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Oil price effect on Nordic equity market indices

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Abstract

This paper empirically investigates the oil price predictability effect documented by Fan and Jahan-Parvar (2012) in the Nordic stock markets at industry-level returns. Using the percentage changes in oil spot prices as a predictor we find that oil price predictability is evident in a relatively small part of the studied industries. The effect was foremost apparent in those industries not directly impacted by oil or impacted with a second order effect. We also examine the contemporaneous effect between oil price changes and equity indices, specifically the Oil and Gas industry across the four Nordic countries are analyzed. The link between the oil price and Oil and Gas industry is apparent in all the Nordic countries. Regarding the rest of the studied industries the result is mixed. We also introduced an interaction term to control for historical oil shocks in the model in order to distinguish between the oil effect under normal price movements and those movements originating from oil shocks. With the introduction of oil shocks in the model the significance of mainly service oriented industries are reduced or removed.

Keywords: Return predictability, Oil price changes, Market Efficiency, Industry-level returns.

Contents

1. Introduction

Today, oil is the most important natural resource of the industrialized nations and forms one of the corner stones of the global economy. Within our daily lives oil is used almost everywhere and both consumers and companies have to account for the commodity in one way or another. Oil is used to make a number of products for a number of industries where some of the most apparent ones are transportation-, heating-, electricity and petrochemical industries (Energimyndigheten 2015). All having a direct or indirect effect on economic activities. A change in oil price therefore affects corporate and consumer's activity either directly or indirectly.

As a consequence of oils large impact in the economy, we want to investigate how different industries in the economy are affected by oil price changes. We therefore decided to study if fluctuations in oil price may have any predictable effects on equity indices returns. Our chosen region includes Sweden, Denmark, Norway and Finland, which serves as a good case to study since the countries are quite similar in size and level of industrialization. The region also includes one oil exporting and three oil importing countries, and thereby provides us to explore both oil input and output relationship between the oil price and equity markets.

Earlier research have shown a predictable effect from oil price changes on equity indices both at country level (Driesprong et al. 2008) and at the industry levels in the US (Fan & Jahan-Parvar, 2012). Driesprong et al. (2008) shows that changes in oil prices may predict index returns for some international and developed financial markets under a relatively short period of approximately two weeks. Their findings reveal statistically significant predictability in several country- and world market indices. Later Fan and Jahan-Parvar (2012) builds on Driesprong et al. (2008) and investigates the impact of oil price fluctuations in different US industries and show how each industry is affected differently by fluctuations in oil price.

In our paper we use a framework similar to Fan & Jahan-Parvar (2012) and Driesprong et al. (2008) and study to what extent the macroeconomic factor, oil, affects the stock returns in Nordic industries. The study will focus on predictable time lagged effects in the equity data, but also look if there is any contemporaneous effect to be found. Predictability is of great interest for financial institutions and investors, since justified models with even small prediction power for asset returns can be used to generate large profits (Fan & Jahan-Parvar 2012).

Our results supports Fan & Jahan-Parvar (2012) findings that oil price changes might have a lagged impact on industry equity returns, specifically in industries that are not directly related to oil. Further on our results show that it might exist a weak predictability effect in industries which are directly and indirectly affected by oil. Our results support part of their results that it might exist a weak predictability effect in industries with a second order effect. We also find that oil prices are incorporated efficiently in the Oil and Gas industry contemporaneously.

The rest of this thesis will proceed as follows: in part 2, we introduce earlier research and theory completed in this area and discusses findings regarding predictability of industry level returns. In part 3, we form our hypotheses and in part 4 we introduce and discuss the data. In part 5, we describe what methodologies and statistical concept we have used. In part 6, we present and discuss our results. Section 7 concludes.

2. Literature review

2.1. The impact of oil price changes on economic activity

Oil has been the world's major commercial energy source for many decades and the consensus view is that it will maintain this leading role well into the 21st century (OPEC 2015). As a consequence the relationship between oil, macroeconomic variables and business cycles has long drawn the attention from researchers' (Hamilton 1983; Gisser and Goodwin 1986; Mork 1989; Mork, Olsen and Mysen 1994). However Hamilton (2003) states that the effects of oil price changes in the economy as a whole and on equity market is not that well understood. But Fan and Jahan-Parvar (2012) contend that the negative relation between oil price and GDP now seems to be accepted by researchers. Contrastingly, Mork, Olsen and Mysen (1994) explain that although most countries in their study are negatively affected by oil prices increases, Norway is positively affected. They suggest that the reason behind this is the relatively substantial oil industry in Norway. Ravazzolo and Rothman (2013) agree with the assumption of a strong correlation between oil prices and GDP. However, when testing the forecasting ability of oil prices on GDP growth, their results are mixed.

In earlier studies by Chen et al. (1986), the authors document no statistically significant effect of the crude oil price changes on stock returns. However these studies were undertaken during a time period where oil price shocks were uncommon (Hamilton 1983).

2.2. The link between oil price changes and stock markets

The efficient market hypothesis (EMH) was formulated by Fama (1970) and is a measure of how well asset prices incorporate available market information. The general idea of this hypothesis is that asset prices should reflect available market information. Thus, in efficient markets, asset prices should be random or follow a random walk or that, in other words cannot be predicted. Bodie et. al, (2011) also states that random price changes indicate a well-functioning market and only unexpected events have an impact on asset prices. With this view as a step stone, it can be argued that when companies that have oil as either an input or output in their production, the stock market should quickly and efficiently incorporate the oil price change in the stock price. Bjørnland (2009) argue that asset prices are calculated by taking the present discount value of future profits. If in these cash flows the current and future impacts of oil price changes are incorporated, they are thereby also incorporated into the stock prices.

Many economists, including among others Schiller (2000), explicitly or implicitly acknowledge the rationality in characterizing investors as bounded in terms of their cognitive ability to process information. As a result of this limitation, they put forth that there are relatively few investors who have the capability to analyze and take part in newly available market information in a scalable way. Hong et Stein (1996) referrers to this concept as the underreaction hypothesis. Hong et al. (2007) indicate that the underreaction hypothesis relies on two key assumptions. The first one is that newly released market information originates in one part of the market and gradually spreads out to investors in other markets with a lag. The second assumption is that due to limited human processing capability many investors might not pay attention in other areas than where they hold their specific field of focus. When considered together they mean these assumptions leads to a cross-asset return predictability.

2.2.1. Oil price changes and channel of influence on the stock market

Oil price changes can affect stock prices through different channels. Huang et al. (1996) contend that oil price changes for most part can either affect the discount rate or influence the cash flows of an industry or a company. An indirect channel of how oil prices affect equity returns is via the discount rate (Fan & Jahan-Parvar 2012). The expected discount rate consists of expected inflation and expected real interest rate. According to Huang et al. (1996), a net importer of oil's trade balance will be negatively affected by increases in oil prices. They contend that this would lead to a downward pressure on the foreign exchange rate and an upward pressure of the inflation rate. The consequence of this increase in inflation rates would thus be a higher discount rate which would then lower stock returns. Huang et al. (1996) further claims that since oil is a commodity, it can therefore be used as a proxy for the inflation rate. Cologni and Manera (2008) build on this and find in their research that unexpected oil shocks are followed by an increase in inflation rates.

Additionally, the influence of oil prices on real interest rates is also suggested by Huang et al. (1996). The logic behind this is that an increase of the oil price in relation to the general price level will cause an increase in the real interest rate. The hurdle rates on corporate investments are thus increased and cause a decrease in stock prices. The authors therefore conclude that an increased oil price itself can put upward pressure on the real interest rate (1996). This relation between oil prices and real interest rates is also confirmed by Park and Ratti (2008) who show that higher world oil prices raised the short-term interest rate in eight European countries as well as the US. Similar result are apparent in Sadorsky (1999) and Papapetrou (2001) who claimed that an increase in the oil price raises the costs for production, and raises inflationary pressure on the economy as a whole which leads to an upward pressure on interest rates.

A prominent view from a microeconomic perspective is that for many companies oil is an essential input and important resource in the production of goods. Viewed from this angle, changes in oil price will have direct impact on a company's costs or cash flows (Fan & Jahan-Parvar 2012). As with any other input resource a change in future expected costs will impact stock prices since this affects future profits (Huang et al. 1996). Nandha and Faff (2008) studied thirty five global industry indices over twenty years and have found that increases in oil prices will negatively affect equity returns for all industries. The only exceptions are the oil, mining and gas industries. Huang et al. (1996) concludes that since oil is an important factor of production, fluctuation in oil prices has a direct profitability impact on sectors such as manufacturing, energy or agriculture. Faff and Brailsford (1999) point to the same negative influence of oil price shocks on diverse industries such as banking, transportation, and paper and packaging. They also conclude that some industries have an easier time passing down increased costs caused by an increase in oil prices by being in a better position toward other stakeholders. In holding this better position, these industries can therefore reduce the negative effect on their profitability. Nandha and Faff (2008) further conclude that hedging against oil price shocks is possible through the use of financial markets and hedging instrument such as derivatives. Fan and Jahan-Parvar (2012) investigate the effect of spot prices on stock return at industry-level in the US, and finds that spot prices have predicting power for some industry-level returns. Park and Ratti (2008) come to a similar conclusion when examining oil price shocks´ impact on real stock returns at the index level in thirteen European countries and the US.

When viewing the question from a macroeconomic perspective, Bjørnland (2008) argues that higher oil prices can be seen as a transfer of wealth from oil importers to oil exporters. Basher and Sadorsky (2006) claims that oil importers will lead to less disposable income and increase costs for non-oil producing companies in the presence of a sudden oil price increase, which will then push them towards alternative energies. They further argue that the uncertainty of a volatile oil price will lead to increased costs and risks for non-oil producing countries, which as a consequences leads to a reduction in stock prices, wealth and investments. On the contrary for oil producing countries, Le and Chang (2015) argue that an increase in oil price will lead to higher wealth and income. They further claim that if this increased government income is used to purchase goods and services, there will be an upswing in the economy and thus positively affect the stock markets.

2.2.2. Oil Price changes impact on stock markets

To date, a number of studies have reported the link between oil prices and their effect on the stock market on an aggregated level. Jones and Kaul (1996) maintain that in the US and Canada in the postwar period oil price changes affects companies current expected future real cash flows. Sadorsky (1999) argues that there is a significant negative relation between oil price and the S&P 500, similar to Papaetrou's (2001) findings for the Greek stock market. On the contrary, Gjerde and Sættem (1999) found that increase in oil price has a positive effect on the Norwegian stock market. They argue that this result might be a driven by Norway's large oil and gas sector. Furthermore they claim that this reaction is an example of the commodity price dependency of Norwegian companies. Bjørnsland (2009) reached a similar conclusion regarding oil's effect on the Norwegian stock market but also claim that there was a lagged effect up to fourteen months. On the other hand, Maghyereh (2004) finds that oil shocks have no significant effect on the stock markets in twenty two emerging countries. In a study by Hong and Stein (1999) and Hong et al. (2007), they find that some stock returns underreacted to newly available information with a lag of around fourteen days.

The close link between oil, business activity and stock markets in developed countries is one reason why Fan and Jahan-Parvar (2012) are interested in the prediction power of oil price on equity data. Their reasoning for studying this connection was that equity returns are also closely related to business cycles. In a prior study, Driesprong et al. (2008) have found empirical evidence that oil price fluctuations affected equity indices in the US. The authors, in this case, focus on stock markets at an aggregated level for different countries and use a thirty year sample of monthly data for developed stock markets. Their findings reveal statistically significant predictability in several country- and world market indices. Prior to Driesprong et al. (2008) similar studies had produced mixed results (Fan & Jahan-Parvar 2012). Fan and Jahan-Parvar (2012) demonstrates that 18% of the 49 industry equity indices are affected by oil price changes with a time lag of two weeks. The industries that are predictable are those not directly related to the energy sector or those with a second order impact. These include construction, retail, meals, autos, telecom, personal services and business services. They replace macroeconomic variables with changes in oil price to study this relationship. The authors bring up the fact that their finding might violate the EMH, but explains this with the capacity of investors' limited ability to process newly released information in real time referred to as the underreaction hypothesis (Hong & Stein 1996).

For most industries´ stock returns are negatively affected by increases in oil prices, but it is not true in the oil industry itself where oil is an output of the production instead of an input. In the present of a positive oil shock the revenues will increase and as a consequence also the profits. One major difference between industries is therefore if oil is an input or output of production. El-Sharif et al. (2005) describe a significant positive relationship between the price of crude oil and equity prices in the oil and gas industries in the UK. Similar positive relationships between oil price and equity returns results are found in other studies regarding the U.S. (Huang et al. 1996), Australia (Faff and Brailsford 1999), the overall global market (Nandha and Faff 2008), China (Cong et al. 2008) as well as Central and Eastern Europe (Mohanty, Nandha and Bota 2010).

Researchers have also spotlighted the volatility of oil price and its effect on stock markets. Park and Ratti (2008) conclude in their research that oil price volatility impacts real stock returns contemporaneously and/or in the following month. They also describe that higher volatility oil prices depresses real stock returns for many European countries they studied. However this does not remain true for the US, where the impact of oil prices is a more important factor for determining real stock returns than change in interest rates. A similar relationship between volatility in oil prices and stock markets is found by Hamma et al. (2014), though at the Industry level in the Tunisian stock market.

2.3. Definition of oil price shocks

According to Hamilton (1983), an extensive literature regarding the effect of oil shocks on the economy exists, where different definitions of oil shocks have developed. Killian (2009) argues that on a general level the topic has moved in two different directions. The focus of the first view is the response in output to oil price movements. Hamilton (1983) was one of the first to study how the economy was affected by the impact of exogenous oil shocks. His work shows that large increases in oil prices are a cause of the majority of US recessions. To define oil price shocks he uses the positive log difference of nominal oil price. However, Mork (1989) contends the exclusion of negative oil price movements as a major flaw in Hamilton's study and redefines oil price shocks to reflect all changes in oil price. He now included both positive and negative movements in the oil price as separate variables and defines both of them as shocks. His model shows a weaker relationship between oil prices and GNP output.

Lee, Ni and Ratti (1995) instead argue that oil shocks are more likely to have a substantial impact in environments where the oil price has been stable than in environments where large price movements are common. They contend that in periods with high oil price volatility there is little information to be drawn from the current price about future price, and movements in oil price are often soon reversed. Hamilton (1996) offers another definition of oil price shocks, which he refers to as net oil price increase (NOPI[1]). The justification behind NOPI is that most increases in the oil price since 1986 were immediately followed by a larger decrease. The correct measure of oil price changes impact is therefore to compare the price of previous years rather than the changes in the previous quarter. This definition is widely used in economic research.

The second and more recent view of the definition of oil prices is the true effect of the shock on oil price movements (Ghosh, Varvares & Morley 2009). Hamilton (1983) claims that exogenous political

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[1] Hamilton (1996) measures NOPI as: $NOPI_t = \max(0, \log P_t - \max(\log P_{t-1} \ldots \log P_{t-4}))$. Where log P is the log level of real oil price at time *t.*

[2] **OPEC - Organization of the Petroleum Exporting Countries** was first formed in 1960 as a coalition between Iraq, Iran, Kuwait, Saudi

events were often the source of major fluctuations in oil prices during the 1970s and 1980s, including, for example, the OPEC[2] oil embargo in 1973. Following the 1980s, shocks have instead mainly occurred because of sudden temporarily oil demands (Barsky & Kilian 2004). Kilian and Park (2009) contends that there are different categories of shocks and notes that in order to determine a shock´s effect on macroeconomic factors it is crucial to first know the source of it. The body of literature deals mostly with three types of oil shocks. In Kilian and Park's (2009) overview, the first type addressed is oil supply shocks. These lead to opposite movement in oil price and oil production due to an exogenous shift in the oil supply curve. One major source of such shocks is political events, often in OPEC countries, including cartel activity and military conflicts. The second type is related to a shock in aggregated demand. These shocks appear as a result of a shift in the demand side of the market and cause oil production and the oil price to move in the same direction. They often occur when macroeconomic activities increase because of high business activity, leading to an increased demand of all commodities. Demand oil shocks could therefore be seen as driven by economic activity. One example Killian and Park discuss is the recent increase of oil demand from emerging economies such as China and India. The third type is a specific demand shock related to oil directly and thus not related to general business activity. Instead it is driven by speculation in the oil price market or fear of low future oil supply. These, and similar definitions, are used throughout the literature (Kilian 2009; Apergis & Miller 2009; Peersman & Van Robays 2012).

3. Hypothesis

Driespong et al. (2008) demonstrates a significant predictability power in twelve out of eighteen stock markets in developed markets with the one month lagged oil price. Fan and Jahan-Parvar (2012) break this effect down at industry level and find differences across industries. Those industries that are directly affected by oil prices as an input or output such as resources, utilities and basic industries could not be predicted by changes in oil price. However, one main finding is that the negative lagged effect on equity returns can be attributed to those industries that are not directly related to oil price changes or are affected in a second stage. If a violation of the Efficient Market Hypothesis is possible it seems reasonable to first find it in those industries that does not have oil price as an important variable to take into account when valuing stock prices. However in Norway as heavy dependent on oil, there might be a higher awareness on oil impact on equity returns and thus oil price changes are more quickly incorporated in stock prices compared to the other Nordic countries. This would mean that less predictability might be found in the Norwegian indices. We expect this lagged effect then to affect stock returns negatively in the following month where there is predictability effect. The hypothesis is therefore stated as follows:

Hypothesis 1: Industry indices that are not directly affected by the energy sector or with a second order energy impact are predictable using the one month lagged oil price change.

A positive relationship between the oil price and oil industry's equity returns has been found among others by El-Sharif et al. (2005), Huang et al. (1996), Faff and Brailsford (1999), Nandha and Faff (2008), Cong et al. (2008), and Mohanty, Nandha and Bota (2010). Their results suggest that price

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[2] **OPEC** - **Organization of the Petroleum Exporting Countries** was first formed in 1960 as a coalition between Iraq, Iran, Kuwait, Saudi Arabia and Venezuela. Today the organization includes several more membership states as Algeria, Angola, Ecuador, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria , Qatar , Saudi Arabia, Venezuela and United Arab Emirates. (OPEC 2015)

moments in crude oil prices are incorporated quickly and efficiently into stock price and thus fall is in line with the Efficient Market Hypothesis. Since this industry`s profitability is directly affected by changes in oil price, they are expected to be consistently aware of changes in oil price. Therefore, this information is probably directly or rapidly incorporated in the oil and gas industry also in the Nordic countries as well. Our hypothesis is therefore as follows:

Hypothesis 2: Changes in oil price are incorporated contemporaneously in the oil and gas industry across the Nordic countries.

However we would also suggest that the effect of stock market that is documented by many earlier researches is a phenomenon that is not affecting all industries equally. Some industries might not be at all contemporaneously affected by the change in oil price. The reason behind this might be a variation in how different industries are affected and to what extent. As an example service related industries would not be as affected by an oil price changes since it might not directly affect their cost of production. Our third hypothesis is therefore states as:

Hypothesis 3: Nordic industries that are impacted by oil with a first order effect are contemporaneously affected by changes in oil price.

4. Data

In this section we describe our data more in-depth. First, the oil price data is considered followed with a brief history of oil shocks. Then we provide a description of the Nordic equity indices data, construction and weight of market value in the indices. Lastly risk-free rate is described.

4.1. Oil Price Data

There are several worldwide oil price indices, amongst which the Brent Crude Oil index. Brent oil quotes oil price and is produced in the North Sea and refined and in the Northwest regions of Europe, and thus especially important to Scandinavian countries. The Brent Crude Oil price index serves as a major price benchmark for oil prices worldwide.

Summary statistics for this series can be seen in Table 1. The data is plotted in a graphical representation Figure 1 and the monthly changes are plotted in Figure 2.

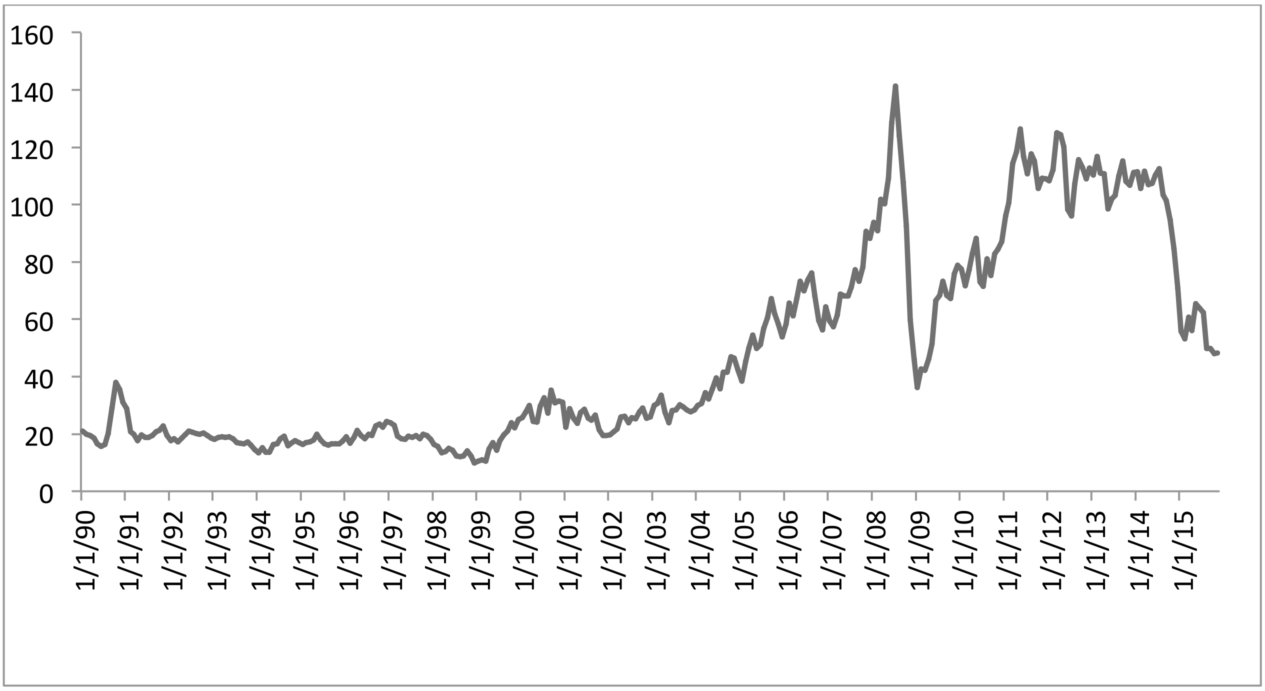

Figure 1 – The price of a barrel of oil between 1990 and 2015, in $US

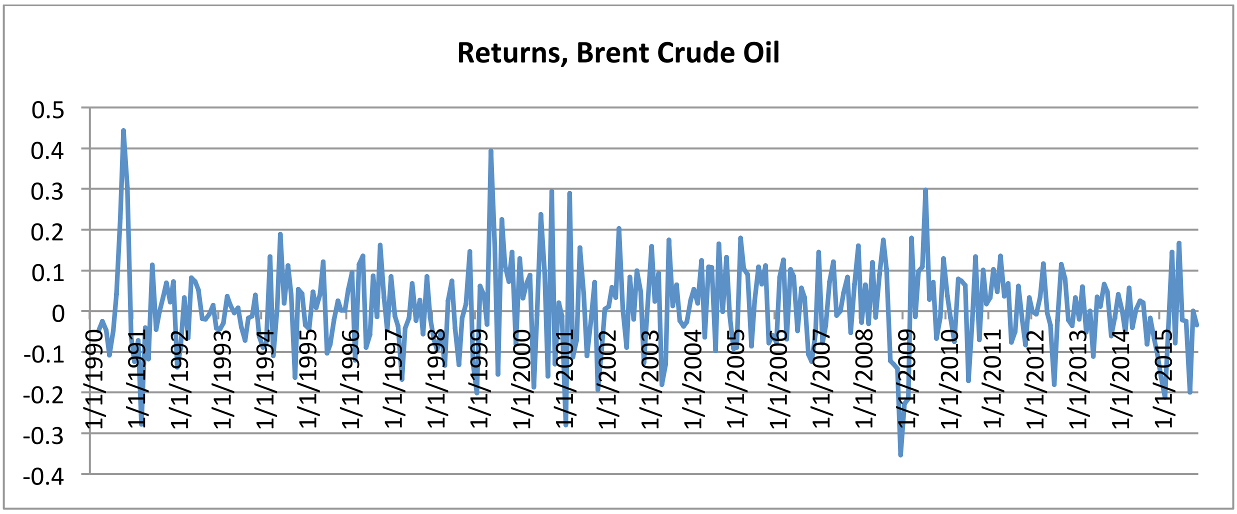

Figure 2 – Monthly changes in oil prices between 1990 and 2015

4.1.1. Oil Price history

Since the 1970s oil prices have been affected by a number of major shocks that had a subsequent impact on financial markets (Kubarych, 2005). Perhaps one of the most well-known events was the OPEC oil embargo in 1973 which was a political consequence of the Yum Kippur War between Israel, Syria and Egypt. The Iranian revolution in 1980 and the Iran-Iraq war lead to yet more financial shocks (Sørensen, 2009).

The first major shock that we can mark during the span of our data is the spike that occurred as a result of the Persian Gulf War, which started in August 1990. Before the 1990s the majority of oil price shocks happened as a consequence of political events such as of OPECs price controls or because of war and other conflicts (Hamilton, 2011). Between 2001- and 2003 the price levels of oil fluctuated rather heavily as a result of the turbulent era which began with the 9/11 terrorist attacks in the US and the following, US led War on Terror in the Middle East. During this period a general strike also hit Venezuela and the production of oil was interrupted. This interruption was followed by the second Gulf War in Iraq and as a consequence a shock in the oil price. (Hamilton, 2011)

The boom of economic growth during 2004-2005 and subsequent increased demand pressure spilled over to global energy consumptions and directly affected an increase in oil price. In 2008, the global financial crisis and the subsequent recession hit the market and as a consequence the price of oil decreased rapidly. The drop was mainly driven by the financial crisis rather than oil related events. (Hamilton, 2011). The oil price rebounded sharply in 2009 after the financial crisis, and the price increased despite a fairly weak global economy linked to the Euro crisis and recession in the US. The instability across the Middle East and the uprising Libya fueled further price growth in 2011. In 2014 the relatively high oil price led to the development of more efficient oil production techniques in US and the global oil market was flooded with oil. During 2015 the global oversupply, which comes a consequence of aggressive production rates from OPEC, has led to a dramatic decrease in oil price.

4.2. Industry returns

Datastream Global Equity Indices provide a comprehensive and independent standard for equity research in fifty three countries by using the Thomson Datastream database. A sample of at least 75-80% of the total market capitalization is used to compute the indices. Six different levels of classification are available where level 1 is the market index, which is then gradually broken down into smaller entities. FTSE and Dow Jones jointly create the Industry Classification Benchmark (ICB) which is the foundation for this classification structure. A representative sample of major stocks creates each industry from which Datastream uses these constituents´ stocks to calculate the indices (Thomson Reuter 2008).

In this study the level 2 classification is used which divides each market into ten industries to cover all the sectors in each country. Their ten classified industries include: *Oil & Gas, Basic Materials, Industrials, Consumer Goods, Healthcare, Consumer Services, Telecommunication, Financials, Technology and Utilities* (Thomson Reuter 2008). For the four markets selected for this study, total market value, constituents stocks and the total return index (RI)[3] for in each industry is collected.

4.2.1. Market Values

Thomson constructs their indices through a selection of companies in each industry. The tables below show the size of each market and constituent industries. Total Market value is reported in dollars in Datastream and industry size is reported in local currency. These numbers recalculated to USD to show each markets relative size. In those industries where no data is reported, the index is either dead or no industry exists in that country according to DataStream´s definition. They number of constituents of each index is shown in Table 2. In Table 10 in the appendix, the constituent companies for each industry are included.

[3] The data in Datastream are reported as either fixed index or recalculated index datatypes. Fixed index datatypes compared to recalculated index datatypes are not recalculated historically when then constituents change which allow for the effect of dead stocks to be incorporated in the index. This way of calculating indices has become the industry standard and because of that it is used as proxy for industry performance in this study (Thomson Reuter 2008).

Market Value is calculated as the sum of share price multiplied by the number of ordinary shares in each constituent:

$$MV_t = \sum_{1}^{n} (P_t * N_t)$$

Where: N_t = number of shares in issue on day t, P_t = price on day t and n = number of constituents in index. Market value is extracted in millions in local currency for each industry and total market value is report in millions of US dollars. Total Market Value and each industry value were then recalculated using exchange rates from the European Central Bank (2015) and are reported in local currency, US dollar and the Euro. The share of each industry of the country's total stock market was then calculated.

The Nordic stock markets differ in respect both to their size and to what industries are the most important nationally. Sweden, as the largest country also has the largest stock market, with the smallest being Norway. From the tables we can conclude that the Swedish stock market consists largely of financial companies followed by Industrials. As a major oil exporter, the Oil & Gas industry also has a heavy presence in Norway, taking almost one third of the total market value. They also have a heavy share in the Financial industry. The Danish market is dominated by their Health care industry which constitutes more than half the total market size. This index is heavily dominated by Novo Nordisk which is the largest traded stock across all the Nordic stock markets. In the Finnish market Industrials has the biggest share of the total market. Basic Materials, Financials and Technology are other big industries in the Finnish stock market.

One notable thing regarding the construction of the indices is that the Oil and Gas industry that we put heavy emphasis on only consists of one constituent in each country except Norway where the industry is represented by several large multinational Oil and Gas companies.

4.2.2. Nordic industry-level returns

We use the Return Index as provided by Thomson Reuter Datastream. The data[4] spans from January 1990 to November 2015 at a monthly frequency making a sample of 310 observations. The summary statistics can be seen in Table 3. Those industries with fewer observations had no constituents in January 1990 and thus started at a later date. Notable is that Norway is the only country that has Oil & Gas companies since January 1990, and also the only oil exporting country in our study.

The Return Index represents the theoretical growth in value of a stock holding. The price of the stock holding is the price of the selected price index. This holding yields a daily dividend (gross dividend) which is used to purchase new stocks at the current price. (Thomson Reuter 2008)

$$RI_t = RI_{t-1} * \frac{PI_t}{PI_{t-1}} \left(1 + \frac{DY * f}{n}\right)$$

[4] We choose monthly observational data since it is a reasonable decision period for most investors. Some investors may have a shorter time horizon such as day traders or algorithmic traders, but for most investors one month time period seems to be enough.

RI_t = return index on day t, RI_{t-1} = return index on previous day, PI_t = price index on day t, PI_{t-1} = price index on previous day, DY = dividend yield of the price index, f = grossing factor (normally 1) - if the dividend yield is a net figure rather than gross, f is used to gross up the yield & n = number of days in financial year (normally 260) * 100. (Thomson Reuter 2008)

Since the RI reflects accumulated returns, the indices were then recalculated as:

$$ln\left(\frac{RI_t}{RI_{t-1}}\right) = \ln\left(\frac{PI_t}{PI_{t-1}}\left(1 + \frac{DY * f}{n}\right)\right)$$

From our summary data, Table 3, we can conclude that the Oil and Gas industry in Sweden has yielded the highest yearly return cross all industries with a mean of 26.8%, and the Telecom industry in Denmark yielded the lowest yearly return of 4.5%. In Denmark the industries has performed very differently with Telecom, Industrials and Financials with the lowest values spanning between 4,3-7,1%. The best performance can be found in the Technology industry with a mean of 19%. This index consists of only two stocks, Simcorp and Nnit. In Finland as the only country consisting of all indices, the stock markets could be divided into low, medium and high performers. The low performers spans between 4,1-7,3% with Oil and Gas, Basic Materials and Consumer Services. The high performer is Consumer Goods with a mean of 22% and the rest are medium performs spanning between 10,7-16%. In Norway it seems as most industries clustered around 8-10,6% in average returns. Only three industries deviates from this which is Industrials (6,2%), Utilities (4,5%) and Consumer Goods (15,5%). In Sweden the Oil and Gas industry has the highest return among all industries. However it is worth noting that this is due to the performance of Lundin Petroleum which is the only companies in this index. Except Consumer Goods with a mean of 20,3% and Technology with a mean of 7,5%, all other industries lies in the span between 10-13% in average return. The in comparison poor performance of the Technology industry can be explained with that Ericsson A and B are major constituents of this index with a very poor performance since the IT bubble in 2000. On a general level the Swedish stock market seems to be best performing with most indices performing over 10% annually on average. Comparing between the countries is seems that Consumer Goods has performed well with an average return of more than 11% in all countries. Financials seems to be a stable investment with around 10% return in all countries. Otherwise returns are very mixed.

In terms of standard deviation, or risk, the Oil & Gas industry in Denmark yields the highest value of 55% and Technology as second with 41%. Health Care industry returns the lowest standard deviation of 17%. In Norway as the only oil exporting country the lowest risk can be found in the Oil and Gas industry with a value of 25,3%. Otherwise the Oil and Gas industry seems to be a quite risky investment in all the other countries compared to other indices in the same country. The Technology has a high risk with a standard deviation of over 40% in all countries. In those countries that has a Health Care industry, the risk in this industry seeds as among the lowest in each country respectively.

A perfectly normally distributed variable has skewness of zero and deviations indicate that it is either positively or negatively skewed (Tsay 2010). The skewness seems to deviate from zero for most industries. However, the Oil & Gas industry seems to stand out a bit in all four countries as quite low, around +(-) 0.2. Finland and Sweden seems to be those countries which has least skewness among the industries with no industry deviating more than one. The highest skewness value can be found in the Telecom industry in Denmark with the only value over two. The most industries indicating heavy skewness can be found I Norway with four industries having a deviation of more than one.

A perfect normal distribution has a kurtosis value of three (Tsay 2010). A distribution with a positive excess kurtosis indicates a heavy tails and is said to be leptokurtic. As we can see in the summary data, all return series except Finnish Oil & Gas are leptokurtic to different extents. Some industries stand out with high kurtosis values around ten or even up to almost eighteen such as the Telecom industry in Denmark. Those which deviates the most are Danish Consumer Services, Swedish Technology and Telecoms in Denmark, Norway and Finland, which are also the industries that deviates the most in terms of skewness except Finland Telecom. Telecom shows heavy kurtosis across all countries except Sweden.

While the Brent Crude Oil pricing data seems to be quite normally distributed, the interest rate data for all four countries have very high kurtosis values. Looking at Figure 4 and Figure 5 the interest rate graphs all have extreme values, explaining the excess kurtosis.

4.3. Interest Rate Data

Risk-free Interest rates were included in the model for testing contemporaneous relationship between oil price and industry returns. In this thesis the risk-free rates proxies recommended by Thomson Reuters (2015) for the main markets are used. For Sweden this is 3-month treasury bills, for Denmark short term repo rate, for Norway 3 month interbank rate and for Finland the 3-month interbank rate. The summary statistics for the interest rates can be seen in Table 4.

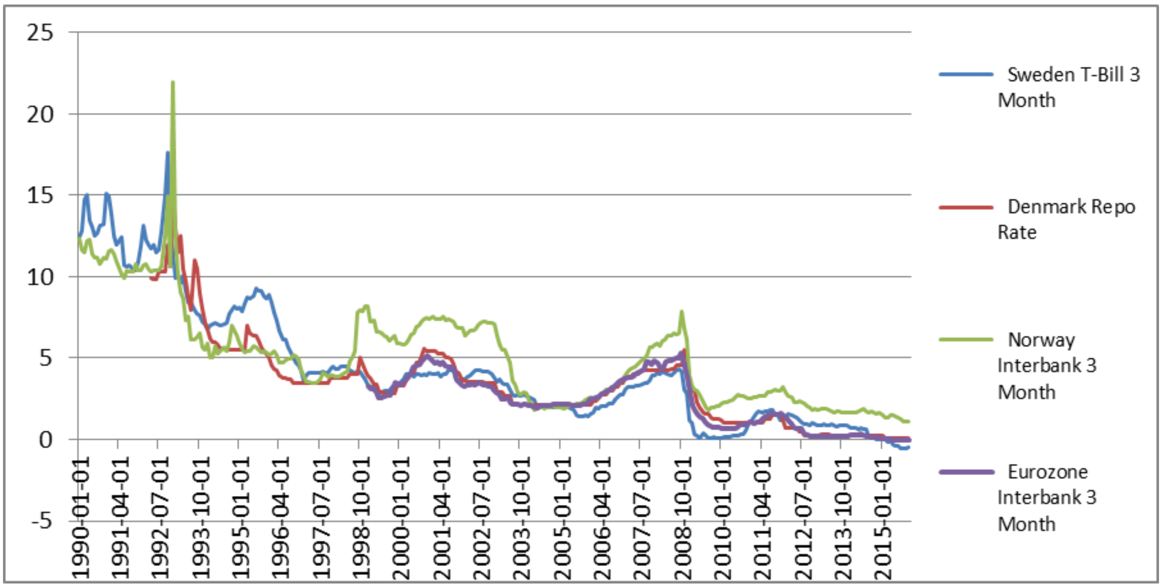

Figure 3 – Interest rates Sweden, Norway, Denmark & Finland from 1990-2015, in percent

The fluctuation of the interest rates can be seen in Figure 3. The interest rate for Sweden, Norway and Finland spans from January 1990 to November 2015. For Denmark it spans from May 1992 to November 2015.

5. Methodology

In order to estimate the effect of oil price changes on equity returns we use a time-series econometric model with stock as the dependent variable and one month lagged oil return as the explanatory variable.

Our model is as follows:

$$r_t^i = \mu_i + \alpha_i \, r_{t-1}^{oil} + \varepsilon_t^i$$

Where r_t^i represents the returns of industry i, at time t, and r_{t-1}^{oil} the one period lagged oil return.

The coefficient of interest is α_i onr_{t-1}^{oil}. When α_i is statistically significant, the null hypothesis of no oil effect is rejected. We can estimate these regressions individually, since one of our objectives is a study of prediction power of oil prices for each industry separately. We will estimate these regressions using ordinary least squares (OLS).

Tsay (2010) suggests the use of Akaike's information criteria (AIC) or Schwarz's Bayesian information criteria (BIC) to select the appropriate lag length and those were also considered in this paper to decide lag length. The information criteria that minimize the numbers of lags are used. One lag of oil price changed is used in the model following the Schwartz Bayesian information criterion (SBIC) [5]. In the study by Fan and Jahan-Parvar (2012) a one month lag for industry returns is included as significant factor to explain the current month's return. We use the information criteria SBIC to decide about the one month lag length of industry return to be included in the model. For interest rate no lag was included according to SBIC.

The residuals for each regression were tested for autocorrelation, heteroscedasticity and normality. The problem of autocorrelation and heteroscedasticity were adjusted for by using Newey standard errors.

In order to also determine the contemporaneous effect of oil price changes on equity returns a second and third specification of the regression model were constructed. One issue with the crude oil price is the presence of shocks in the data. In our second model and third specification large oil shock was defined from historical events described in data section 4.1.1. Both large upward and downward movements were considered. The shocks controlled for were: The Persian Gulf war august 1990, World Trade Center terrorist attack in the US in September 2001, the second gulf war in 2003, the Financial crisis autumn 2008 and the global oversupply early 2015. To control for these shocks we use a dummy which takes the value of 1 in the month of the shock and 0 otherwise. Interaction terms between oil shock dummy and Brent Crude Oil price is added to make the interaction terms take on the value of the shock in those months. We first test the model without and then with the interaction term.

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[5] To determine lags to be included in the model, we also used the t-test procedure where we start with 12 lags and run the regression on industry returns. These test yielded the same results as the SBIC.

Further on, the interest rate[6] variable is controlled for in the second model specification and estimated as follows:

$$r_t^i = \mu_i + a_1 r_t^{oil} + \alpha_2 Oil\ Shock_t + a_3 Interest\ rate_t + a_4 r_{t-1}^i + \varepsilon_t^i$$

To test for the oil shock effect, the third model specification is estimated as follows:

$$r_t^i = \mu_i + a_1 r_t^{oil} + \alpha_2 Oil\ Shock_t + \alpha_3 Oil\ Shock_t * r_t^{oil} + a_4 Interest\ rate_t + a_5 r_{t-1}^i + \varepsilon_t^i$$

Changes in oil prices were computed using the formula:

$$r_t^{oil} = \ln\left(\frac{P_{oil,t}}{P_{oil,t-1}}\right)$$

Where r_t^{oil} denoted changes in oil price, $P_{oil,t}$ denotes Brent Crude Oil price in period 1 and $P_{oil,t-1}$ denotes Brent Crude Oil price in period 0.

To reflect the fluctuations in interest rate, the data are transformed using the formula:

$$\Delta I_i = \ln\left(\frac{I_1}{I_0}\right)$$

Where ΔI_i denotes change in interest rate i, I_1 denotes exchange rate in period 1 and I_0 denotes exchange rate in period 0.

6. Results

6.1. Pre-estimation data diagnostics

6.1.1. Stationarity in time series

A fundamental condition of time series is that the variables are stationary and can be tested with a unit root test (Tsay 2010, p.30). The stationarity of the data in this thesis is controlled by an augmented Dickey and Fuller (ADF) (1979) test. The ADF test turn out that all the return series in our data can reject the null hypothesis of non-stationarity at the 1% level except interest rate in Finland which can be rejected at the 10% level. The result from the test is shown in Table 5.

6.1.2. Robustness

We performed statistical robustness test for our data. As one of the assumptions of OLS regression is normality in the error terms the Jarque-Bera test is conducted to test for normality. The null hypothesis of normality is rejected in all models except Swedish Telecom and Health Care as well as Finland Consumer Services, Health Care and Oil and Gas. Further on we also made a test if constant variance in the error exist, meaning the data are not heteroscedastic and as a result standard estimation methods would prove to be valid. We ran two tests for checking the heteroscedasticity, the Breusch-Pagan test and the White test. Both of them are based on the residuals of the fitted model. The Breusch-Pagan test evaluates conditional heteroscedasticity in the error term. The test results show that in 16 out of 36 regressions the null hypothesis of no heteroscedasticity can be

[6] Exchange rate was considered as a control variable but where excluded as not important for this analysis.

rejected. The White test is another way to test for heteroscedasticity by assuming the residual variance in the distribution is constant and the model would thereby be homoscedastic. The test results give a bit different results than the Breusch-Pagan test and 12 out of 36 regression show signs of heteroscedasticity according to this test. In an OLS regression model another underlying assumption for the robustness is to check for serial correlation in the data. There are several ways to do this. The Durbin-Watson alternative test is one of them and is performed by checking if the residuals from a linear regression or multiple regressions. 5 of 36 regressions showed sign of autocorrelation according to this test.

The result from the Breusch-Pagan-, the White- and the Durbin-Watson test is showed in Table 6.

6.2. Predictive regression Results

What can be concluded from the regression results in Table 7, Panel A is that the lagged oil price predicts asset return for the Health Care industry and the Technology industry with a coefficient of -0.064 and -0.170 both on at a 5% significance level, respectively, in Denmark. The effect is also evident for the Telecom industry with a coefficient of -0.190 at confidence level of 5% and the Technology industry with a coefficient of -0.162 at a 10% confidence level in Finland. Further on, the Utility industry in Norway is the only industry in that country that show a negative coefficient to price changes with strength of -0.116 at a 5% significance level. Lastly, the Consumer Goods industry returns a coefficient of -0.134 at a 1% significance level while the industries Consumer Services, Telecom and Technology returns coefficients of -0.076, -0.102 respective -0.143, all at a 5% significance level in Sweden. This indicates that the lagged effect of a positive change in the oil price will affect theses mentioned industries negatively. The strength of this relation is determined by the size of the coefficient and as the result shows every affected industry show a negative relation to changes in oil price.

It is apparent from our results in Table 7 that the Oil & Gas-, Basic Materials-, Financials- and Industrials industries show no predictability of oil price changes through statistically significant parameters for lagged oil returns. These results were quit similar, except for the Financial industry, with both the underreaction hypothesis and the findings of Fan and Jahan-Parvar (2012). Their results indicate that industries' with a first order impact from oil prices to have a significant impact on oil related industries' returns, and thus, also expect this information to be contemporaneously incorporated in the market prices. The only result deviating from Fan and Jahan-Parvar (2012) was that no lagged effect is found for the Financial industry. The Financial industry is quite large for all the four Nordic countries and the composition of how the industry indices are composed can be viewed in Table 10. A probable cause for this can be the Financial industry's nature to be closely updated on newly available market information and therefore incorporates all new oil information quickly. Another possible explanation can be that the Financial industry is quite far from the action of fluctuating oil prices, but since Norway is so closely associated with oil, and the same result is reported for the Financial industry over the whole region, the first explanation is rather true.

Interestingly, the data in Table 7 shows that several industries in each country show significant lagged effect, of oil price information, in one or two countries but not the others. These are industries which are not directly related to the energy sector, or those with a significant second order energy impact. Fan and Jahan-Parvar (2012) report a negative lagged effect in these industries affected in a second stage in the US. Their findings are rather surprising since oil price is a both free and publicly available and violates the EMH. Our result point in the same direction with, starting with Norway, the Norwegian Utilities industry shows a lagged effect. Further on the Danish industries Health Care and Technology also show a significant lagged effect as Consumer Goods-, Consumer Services- and Technology industries do in Sweden. In Finland there are two industries that show a lagged effect, the Telecom and Technology industries. Across the different countries Technology shows a lagged effect in three countries and Telecom in two countries, both industries which are not directly related to oil. All the results are not fully expectable and indicate a second order oil effect. In a nutshell, a second order effect according to the underreaction hypothesis implies that since these industries are not sensitive or directly related to the energy sector, for example, they do not incorporate oil price changes contemporaneously. Notable to mention here is that the indices constructed by Datastream differ heavy from each other in terms of size and constituents of the companies in each industry and country.

6.3. Impact on Oil and Gas industry

In the second hypothesis we examine the contemporaneous effect of oil price changes on the Oil and Gas industry in the Nordic countries. Our results for the second model are presented in Table 8.

In Panel A, the result for the Danish oil and gas industry is quite strong and shows a significant effect on a 5% level for oil price changes. The coefficient shows a positive effect on Oil and Gas returns of oil price changes. Notable however is that the Danish Oil and Gas industry just hold one constituent, the Vestas Group AS. The company only produces wind turbines which in our sense it not directly oil related but should be included in energy sector. The Oil and Gas index stands for 90 0078 million DKK and 4.1% of the market as seen in Table 2. The industry seems to contemporaneously adapt newly publicized oil related information.

The Oil and Gas industry for Finland, in Panel B, also shows significant effect between the industry and oil price changes. In this index the only included company is Neste Oil. The company produces renewable diesel and the largest producer of renewable fuels from waste and residues. Since the company's core input and output are not oil we expect it to not be as sensitive to oil price changes as a purely oil and gas producing company as the Swedish Lundin Oil and the several oil producing companies in the Norwegian Oil and Gas industry. This result is in line with our expectations.

The strongest effect for the Oil and Gas industry captured in our data can be viewed in Panel C, for Norway, where the Oil and Gas industry shows highly positive correlated effects from changes in oil price. The significance level is 1% and the result is in line with the expectations that the Norwegian Oil & Gas companies and the whole economy are highly sensitive to changes in oil price. Looking at the constituents of the Norwegian Oil and Gas industry in Table 10; the index includes as many as nine oil and gas companies. The combined market value for that index is 546 575 million NOK and stands for 32.2% of all the Norwegian market. It is reasonable to expect that oil and gas companies in an oil exporting country as Norway would be very quick to absorb new oil related financial information.

The data for Sweden, Panel D, also reveals a highly correlated and positive effect of oil price changes on Oil & Gas companies at 1% significance level. Also notable is the oil and gas industry index for Sweden viewed in Table 10 includes only one constituent, Lundin Petroleum, with a market value of 38 293 million SEK and a 0.8% of the total market value. The result seems congruent with our expectation that the included oil company in this index is following market reaction closely and the theory of efficient markets holds.

When comparing the Oil and Gas companies across the Nordic countries they share the similarity that they are all significant and have a positive coefficient meaning that if oil price increases, the equity return of the industry will increase as well. Norway, Denmark and Sweden are significant at the 1% level and Finland deviates by being significant at the 5%. These findings are in line with what earlier studies has found regarding as diverse countries as the UK (El-Sharif et al. 2005), U.S. (Huang, Masulis and Stoll 1996), Australia (Faff and Brailsford 1999), the global market (Nandha and Faff 2008), China (Cong et al. 2008), as well as Central & Eastern Europe (Mohanty, Nandha and Bota 2010). Concerning the economic significance and the size of the coefficients the Swedish Oil and Gas are being the most affected by the change in oil price with a coefficient of 0,445 compared to 0,312 for Denmark, 0.296 for Norway and the lowest coefficient is Finland's with 0.236. The lower significance and lowest coefficient of the Oil and Gas in Finland is not surprising since it in fact does not contain a company that has oil as its output as the other countries has. Since oil is an important output for these companies we can in accordance with the efficient market hypothesis (Fama 1970) expect stock markets to quickly absorb new information of an oil price change, and incorporate it into the stock price.

6.4. Impact of oil price changes on other industries

Another interesting aspect of the results in Table 8 is what industries that are the drivers of the contemporaneous oil effect on the Nordic stock markets.

As seen in Panel A, other industries that are contemporaneously affected in the Danish market are the Industrials-, Consumer Services- and Financials industries at 5% and the Consumer Goods- as well as Technology industry on the 1% significance level. Notable is that all five industry industries show a positive effect on oil price increases contemporaneously. From these results these industries seem to contemporaneously adapt newly publicized oil related information. The Danish industries of Health Care and Telecom are unaffected in our regression and therefore do not respond directly to oil price changes according to our model. Also the Health Care-, Consumer Services- and Financials industry respond negatively to the oil shock dummy variable at 10% significance level as well as 5% negative significance level for the Technology industry. This indicates that these industries are affected by the change in oil price during an oil shock.

In Finland, Panel B, four other industries show a positive correlation with changes in oil price: Industrials, Consumer Goods, Telecom and Utilities. The results show significance on a 1% level for Consumer Goods and on a 5% for the other two industries. The Finnish Consumer Goods industry shows the highest significant effect from oil price changes in our study. This might be reasonable since the index includes several consumer goods producing companies such as cereals manufacturing, brewery, sport cloths manufacturing, kitchen tools manufacturing and car tires. Further on in the data for Panel B, the only industry responding to the oil shock dummy is the Consumer Goods industry that shows a negative effect at a 1% significance level.

In Panel C, the other industries in Norway that shows a contemporaneous positive effect on oil price changes is the Basic Materials industry at the 1% significance level. At the 5% significance level the Consumer Goods- and the Financials industries is further added to this list. Gjerde and Sættem

(1999) and Bjørnsland (2009) have earlier found a positive relationship between oil price and the Norwegian stock market. The positive correlation between oil price changes and these industry returns may be consistent with their findings; however they only explain it with a large Oil and Gas industry in Norway. Mork, Olsen & Mysen's (1994) as well found that the whole Norwegian economy was positively affected by increase in oil price. It might therefore be reasonable that the positive effect of increased oil price may not be only attributed to the Oil and Gas industry. The Basic Materials industry as an example is constructed by companies producing fertilizers, aluminum and biochemicals. It is therefore hard to think why this index is positively correlated with oil price changes without doing more extensive research in the structure of these organizations. A general thought may be that oil is used in the production or logistics and therefore theses industries is sensitive to oil price changes. Interestingly, there are also three industries that respond to the oil shock dummy in Panel C. The Utility-, Financial- and Technology industries all responds with a negative correlated effect on oil shocks at a 1%, 5% and 10% significance level, respectively.

In Panel D, the Health Care industry is the only other industry in Sweden showing significant effect for the change in oil price at the 5% significance level except Oil and Gas. This is a surprising result since Sweden has a big industrial industry which might be quite oil dependent. The Basic Materials- and the Consumer Goods industries both responds quite negative on the dummy shock, while the Financials- and Technology industries also respond to the dummy variable negatively but with a weaker effect.

The industries that seems to be most commonly affected across the region are the Industrials-, and Consumer Goods industries in Denmark and Finland. The Basic Material industry in Norway is also interesting due to its industrial nature. It is a bit surprising that none of these industries are affected in Sweden. Looking at the Industrial index compositions in Table 10 for all countries, they all include many constituents and they all seem to be well diversified. The Basic Materials industry is weighted over on paper pulps and forest companies in Sweden and Finland while in Norway this index is constructed by companies producing fertilizers, aluminum and biochemicals. Regarding the composition of the Consumer Goods indices they do not include as many constituents as the Industrial indices but nevertheless seems to be well diversified for all countries except for Norway, which mainly includes companies in the Salmon sector. We cannot think of any apparent explanation why these industries do not show an effect in Sweden compared to the other countries.

Across the Nordic countries there I throughout a positive coefficient when there is a significant contemporaneously effect of oil on their respective stock market. These results are somewhat puzzling because earlier studies has shown that in most developed oil importing countries, the effect of oil on stock return are negative for industries that has oil as an input of production. One plausible could that companies has become more sophisticated in reading financial commodity markets and is therefore better informed to anticipate shifts in factor prices. A firm could then compensate increased fuel costs by compensating with switching production processes. Another complementary explanation could be that oil price could work as an indicator for the global economy as in 2008 when booming global economy raised the demand for oil and as a consequence an increase in oil price. As well negative shocks or sharp decreases could be a sign to investors that there is instability in the market, by political events or other reasons. It might be plausible that investors are sensitive to sign of nervousness in the market, therefore the stock prices might go up with increasing oil prices and down with decreasing oil prices if oil price is one of these indicators investors use. Another possible explanation could also be that the results are driven mainly by sub-periods of the data, for example the sharp increase and decrease of both oil price and stock market before and after the global financial crisis. To check for this, the data could be divided in sub-periods and running regressions on each of these to check is the results are consistent. However Norway is different from the other markets because its position as an oil exporter, therefore the positive effect on other industries might be reasonable. If oil is an important driver of the whole Norwegian economy, it might therefore be the case that this impact has spillover on other industries as well.

The results differ from country to country. The only similarities that can be found is firstly, the Consumer Goods industry that is affected contemporaneously in Norway, Finland and Denmark; secondly Industrials in Denmark and Finland and thirdly Financials in Denmark and Norway. Other than that there are no industries that are contemporaneously affected in more than one country.

Another interesting note is concerning the dummy variable which shows the difference in effect between the base group of no shock, normal circumstances, and when there is an oil shock in the data. Across the Nordic countries most of the equity indices are negatively affected by an oil shock except Technology industry in Finland and Denmark. This are in line with previous research that suggested that stock markets are negatively influenced by increases in oil price. This might be explained with that oil shocks are an effect of political or economic turbulence which send negative and unexpected reactions to the financial markets.

6.5. Impact with Shock Interaction

In this section an interaction term is introduced to control for the shocks in the data. The results from this regression are presented in Table 9.

When controlling for oil shocks, the significance of the contemporaneous effect of oil, shown in Panel A, are removed for the Financials- and Consumer Service industries. For the other industries the significance level decreases. Notably is that the Consumer Goods industry is both affected contemporaneously under normal circumstances and during oil shocks. Taken this in to consideration, in the presence of an oil shock the total effect is interpreted as the coefficient of Brent Crude Oil spot price and the interaction term. This indicates that if oil price increase with 1% during an oil shock, the equity index of the Consumer Goods industry increases by approximately 0,458%. Thus, under normal circumstances the effect would be 0,106%.

In Panel B, Finland is the only country where the results remain similar with or without the interaction term. However the level of significance decreases in the Telecom- and Industrials industries.

For the results in Panel C, when the interaction term is introduced, the significance of the contemporaneous effect of oil on the Consumer Goods- and the Financials industries are removed. This would indicate that the results are actually driven by the shocks in the data and thus these industries are not contemporaneously affected by oil under normal circumstances. However oil price on the Telecom industry now appears as significant. The interaction term is significant for the Consumer Goods industry with a positive coefficient of 0,230 which indicate that in the present of an oil shock, 1% increase in oil price has led to 0,23% increase in this index.

As well in Sweden, Panel D, the industries loses its significance. The Health Care industry was the only industry that was contemporaneously affected by changes in oil prices and with the interaction terms no industries are now contemporaneously affected in absence of an oil shock. Concerning the interaction term we can see that the Health Care industry has a positive coefficient of 0,233 and the Consumer Services industry has a negative coefficient of -0,150. These industries are those differently affect during an oil shock.

The introduction of the interaction terms changes the results for all the Nordic countries. When controlling for oil shocks, in all countries except Finland, there exist industries which are still mainly affected by changes in oil price only under normal circumstances or in the absence of oil shocks. The results suggest that some of these previous contemporaneous affected industries are indeed mainly affected by shocks in oil prices. Similarities between those industries which are no longer contemporaneously affected during normal circumstances are seemingly the lack of a direct relation to oil as either an input or an output. Summarized across the Nordic countries these includes: Consumer Goods, Financials, Consumer Services and Health Care. Of these industries only the Consumer Goods industry might seemingly use oil as an input factor in production. The rest of the industries are service oriented and therefore one might expect that changes in oil prices are not directly affecting their business activities.

When looking more closely at the Consumer Goods industry, it is important to emphasis that the oil shock dummy variable for this industry is the only variable that is statistical significant across all Nordic countries. It makes this variable different compared to the other variables that loses their significance. The difference between the Consumer Goods industry and the other industries are that the Consumer Goods indices all consist of producing companies that probably have quite similar chains of production or organization. Under normal circumstances the Consumer Goods industry is not affected in all countries by oil price changes but in a situation when a shock occur the indirect effect sudden oil price changes might influence the organizations similarly and thus explain our result.

7. Conclusions

This paper aimed at looking at the predictability of equity returns on industry level across the Nordic countries and also studies which industries are contemporaneously affected by changes in Brent Crude Oil price.

We use equity return data for stock markets the Nordic region to examine the oil predictability effect documented by Fan and Jahan-Parvar (2012). As Fan and Jahan-Parvar (2012) demonstrates, oil price changes might have a lagged impact on industry equity returns in some industries that are not directly related to oil. This result was one of their major findings we wanted to explore to see how this applied on equity indices in the Nordic region. The hypothesis we used were: *Industry indices that are not directly affected by the energy sector or with a second order energy impact are predictable using the one month lagged oil price change.* Our results support part of their results that it might exist a weak predictability effect in industries with a second order effect. This negative lagged effect on equity returns can be attributed to those industries that are not directly related to oil price changes or are affected in a second stage. These include Utilities in Norway; Health Care and Technology in Denmark; Consumer Services, Telecom, Consumer Goods and Technology in Sweden; Telecom and Technology in Finland. These are in some aspects similar to the industries that Fan and

Jahan-Parvar (2012) finds in the US, among them Telecom, Personal Services, Business Services and Retail. However they did not find a predictability effect of Health Care which makes Denmark different in that aspect. Technology related companies were found not to be predictable in their study. A distinction also needs to be drawn between the primary drivers of oil prices and the drivers of corporate stock prices. An effect from oil price changes might be possible to show in certain industries, but return indices in general are based on information from published market information, intrinsic values and investor risk tolerances and a large number of other causes. Therefore our model and analysis is probably not substantial enough to decide if the found effect is real and only depends on changes in oil prices. The economy is simply too complex to expect one commodity to drive business activities in a predictable way.

Our second hypothesis was that *changes in oil price are incorporated contemporaneously in the oil and gas industry across the Nordic countries.* Our findings suggest that Oil and Gas is significantly affected across all four countries contemporaneously and can thus support our hypothesis. This supports the findings of Fan and Jahan-Parvar (2012) as well as many earlier scholars that oil prices are incorporated contemporaneously in the Oil and Gas industry. It also supports the underreaction hypothesis that industries sensitive to a certain type of market news incorporate this information quickly and efficiently.

Our third hypothesis was that *Nordic industries that are impacted by oil with a first order effect are contemporaneously affected by changes in oil price.* The findings regarding this hypothesis were different across the countries. Similarities across the countries were that with the second specification of the model, Consumer Goods were shown to be contemporaneously affected in Denmark, Finland and Norway. Industrials were found to be affected in Denmark and Finland. Apart from these industries the results were different for each country. Denmark was the country most affected by changes in oil price with six out of eight industries being affected contemporaneously. In Sweden only Health Care was contemporaneously affected. However with the introduction of the interaction term some of the industries that were significantly contemporaneously affected by changes in oil price lost or decreased its significance. Most of the affected industries were service-related which on the surface is seemingly not directly affected by oil price changes.

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Tables

Table 1 – Brent Crude Oil Data

Oil	Obs.	Mean	Std dev	Skewness	Kurtosis
Brent crude oil	310	0,032	0,364	-0,238	4,465

Table 2 – Market values of equity index data

Panel A - Denmark	Constituents	DKK	USD	Share
Total Market Value		2 221 974	328 741	100,0%
Oil & Gas	1	90 078	13 327	4,1%
Basic Materials		-	-	0,0%
Industrials	14	391 977	57 993	17,6%
Consumer Goods	6	204 546	30 263	9,2%
Health Care	13	1 145 986	169 549	51,6%
Consumer Services	2	6 908	1 022	0,3%
Telecom	1	29 240	4 326	1,3%
Utilities		-	-	0,0%
Financials	11	335 304	49 608	15,1%
Technology	2	17 935	2 653	0,8%
Total	50			
			USD/DKK	
		Exchange rate	0,1479	

Panel B - Finland	Constituents	Euro	USD	Share
Total Market Value		166 431	183 654	100%
Oil & Gas	1	5 841	6 445	3,5%
Basic Materials	7	21 412	23 628	12,9%
Industrials	18	44 926	49 575	27,0%
Consumer Goods	5	10 023	11 060	6,0%
Health Care	3	5 174	5 709	3,1%
Consumer Services	4	4 070	4 491	2,4%
Telecom	1	5 746	6 341	3,5%
Utilities	1	12 135	13 391	7,3%
Financials	5	29 250	32 277	17,6%
Technology	5	27 854	30 736	16,7%
Total	50			
			USD/EUR	
		Exchange rate	1,1035	

Panel C - Norway	Constituents	NOK	USD	Share
Total Market Value		1 697 053	200 147	100,0%
Oil & Gas	9	546 575	64 462	32,2%
Basic Materials	3	175 415	20 688	10,3%
Industrials	10	101 285	11 945	6,0%
Consumer Goods	6	178 006	20 994	10,5%
Health Care		-	-	0,0%
Consumer Services	5	92 289	10 884	5,4%
Telecom	1	240 083	28 315	14,1%
Utilities	2	11 133	1 313	0,7%
Financials	10	324 372	38 256	19,1%
Technology	3	27 895	3 290	1,6%
Total	49			
			USD/NOK	
		Exchange rate	0,1179	

Panel D - Sweden	Constituents	SEK	USD	Share
Total Market Value		4 853 197	570 435	100,0%
Oil & Gas	1	38 293	4 501	0,8%
Basic Materials	4	120 803	14 199	2,5%
Industrials	19	1 175 803	138 202	24,2%
Consumer Goods	7	372 828	43 821	7,7%
Health Care	4	151 534	17 811	3,1%
Consumer Services	7	622 200	73 132	12,8%
Telecom	3	241 264	28 358	5,0%
Utilities		-	-	0,0%
Financials	21	1 729 187	203 245	35,6%
Technology	4	401 285	47 166	8,3%
Total	70			
			USD/SEK	
		Exchange rate	0,1175	

Exchange rate source: https://www.ecb.europa.eu/stats/exchange/eurofxref/html/index.en.html

Table 3 – Summary statistics of equity index data

Industry	Obs.	Mean	Std dev	Skewness	Kurtosis
Panel A - Denmark					
Oil & Gas	210	0,157	0,549	-0,262	4,155
Industrials	310	0,065	0,281	-0,544	4,846
Consumer Goods	310	0,114	0,285	-0,708	6,332
Health Care	310	0,146	0,175	-0,361	3,716
Consumer Services	215	0,071	0,288	1,296	9,750
Telecom	258	0,043	0,330	-2,152	17,941
Financials	310	0,092	0,216	-0,659	5,166
Technology	199	0,190	0,410	-0,479	6,427
Panel B - Finland					
Oil & Gas	126	0,064	0,337	-0,022	2,830
Basic Materials	310	0,073	0,309	0,027	3,903
Industrials	310	0,096	0,272	-0,324	4,726
Consumer Goods	243	0,220	0,314	-0,476	6,221
Health Care	310	0,123	0,236	-0,204	4,157
Consumer Services	310	0,041	0,219	-0,154	3,820
Telecom	215	0,126	0,435	-0,405	9,098
Utilities	250	0,139	0,271	-0,060	5,625
Financials	310	0,107	0,302	-0,547	6,670
Technology	310	0,160	0,458	-0,133	3,547
Panel C - Norway					
Oil & Gas	310	0,080	0,253	-0,627	4,355
Basic Materials	310	0,091	0,305	-0,949	6,797
Industrials	310	0,062	0,302	-0,475	4,222
Consumer Goods	255	0,155	0,258	-0,906	6,743
Consumer Services	310	0,108	0,348	-0,637	6,602
Telecom	195	0,092	0,380	-1,365	10,085
Utilities	310	0,045	0,315	-1,148	10,341
Financials	310	0,091	0,306	-1,009	7,372
Technology	310	0,106	0,400	-1,002	8,377
Panel D - Sweden					
Oil & Gas	169	0,268	0,404	0,254	3,290
Basic Materials	310	0,103	0,243	-0,176	4,643
Industrials	310	0,115	0,253	-0,556	4,444
Consumer Goods	310	0,124	0,265	0,108	4,256
Health Care	291	0,125	0,228	-0,330	3,814
Consumer Services	310	0,203	0,221	0,034	3,087
Telecom	257	0,115	0,302	-0,091	4,131
Financials	310	0,111	0,279	-0,295	5,226
Technology	310	0,075	0,459	-0,239	7,603

Table 4 – Risk free interest rate

Interest Rate	Obs.	Mean	Std dev	Skewness	Kurtosis
Interest rate Denmark	283	-0,224	0,447	-5,268	53,151
Interest rate Finland	202	-0,320	0,419	-2,868	15,214
Interest rate Norway	310	-0,094	0,308	0,492	25,263
Interest rate Sweden	310	-0,247	0,998	-2,635	37,479

Table 5 – Unit Root test: Augmented Dickey-Fuller test

Stock index returns	C	C & T
Panel A - Denmark		
Oil & Gas	-8.226 (1) [a]	-8.223 (1) [a]
Industrials	-10.490 (1) [a]	-10.472 (1) [a]
Consumer Goods	-11.100 (1) [a]	-11.094 (1) [a]
Health Care	-17.724 (0) [a]	-17.779 (0) [a]
Consumer Services	-14.559 (0) [a]	-14.627 (0) [a]
Telecom	-17.741 (0) [a]	-17.740 (0) [a]
Financials	-10.540 (1) [a]	-10.521 (1) [a]
Technology	-11.578 (0) [a]	-11.557 (0) [a]
Panel B - Finland		
Oil & Gas	-11.873 (0) [a]	-11.906 (0) [a]
Basic Materials	-16.308 (0) [a]	-16.280 (0) [a]
Industrials	-11.270 (1) [a]	-11.294 (1) [a]
Consumer Goods	-7.472 (2) [a]	-7.526 (2) [a]
Health Care	-16.908 (0) [a]	-16.957 (0) [a]
Consumer Services	-10.455 (1) [a]	-10.441 (1) [a]
Telecom	-12.451 (0) [a]	-12.423 (0) [a]
Utilities	-15.850 (0) [a]	-15.970 (0) [a]
Financials	-15.899 (0) [a]	-15.977 (0) [a]
Technology	-11.734 (1) [a]	-11.910 (1) [a]
Panel C - Norway		
Oil & Gas	-17.191 (0) [a]	-17.174 (0) [a]
Basic Materials	-15.503 (0) [a]	-15.478 (0) [a]
Industrials	-15.778 (0) [a]	-15.764 (0) [a]
Consumer Goods	-14.799 (0) [a]	-14.773 (0) [a]
Consumer Services	-11.733 (1) [a]	-11.800 (1) [a]
Telecom	-5.633 (3) [a]	-5.670 (3) [a]
Utilities	-17.003 (0) [a]	-16.973 (0) [a]
Financials	-18.601 (1) [a]	-9.914 (1) [a]
Technology	-18.601 (0) [a]	-18.578 (0) [a]
Panel D - Sweden		
Oil & Gas	-7.963 (1) [a]	-8.168 (1) [a]
Basic Materials	-15.332 (0) [a]	-15.308 (0) [a]
Industrials	-15.969 (0) [a]	-15.950 (0) [a]
Consumer Goods	-17.694 (0) [a]	-17.669 (0) [a]
Health Care	-15.906 (0) [a]	-15.879 (0) [a]
Consumer Services	-16.993 (0) [a]	-17.266 (0) [a]
Telecom	-13.911 (0) [a]	-13.971 (0) [a]
Financials	-7.490 (3) [a]	-7.475 (3) [a]
Technology	-16.346 (0) [a]	-16.351 (0) [a]
Other		
Brent crude oil	-15.882 (0) [a]	-4.867 (0) [a]
Interest rate Sweden	-4.787 (5) [a]	-16.302 (5) [a]
Interest rate Denmark	-16.157 (0) [a]	-6.774 (0) [a]
Interest rate Norway	-6.782 (3) [a]	-16.294 (3) [a]
Interest rate Finland	-2.662 (2) [c]	-3.191 (2) [c]

Notes: In the table the results of an Augmented Dickey Fuller test (Dickey & Fuller 1981) for unit root is presented. Schwartz information criterion is used to choose the optimal lag of maximum 12 lags. The optimal lag used in the test is presented in the parenthesis. Column C shows test with constant and C&T shows test with constant and trend. The rejection of the null hypothesis of a unit root at 1%, 5% and 10% level of significant is denoted by subscript a, b and c respectively. The one-sided critical values are obtained from MacKinnon (1996).

Table 6 – Heteroscedasticity and Autocorrelation test

Stock index returns	Breusch-Pagan		White		Durbin Watson	
Dependent Variable	**Ci-square**	**P-value**	**Ci-square**	**P-value**	**Ci-square**	**P-value**
Panel A - Denmark						
Oil & Gas	1.61	0.2042	14.38	0.5706	2.738	0.0980
Industrials	0.04	0.8471	9.64	0.8848	1.447	0.2291
Consumer Goods	1.41	0.2355	11.78	0.7588	0.027	0.8691
Health Care	1.38	0.2400	8.39	0.9366	0.552	0.4577
Consumer Services	1.73	0.1888	14.73	0.5442	0.422	0.5162
Telecom	0.56	0.4543	5.27	0.9943	1.062	0.3027
Financials	0.19	0.6599	12.75	0.6908	0.117	0.7323
Technology	7.58	0.0059 [a]	28.75	0.0257 [b]	2.510	0.1131
Panel B - Finland						
Oil & Gas	0.15	0.6956	8.24	0.8274	0.001	0.9782
Basic Materials	0.11	0.7350	18.20	0.3123	0.199	0.6556
Industrials	1.43	0.2321	7.37	0.9656	0.013	0.9088
Consumer Goods	3.11	0.0778	15.00	0.5247	0.337	0.5618
Health Care	5.58	0.0181 [b]	11.43	0.7821	3.159	0.0755 [c]
Consumer Services	0.53	0.4678	10.24	0.8540	0.297	0.5856
Telecom	7.22	0.0072 [a]	17.02	0.3840	4.150	0.0416 [b]
Utilities	69.41	0.0000 [a]	138.14	0.0000 [a]	0.307	0.5797
Financials	0.00	0.9499	15.88	0.4611	1.008	0.3153
Technology	1.24	0.2652	7.39	0.9649	1.150	0.2835
Panel C - Norway						
Oil & Gas	19.64	0.0000 [a]	73.06	0.0000 [a]	2.299	0.1295
Basic Materials	35.33	0.0000 [a]	68.22	0.0000 [a]	0.626	0.4289
Industrials	11.72	0.0006 [a]	57.21	0.0000 [a]	2.547	0.1105
Consumer Goods	6.01	0.0142 [b]	19.30	0.2536	1.055	0.3044
Consumer Services	4.91	0.0268 [b]	38.66	0.0012 [a]	0.240	0.6240
Telecom	29.57	0.0000 [a]	53.47	0.0000 [a]	2.190	0.1389
Utilities	0.06	0.8093	3.77	0.9993	2.632	0.1047
Financials	7.59	0.0059 [a]	77.73	0.0000 [a]	10.227	0.0014 [a]
Technology	0.06	0.8057	12.37	0.7179	1.140	0.2856
Panel D - Sweden						
Oil & Gas	0.14	0.7120	10.90	0.6936	1.134	0.2869
Basic Materials	4.98	0.0256 [b]	29.03	0.0237 [b]	1.833	0.1758
Industrials	33.96	0.0000 [a]	58.53	0.0000 [a]	0.205	0.6511
Consumer Goods	1.58	0.2083	17.99	0.3243	0.007	0.9334
Health Care	3.22	0.0729 [c]	15.15	0.5134	2.869	0.0903 [c]
Consumer Services	0.19	0.6647	17.83	0.3339	0.818	0.3657
Telecom	3.22	0.0727 [c]	49.27	0.0000 [a]	1.245	0.2645
Financials	3.69	0.0549 [c]	9.53	0.8899	2.714	0.0995 [c]
Technology	11.04	0.0009 [a]	52.46	0.0000 [a]	0.078	0.7802

Notes: The table presents the results of Breusch-Pagan and White tests for heteroskedasticity as well as the results for Durbin Watson test for autocorrelation for each of the regression models. Breusch-Pagan is designed to detect linear forms of heteroscedasticity. Null hypothesis: constant variance in the error terms. White test work better to detect non-linear forms of heteroscedasticity. Null hypothesis: error terms are homoscedastic, alternative hypothesis: unrestricted heteroscedasticity. Durbin Watson alternative test for autocorrelation. Null hypothesis: no serial correlation. Superscript a, b, c denotes rejection of the null hypothesis at the 1%, 5% and 10% level of significance.

Table 7 – Regression Results

Panel A - Denmark	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil (t-1)	0.145		0.017	-0.006	-0.064**	0.045	-0.093	0.015		-0.170**
	(0.094)		(0.053)	(0.060)	(0.031)	(0.080)	(0.091)	(0.048)		(0.084)
Constant	0.012		0.005	0.010*	0.012***	0.006	0.004	0.008*		0.017*
	(0.012)		(0.005)	(0.005)	(0.003)	(0.006)	(0.006)	(0.004)		(0.009)
Observations	210		309	309	309	215	258	309		199

Panel B - Finland	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
laglogBrentOil	0.035	-0.085	-0.022	0.024	-0.053	-0.051	-0.190**	-0.025	0.048	-0.162*
	(0.110)	(0.062)	(0.065)	(0.072)	(0.036)	(0.042)	(0.096)	(0.047)	(0.069)	(0.083)
Constant	0.005	0.006	0.008	0.018***	0.010**	0.004	0.011	0.009*	0.011**	0.014*
	(0.008)	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)	(0.009)	(0.005)	(0.005)	(0.008)
Observations	126	309	309	243	309	309	215	309	250	309

Panel C - Norway	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
laglogBrentOil	0.043	-0.051	-0.007	0.019		-0.031	-0.019	0.037	-0.116**	-0.088
	(0.048)	(0.068)	(0.058)	(0.057)		(0.068)	(0.091)	(0.066)	(0.059)	(0.074)
Constant	0.006	0.007	0.005	0.013***		0.009	0.008	0.007	0.003	0.009
	(0.004)	(0.005)	(0.005)	(0.005)		(0.006)	(0.009)	(0.006)	(0.005)	(0.006)
Observations	309	309	309	255		309	195	309	309	309

Panel D - Sweden	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
laglogBrentOil	0.038	-0.021	-0.077	-0.134***	-0.019	-0.076**	-0.102**	-0.054		-0.143**
	(0.109)	(0.055)	(0.059)	(0.051)	(0.049)	(0.037)	(0.050)	(0.053)		(0.070)
Constant	0.022**	0.009**	0.010**	0.011**	0.010***	0.017***	0.010*	0.010*		0.006
	(0.010)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)		(0.008)
Observations	169	309	309	309	291	309	257	309		309

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8 – Regression Results: contemporaneous effect with no shock

Panel A - Denmark	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.312***		0.144**	0.176***	0.028	0.115**	0.052	0.086**		0.289***
	(0.117)		(0.057)	(0.060)	(0.030)	(0.052)	(0.070)	(0.044)		(0.100)
Oil Shocks dummy	0.038		0.002	-0.079**	-0.039*	-0.070**	-0.047	-0.065**		0.069*
	(0.059)		(0.037)	(0.038)	(0.020)	(0.033)	(0.031)	(0.029)		(0.038)
Interest rate	-0.046		-0.021	-0.040	-0.025	-0.005	-0.015	-0.025		-0.022
	(0.078)		(0.027)	(0.034)	(0.024)	(0.019)	(0.024)	(0.025)		(0.056)
Industry return (t-1)	0.167**		0.171**	0.098	-0.029	-0.032	-0.120	0.146*		0.178*
	(0.069)		(0.069)	(0.070)	(0.062)	(0.083)	(0.091)	(0.077)		(0.098)
Constant	0.007		0.004	0.011**	0.013***	0.008	0.005	0.009**		0.008
	(0.011)		(0.005)	(0.005)	(0.003)	(0.006)	(0.006)	(0.004)		(0.008)
Observations	209		283	283	283	214	257	283		198

Panel B - Finland	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.236**	0.095	0.153**	0.213***	0.034	0.064	0.183**	0.023	0.174**	0.058
	(0.102)	(0.064)	(0.062)	(0.066)	(0.046)	(0.043)	(0.084)	(0.037)	(0.076)	(0.088)
Oil Shocks dummy	-0.015	-0.013	-0.026	-0.090***	-0.014	-0.026	0.005	-0.028	-0.021	0.038
	(0.051)	(0.026)	(0.029)	(0.029)	(0.027)	(0.021)	(0.029)	(0.024)	(0.062)	(0.035)
Interest rate	-0.070	-0.018	-0.016	-0.063*	-0.067	-0.019	-0.016	-0.022	0.006	-0.009
	(0.049)	(0.050)	(0.030)	(0.033)	(0.044)	(0.036)	(0.036)	(0.033)	(0.043)	(0.067)
Industry return (t-1)	-0.124	0.021	0.058	0.021	-0.067	0.093	0.141	-0.014	-0.030	0.169**
	(0.101)	(0.078)	(0.066)	(0.083)	(0.076)	(0.073)	(0.116)	(0.067)	(0.131)	(0.071)
Constant	0.004	0.005	0.010*	0.013**	0.010**	0.002	0.002	0.013***	0.011**	-0.003
	(0.010)	(0.006)	(0.005)	(0.007)	(0.005)	(0.004)	(0.010)	(0.005)	(0.005)	(0.010)
Observations	118	195	195	195	195	195	195	195	195	195

Panel C - Norway	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.296***	0.160***	0.084	0.102**		0.065	0.153	0.102**	0.044	0.079
	(0.036)	(0.060)	(0.054)	(0.049)		(0.068)	(0.114)	(0.050)	(0.048)	(0.065)
Oil Shocks dummy	-0.008	-0.055	-0.042	-0.059		-0.054	-0.082	-0.096**	-0.070***	-0.055**
	(0.022)	(0.037)	(0.045)	(0.036)		(0.045)	(0.090)	(0.038)	(0.026)	(0.027)
Interest rate	-0.098	-0.210**	-0.238***	-0.353***		-0.208*	-0.163	-0.215*	0.012	-0.175*
	(0.093)	(0.104)	(0.065)	(0.094)		(0.111)	(0.166)	(0.124)	(0.047)	(0.095)
Industry return (t-1)	-0.047	0.044	0.080	0.034		0.100	0.066	0.129	0.029	-0.084
	(0.054)	(0.070)	(0.065)	(0.074)		(0.064)	(0.083)	(0.080)	(0.058)	(0.063)
Constant	0.005	0.007	0.004	0.012**		0.008	0.007	0.008	0.005	0.010
	(0.004)	(0.005)	(0.005)	(0.005)		(0.006)	(0.007)	(0.005)	(0.005)	(0.007)
Observations	309	309	309	254		309	194	309	309	309

Panel D - Sweden	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.445***	0.057	0.039	0.034	0.112**	0.024	0.078	0.018		-0.012
	(0.106)	(0.049)	(0.064)	(0.051)	(0.046)	(0.042)	(0.062)	(0.055)		(0.076)
Oil Shocks dummy	0.011	-0.053**	-0.064	-0.085***	-0.025	-0.021	-0.009	-0.055*		-0.064*
	(0.066)	(0.027)	(0.043)	(0.030)	(0.032)	(0.020)	(0.029)	(0.032)		(0.038)
Interest rate	0.034**	-0.013	-0.020	-0.011	-0.003	-0.005	-0.015*	-0.022*		-0.005
	(0.017)	(0.014)	(0.014)	(0.012)	(0.012)	(0.009)	(0.008)	(0.013)		(0.014)
Industry return (t-1)	0.114	0.096	0.054	-0.023	0.046	0.029	0.125	0.161**		0.066
	(0.071)	(0.068)	(0.074)	(0.069)	(0.065)	(0.059)	(0.085)	(0.068)		(0.092)
Constant	0.016*	0.009**	0.011***	0.013***	0.010**	0.018***	0.009	0.010*		0.008
	(0.009)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.006)	(0.005)		(0.008)
Observations	159	300	300	300	281	300	247	300		300

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9 – Regression Results: contemporaneous effect with shock

Panel A - Denmark	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.257**		0.100*	0.106*	0.022	0.108	0.066	0.037		0.291**
	(0.115)		(0.058)	(0.063)	(0.036)	(0.066)	(0.080)	(0.044)		(0.117)
Oil Shocks dummy	0.050		0.013	-0.060**	-0.038*	-0.068**	-0.051	-0.052**		0.068*
	(0.055)		(0.036)	(0.024)	(0.020)	(0.030)	(0.033)	(0.021)		(0.036)
Oil shock * Oil brent	0.245		0.233*	0.352***	0.027	0.032	-0.067	0.243***		-0.012
	(0.257)		(0.139)	(0.110)	(0.090)	(0.127)	(0.138)	(0.092)		(0.159)
Interest rate	-0.046		-0.022	-0.042	-0.026	-0.005	-0.014	-0.027		-0.021
	(0.078)		(0.027)	(0.036)	(0.024)	(0.019)	(0.024)	(0.025)		(0.056)
Industry return (t-1)	0.155**		0.139**	0.074	-0.031	-0.037	-0.121	0.123		0.178*
	(0.070)		(0.070)	(0.071)	(0.061)	(0.095)	(0.091)	(0.077)		(0.098)
Constant	0.008		0.005	0.012**	0.014***	0.009	0.005	0.009**		0.008
	(0.011)		(0.005)	(0.005)	(0.003)	(0.006)	(0.006)	(0.004)		(0.008)
Observations	209		283	283	283	214	257	283		198

Panel B - Finland	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.232**	0.062	0.109*	0.218***	-0.003	0.034	0.212*	-0.003	0.184**	-0.004
	(0.107)	(0.077)	(0.063)	(0.078)	(0.047)	(0.049)	(0.114)	(0.044)	(0.082)	(0.106)
Oil Shocks dummy	0.017	-0.006	-0.018	-0.091***	-0.007	-0.020	-0.000	-0.023	-0.023	0.051*
	(0.127)	(0.023)	(0.025)	(0.028)	(0.027)	(0.020)	(0.027)	(0.023)	(0.055)	(0.026)
Oil shock * Oil brent	0.112	0.127	0.185*	-0.020	0.146	0.116	-0.113	0.101	-0.040	0.241*
	(0.338)	(0.106)	(0.097)	(0.128)	(0.105)	(0.084)	(0.129)	(0.081)	(0.183)	(0.127)
Interest rate	-0.070	-0.024	-0.026	-0.062*	-0.074	-0.025	-0.011	-0.026	0.008	-0.020
	(0.049)	(0.050)	(0.032)	(0.034)	(0.047)	(0.036)	(0.035)	(0.032)	(0.042)	(0.067)
Industry return (t-1)	-0.125	0.022	0.036	0.023	-0.067	0.094	0.141	-0.014	-0.028	0.170**
	(0.101)	(0.079)	(0.067)	(0.082)	(0.074)	(0.073)	(0.116)	(0.068)	(0.134)	(0.071)
Constant	0.004	0.005	0.010*	0.013**	0.011**	0.002	0.002	0.013***	0.011**	-0.003
	(0.010)	(0.006)	(0.005)	(0.007)	(0.005)	(0.004)	(0.010)	(0.005)	(0.005)	(0.010)
Observations	118	195	195	195	195	195	195	195	195	195

Panel C - Norway	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.282***	0.166***	0.056	0.054		0.050	0.156**	0.063	0.039	0.107
	(0.043)	(0.056)	(0.050)	(0.047)		(0.063)	(0.075)	(0.052)	(0.054)	(0.084)
Oil Shocks dummy	-0.010	-0.054	-0.046	-0.051*		-0.055	-0.083	-0.101***	-0.071***	-0.052*
	(0.022)	(0.040)	(0.043)	(0.028)		(0.044)	(0.095)	(0.037)	(0.027)	(0.028)
Oil shock * Oil brent	0.058	-0.024	0.112	0.230**		0.059	-0.015	0.158	0.022	-0.110
	(0.088)	(0.161)	(0.163)	(0.107)		(0.179)	(0.481)	(0.133)	(0.113)	(0.118)
Interest rate	-0.104	-0.208**	-0.249***	-0.386***		-0.213*	-0.160	-0.231*	0.010	-0.164*
	(0.097)	(0.106)	(0.068)	(0.099)		(0.115)	(0.171)	(0.133)	(0.048)	(0.093)
Industry return (t-1)	-0.055	0.046	0.071	0.013		0.100	0.067	0.116	0.028	-0.081
	(0.056)	(0.066)	(0.065)	(0.071)		(0.064)	(0.088)	(0.083)	(0.058)	(0.063)
Constant	0.005	0.007	0.004	0.012***		0.008	0.007	0.008	0.005	0.010
	(0.004)	(0.005)	(0.005)	(0.005)		(0.006)	(0.007)	(0.005)	(0.005)	(0.007)
Observations	309	309	309	254		309	194	309	309	309

Panel D - Sweden	Oil & Gas	Basic Materials	Industrials	Consumer Goods	Health Care	Consumer Services	Telecom	Financials	Utilities	Technology
Brent Oil, spot price	0.456***	0.074	0.060	0.057	0.064	0.063	0.110	-0.010		-0.018
	(0.110)	(0.052)	(0.056)	(0.057)	(0.041)	(0.051)	(0.073)	(0.055)		(0.097)
Oil Shocks dummy	-0.001	-0.052*	-0.062	-0.083***	-0.012	-0.018	-0.017	-0.057*		-0.064*
	(0.063)	(0.027)	(0.043)	(0.029)	(0.023)	(0.016)	(0.027)	(0.031)		(0.039)
Oil shock * Oil brent	-0.070	-0.065	-0.080	-0.084	0.233**	-0.150**	-0.146	0.105		0.021
	(0.287)	(0.112)	(0.179)	(0.114)	(0.095)	(0.073)	(0.119)	(0.128)		(0.152)
Interest rate	0.034*	-0.013	-0.020	-0.012	-0.001	-0.006	-0.016**	-0.021		-0.005
	(0.017)	(0.014)	(0.014)	(0.011)	(0.012)	(0.008)	(0.008)	(0.014)		(0.014)
Industry return (t-1)	0.113	0.104	0.059	-0.021	0.033	0.032	0.123	0.156**		0.067
	(0.072)	(0.069)	(0.074)	(0.068)	(0.065)	(0.058)	(0.085)	(0.069)		(0.092)
Constant	0.016*	0.009**	0.011**	0.013***	0.011**	0.018***	0.008	0.010**		0.008
	(0.009)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.006)	(0.005)		(0.008)
Observations	159	300	300	300	281	300	247	300		300

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix

Table 10 – The construction of equity indices, included company in each equity index

Denmark	Finland	Norway	Sweden
Oil & Gas - DK	**Oil & Gas - FI**	**Oil & Gas - NW**	**Oil & Gas - SW**
Vestas Windsystems	Neste	Statoil	Lundin Petroleum
		Seadrill	
		Subsea 7	
		Aker Solutions	
		DNO	
		Petroleum Geo Services	
		TGS-Nopec Geophysical	
		Det Norske Oljeselskap	
		Prosafe	
Basic Materials - DK	**Basic Materials - FI**	**Basic Materials - NW**	**Basic Materials - SW**
	UPM-Kymmene	Yara International	Billerud Korsnäs
	Stora Enso R	Norsk Hydro	Boliden
	Outokumpu A	Borregaard	Holmen B
	Metsa board B		Hexpol B
	Kemira		
	Munksjo		
	Stora Enso A		
Industrials - DK	**Industrials - FI**	**Industrials - NW**	**Industrials - SW**
A P Möller Maersk B	Kone B	Kongsberg Gruppen	Atlas Copco A
ISS AS	Wartsila	AF Gruppen 'A'	Assa Abloy B
DSV B	Metso	BW LPG	Volvo B
DFDS	Cargotec B	Hoegh Long Holdings	Sandvik
Flsmidth & company B	Huhtamaki	Ocean Yield	SKF B
NKT	Caverion Corporation	Stolt-Nielsen	Alfa Laval
Rockwool B	Konecranes	Tomra Systems	Skanska B
Aktieselskabet Schouw and Company	Uponor	Veidekke	Securitas B
Torm A	Valmet	Wilh. Wilhelmsen	Fingerprint Cards B
Dampskibsselskabet Norden	Cramo	Wilh. Wilhelmsen Hold. 'A'	Nibe Industrier B
Per Aarsleff	Finnlines		Saab B
Solar B	Outotec		Trelleborg B
A P Möller Maersk A	Ramirent		Indutrade
Rockwool A	YIT		Loomis B
	Lassila & Tikanoja		NCC B
	PKC Group		Lifco B
	Ponsse		PEAB B
	Tikkurila		Atlas Copco B
			Volvo A
Consumer Goods - DK	**Consumer Goods - FI**	**Consumer Goods - NW**	**Consumer Goods - SW**
Pandora	American Sports	Orkla	SCA 'B'
Carlsberg 'B'	Nokian Renkaat	Marine Harvest	Electrolux 'B'
Royal Unibrew	Fiskars 'A'	Leroy Seafood Group	Swedish Match
IC Group	Olvi 'A'	Austevoll Seafood	Aarhuskarlshamn
United International Enterprises	Raisio	Bakkafrost	Husqvarna 'B'
Carlsberg 'A'		Salmar	Nobia
			SCA 'A'
Health Care - DK	**Health Care - FI**	**Health Care - NW**	**Health Care - SW**
Novo Nordisk 'B'	Orion 'B'		Getinge
Coloplast 'B'	Oriola-KD 'B'		Meda 'A'
Novozymes	Orion 'A'		Swedish Orphan Biovitrum
CHR Hansen Holding			Elekta 'B'
Genmab			
H Lundbeck			
GN Store Nord			
William Demant Holding			
ALK-Abello			
Ambu 'B'			

Bavarian Nordic			
Veloxis Pharmaceuticals			
Zealand Pharma			

Consumer Services - DK	**Consumer Services - FI**	**Consumer Services - NW**	**Consumer Services - SW**
Matas	Kesko 'B'	Schibsted A	Hennes and Mauritz 'B'
Tivoli 'B'	Sanoma	Norwegian Air Shuttle	ICA Gruppen
	Finnair	XXL	Axfood
	Kesko 'A'	Europris	Betsson 'B'
		Schibsted B	Modern Times Group Mortgage 'B'
			Netent
			Unibet Group SDB

Telecom - DK	**Telecom - FI**	**TELCMNW - NW**	**Telecom - SW**
TDC	Elisa	Telenor	Teliasonera
			TELE2 'B'
			Com Hem Holdings

Utilities - DK	**Utilities - FI**	**Utilities - NW**	**Utilities - SW**
	Fortum	Arendals Fossekompani	
		Hafslund 'A'	

Financials - DK	**Financials - FI**	**Financials - NW**	**Financials - SW**
Danske Bank	Sampo 'A'	DNB	Nordea Bank
Tryg	Citycon	Gjensidige Forsikring	Svenska Handelsbanken 'A'
Jyske Bank	Aktia 'A'	Aker	Swedbank 'A'
Topdanmark	Sponda	Entra	SEB 'A'
Sydbank	Technopolis	Olav Thon Eiendomsselskap	Investor 'B'
Almanij Brand		Sparebank 1 Series Bank	Kinnevik 'B'
Carnegie Worldwide		Storebrand	Melker Schorling
Jeudan		Norwegian Property	Industrivarden 'A'
Ringkjobing Landbobank		Protector Forsikring	Fabege
Spar Nord Bank		Sparebank 1 SMN	Fastighets Balder 'B'
Nordjyske Bank			Hufvudstaden 'A'
			Intrum Justitia
			JM
			Latour Investment 'B'
			Lundbergforetagen 'B'
			Wallenstam 'B'
			Atrium Ljungberg 'B'
			Castellum
			Ratos 'B'
			Industrivarden 'C'
			Investor 'A'

Technology - DK	**Technology - FI**	**Technology - NW**	**Technology - SW**
Simcorp	Nokia	Atea	Ericsson 'B'
Nnit	Tieto OYJ	Opera Software	Hexagon 'B'
	Basware	Nordic Semiconductor	Axis
	Bittium Corporation		Ericsson 'A'
	F-Secure		

Figure 4 - Monthly changes in interest rate for Sweden and Norway, in percent

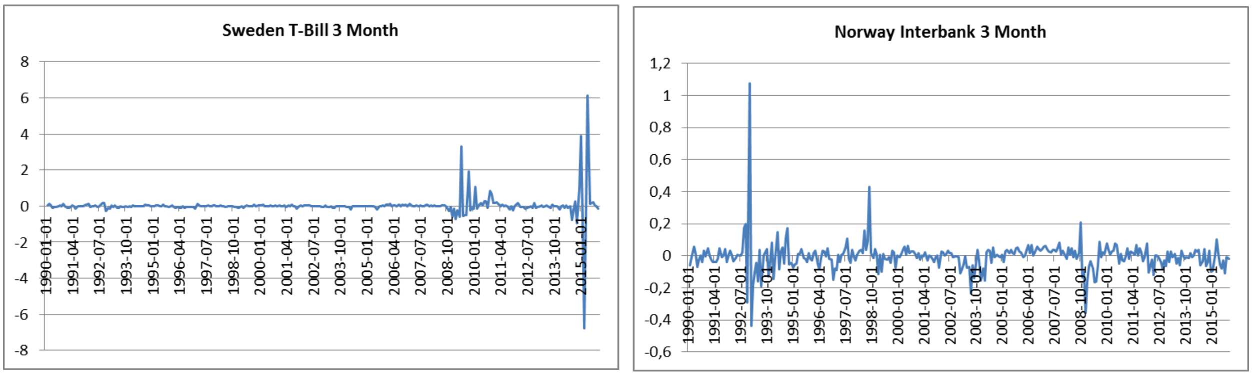

Figure 5 - Monthly changes in interest rate for Demark and Finland (Eurozone), in percent