by Bartram (2002). Second, interest rate changes have an influence on the market value of the financial assets and liabilities of the nonfinancial company. Third, fluctuations in interest rates influence the opportunity costs of investments. An increase in interest rate makes bonds more interesting due to their risk-return nature, and motivates investors to change their portfolios by buying bonds and selling shares, and therefore depress share prices (Bernanke and Kuttner, 2005). Moreover, an increase in the market interest rate, can make government securities more desirable since they are viewed as safer investment opportunities.

In conclusion, low interest rates tend to improve the economy and raise the value of stock, while high interest rates tend to lower the economy.

2.2.2.2 Interest rates and stock; an empirical review

Kasman et al. (2011) and Dinenis and Staikouras (1998) are two of the many studies that investigate the influences of the interest rate on the stock performance in the banking sector. Their results suggest that the interest rate has a negative and significant effect on the stock returns. Empirical research out of the financial sector is relatively scarce, and will be discussed below.

Alam and Uddin (2009) argue that the effects of interest rate on stock returns provide crucial information for risk management, valuation of securities and government and monetary policy, and

investigate this relationship for fifteen developed and developing countries using data between 1988 and 2003. For all of the countries they provide evidence that the interest rate has a significant negative relationship with share prices. Jefferis and Okeahalam (2000) investigate the South African, Botswana and Zimbabwe stock market and hypothesize that interest rates have a negative influence on stock prices through three channels, namely the substitution effect, a rise in the discount rate and a depressing influence on investments. Empirical studies in this context mentioned in general a significant negative influence of interest rates on stock (Reilly, Wright and Johnson, 2007; Aurangzeb, 2012; Asprem, 1989; Muktadir-Al-Mukit, 2012). Moreover, Korkeamäki (2011) and Czaja, Scholz and Wilkens (2010) find also that interest rates have a negative impact on stock, but argue that the influence of interest rate has decreased over time due to the rise in the enhanced tools for handling interest rate risk. The growth in corporate bond markets and derivative markets has played a crucial role in this decreasing relation.

Martinez-Moya et al. (2013) analyse the Spanish stock market. Their results show that there is a significant level of interest rate exposure in the Spanish stock market and notable differences across sectors can be observed. Heavily regulated and indebted sectors such as utilities, financials and real estate are the most interest rate sensitive and hardest influenced. The interest rate sensitivity is also negative, which indicates that the Spanish firms are adversely affected by interest rate increases. Non-financial companies in regulated or highly leveraged sectors such as real estate and utilities are mostly mentioned as the sectors that are hardest influenced (Bartram, 2002; Reilly et al., 2007). The cost of debt in highly leveraged firms is directly linked to the interest rates and regulated firms align the prices of their products with some delay due because of the constraints by the regulators. These both strengthen the negative affect of interest rate increases on the stock returns of the companies in these sectors (Martinez-Moya et al., 2013).

2.2.3 Exchange rate

The U.S. dollar and the Euro are the most traded currencies in the world (BIS, 2013). It has become as main sources for international transactions. On January 2002 the Euro became official and after the introduction the Euro appreciated against the Dollar. Important determinants of the exchange rate are the demand and supply for the currency, inflation, interest rate and the economic and political risk (Shapiro, 2013, p.52; Lipsey and Chrystal, 2007, p.508). Due to the wide worldwide usage the U.S. dollar and the Euro are accepted as the most important exchanges currencies.

Many academics examine the relationship between exchange rate and stock performance for both theoretical and empirical reasons. This paragraph will present the theoretical linkage between exchange rates and stock performance followed by the empirical evidence about this relation.

2.2.3.1 Exchange rates and stock; a theoretical review

The large increase in the world trade and capital movements have made the currency value as one of the important factors that influence business profitability and equity prices (Kim, 2003). Exchange rate fluctuations affect the international competitiveness of companies, considering their influence on import and export prices. It influences the value of the company since the future cash flows change together with the fluctuations in the currency values. Economic theory suggests that fluctuations in exchange rates will result in a change in the investments and profitability, reflected in the financial performance. Consequently, movements in the company's operations affect stock returns (Agrawal, Srivastav and Srivastava, 2010). The earlier and frequently cited study by

Dornbusch and Fisher (1980) indicate the same with a flow oriented model. They argue that a depreciation in the local currency improves the competitiveness of domestic companies and their exports and future cash flows. This will result in increasing stock prices, as a response to the rise in expected cash flows. Conversely, an appreciation in the local currency will decrease the foreign demand of an exporting company. This will lead to a decline in the profit, as would the stock returns. Consistently, for an importing company the sensitivity of the firm value to currency value fluctuations is just the opposite (Yau and Nieh, 2006).

Exchange rate volatility can affect the stock performance not only for international firms, but also domestic firms can be affected (Agrawal et al., 2010). Domestic companies with no international operations, assets, liabilities and transactions are also exposed to exchange rate fluctuations since their input and output price channels, supply and demand chains or the prices of the competitors might be affected by exchange rate fluctuations.

2.2.3.2 Exchange rates and stock; an empirical review

Theory explained that fluctuations in the currency values influence company's profits and hence their stock performance. The theoretical explanation is clear and may seem obvious at times, although the empirical results are mixed.

Agrawal et al. (2010) examine the dynamics between the movements of the Indian Rupee value and the stock returns, and indicate a slight negative influence. Chkili and Nguyen (2014) examine the stock prices and exchange rate linkage in a regime-switching environment. The affect from exchange rates to stock market returns is not significant for the BRICS countries, which represent the five major emerging national economies in terms of stock market development and economic growth. The results show that the exchange rate does not impact stock market returns of BRICS countries, regardless of the regimes. Caporale, Hunter and Ali (2014) also examine movements in the exchange rate during times of volatility using data for six advanced economies on the pre-crisis and the crisis period and reach a similar conclusion for the United States and United Kingdom for the crisis period.

However, there is also empirical research available that supports the theoretical linkage between exchange rates and stock performance. Kurihara (2006) investigates the relationship between macroeconomic variables and stock prices. Exchange rate is the main target variable and it is found that the exchange rate influence stock prices. Phylaktis and Ravazzolo (2005), Pan, Fok and Liu (2007), Sharma and Mahendru (2010) and Chen, Naylor and Lu (2004) shows also a significant causal relation from exchange rates to stock returns. Yang, Tu and Zeng (2014) indicate that most foreign exchange markets and stock markets are negatively correlated for nine Asian markets over the period 1997 to 2010. Moore and Wang (2014) find a also a negative linkage between the stock prices and real exchange rates for the United States market in relation to the developed and emerging Asian markets. Can Inci and Soo Lee (2014) examine the linkage between stock returns and exchange rate fluctuation in five major European countries and show causality from exchange rate fluctuations to stock returns. They conclude also that the linkage has been more significant and stronger in recent years and during recession periods rather than in former times and expansion periods.

As can be seen, the empirical results are mixed. Some authors try to clarify these mixed results with focusing on the industry level. Can Inci and Soo Lee (2014) argue that an industrial analysis of the linkage between stock returns and the exchange rate is warranted, due to the industrial differences and because the exposures could be more relevant at the sector level. Al-Shboul and Anwar (2014)

use weekly data from 2003 to 2011 and examine the exchange rate exposure in Canadian industries. They find evidence for four out of thirteen industries. Olugbode, El-Masry and Pointon (2013) examine the sensitivity of 31 non-financial industries in the United Kingdom to the exchange rate from 1990 to 2006, and conclude that competitive industries are harder influenced compared to other industries, as discussed in Aray and Gardeazabal (2010). Miao, Zhou, Nie and Zhang (2013) investigate the influence of exchange rate movements on stock returns for 16 Chinese industries and found evidence for seven out of sixteen industries.

2.2.4 Gold

Gold is a financial instrument that owns the characteristics of both a commodity and currency. In the past it is used as money and as a medium of exchange. Nowadays it acts as a store of wealth and it is a known instrument for investment uses. It has been highly demanded for many reasons such as scarcity, highly mobile, liquidity and uniformity. The price of gold depends on the supply and demand for the commodity and government auction policy. Throughout history, gold is also considered to reduce risks and portfolio diversification (Ciner, 2001). Gold is also stored in central banks for various reasons, such as diversification, economic security, physical security, confidence, income and insurance (Tully and Lucey, 2007). Throughout the recent decade the demand for gold has been expand rapidly. The economic recession, high inflation rates and reduction in world gold production may be reasons for that (Do, Mcaleer and Sriboonchitta, 2009). Since gold is also used to hedge the risks, investors tend to replace their shares with gold which results in a lower demand for shares and volatility on stock markets. Therefore, getting a better understanding of this linkage will help investors and firms to diversify their portfolios and reduce their risks.

2.2.4.1 Gold and stock; an empirical review

Due to unstable world markets, there is an increasing interest in gold. Some financial theories argue that gold could be considered as a safe investment when the economic environment is uncertain. When other investments are decreasing, gold usually increase. Gold is mostly considered as independent from other factors, and therefore it is believed that it is low correlated with stock (Baur and Lucey, 2010). However, the theoretical linkage between gold and stock is unclear, and there is a lack of theoretical research. Therefore, in order to examine this relationship only empirical evidence will be used.

Empirical research in this area focus on two different segments. One part examines safe havens and the other part focuses on the nature and influences of the gold market. Relevant studies to the aim of this paper are studies about the influences of the gold market, however, studies about this subject are relatively scarce. Some of these will be discussed below.

Sumner, Johnsons and Soenen (2010) conclude an effect from gold to stock returns. However, this affect is not very strong which restricts the forecasting power of gold. Nevertheless, the slightly negative linkage between them remains a positive view from the portfolio diversifier perspective. Considering the safe haven gold stays an important asset for the investor. Lawrence (2003) use data from January 1975 to December 2001 conclude that there is low correlation between gold and equities, as is also the case with the relation between gold and other financial assets. Ozdemir and Yesilyurt (2013), Hood and Malik (2013) and Akgun, Erem Şahin and Yilmaz (2013) reach the conclusion that gold has no impact on stock. Hillier, Draper and Faff (2006) analyse daily data for gold, platinum and silver from 1976 to 2004 and come to the conclusion that all three metals have no

influence on stock index returns. They argue that precious metals have potential portfolio diversification benefits.

Ratner and Klein (2008) investigate the relation between changes in gold prices and US stocks between 1975-2005 and demonstrate that gold has a low impact on the US stock market. They use ten industries as defined by the Financial Times Actuaries index. They conclude that the largest positive impact occurs in the technology sector, while the largest negative impact is in the telecommunications sector. They mention no further arguments or explanations for these industries. All the coefficients are negative or close to zero across the sectors. Similarly to Ratner and Klein (2008), Liao and Chen (2008) argue that commodity prices should have different impacts to sectors and analyse 18 individual sectors instead of the whole market. They conclude that movements in the gold price will influence the chemical, cement, automobile, food and textiles sector stock returns, but again, no further explanations for the findings for these sectors are presented.

3. Hypotheses

Previous chapter presented in detail the relation between each of the macroeconomic variables and stock performance. In general, authors argued a linkage between the variables. However, the variables could still have a positive, negative or no impact. Based on these studies, this chapter will mention the main arguments from prior studies and develop hypotheses.

3.1 Crude oil

Huang et al. (1996) and Mussa (2000) mentions the linkage between oil and stock performance with underlying economic relations regarding the cash flows and discount rates. Expected cash flows are influenced because oil is an essential resource for the production of several goods. Fluctuations in the oil prices will affect the expected costs and higher oil prices will depress the stock performance. Obviously this will depend on whether the firm is a producer or consumer of oil. But for the world economy in general, oil is an essential input and increases in oil prices will decline stock returns. Kilian (2007), Lardic and Mignon (2008) and Lescaroux and Mignon (2008) add to this that oil prices movements also influence the consumer expenditures. Higher oil prices and consumer expenditures will lead to a lower disposable income and a fall in demand for the company's output. Increasing oil prices could also create uncertainty in financial markets and hence lower stock prices (Filis, 2010). The discount rate that is used to estimate the stock prices is also influenced by changes in oil prices. The expected inflation rate and expected interest rate is used to calculate the expected discount rate. Both of these components may depend on oil prices. For oil importing countries, higher oil prices will affect the balance of payments negatively, put a pressure on foreign exchange rates and as a consequence an upward pressure on inflation rates (Mussa, 2000; Lardic and Mignon, 2008). Therefore, an increase in inflation rate is positively linked to the discount rate and adversely related to stock. Furthermore, fluctuations in oil price track the inflation rate, and can be used as a proxy for the inflation rate. The interest rate is also closely linked to the oil price. Oil is an important resource in the economy, higher oil prices comparative to the inflation could force the interest rate to rise and lead to a decline in stock prices.

In conclusion, the linkage between higher oil prices and stock performance can be clarified using cash flows and the discount rate. With this, higher production costs, inflation and interest rate are important factors. The consumer expenditures and financial uncertainty are also factors to take into account when assessing the effects. A negative impact of higher oil prices on stock performance is also documented by Nandha and Faff (2008), Narayan and Sharma (2011) and Park and Ratti (2008) reaching the same relationship and conclusion. This leads to the following hypothesis:

Hypothesis 1: *An increase in the oil price has a negative influence on stock performance.*

3.2 Interest rate

There are a several ways through which the interest rate affect the performance of companies (Bartram, 2002). In general, an increase in the interest rate means for both consumers and banks that it will be more expensive to borrow money. Consumers need to pay more for their borrowings and mortgages, which will result in a decrease in consumer spending and less demand for products from companies and depress stock performance. Because companies borrow also money from the central bank, the companies are also influenced in a more direct way. Higher interest rates means higher expenses and less revenues. As aforementioned, expected future cash flows and the discount rate are the two components to value a company. Higher expenses and less revenues will result in

lower expected cash flows and influences the stock prices negatively. Martinez-Moya et al. (2013) state this relationship as well, and argue that the interest rate influence both the future cash flows for companies and the discount rate to value these companies and, hence, the stock price of the company. They mentioned three channels through which the interest rate influence the value of companies. The first channel is the general valuation methodology which is mentioned before. Second, the market value of financials assets and liabilities held by companies are effected through interest rate fluctuations. Third, an increase in the interest rate makes bonds more attractive, lead to a fall in demand for stock and consequently falling stock prices. This relation is also confirmed by Bernanke and Kuttner (2005). The findings of Martinez-Moya et al. (2013) are also in line with Jefferis and Okeahalam (2000) who mention the same two channels. First, reduced expected cash flows due to increased discount rates and costs and second, the substitution effect of bonds which leads to lower stock prices are mentioned. They add also the depressing influence on investments due to higher costs as another way through which the stock prices are negatively influenced.

To conclude, higher interest rates have both an influence on the expectations about future cash flows and discount rates and consequently a negative influence on stock performance. The substitution effect, consumer spending and investment behaviour are also factors which can influence the impact from interest rate movements on stock performance. The results of Martinez-Moya et al. (2013) confirmed that the interest rate sensitivity is negative, consequences that the stock performance is adversely influenced by interest rate increases. Alam and Uddin (2009) report also a significant negative impact from interest rate on stock returns. In general, empirical studies in this context argued a significant negative effect of higher interest rates on stock performance (Korkeamäki, 2011; Czaja et al., 2010; Reilly et al., 2007). This results in the following hypothesis:

Hypothesis 2: *An increase in the interest rate has a negative influence on stock performance.*

3.3 Exchange rate

The exchange rate influences the international competitiveness of firms, it affects the value of the company since the expected cash flows change together with changes in the currency values. This will also result in a change in the investments and profitability, reflected in the financial performance and stock returns (Kim, 2003; Agrawal et al., 2010). Also domestic firms with no international activities are exposed to the exchange rate since their price channels, supply and demand chains or the competitors might be influenced (Agrawal et al.,2010). The influence of changing currency values on the stock performance of firms is transmitted through three components, namely the local currency value, the foreign currency value and the imported input price (Kim, 2003). The domestic and foreign currency prices influence the domestic sales and export revenues. Consequently, the earnings will change in the opposite way of the currency movements. A depreciation of the local currency will result in higher import prices, while an appreciation of the local currency have the opposite influence, resulting in lower costs for imports. For exporters it has the reverse influence. Dornbusch and Fisher (1980) indicate the same, they argue that a depreciation in the domestic currency improves the competitiveness of exporting companies, resulting in increasing stock performance. On contrary, an appreciation in the local currency will lead to a downwards movement in the demand of an exporting company and will lead to a decline in the profit and the stock returns. As for the third channel mentioned by Kim (2003), the exchange rate has a direct influence on the earnings of a company by changing prices in imported materials and inputs.

The expected cash flows are influenced through fluctuations in the exchange rate. With this, it is important to take into account the import or export oriented nature of the business. In general, an increase in the exchange rate, which stands for a lower domestic currency value, means a higher input price and has a negative impact on stock performance. The frequently cited study by Yau and Nieh (2006) argue that the sensitivity of the stock performance to the exchange rate is just the opposite. Yang et al. (2014) and Moore and Wang (2014) find as well an opposite impact from exchange rates on stock performance. The hypothesis is stated as follows:

Hypothesis 3: *An increase in the exchange rate has a negative influence on stock performance.*

3.4 Gold

Hillier et al. (2006) investigate gold, platinum and silver prices and reach the conclusion that gold prices have no impact on stock returns. They mention the ability to hedge against market conditions as a major advantage of precious metals. These precious metals perform well during times of high market volatility (Hillier et al., 2006). Baur and Lucey (2010) mention that gold is often considered as independent from other variables and mention that it has no relation with stock. Baur and McDermott (2010) present that gold is a safe haven against stock in emerging and major countries. They mention the strengths of gold as a physical asset with its intrinsic value and the simplicity of the gold market. Different from other financial assets, gold is not dependent on future earnings or other financial properties such as worries about the risk of default (Baur and McDermott, 2010). Akgun et al. (2013) find also that gold has no influence on the stock performance. Sumner et al. (2010) argue in the same direction and find a slightly negative impact from gold to stock returns. As well in studies between movements in gold prices and industry stock returns, gold has no impact on the stock performance across the industries (Ratner and Klein, 2008; Liao and Chen, 2008). This results in the following hypothesis:

Hypothesis 4: *There is no relation between gold and stock performance.*

4. Methodology and Data

This section starts with a brief review of the methodologies used in aforementioned studies about macroeconomic variables and stock performance. Thereafter, the methodology that will be used in this study will be presented. This chapter ends with a description of the variables that will be used.

4.1 Review of methodology

The methodology used in prior studies varies on their purpose of the research. One of the most popular techniques in economic and financial research is the multiple regression technique with employing the Ordinary least squares method to estimate the effects (Asprem, 1989 and Korkeamaki, 2011). Some studies used more advanced models such as GARCH, wavelet analysis and Vector autoregressive (Tully and Lucey, 2007; Kurihara, 2006; Filis, 2010; Moya-Martinez et al., 2014). In order to select the most appropriate methodology for this research, this part will briefly review the methodologies of the aforementioned studies in paragraph 2.2.

Regression models

The regression technique is an important tool in econometrics. In general, a regression is concerned with examining the linkage between a given variable and one or more other variables. It is an attempt to describe changes in a variable by reference to changes in other variables. The regression model is stated as follows:

$$R = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_x X_x + \varepsilon$$

This regression model can be interpreted whether a set of macroeconomic factors has a linkage with stock performance, where R is stock performance and X represents the macroeconomic variables used in the research. The frequently cited study by Chen et al. (1986) presents a multifactor model with this technique and provide evidence for the Arbitrage pricing theory. They used several macroeconomic variables that have become the mainstream of later research on macroeconomic and stock performance.

The regression model describes the linkage between variables with a line. Ordinary least squares is a statistical technique for estimating the unknown parameters in this linear regression model. It attempts to fit a line which most closely approximates the data. Ozdemir and Yesilyurt (2013), Korkeamäki (2011), Asprem (1989) and Sharma and Mahendru (2010) are some of the studies focusing on macroeconomic variables and stock performance in which this model is used.

GARCH

Some studies that focus on macroeconomic variables and stock performance focus on the volatility between these variables. The Generalized Autoregressive Conditional Heteroskedastics or the GARCH model is used for modelling and forecasting volatility. This model has two equations and is used as a variance formula to be estimated simultaneously with the normal regression model in the mean formula. Olugbode et al. (2013), Tully and Lucey (2007), Caporale et al. (2014), Liao and Chen (2008) and Do et al. (2009) used the GARCH model to study macroeconomic variables in relation to stock performance.

Wavelet analysis

Wavelet analysis is another technique for analysing the relation between macroeconomic variables and stock and is used by Moya-Martinez et al. (2014), Hamrita and Trifi (2011) and Ramsey and Lampart (1998). It is a tool for investigating variations within a time series. In this case, the time series data is decomposed into time-frequency space, which makes it able to determine the dominant modes of variability and how these modes vary in time (Torrence and Compo, 1998).

VAR models

The Vector Autoregressive (VAR) is a multivariate dynamic model which the relation between pairs of time-series variables explores. It takes the dynamic properties and interactions between the variables into account. There are various econometric techniques to estimate the model, nonlinear system least squares and two-step least squares procedures are some of them. Authors focusing on macroeconomic variables that used this technique are Kurihara (2006), Filis (2010), Park and Ratti (2008), Phylaktis and Ravazzolo (2005) and Pan et al. (2007).

4.2 Regression model

As seen in prior paragraph, the methodologies used in studies about macroeconomic variables and stock performance are mixed. Among the methodologies, linear regression models are used. In general, regressions are tools to describe and evaluate the linkage between a given variable and one or more other variables (Brooks, 2008, p. 27). This study uses the ordinary least squares method in Eviews to estimate the parameters. Some advantages and disadvantages about ordinary least squares and the more advanced models such as GARCH, VECM and wavelet analysis can be found in the discussion section in chapter six.

The regression analysis in this study is largely based on the methodology used by Ozdemir and Yesilyurt (2013) and Asprem (1989). Korkeamaki (2011) and Sharma and Mahendru (2010) is also used. These authors used regression analysis to explain fluctuations in the stock performance by reference to fluctuations in the macroeconomic variables. In this context, the ordinary least squares method is used. Moreover, in order to get more structure and a comprehensive view about regression analysis and especially about ordinary least squares, Brooks (2008) is also followed.

When attempting to test a linkage between macroeconomic variables and stock performance, some of the variables in the regression equation need to be transformed into suitable forms. Using log returns for the variables, express the data as continuously compounded returns which are comparable and interpretable (Brooks, 2008, p.8). Therefore, the first step is to transform the prices into returns, as is shown below.

$$r_t = 100\% \times \ln\left(\frac{p_t}{p_{t-1}}\right)$$

The oil prices, gold prices and stock indices are transformed into log returns. The interest rate is yet in percentages and the exchange rate is a ratio between two currency values. More about the variable definitions can be found in paragraph 4.3 about the data. Ozdemir and Yesilyurt (2013) and Sharma and Mahendru (2010) specify the stock returns with a linear function. The regression equation that is used in this study can be written in the following way:

$$R_{i,t} = \alpha + \beta_{1,i}oil_t + \beta_{2,i}int_t + \beta_{3,i}exch_t + \beta_{4,i}gold_t + \varepsilon$$

Where:

R_{it} is the log return for industry *i* for period *t*;

Oil is the log return for oil;

Int represents the interest rate;

Exch is the exchange rate;

Gold is the log return for gold.

ε is a random disturbance term that is added for outside influences and errors which cannot be modelled

Furthermore, a series of tests is conducted to reveal the important features of the regressions that are about to be estimated (Brooks, 2008, p.129). First, the White's test is used to test for heteroscedasticity problems. The consequence of heteroscedasticity is that the regression coefficients no longer have the minimum variance and the standard errors are biased. To deal with heteroscedasticity problems, the regressions need to be estimated with the heteroscedasticity-robust standard errors (Brooks, 2008, p.137). Second, the Durbin and Watson test and Breusch-Godfrey Lagrange Multiplier (LM) test is used to test for autocorrelation and to detect repeating patterns in time series data. It is assumed that the covariance among the error terms is zero over time and cross-sectional. It implies that the error terms are uncorrelated with one another. When the errors are not uncorrelated with each other, autocorrelation occurs (Brooks, 2008, p.139). To deal with autocorrelation the Cochrane-Orcutt procedure will be used. Third, the correlation matrix is used to detect multicollinearity problems. To deal with multicollinearity, one of the highly correlated variables will be removed from the multiple regression model and tested with a simple regression model.

4.3 Data

For studying the relationship between macroeconomic variables and industries, several data is needed. The dataset includes observations on a monthly interval from February 1997 to September 2014, for a total of 212 observations. All data is collected with the end values, in other words, closing prices at the last day of the months are gathered. Moreover, with the recent financial crisis in mind, the total time interval is also divided into two sub periods. According to the NBER (2014), the financial crisis has started in December 2007 and ended in June 2009. The first subsample includes monthly observations between February 1997 till November 2007 and the second subsample includes monthly observations between July 2009 till September 2014. The data for this study focus on the United States market. The industries in this study are represented by the Dow Jones sector

indices. Therefore, the proxies for the macroeconomic variables will be also chosen from an United States perspective. This paragraph will discuss the definitions and the measurement units for the macroeconomic variables and industries.

Oil

There are various key measures of crude oil. Crude oil can be classified into several groups, such as Brent, Dubai or West Texas Intermediate (WTI). The classification depends on the location where it is produced and specific molecular characteristics. Park and Ratti (2008) analyse the influence of oil shocks on stock returns in the U.S. and thirteen European countries and use the first log difference of the nominal oil price per barrel for Brent crude oil. Filis (2010) transformed the Brent crude oil price into logarithms when analysing the Greek stock market. Brent oil is also used by Tully and Lucey (2007) which use simple returns of the oil price per barrel. The second group, WTI, is also used by several researchers. Nandha and Faff (2008) analyse 35 global industry indices and use log returns of the WTI oil price. Mollick and Assefa (2013) analyse the effect of WTI oil returns on U.S. stock returns. Basher and Sadorsky (2006) use log differences in WTI when analysing a large set of emerging stock markets. Liao and Chen (2008) use also WTI as a benchmark for crude oil for analysing stock returns in Taiwan. For this end, they use simple returns for the crude oil price. The third classification, Dubai crude, is used by Driesprong et al. (2008) in predicting stock market returns worldwide. All these three forms are used as a grade of crude oil around the globe (Driesprong et al., 2008). Typically, Dubai crude is more locally applied throughout Asia, Brent Oil is a global reference and WTI is considered as a reference for the United States (Energy and Capital, 2012).Since this study is focusing on the United States and several authors used WTI, the log returns on the price level for a barrel WTI will act as a benchmark for crude oil.

Interest

The interest rate on government debt from the central bank of a country or union acts as a reference for the interest rate (Czaja, Scholz and Wilkens, 2010; Memmel; 2011). United States Treasury Securities are government debt instruments backed by the U.S. government. U.S. Treasury Securities exists in various forms, such as Treasury bills, Treasury notes and Treasury bonds. The various forms are maturity related, T-Bills are short term obligations with a maturity of one year of less, T-Notes have a maturity up to ten year and T-Bonds are long term investments with a maturity longer than ten year. In order to investigate the influences of the interest rate, prior research has used the three-month and ten-year securities mostly. Tully and Lucey (2007) use monthly percentage changes of the three-month T-Bills. Hamrita and Trifi (2011) use the three-month constant maturity rate provided by the Federal Reserve and Adam and Tweneboah (2008) use the log of the three-month T-Bill rate as a measure for the interest rate. Abugri (2008), Park and Ratti (2008) and Gogineni (2010) use the three-month T-Bill rate without adjustments. The long term interest rate is also used in prior research. Ciner, Gurdgiev and Lucey (2013) use the ten-year government bonds from the U.S. and U.K., Mollick and Assefa (2013) use the two year and ten year Treasury securities and Moya-Martinez et al. (2014) use the ten-year Spanish government bonds in order to measure the effects of the interest rate. Since the short term interest rate is frequently used in prior research, this study uses the three-month constant maturity rate provided by the Federal Reserve as a proxy for the interest rate.

Exchange rate

The variables used for measuring the effects of the exchange rate depends on the market on which the study is focusing. The domestic currency value relative to a foreign value is taken. Since the U.S. dollar is the most traded currency in the world (BIS, 2013), many authors use the own currency value in relation with the U.S. dollar. Moore and Wang (2014) use six Asian emerging market currencies and four developed market currencies relative to the U.S. dollar. Chkili and Nguyen (2014) use exchange rate changes as log differences of the U.S. dollar exchange rate for the BRICS countries. Yang and Zeng (2014) analyse 9 Asian countries and expressed the exchange rate as a number of local currencies per U.S. dollar. The Euro is the second most traded currency behind the U.S. dollar (BIS, 2013). Therefore, authors focusing on U.S. stock returns analyse the Euro/U.S. dollar exchange rate. This is due to the fact that most prices in the United States are denominated in U.S. dollars and since the Euro is the second most traded currency in the world, it is expected that the performance of companies would be mostly influenced by changes in the Euro/U.S. dollar exchange rate (Mollick and Assefa, 2013; Hamrita and Trifi, 2011). In this study, the exchange rate between the European Monetary Union Euro and the U.S. dollar is taken as a reference for the exchange rate.

Gold

In contrast to aforementioned variables, there are few definitions of gold used in prior research, namely the price for a troy ounce gold or gold futures traded on Comex. The troy ounce is a unit of measure for precious metals and is defined as 31,1 grams (Corti, Holliday and Thompson, 2002). Hillier et al. (2006) use log returns for the troy ounce gold price when analysing the role of gold with stock index returns. Ratner and Klein (2008) use also the U.S. dollar per troy ounce gold and transformed it into returns when measuring the effects. Mollick and Assefa (2013) use also the return series on the price in Dollars per troy ounce gold. The returns on COMEX gold futures are also used. Tully and Lucey (2007) use monthly percentage changes in the COMEX gold futures and Ciner et al. (2013) and Hood and Malik (2013) use daily returns for the COMEX gold futures series. As a reference for the gold price, the log returns for the price for a troy ounce gold in U.S. dollars is taken (Hillier et al., 2006; Ratner and Klein, 2008).

Sector returns

The Dow Jones indices are comprehensive global index series and one of the oldest United States stock market indices. These indices are among the frequently analysed indices in the United States, providing a complete range of portfolio management and benchmarking tools for targeting stock performance. Dow Jones include a wide range of indices, available at the country, regional and global levels. Among this array of indices are ten Dow Jones U.S. sector indices, which are defined by the widely adopted classification system' from Dow Jones (Dow Jones, 2014). Firms are allocated to the sector from which the definition most closely describes its business, based on the majority of its revenues. Together, these ten sector indices make up the Dow Jones U.S. index, which make up close to 95% of United States market capitalization. Furthermore, there are two versions available, price return and total return. The total returns series with gross dividends reinvested is analysed in this study.

4.3.1 Data sources

The data for this study is collected from several renowned sources, such as the Wall Street Journal, Eurostat and the Federal Reserve Economic Data. All these sources are public, reliable and known sources that provide independent information.

Table 2
Data sources and references

Variable	Source	Reference
Log return of oil (WTI)	Databank Worldbank http://databank.worldbank.org/data	Nandha and Faff (2008) Mollick and Assefa (2013) Liao and Chen (2008)
Interest Rate (3-month T-Bill)	Federal Reserve http://www.federalreserve.gov/releases/h15/data.htm	Tully and Lucey (2007) Abugri (2008) Park and Ratti (2008 Gogineni (2010)
Exchange rate (Euro / USD)	Database Eurostat	Mollick and Assefa (2013) Hamrita and Trifi (2011)
Log return of gold (Troy ounce)	Databank Worldbank http://databank.worldbank.org/data	Hillier et al. (2006) Ratner and Klein (2008) Mollick and Assefa (2013)
Log return of Dow Jones Sector stock indices	The Wall Street Journal http://quotes.wsj.com	Al-Shboul and Anwar (2014) Moya-Martinez et al. (2014)

This table presents the sources and references for the dependent and independent variables used in this study.

5. Results

This chapter will first present the results of the descriptive statistics of the variables used in this study and the correlations between the variables. Thereafter, the regression results will be given.

5.1 Descriptive statistics

Table 3 presents the descriptive statistics for the macroeconomic variables for the whole period. The descriptive statistics for the pre-crisis and after-crisis period can be found in appendix A .

Table 3
Descriptive statistics - Macroeconomic variables

	Mean	Median	Max.	Min.	Std.Dev.
Crude oil (%)	0.62	1.69	19.94	-32.40	8.33
Interest (%)	2.41	1.74	6.38	0.01	2.17
Exchange rate	1.22	1.24	1.58	0.84	0.18
Gold (%)	0.59	0.56	14.89	-19.66	4.99

This table presents the descriptive statistics for the macroeconomic variables. The dataset includes observations on a monthly interval from February 1997 to September 2014, for a total of 212 observations. Crude oil is defined as log returns on the crude oil price per barrel, Interest is the rate for the three-month T-Bill constant maturity, Exchange rate is defined as the Euro/USD rate and Gold is defined as the log returns on a troy ounce gold.

Crude oil has a mean return of 0.62% and the median return is 1.69%. Variability in the data is measured with the standard deviation which is 8.33%. The return series of oil prices is also used by Mollick and Assefa (2013). However, they show a mean return of 0.12% and a standard deviation of 2.3% which is lower than the features of the data in this study. Mollick and Assefa (2013) analyse an observation period between 1997-2007 which includes the observation period of this study, but they use daily data. Because prices fluctuate usually less on a daily basis, the standard deviation is lower for higher observation frequencies. Mollick and Assefa (2013) provide also the descriptive statistics for the raw data for the WTI crude oil price which shows the same values as the data used in this research when adjusting for the same period. Nanndha and Faff (2008) and Liao and Chen (2008) use also a different observation period, which makes it not possible to compare the statistics. As mentioned before, there is a growing demand for oil which could cause high volatility which is reflected with the standard deviation (Kilian and Hicks, 2013). The high volatility is also confirmed by Regnier (2007), who argues that oil prices are more volatile than other products. However, since the observation period and the observation frequencies of this study is different from other studies, and this study does not compare crude oil returns with returns on similar products, it is not possible to draw conclusions from the statistics presented in table 3. This is also the case for the gold returns. Gold has a mean return of 0.59% and the median return is 0.56%. Hillier et al. (2006) and Ratner and Klein (2008) analyse also the gold returns, but again, Hillier et al. (2006) use daily data from 1976 to 2004 and Ratner and Klein (2008) use monthly data between 1975-2005 which makes it difficult to compare.

The interest rate has a maximum of 6.38% and reached this rate at the end of 2000. The graph for the interest rate can be found in appendix B. There is a sharp decline after this period till April 2004, after this month the interest rate increased till February 2007 and reached another high rate in the observation period. The high interest rate continued a few months, but at the end of 2007 the Federal Reserve took extraordinary actions to stabilize the financial system and reduced the interest rates near to zero, after which the interest rate reached the minimum of 0.01% in November 2008. The three-month constant maturity T-Bill rate from the Federal Reserve is also used by Gogineni

(2010), Abugri (2008) and Park and Ratti (2008), but since the observation period starts earlier in these studies, and the observation frequency is shorter for some of them, it is inappropriate to compare these risk statistics using different underlying periodicity. The exchange rate has a minimum of 0.84 and a maximum of 1.58, with a mean of 1.22. In the observation period between January 1997 and September 2014 the dollar has his highest value before the official introduction of the Euro and never reached this value again. The graph of the Euro/USD rate can be found in appendix B. Since February 2002 the dollar depreciated against the Euro and experienced its highest depreciation during the financial crisis in 2007. Adam and Tweneboah (2008), Mollick and Assefa (2013) and Hamrita and Trifi (2011) use also the dollar currency value, but again, since the observation period is different, the statistics are not comparable.

Table 4 presents the descriptive statistics for the industry stock returns. In order to compare the returns against standard deviations, Mollick and Assefa (2013) is followed and the Sharpe ratio, which is the mean divided by the standard deviation, is added.

Table 4
Descriptive statistics – Industry stock returns

	Mean	Median	Max.	Min.	Std.Dev.	Sharpe
Basic Materials (%)	0.56	0.93	23.97	-30.00	6.91	8.10
Consumer Goods (%)	0.65	0.98	12.44	-16.93	3.98	16.33
Consumer Services (%)	0.77	0.91	12.09	-18.35	5.23	14.72
Financials (%)	0.44	1.30	18.21	-27.36	6.33	6.95
Healthcare (%)	0.80	1.26	11.06	-13.42	4.19	19.09
Industrials (%)	0.58	1.28	16.56	-23.17	5.57	10.40
Oil and Gas (%)	0.86	0.93	16.68	-20.96	6.50	13.23
Technology (%)	0.57	1.21	19.91	-33.40	8.34	6.83
Telecommunications (%)	0.33	1.15	27.65	-16.92	6.08	5.43
Utilities (%)	0.64	1.25	12.77	-13.62	4.51	14.19

This table presents the descriptive statistics for the industries. The dataset includes observations on a monthly interval from February 1997 to September 2014, for a total of 212 observations. The sectors are defined as the log returns on the Dow Jones sector indices.

Looking to the descriptive statistics between the industries in table 4, a few observations are worth to mention. The oil and gas industry and the healthcare sector show the highest mean returns. The oil and gas industry has an average return of 0,86% and the healthcare sector has an average return of 0,80%. As suggested by Hillier et al. (2010), higher returns are associated with higher risk, which is measured by the standard deviation. Indeed, the oil and gas sector provide also a high standard deviation of 6.50% compared with other industries. However, comparing the standard deviations and returns across the industries, the risk-return linkage is not always respected. The healthcare sector has one of the lowest standard deviations (4.19%) and the highest mean returns (0.80%) between the industries. This turns out in a high Sharpe ratio of 19% for the healthcare sector and indicates that the healthcare sector provides higher returns for the same risk. The technology sector has the highest standard deviation. With a standard deviation of 8.34%, it implies that this sector is high volatile compared with the other industries. Moya-Martinez et al. (2014) present also a high standard deviation for the technology sector in comparison with the other industries. This is also confirmed by Nandha and Faff (2008), who present that the oil industry and the information technology industry share the highest standard deviations between the industries. Bello (2013), Kumar (2014) and Al-Shboul and Anwar (2014) provide also high standard deviations between the sectors for the energy sector, which could be compared with the oil and gas sector. Kumar (2014) provide also highest

mean return for the energy sector between the industries. On the other hand, telecommunications has the lowest mean stock returns (0.33%). Bello (2013), Al-Shboul and Anwar (2014) and Nandha and Faff (2008) provide also, compared with the other industries, low mean returns for the telecom services industry.

5.2 Correlations

The correlations between the macroeconomic variables are presented in table 5. Moreover, as mentioned in paragraph 4.2 about the regression model, various tests to avoid heteroscedasticity and autocorrelation problems are also performed. The results of these tests can be found in appendix D.

Table 5
Correlations – macroeconomic variables

	Crude oil	Interest	Exchange	Gold
Crude oil	1			
Interest	0.011	1		
Exchange	-0.037	0.502***	1	
Gold	0. 157**	-0.056	-0.100	1

This table presents the correlation coefficients between the macroeconomic variables for the period February 1997 to September 2014. Statistical significance at the 10%, 5% and 1% level is indicated with *, ** and , *** respectively.

As can be seen, there is a correlation at the 1% significance level between the interest rate and the exchange rate. As mentioned before in paragraph 2.2.4, the interest rate is a determinant of the exchange rate and used by policymakers to affect currency values. When the interest rate increases, the interest bearing assets of the United States become more attractive, all else being equal. This will induce investors to own more of these assets, and will affect the exchange rate (Hacker, Karlsson and Mansson, 2014). The correlation between gold and crude oil is also significant, but less strong, with a significance level of 5% and a coefficient of 0.157. The main idea behind the gold and oil correlation is that prices of crude oil and gold tend to appreciate with increasing inflation (Narayan and Zheng, 2010). So, a rise in the inflation can eventually be translated into higher prices of commodities.

As mentioned in paragraph 4.2 about the regression model, the high correlation between the interest rate and exchange rate could cause multicollinearity problems in the regressions. In order to control for this issue, the exchange rate is removed from the multiple regression model and tested with a simple regression. Moreover, to get a better understanding of the exchange rate, the period before and after the official Euro introduction is also analysed.

Table 6
Correlations – industry stock returns

	BM	CG	CS	FI	HE	IN	OAG	TEC	TEL	UT
BM	1									
CG	0.671	1								
CS	0.694	0.702	1							
FI	0.684	0.780	0.762	1						
HE	0.442	0.689	0.545	0.616	1					
IN	0.816	0.733	0.857	0.792	0.594	1				
OAG	0.700	0.507	0.461	0.497	0.392	0.629	1			
TEC	0.515	0.420	0.738	0.498	0.443	0.749	0.412	1		
TEL	0.408	0.463	0.633	0.485	0.443	0.565	0.304	0.549	1	
UT	0.400	0.497	0.294	0.428	0.442	0.426	0.554	0.184	0.317	1

This table presents the correlation coefficients between the industry stock returns for the period February 1997 to September 2014.

Table 6 presents the correlations between industry stock returns. The industrials sector has the highest correlation with the consumer services sector and basic materials sector. The industrials sector consists of manufacturers in the construction and refurbishment of buildings industry, and industrial goods and services. The consumer services sector consists of firms in the retail, media, and travel and leisure trades, while the basic materials sector contain firms with operations in the chemical and basic resource fields. The lowest correlation is between the telecommunications sector, which consists of providers of fixed line and mobile phone services, and the oil and gas sector, and between the telecommunications sector and the utilities sector, which is composed of companies generating and distributing electricity and water. The correlations between the dependent variables do not influence the regressions, but since a high correlation is an indication for a systematic change in both variables, it could be expected that the results for the sectors with high correlations could point in the same direction. The sector classification for all industries can be found in appendix C.

5.3 Regressions

Table 7

Regression results – Model 1

	Basic materials			Consumer goods			Consumer services			Financials			Healthcare		
Variables	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period
Crude oil	-0.091	0.238	0.148	-0.120	0.104	0.019	-0.120	0.140	0.026	-0.142	0.216	0.085	-0.110	0.108	0.015
	(-1.087)	(1.957)*	(1.698)*	(-3.177)***	(1.412)	(0.415)	(-1.992)**	(1.732)*	(0.419)	(-2.385)**	(1.905)*	(1.114)	(-2.468)**	(1.259)	(0.303)
Interest	-0.197	26.175	-0.050	-0.093	10.749	-0.095	-0.002	13.601	-0.086	0.045	22.122	0.067	0.282	-4.160	0.029
	(-0.620)	(1.369)	(-0.224)	(-0.487)	(1.020)	(-0.717)	(-0.006)	(1.020)	(-0.527)	(0.164)	(1.618)	(0.320)	(1.362)	(-0.432)	(0.207)
Gold	-0.013	-0.164	-0.110	0.038	-0.156	-0.085	-0.174	-0.213	-0.225	-0.006	-0.461	-0.223	0.086	-0.130	-0.044
	(-0.101)	(-0.751)	(-0.985)	(0.428)	(-1.466)	(-1.129)	(-1.431)	(-1.771)*	(-2.513)**	(-0.034)	(-3.176)***	(-1.603)	(0.864)	(-1.056)	(-0.488)
Adj. R^2	-0.007	0.045	0.018	0.036	0.033	-0.005	0.035	0.046	0.015	0.024	0.154	0.014	0.036	0.010	-0.012

	Industrials			Oil and gas			Technology			Telecommunications			Utilities		
	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period
Crude oil	-0.073	0.219	0.098	0.153	0.360	0.241	-0.022	0.155	0.117	-0.108	-0.003	-0.024	-0.032	0.015	0.057
	(-1.371)	(2.237)**	(1.551)	(2.274)**	(2.881)***	(4.258)***	(-0.204)	(1.431)	(1.532)	(-1.343)	(-0.034)	(-0.437)	(-0.580)	(0.195)	(1.334)
Interest	-0.064	19.917	-0.076	0.058	23.339	0.085	-0.063	9.390	-0.109	0.124	12.156	-0.006	0.287	3.727	0.134
	(-0.255)	(1.369)	(-0.443)	(0.211)	(1.597)	(0.492)	(-0.122)	(0.698)	(-0.398)	(0.321)	(1.258)	(-0.031)	(1.106)	(0.445)	(0.918)
Gold	-0.104	-0.312	-0.242	0.041	-0.211	-0.151	-0.225	-0.154	-0.256	-0.131	-0.093	-0.208	0.018	-0.113	-0.122
	(-1.009)	(-1.964)*	(-2.395)**	(0.341)	(-1.233)	(-1.468)	(-1.186)	(-1.003)	(-2.061)**	(-0.922)	(-0.701)	(-2.142)**	(0.171)	(-0.911)	(-1.442)
Adj. R^2	-0.000	0.097	0.029	0.027	0.158	0.100	-0.015	0.008	0.010	0.005	-0.022	0.006	-0.009	-0.033	0.010

This table presents the OLS regression output for the regression equation: $R_{i,t} = \alpha + \beta_{1,i}oil_t + \beta_{2,i}int_t + \beta_{3,i}gold_t + \varepsilon$. The dataset covers ten sectors using monthly data for three observation periods. The first sample covers the pre-crisis period and is between February 1997 to September 2007 with N=130. The second sample covers the post-crisis period between July 2009 to September 2014 with N=63. The third sample covers the whole period and is from February 1997 to September 2014 with N=212. Crude oil is defined as log returns on the crude oil price per barrel, Interest is the three-month T-Bill constant maturity rate, Gold is defined as the log returns on a troy ounce gold and the sectors are defined as the log returns on the Dow Jones sector indices. The White heteroscedasticity corrected t-statistics are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated with *, ** and *** respectively.

Table 8
Regression results – Model 2

	Basic materials			Consumer goods			Consumer services			Financials			Healthcare		
Variables	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Exchange	-0.009	0.017	0.230	-0.001	0.035	0.130	0.164	-0.079	0.146	0.036	-0.101	0.088	0.083	0.032	0.107
	(-0.128)	(0.240)	(1.931)*	(-0.012)	(0.892)	(2.182)**	(2.596)**	(-1.530)	(1.721)*	(0.540)	(-1.580)	(0.807)	(1.512)	(0.828)	(1.391)
Adj. R^2	-0.014	-0.016	0.040	-0.014	-0.003	0.053	0.054	0.029	0.040	-0.011	0.057	-0.003	0.014	-0.005	0.026

	Industrials			Oil and gas			Technology			Telecommunications			Utilities		
	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Exchange	0.102	-0.032	0.160	0.029	0.043	0.180	0.301	-0.057	0.180	0.285	0.010	-0.000	0.036	0.055	0.100
	(1.491)	(-0.583)	(1.510)	(0.416)	(0.616)	(1.589)	(2.304)**	(-0.773)	(1.918)*	(3.737)***	(0.117)	(-0.005)	(0.603)	(0.975)	(1.597)
Adj. R^2	0.016	-0.009	0.029	-0.012	-0.012	0.031	0.049	-0.005	0.048	0.112	-0.017	-0.016	-0.010	0.005	0.023

This table presents the OLS regression output for the regression equation: $R_{i,t} = \alpha + \beta_i exch_t + \varepsilon_t$. The dataset covers ten sectors using monthly data for three observation periods. The first subsample covers the period before the official Euro introduction and is between February 1997 to December 2001 with N=59. The second subsample covers the pre-crisis period and is from January 2002 to November 2007 with N=71. The third subsample covers the after crisis period and is from July 2009 to September 2014 with N=63. Exchange is defined as the Euro/USD rate and the sectors are defined as the log returns on the Dow Jones sector indices. The White heteroscedasticity corrected t-statistics are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated with *, ** and *** respectively.

Hypothesis 1: *An increase in the oil price has a negative influence on stock performance.*

By looking at the coefficients and the significance levels in table 7, it can be seen that not all industries are affected through changes in crude oil returns. This implies that crude oil returns have a heterogeneous effect on sector returns, which is also confirmed by Narayan and Sharma (2011) and Gogineni (2010). Although nine of the ten industries show insignificant results for the full period, there are some significant coefficients for the subsamples. The only sector which shows highly significant results throughout the full period is the oil and gas sector. The industrials sector also has a positive coefficient (0.219) for the after-crisis period at a significance level of 5%. The oil and gas sector and the industrials sectors are the only two industries with a positive coefficient, which is significant at the 5% level or stronger. These results are consistent with the findings of Nandha and Faff (2008) and Narayan and Sharma (2011) who also report significant positive coefficients for the mining, oil, energy and gas industries. The industrials sector consists of firms with industrial engineering operations but also the metals and mining industry. The oil and gas industry consists of oil and gas producers and suppliers of oil equipment, services and distribution. Considering that oil is the primary output for this industry, this industry will profit from an increase in the oil prices, since higher prices will lead to an increase in the future expected cash flows. When looking at the sub samples, the crisis period strengthened the responsiveness of stock returns in the oil and gas sector to changes in the oil prices. The coefficient (0.360) is stronger during the after crisis period, during the pre-crisis period this relationship is weaker (0.153). The financials sector is the hardest negatively (-0.142) influenced sector by oil returns during the post crisis period and has a significance level of 5%. Gogineni (2010), Narayan and Sharma (2011) and Nandha (2008) who all used data from before the crisis, also proved a significant negative impact of changes in oil prices on stock returns in the sectors which could be compared with the financials sectors in this study, namely the banking sector, finance and insurance sector. During the after-crisis period, this coefficient (0.216) is just the opposite for the financials sector. A clarification for this could be that firms in the financials sector support clients with risk management. Hedging of energy and commodity prices with derivatives is common within this area (Nanndha and Faff, 2008 and Sadorsky, 2001). If there is a change in oil prices and uncertainty in the financial environment such as a financial crisis, firms should be more willing to hedge and reduce their exposure to fluctuations in oil prices. This will increase the trade volume, and probably the income and future cash flows for firms within the financial sector. This reasoning implies that the financials industry could benefit from a rise in oil prices. However, the positive coefficient for oil during the after-crisis period is significant at 10% level, which is not strong, and is a low presumption against the null hypothesis of no impact. The basic materials sector also has a positive coefficient for the period after the crisis (0.238) and throughout the whole period (0.148), but again, the statistical significance is very low (1%) which makes it not possible to draw any strong conclusions from these results. The consumer goods, consumer services and healthcare industries have negative coefficients (-0.120, -0.120, -0.110 respectively) during the pre-crisis period which are highly significant at the 5% and 1% level. The consumer goods sector consists of manufacturers of food and beverages, automobiles and parts and personal and household goods. The consumer services sector consists of food companies, general retailers and travel and leisure, and the healthcare sector includes companies selling or manufacturing healthcare equipment and pharmaceuticals. When comparing these results with prior studies, common results can be found. Narayan and Sharma (2011) provide evidence for the medical, chemical and transport sectors; Gogineni (2010) also provides evidence for the food sector and indicates that oil prices changes

influence stock returns. As can be seen, also industries which do not use crude oil are sensitive to crude oil returns (Gogineni, 2010). For all these four industries, the consumer goods, consumer services, financials and healthcare, the responsiveness to oil returns decreased after the crisis. However, the role of oil during and after crisis periods is unclear and there is a lack in empirical research, which makes it difficult to explain these differences and need to be further investigated. There are also some industries from which the coefficients are insignificant, such as the utilities sector, which is consistent with the results of Gogineni (2010). These sectors could be negligibly oil intensive, or since the results of this study and the results of Gogineni (2010) also provide significant results for some non-oil intensive industries, the industries which are insignificant could compensate the increased operational costs with increased prices towards customers, which in turn will result in unaffected expected future cash flows. However, the possibility to raise prices is linked to market characteristics and economic environment, such as the financial crisis, and is only possible for firms with products which are not standardized.

Hypothesis 2: *An increase in the interest rate has a negative influence on stock performance.*

Surprisingly, the results for all industries are insignificant for all three samples. This is not in line with the main body of the prior research. Prior research in this area provided evidence of a significant negative linkage between fluctuations in the interest rate and stock returns (Reilly, Wright and Johnson, 2007; Asprem, 1989; Aurangzeb 2012). However, more recent studies conclude that the influence of interest rate movements on stock returns has decreased over time due to the rise in enhanced tools for managing interest rate risk (Korkeamaki, 2011; Czaja, Scholz and Wilkens,2010). Also, the growth in corporate bond markets and interest derivative markets has played a crucial role in this context (Moya Martinez et al., 2014). As mentioned in paragraph 2.2 about interest rates, changes in the interest rate influence both the expected future cash flows and the discount rate (Moya-Martinez-et al., 2014). Bredin and Hyde (2011) analysed the interest rate exposure on industry level for seven countries, decomposing the exposure into cash flows and discount rate effects. They only show an influence of interest rate changes on industry returns in the U.S. for two out of the nine industries, which are the oil and gas and the utilities sector. The results for the other six countries present a significant influence from interest changes on returns for more industries. A lack of significance between fluctuations in the interest rate and stock returns for US industries is also reported by the earlier studies by Sweeney and Warga (1986) and Prasad and Rajan (1995).

Despite the studies which also present insignificant results, the results of this study are still somewhat confusing. Therefore it is useful to check for the robustness of the definition of the interest rate variable used in this study. As a robustness check, an interest rate with a different maturity could be used (Czaja et al., 2009; Korkeamaki, 2011). Therefore, the three-month T-Bill constant maturity rate will be substituted by the one year T-Bill constant maturity rate. The results can be found in appendix E. Still, the results are the same and the coefficients are insignificant. A common feature of the studies with insignificant results and this study is that the Ordinary Least Squares (OLS) method is used. Interestingly, studies which use more advanced economic methods such as wavelet analysis and VECM (Moya-Martinez et al., 2014; Adam and Tweneboah, 2008), found significant results between the interest rate and stock returns. Olugbode and Pointon (2013) argue that the OLS method could lead to biased or misleading results when analysing the interest rate. More about this issue will be discussed in chapter six.

Hypothesis 3: *An increase in the exchange rate has a negative influence on stock performance.*

The results for the exchange rate are shown in table 8. Some of the sectors show positive significant signs. Since the exchange rate is defined as the Euro/USD rate, the positive signs indicate that a depreciation of the U.S. dollar coincides with an increase in stock returns. When looking at the positive signs in table 8 for the Euro/USD rate, it is important to make a distinction between importing and exporting firms and hence the sectors (Yau and Nieh, 2006). The technology sector is significantly influenced by changes in the currency values during sample the pre-crisis period (0.301) and the full period (0.180). The positive signs indicate that this industry gains higher stock returns when the U.S. dollar depreciates against the Euro. According to data from the Worldbank (2014b), the United States is the world's third largest exporter of technology behind Germany and China. An depreciation in the U.S. dollar will increase the foreign demand for the products in this industry, hence higher exports and stock returns. The positive coefficients for the consumer goods(0.130), consumer services (0.164) and telecommunications sector (0.285) also indicate that these sectors could be export oriented, all else being equal, and gain returns from a depreciation in the local currency (Choi and Kim, 2003).

As mentioned in paragraph 3.3, the majority of the prior research argued that stock returns are negatively influence by depreciating domestic currency values. The results of this study are not in line with these aforementioned studies. Again, a robustness check is performed. The Euro/USD rate is substituted by the GBP/USD rate, which is the third most traded currency (BIS, 2013). The results can be found in appendix E. All results are insignificant, but only the healthcare sector and telecommunications sector present positive significant results, which are in line with prior research. However, these coefficients are significant only at the 10% level, which makes it impossible to draw strong conclusions. All the other coefficients present insignificant results, which is in line with the regression results of the Euro/USD rate. Bartram, Brown and Minton (2010) argue that the stock performance is not exposed to exchange rate movements and provide evidence that companies successfully pass through a part of the changes in the exchange rates to customers. Also, the use of operational and financial hedges decreases the exposure of exchange rate changes, which could be an explanation for the insignificant results. A combination of these factors reduces the level of exchange rate exposure to a minimum (Bartram et al., 2010). Choi and Kim (2003) argue along the same lines and mention that hedging as well as operational strategies reduce the exposure profile of the company. These results are consistent with the findings of Chkili and Nguyen (2014).

Hypothesis 4: *There is no relation between gold and stock performance.*

From the regression results in table 7 it could be noted that changes in the gold price have no influence on stock returns for all ten sectors in the pre-crisis period. As mentioned in paragraph 2.2.5, gold is a commodity and has the characteristics of a financial instrument. However, there are differences between gold and other commodities. Gold has crucial attributes, it is homogenous, the inventory of above-ground stock is very large and throughout history gold has also been stored in central banks for economic security (Lawrence, 2003; Ciner, 2001). More specific characteristics of gold are mentioned in paragraph 2.2.5. These characteristics set gold apart from other financial assets and tend to make the fluctuations in the economic environment irresponsive to fluctuation in the returns of gold. But, as presented in the correlation table 5 in paragraph 5.2, gold has a

correlation coefficient of 0.157 with oil at a significance level of 5%. This correlation tends to be small, and is attributed to the extent to which gold shares some crucial characteristics with oil. While returns on gold may be correlated with other commodities, fluctuations in GDP, short term interest rates and the money supply are not correlated with gold returns (Lawrence, 2003). It is worth mentioning that correlation does not mean causation, but it can be seen as an underlying reasoning for the linkage between the variables. Due to the lack of correlations with other macroeconomic variables and equity returns, gold is regarded as a safe haven asset and is used for diversification. The price of gold typically rises during times of financial uncertainty (Arouri, Lahiani and Nguyen, 2013). The returns on gold returns are also not correlated with those on equities (Hood and Malik, 2013; Ozdemir and Yesilyurt, 2013 and Akgun et al., 2013). Lawrence (2003) also concludes with a VAR framework that gold returns do not influence the S&P 500 index, which is in line with the results of this study. A reason for this could be the low demand for gold as an input in the manufacturing of products (Lawrence, 2003). While the results of this study present no significant coefficients for the pre-crisis period, the financials sector has a significant negative coefficient during the post-crisis period (-0.461). The consumer services, financials, industrials, technology and telecommunications sectors present significant negative coefficients (-0.225, -0.461, -0.242, -0.256, -0.208 respectively). While the bulk in this area presents no relationship between gold and stock returns, there are also some studies which found an impact of gold on stock returns. Arouri, Lahiani and Nguyen (2013), Davidson and Faff (2003) and Sumner et al. (2010) provide evidence for a negative influence of changes in gold returns on stock returns. Stock returns could be indirectly affected by changes in the gold returns. Higher gold returns could lead to a lower demand for shares, since investors tend to replace their shares with gold. Also, increasing gold returns will lead to a growing demand for gold, and hence a lower demand for competing products (Davidson and Faff, 2003). Furthermore, all aforementioned authors focus on the whole aggregate market of countries and not on industries, and none of these authors include the recent financial crisis and recent data in their data sample which makes it difficult to compare the post crisis period and the full period with the results of these earlier studies.

6. Discussion

The relationship between fluctuations in macroeconomic variables and stock returns has received a great deal of attention in the literature and has been investigated by using various econometric approaches. The classical ordinary least squares method has been the most common approach to assess this relationship (Moya-Martinez et al., 2014; Olugbode and Pointon, 2013). It is one of the earliest general prediction methods, it is easy to implement and, in contrast with other regression techniques, it is not too difficult to analyse the results (Dwinnel, 2014). The implementation is also efficient, it can be very quickly applied to problems with many data points. Because of the advantages of being numerically simple, the ordinary least squares method has earned its place as the primary tool for estimations. Due to these advantages, and a lack of knowledge about the more advanced econometric tools which will be discussed below, the ordinary least square method is also used in this study to estimate the effects.

However, despite the advantages, there are also limitations of this approach. A major limitation of the ordinary least squares method is its incapability to capture the time-varying properties of time series. As mentioned in the results section, especially the results for the interest rate may be biased and misleading, which could be a consequence of the use of the ordinary least squares method. Therefore, more recent studies have utilized advanced time series methods in the time domain, such as granger causality, generalized autoregressive conditional heteroscedasticity (GARCH), vector autoregressive (VAR) and wavelet analysis.

Moya-Martinez et al. (2014) argue that the influence of relevant features, such as the investment horizon on the interest rate, should be taken into account when estimating the influences (Moya-Martinez et al., 2014). Stock markets and bond markets are complex systems with many heterogeneous agents, making decisions based on different time horizons, which vary from minutes to years. Day traders make decisions typically linked to sporadic events such as announcements, while agents with long horizons largely base their decisions on investment activities and follow the macroeconomic environment more closely (Moya-Martinez et al., 2014). Therefore, it is not unreasonable to also take different time scales associated with various time horizons into account. In this way, a wavelet analysis could be preferred as an alternative to the classical regression methods. Joseph and Vezos (2006), (cited in: Olugbode, 2013, p.7), examine the exchange rate and the interest rate exposure for U.S. banks with the ordinary least squares method and EGARCH approach and conclude that the results are stronger for the same dataset with the EGARCH method. Kasman et al. (2011) investigate the effects of the interest rate and exchange rate on stock returns with the OLS and GARCH methods and argue that when the GARCH method is used, the significant exposures are higher. Therefore, an extension of this paper will go from the ordinary least squares method to the use of more advanced econometric methodologies.

7. Conclusions

In this study, the relationship between changes in macroeconomic variables and stock returns of U.S. industries is documented. The analysis is useful to determine whether these variables can be used to diversify risk. This study answers the following research question:

What is the influence of macroeconomic variables on the stock performance of various industries?

Four macroeconomic variables and the stock returns of ten U.S. industries are investigated. The study uses monthly data from February 1997 to September 2014 and the ordinary least squares approach. The findings of this paper demonstrate that the impact of some macroeconomic variables differs between industry sectors, whereas one variable has a homogenous impact.

The first hypothesis, a negative influence from crude oil on stock returns, is confirmed for four industries. The empirical results indicate that the consumer goods, consumer services, financials and healthcare sectors exhibit a negative significant exposure to a change in the oil price. As expected, the oil and gas and industrials industries present positive significant results and profit from an increase in the oil prices. The degree of oil price exposure differs considerably across industries. In addition to industries which are oil-intensive, it can be concluded that the returns of industries which use virtually no oil are also sensitive to fluctuations in the oil prices. The second hypothesis, an increase in the interest rate has a negative influence on stock performance, is rejected. The results of this study present insignificant results for all industries during all observation periods; furthermore, they prove that the interest rate has a homogenous effect across the industries. A reason for the insignificant results could be the rise in the enhanced tools for managing interest rate risk, and the growth in the corporate bond and derivative markets. The evidence found in this study suggests that interest rate changes do not significantly influence stock returns. However, this notion needs further support, as discussed in the previous chapter about the advantages and disadvantages of the methodology. The third hypothesis, an increase in the exchange rate has a negative influence on stock performance, is rejected for all industries. Six out of the ten industries present insignificant results. Four industries are significant positive affected by a depreciation in the U.S. dollar against the Euro, which could be a consequence of the export oriented nature of these industries. A decrease in the U.S. dollar rate will increase foreign demand from Euro countries and lower stock returns. The fourth hypothesis, that there is no relation between gold and stock performance, is accepted for all industries in the pre-crisis period. During the post-crisis period and throughout the whole period, the results are for some sectors significantly negative, which could be the outcome of a substitution effect from shares to gold.

The results overall indicate the negative influence of crude oil on stock returns for some industries, while the interest rate has no influence on stock performance for all industries. Industries which are export oriented are influenced by changes in the Euro/USD rate and changes in gold returns do not influence the stock returns for the pre-crisis period, while an opposite effect is observed during the pre-crisis period and the whole period for some industries.

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Appendix A: Descriptive statistics subsamples

Table 9 presents the descriptive statistics for the first sample, which is the period between February 1997 – November 2007. Table 10 presents the descriptive statistics for the second sample, which covers the period from July 2009 to September 2014. Table 11 presents the descriptive statistics for the exchange rate for three subsamples: The first sample covers the period February 1997 to December 2001, the second sample covers the period from January 2002 to November 2007 and the third sample covers the period July 2009 to September 2014.

Table 9
Descriptive statistics – Sample 1

	Mean	Median	Max.	Min.	Std.Dev.	Sharpe
Crude oil (%)	1.03	2.19	19.94	-19.06	7.90	
Interest (%)	3.73	4.48	6.38	0.90	1.70	
Gold (%)	0.63	0.16	16.01	-12.48	3.75	
Basic Materials (%)	0.68	0.68	23.97	-14.72	6.03	11.28
Consumer Goods (%)	0.60	0.89	12.44	-16.93	3.87	15.50
Consumer Services (%)	0.67	0.57	12.09	-16.02	5.25	12.76
Financials (%)	0.74	1.06	15.69	-25.02	5.28	14.02
Healthcare (%)	0.72	1.16	11.06	-12.41	4.13	17.43
Industrials (%)	0.59	1.07	12.01	-15.87	4.94	11.94
Oil and Gas (%)	1.15	0.46	16.68	-13.06	5.62	20.46
Technology (%)	0.49	1.16	19.91	-33.40	9.58	5.11
Telecommunications (%)	0.31	1.27	27.65	-16.92	6.71	4.62
Utilities (%)	0.81	1.24	12.77	-13.62	4.67	17.34

This table presents the descriptive statistics for the independent and dependent variables. The dataset includes observations on a monthly interval from **February 1997 to November 2007**, for a total of 130 observations. Crude oil is defined as log returns on the crude oil price per barrel. Interest is the rate for the three-month T-Bill constant maturity. Gold is defined as the log returns on a troy ounce gold and the sectors are defined as the log returns on the Dow Jones sector indices.

Table 10
Descriptive statistics – Sample 2

	Mean	Median	Max.	Min.	Std.Dev.	Sharpe
Crude oil (%)	0.46	0.96	13.93	-13.94	5.78	
Interest (%)	0.08	0.07	0.18	0.01	0.05	
Gold (%)	0.43	0.68	11.19	-6.83	3.71	
Basic Materials (%)	1.27	1.76	17.81	-21.92	6.31	20.13
Consumer Goods (%)	1.41	1.45	8.87	-6.16	3.24	43.52
Consumer Services (%)	1.77	2.37	10.79	-9.64	4.01	44.14
Financials (%)	1.23	2.31	12.91	-11.73	4.97	24.75
Healthcare (%)	1.60	1.56	9.04	-7.39	3.38	47.34
Industrials (%)	1.57	2.04	13.77	-10.03	4.91	31.98
Oil and Gas (%)	1.09	2.05	15.99	-14.11	5.43	20.07
Technology (%)	1.39	1.99	11.68	-8.95	4.65	29.89
Telecommunications %)	1.11	1.15	9.29	-9.06	3.85	28.83
Utilities (%)	1.05	1.51	7.03	-8.46	3.30	31.82

This table presents the descriptive statistics for the independent and dependent variables. The dataset includes observations on a monthly interval from **July 2009 to September 2014**, for a total of 63 observations. Crude oil is defined as log returns on the crude oil price per barrel. Interest is the rate for the three-month T-Bill constant maturity. Gold is defined as the log returns on a troy ounce gold and the sectors are defined as the log returns on the Dow Jones sector indices.

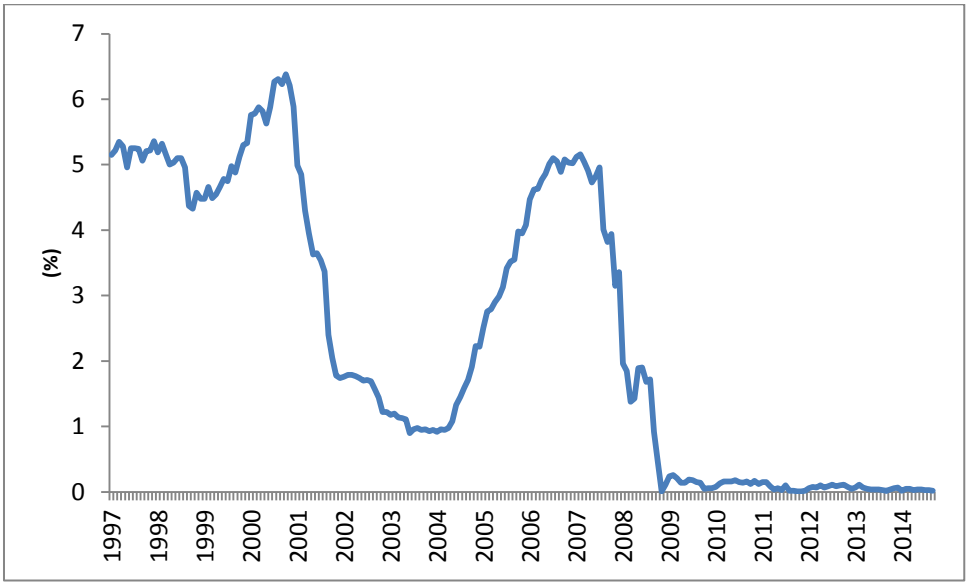
Table11
Descriptive statistics – Exchange rate

	Mean	Median	Max.	Min.	Std.Dev.
Exchange rate - sample 1	1.02	1.06	1.19	0.84	0.11
Exchange rate - sample 2	1.20	1.22	1.48	0.86	0.14
Exchange rate - sample 3	1.35	1.35	1.50	1.23	0.06

This table presents the descriptive statistics for the exchange rate. Exchange rate is defined as the Euro/ USD rate. The dataset includes observations on a monthly interval for three samples. The first sample covers the period **February 1997 to December 2001** with N=59. The second sample covers the period from **January 2002 to November 2007**, with N=71. The third sample covers the period **July 2009 to September 2014**, with N=63.

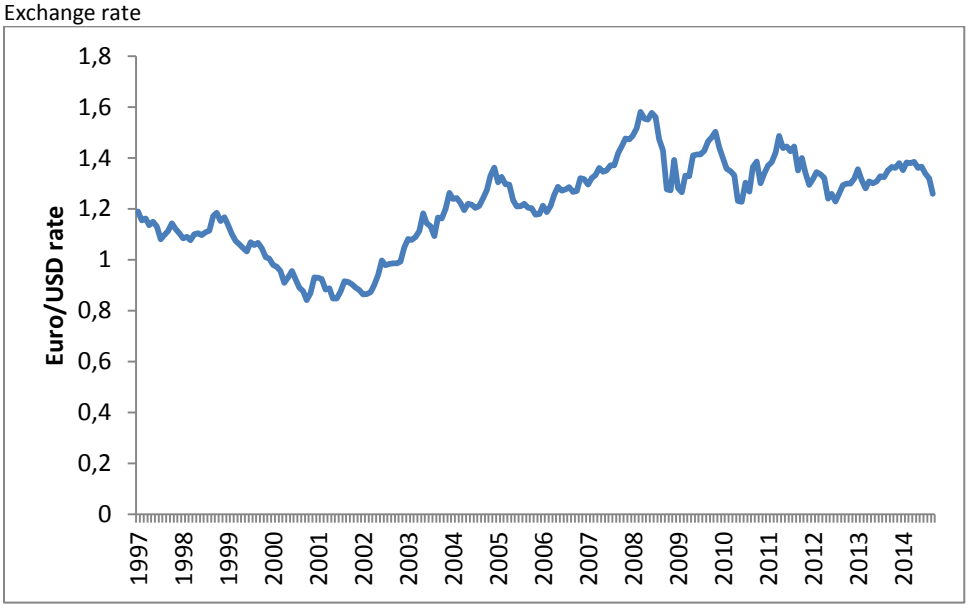
Appendix B: Figures interest and exchange rate

Figure 3
Interest rate



This figure presents the three-month constant maturity T-Bill rate in percentages from January 1997 till September 2014. (data is in monthly frequencies).

Figure 4
Exchange rate



This figure presents the Euro/USD rate from January 1997 till September 2014 (data is in monthly frequencies).

Appendix C: Industry classification

Industry	Subindustry
Basic materials	Chemicals
	Forestry & paper
Consumer goods	Automobiles & parts
	Beverages
	Food producers
	Household goods & home construction
	Leisure goods
	Personal goods
	Tobacco
Consumer services	Food & drug retailers
	General retailers
	Media
	Travel & leisure
Financials	Banks
	Nonlife insurance
	Life insurance
	Real estate investment & services
	Real estate investment trusts
	Financial services
	Equity investment instruments
	Nonequity investment instruments
Healthcare	Health care equipment & services
	Pharmaceuticals & biotechnology
Industrials	Construction & materials
	Aerospace & defense
	General industrials
	Electronic & electrical equipment
	Industrial engineering
	Industrial transportation
	Industrial metals & mining
	Mining
	Support services
Oil and gas	Oil and gas producers
	Oil equipment, services & distribution
	Alternative energy
Technology	Software & computer services
	Technology hardware & equipment
Telecommunications	Fixed line telecommunications
	Mobile telecommunications
Utilities	Electricity
	Gas, water & multiutilities

Source: Dow Jones sector Classification (Dow Jones, 2014)

Appendix D: Results heteroscedasticity and autocorrelation tests

Table 12 and table 13 presents the results for the heteroscedasticity and autocorrelation tests for the first regression equation: : $R_{i,t} = \alpha + \beta_{1,i}oil_t + \beta_{2,i}int_t + \beta_{3,i}gold_t + \varepsilon$. Table 14 and table 15 presents the results for the heteroscedasticity and autocorrelation tests for the second regression equation: $R_{i,t} = \alpha + \beta_i exch_t + \varepsilon$.

Table 12
Heteroscedasticity test

	Sample1	*Sample2*	*Sample3*
1. Basic materials	0.247	0.553	0.000
2. Consumer goods	0.974	0.001	0.036
3. Consumer services	0.858	0.012	0.000
4. Financials	0.833	0.322	0.016
5. Healthcare	0.786	0.011	0.000
6. Industrials	0.629	0.034	0.001
7. Oil and gas	0.750	0.039	0.372
8. Technology	0.548	0.358	0.030
9. Telecommunications	0.832	0.899	0.618
10. Utilities	0.571	0.859	0.416

This table presents the results (p-values) for the White test for the regression equation: $R_{i,t} = \alpha + \beta_{1,i}oil_t + \beta_{2,i}int_t + \beta_{3,i}gold_t + \varepsilon$.

Table 13
Autocorrelation tests

	DW-statistic *Sample1*	Breusch-Godfrey	DW-statistic *Sample2*	Breusch-Godfrey	DW-statistic *Sample3*	Breusch-Godfrey
1. Basic materials	2.146	0.813	2.550	0.518	1.989	0.668
2. Consumer goods	1.873	0.241	2.489	0.096	1.849	0.650
3. Consumer services	1.846	0.311	2.421	0.269	1.741	0.465
4. Financials	2.198	0.401	2.334	0.613	1.878	0.062
5. Healthcare	2.245	0.698	2.276	0.069	2.060	0.540
6. Industrials	1.927	0.815	2.521	0.327	1.854	0.575
7. Oil and gas	2.222	0.897	2.419	0.572	2.278	0.701
8. Technology	2.034	0.708	2.331	0.519	1.970	0.843
9. Telecommunications	2.043	0.262	2.373	0.184	1.973	0.284
10. Utilities	1.849	0.910	2.460	0.163	1.886	0.535

This table presents the Durbin and Watson statistics and the results (p-values) for the Breusch-Godfrey Serial Correlation LM test for the regression equation: $R_{i,t} = \alpha + \beta_{1,i}oil_t + \beta_{2,i}int_t + \beta_{3,i}gold_t + \varepsilon$.

Table 14
Heteroscedasticity test

	Sample1	*Sample2*	*Sample3*
1. Basic materials	0.274	0.530	0.810
2. Consumer goods	0.171	0.661	0.929
3. Consumer services	0.166	0.233	0.561
4. Financials	0.375	0.007	0.522
5. Healthcare	0.299	0.872	0.188
6. Industrials	0.714	0.048	0.525
7. Oil and gas	0.972	0.678	0.748
8. Technology	0.052	0.633	0.862
9. Telecommunications	0.161	0.000	0.986
10. Utilities	0.058	0.128	0.363

This table presents the results (p-values) for the White test for the regression equation: $R_{i,t} = \alpha + \beta_i exch_t + \varepsilon_.$

Table 15
Autocorrelation tests

	DW-statistic *Sample1*	Breusch-Godfrey	DW-statistic *Sample2*	Breusch-Godfrey	DW-statistic *Sample3*	Breusch-Godfrey
1. Basic materials	2.194	0.738	2.213	0.827	2.163	0.779
2. Consumer goods	1.894	0.736	1.717	0.485	2.200	0.594
3. Consumer services	1.880	0.077	1.858	0.880	2.115	0.803
4. Financials	2.251	0.573	1.713	0.243	1.942	0.986
5. Healthcare	2.348	0.825	1.771	0.617	2.011	0.495
6. Industrials	2.058	0.789	1.801	0.605	2.043	0.958
7. Oil and gas	2.096	0.975	2.404	0.056	1.891	0.891
8. Technology	2.193	0.914	1.963	0.934	2.136	0.391
9. Telecommunications	2.394	0.073	1.643	0.237	2.313	0.156
10. Utilities	1.978	0.874	1.541	0.266	2.434	0.237

This table presents the Durbin and Watson statistics and the results (p-values) for the Breusch-Godfrey Serial Correlation LM test for the regression equation: $R_{i,t} = \alpha + \beta_i exch_t + \varepsilon_.$.

Appendix E: Results robustness check

Table 16 presents the regression results for the first regression equation: : $R_{i,t} = \alpha + \beta_{1,i}oil_t + \beta_{2,i}int_t + \beta_{3,i}gold_t + \varepsilon$. In this regression equation the interest rate is the one year T-Bill constant maturity rate instead of the three month constant maturity rate. Table 17 presents the regression results for the exchange rate: $R_{i,t} = \alpha + \beta_i exch_t + \varepsilon$. In order to test for robustness, the exchange rate is substituted with the GBP/USD rate (instead of the Euro/USD rate)

Table 16

Regression results robustness check- interest rate

	Basic materials			Consumer goods			Consumer services			Financials			Healthcare		
Variables	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period
Crude oil	-0.090	0.227	0.148	-0.120	0.100	0.019	-0.120	0.134	0.026	-0.142	0.208	0.085	-0.111	0.110	0.015
	(-1.079)	(1.824)*	(1.700)*	(-3.152)***	(1.330)	(0.419)	(-1.996)**	(1.623)	(0.423)	(-2.383)**	(1.795)*	(1.112)	(-2.523)**	(1.263)	(0.304)
Interest	-0.195	11.634	-0.104	-0.085	4.504	-0.117	0.028	6.563	-0.112	0.084	8.987	0.037	0.326	-2.014	0.007
	(-0.582)	(1.420)	(-0.478)	(-0.412)	(0.904)	(-0.902)	(0.100)	(1.355)	(-0.699)	(0.287)	(1.492)	(0.184)	(1.476)	(-0.468)	(0.048)
Gold	-0.014	-0.180	-0.112	0.038	-0.161	-0.086	-0.172	-0.225	-0.227	-0.003	-0.469	-0.224	0.090	-0.126	-0.044
	(-0.107)	(-0.804)	(-1.002)	(0.427)	(-1.466)	(-1.140)	(-1.417)	(-1.785)*	(-2.521)**	(-0.017)	(-3.111)***	(-1.606)	(0.906)	(-1.027)	(-0.495)
Adj. R^2	-0.007	0.037	0.019	0.036	0.025	-0.003	0.035	0.045	0.015	0.0242	0.138	0.013	0.039	0.010	-0.012

	Industrials			Oil and gas			Technology			Telecommunications			Utilities		
	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period	Sample 1	Sample 2	Full period
Crude oil	-0.072	0.210	0.098	0.153	0.356	0.241	-0.021	0.150	0.117	-0.109	-0.007	-0.024	-0.033	0.012	0.057
	(-1.362)	(2.097)	(1.554)	(2.277)**	(2.842)***	(4.249)***	(-0.193)	(1.364)	(1.534)	(-1.357)	(-0.079)	(-0.435)	(-0.613)	(0.164)	(1.329)
Interest	0.005	9.633	-0.093	0.112	5.122	0.073	0.067	5.545	-0.098	0.141	4.314	-0.027	0.321	2.195	0.114
	(0.019)	(1.687)	(-0.560)	(0.398)	(0.892)	(0.433)	(0.126)	(0.923)	(-0.372)	(0.342)	(0.918)	(-0.151)	(1.173)	(0.524)	(0.803)
Gold	-0.100	-0.330	-0.243	0.045	-0.189	-0.151	-0.217	-0.169	-0.256	-0.129	-0.093	-0.209	0.021	-0.119	-0.123
	(-0.981)	(-2.050)**	(-2.401)**	(0.373)	(-1.006)	-(1.468)	(-1.148)	(-1.032)	(-2.061)**	(-0.905)	(-0.685)	(-2.143)**	(0.205)	(-0.947)	(-1.443)
Adj. R^2	-0.001	0.095	0.030	0.027	0.121	0.100	-0.015	0.012	0.010	0.004983	-0.034131	0.006	-0.007	-0.032	0.009

This table presents the OLS regression output for the regression equation: $R_{i,t} = \alpha + \beta_{1,i}oil_t + \beta_{2,i}int_t + \beta_{3,i}gold_t + \varepsilon$. The dataset covers five sectors using monthly data for three observation periods. The first sample covers the pre-crisis period and is between February 1997 to September 2007 with N=130. The second sample covers the post-crisis period between July 2009 to September 2014 with N=63. The third sample covers the whole period and is from February 1997 to September 2014 with N=212. Crude oil is defined as log returns on the crude oil price per barrel, **Interest is the one year T-Bill constant maturity rate**, Gold is defined as the log returns on a troy ounce gold and the sectors are defined as the log returns on the Dow Jones sector indices. The White heteroscedasticity corrected t-statistics are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated with *, ** and *** respectively

Table 17

Regression results robustness check– exchange rate

	Basic materials		Consumer goods		Consumer services		Financials		Healthcare	
Variables	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
Exchange	0.021	0.171	0.014	0.066	0.012	0.055	-0.013	0.071	0.045	0.121
	(0.579)	(1.236)	(0.672)	(0.735)	(0.382)	(0.496)	(-0.395)	(0.553)	(1.961)*	(1.280)
Adj. R^2	-0.009	0.005	-0.007	-0.004	-0.012	-0.011	-0.011	-0.010	0.050	0.021

	Industrials		Oil and gas		Technology		Telecommunications		Utilities	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
Exchange	0.037	0.036	0.051	0.128	0.052	0.132	0.078	0.001	0.058	0.078
	(1.181)	(0.263)	(1.413)	(0.946)	(0.868)	(1.302)	(1.376)*	(0.012)	(1.687)	(0.788)
Adj. R^2	0.012	-0.015	0.012	0.000	0.003	0.007	0.028	-0.016	0.044	-0.000

This table presents the OLS regression output for the regression equation: $R_{i,t} = \alpha + \beta_i exch_t + \varepsilon_t$. The dataset covers ten sectors using monthly data for two observation periods. The first subsample covers the pre-crisis period and is from January 2002 to November 2007 with N=71. The second subsample covers the after crisis period and is from July 2009 to September 2014 with N=63. Exchange is defined as the GBP/USD rate and the sectors are defined as the log returns on the Dow Jones sector indices. The White heteroscedasticity corrected t-statistics are reported in parentheses. Statistical significance at the 10%, 5% and 1% level is indicated with *, ** and *** respectively.