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Chapter 1
Introduction and motivation

Out of all the variables that affect the global economy, the oil price might be the one of highest importance. For more than a century it's impact and dependence throughout the world has increased. The effects of an oil price shock are heavily debated, both on an empirical and theoretical level. Hamilton (1983) argued that oil prices and recessions show a clear pattern, where a spike in the oil price precede recessions. Later Kilian (2009) claimed demand and supply shocks in the oil market led to different macroeconomic outcomes.

Exporting countries has benefitted a great deal as prices has soared for major parts of the past two decades, before prices experienced their biggest decline in modern history in the second half of 2014. Baumeister and Killian (2016) showed that different from most previous shocks, the shock in 2014 was partly caused by a positive supply shock to a higher degree than before. OPEC announcements also helped lower expectations creating a "perfect storm" for the oil price. The American shale revolution massively increased the US domestic production of oil, as well as countries like Libya, Iraq and Syria restarting their production following years of political turmoil and unrest (Baumeister & Kilian, 2016).

The literature looking into the correlation between stock markets and the oil price is quite limited. Most papers have focused on Asian, European and the US market, whereas we intend to look at the global economy, as well as a closer look at the effects in Norway. Our aim is to examine if the current change in correlation between the oil price and stock markets could be the result of rich oil exporting countries, and companies, inflating the asset prices during the period of exceptionally high oil prices. This, as well as struggling with lower creditworthiness when oil prices decline (Bernanke, 2016), which could also have been amplifying the effect.

Jones and Kaul (1996) showed that changes in oil prices had a detrimental effect on stock returns. In other words, they found a negative correlation between the oil

prices and stock returns in their dataset which ran until 1991. When oil became more expensive, part of the capital stock was made obsolete. Inefficient machines were shut down, leading to higher costs and lower returns to investors(Baily, Gordon, & Solow, 1981).

Recently there has been a change. It is natural to think that lower oil prices would be good for stock returns. It lowers costs which leads to higher cash flows, and since most countries are net importers of oil you would think that the global economy, and also stock markets, would react positively. Especially when there has been a massive decline in oil prices that was partially driven by excess supply(Baumeister & Kilian, 2016). Supply shocks should only have adverse consequences for the oil companies, but the current decline has seen correlation between the S&P 500 and Brent crude get as high as 95 percent (Makenzie, January 26, 2016).

The existing literature mostly focuses on the change in the relationship between oil price shocks and the stock markets. And to our knowledge not much research has been done to see if the lower cash flow and creditworthiness of oil exporters and companies, could be a cause of the change in the aforementioned correlation.

Research objectives

1. Investigate if the reason for shift to positive correlation between the oil price and global stock markets could be that; cash rich oil exporting countries (sovereign wealth funds) and oil companies were inflating the stock prices whilst oil prices were high, and that their changed financial situation has led to stock market decline.
2. Compare the development in global markets to Norway, where historically the stock market and oil price have been positively correlated. Has there been a change towards less correlation in Norway?

To provide a meaningful structure to this examination the thesis will be structured as follows:

Chapter 2 will provide a literature review where we look at the most recent studies of the causes of the decline, as well as articles regarding oil price shocks and

effects on the correlation with stock markets, effects on macroeconomic variables as well as financial indices, differences in supply and demand shocks and the development of oil price volatility and uncertainty.

Chapter 3 will present the methodology we will use in order to answer the questions above. We are going to use data from 1990-2016, and study the data in two sub periods 1990-2008 and 2008-2016 to see there is a difference in correlation as mentioned by Mohades and Pesaran (2016). Also see if the results they found are applicable for Norway, a small open economy which is also a net exporter of oil. We also need to find some data on sovereign wealth funds, and oil exporters investment's in foreign assets.

Chapter 2
Theory and literature review

In this part of the preliminary thesis we will present a short summary of the theory and research that exist in our area of research. We have based our review on a variety of different articles that we mean have had significant importance, and that we find relevant for our thesis.

There is a vast amount of research dedicated to the study of oil price shocks to important economic variables such as GDP and exchange-, inflation-, interest- and unemployment-rates. In fact, there is conducted several studies where the result has been that oil price does contribute to fluctuations in the economy. A high oil price has a negative effect for oil importers and opposite for exporters. In retrospect, oil price, has been a key contributing factor to several of the previous economic recessions. There has not been much published about the correlation between oil price shocks and the stock markets compared to what has been published about the impact on macroeconomic variables. However, in more recent time, it has gotten more important.

The impact of an oil price shock on the economy is heavily debated, both empirically as well as theoretically. In the early eighties one of the most important papers in regards to the importance of oil to the economy was released by

Hamilton (1983). He argues that oil price shocks and recessions are correlated, and it showed that 7 out of 8 US recessions since World War II came approximately 3 quarters after an oil price boom. This indicates that oil price shocks could be a leading indicator for economic recessions, due to the evidence that there was a systematic relationship between oil price and output. Mork (1989), Gisser and Goodwin (1986) and Hamiliton (2005) provided evidence in support of this argument, that oil price fluctuations have an important negative impact on oil importing economies.

However, other studies show that the relationship might not be that strong, and there is a growing agreement among researchers that from the end of the 80s that the correlation between oil and output has decreased. Hooker (1996) found strong evidence that oil price no longer Granger cause many US macroeconomic variables, using data after 1973. The study presents several potential explanations for why this is the case. The potential reasons were as followed: that sample stability issues are responsible, that oil prices are now endogenous, and that linear and symmetric specifications misrepresent the form of the oil price interaction. However, none of these hypotheses are supported by the data. Blanchard and Gali (2007), published a paper which presented reasons to why the oil price-output relationship seems to lose footing. They believe that it was because of a decrease in real wage rigidities, increased credibility of monetary policy and a decrease in the share of oil in consumption and production. They argued initially that the shocks in the 70s "hit at the same time" as other large shocks of different natures. They also argued that the effects of shocks had changed over time, with a decreasing effect on prices, wages, output and unemployment.

The common opinion among researchers is that positive oil price shocks have a decreasing effect on output (Gisser & Goodwin, 1986), (Bjornland, 2000). Mork (1989) as an extension to the work Hamilton did (1983), found out that an oil price increase compared to an oil price decrease, have a larger impact on output.

Cross country differences and demand vs. supply shocks

There may be variations in the impact oil price shocks have on economic variables if we compare different countries. In a paper by Bjørnland (2000) the dynamic effect of oil price shocks on the GDP and unemployment in UK, US, Germany and Norway was analyzed. She found out that adverse oil price shocks had a negative effect on output in the short run, this applied to all countries in the

study except for Norway. A similar result was made in a paper from Mork, Olsen and Mysen (1994), they investigated the correlations between oil price movements and GDP fluctuations for US, Canada, Japan, West-Germany, France, UK and Norway. They found that the correlations with oil price increases were negative and significant for most countries, but positive for Norway. Since not all oil price shocks are the same, they might either be rooted in fluctuations in supply or demand for oil. Peersman and Van Robays (2009) compared the responses in the US and the Euro area. They found that the decisive responses are similar, however, that there are differences in the transmission mechanisms. Some years later, Peersman and Van Robays (2012), found that there were differences in the responses to an oil supply shock for industrialized net exporters and net importers. When faced with a demand shock caused by either a rise in oil specific demand or increased economic activity globally, almost all of the countries in the study experienced a temporary GDP increase. However, when faced with an exogenous oil supply shock, net oil and energy importing economies experienced a fall in activity whereas in exporting economies the effect was either insignificant or positive.

Kilian (2009) came to a relatable conclusion, that the underlying cause of the shift in oil prices had a significant impact on the economy. He also noticed that the results were time dependent, meaning that the impact of the shock would vary over time dependent of economic environment and policies. He claimed demand and supply shocks in the oil market led to different macroeconomic outcomes. He distinguished between different types of shocks by splitting them into: crude oil supply shock, shocks to global demand for all industrial commodities and demand shocks that are specific to the global crude oil market. He did this because that oil price increases may have very different effects on the real price of oil depending on the causal causes of the price increase. He found there are significant differences in the impact of the oil price to the different shocks. The most important findings were that supply did not account for much of the price fluctuations, and that global demand and oil market specific demand had a persistent and significant effect.

In an article by Aastveit et al (2015) also included emerging economies in their model. Their goal was to explain which type of shock that accounted for the most of the fluctuations in the real price of oil, and if activity in one part of the world

accounts for more of the fluctuations than others. They found out that activity in developed countries only stood for half as much of the fluctuation in the real price of oil as emerging countries. They explained this mostly by increased demand in Asia, and showed this by looking at the share of consumption, investment, and openness for the different types of countries, and the correlation between these shares and different types of oil price shocks.

After the steep decline in the price of oil between June and December 2014, Baumeister and Kilian (2016) found out that a positive oil supply shock had to account for more of the fluctuations than previously assumed. They also showed that more than half of the decline in the price was predictable before the actual downturn. They attributed the predictable decline to the cumulative effects of adverse demand shocks, reflecting a slowing global economy, positive oil supply shocks and shocks to expected oil production. They also stated that "the supply side of the oil market appears to have played an important part in generating the predicted decline".

There has not been much published about the correlation between oil price shocks and the stock markets, compared to research about the impact on macroeconomic variables. Jones and Kaul (1996), looked at the response in international stock markets to fluctuations in oil prices. The study used data from the US, Canada, Japan and UK, and the found detrimental effect on stock returns by an increase in oil prices. Sadorsky (1999) found similar effects from an analysis of the US stock market and oil prices. Results show that oil prices and oil price volatility both play important roles in affecting real stock returns. The analysis present evidence supporting that the oil price dynamics have changed, and that oil price volatility shocks have asymmetric effects on the economy. However, Huang et al (1996), investigated the relationship between daily oil futures returns and daily US stock returns. They found that oil futures and US stock returns did not have a significant correlation. Ciner (2001) argued that this conclusion could be due to the fact that only linear linkages were examined. Relying on nonlinear causality tests, he concludes that a statistically significant relationship exists between real stock returns and oil price futures. The study also found that the linkage between oil prices and the stock market was stronger in the 1990s.

Most of the studies conducted focused on larger importing countries, and not on exporting countries. A paper from Bjørnland (2009) analyses the effect of oil price shocks on stock returns in Norway, a small oil exporting country. She finds that that increased oil prices have a stimulating effect on several economic variables, especially the stock market returns. She found that after a 10 percent increase in oil prices, stock returns increased by 2.5 percent. Also Park and Ratti (2008) found similar results. They examined the relationship between oil price shocks and stock markets in the US and 13 European countries. From the study it is evident that oil price shocks have a statistically significant impact on stock returns contemporaneously for all countries, and for Norway they show a statistically significantly positive response of real stock return to an oil price increase. On the other hand, Apergis and Miller (2009), found that international stock market returns do not respond in a large way to oil market shocks, whether they are positive or negative for both oil importing and exporting countries.

Kilian and Park (2009) showed that the reaction of U.S. real stock returns to an oil price shock differs greatly depending on if it was demand or supply shocks in the oil market. They also showed that oil shocks, demand and supply jointly, could account for almost a fifth of the long run variation in US stock returns. This was a new way of understanding the correlation between oil price fluctuations and stock market fluctuations. Filis, Degiannakis and Floros (2011) investigates the time varying correlation between stock market prices and oil prices for oil importing and exporting countries. They found that demand and supply shocks affected stock markets differently. They examined the correlation between oil prices and stock markets, and they found that supply side shocks do not influence the relationship. Degiannakis, Filis and Floros (2013) studied the relationship between industrial stock market returns and oil price returns in a static environment. They found that the link is significantly influenced by the origin of the oil price shock. They found that supply side oil price shock result in low to moderate positive correlation levels, while the aggregate demand oil price shocks generate significant changes in the correlation levels, either upwards or downwards.

Chapter 3

Methodology and data

3.1 Model

We aim to examine if the shift in correlation between oil prices and stock markets could be because oil companies and oil exporting countries inflated asset prices leading up to the oil price collapse. Also, we want to examine if there is a difference between Norway and global markets. For our main analysis we will use a structural VAR model, as proposed by Hilde Bjørnland in the article "Oil price shocks and stock market booms in an oil exporting country, (2009)". The VAR model is very well suited for analysis of multivariate time series. The model is widely used to examine the effects macroeconomic activity and oil prices have on each other, as it allows for interaction between the shocks and responses from monetary policy. If we have time we will do a rolling regression to look at how the correlation between oil and stock markets have evolved over time.

By looking at the impulse response functions produced by the SVAR, we can see how the different variables and transmission channels in the economy reacts to structural shocks. Kilian and Park (2009) claim that stock returns react differently depending on the cause of the oil price shock. Therefore, they expect the stock returns to act differently depending on if the shock was caused by demand or supply in the oil market. Kilian (2009) proposed a structural decomposition of the crude oil price into three different shocks, "crude oil supply shocks", "global demand for industrial commodities" and "precautionary shocks to oil demand". We will look at the effects on global stock markets separately when affected by these shocks.

The VAR model of order *p* can be estimated:

$$Z_t = \alpha + \sum_{i=1}^{p} A_i Z_{t-i} + v_t$$

Where Z_t is the (5x1) vector of the endogenous variables.

Variables in Z_t:

Q_{oil} = global oil production

Y_w = global real activity

p_{oil} = nominal oil price

sp = the stock price index

fi = financial investments from oil producers (or a proxy)[1]

Where the first three variables concern the oil market, and the last two stock markets and investments. v_t is a vector of reduced form white noise residuals. (Bjørnland (2009) and Kilian (2009))

Assuming the vector of the endogenous variables Z_t is stationary, the VAR system can be inverted and written in the form of an infinite moving average:

$$Z_t = \gamma + \sum_{i=0}^{\infty} B_i \, v_{t-i}$$

where $B_i = (I_n - \sum_{i=1}^{\infty} B_i \, L^i)^{-1}$ and $\gamma = (I_n - \sum_{i=1}^{p} A_i)^{-1}\alpha$. L is the lag operator ($LZ_t = Z_{t-1}$).

The residuals are still correlated and cannot be interpreted as structural shocks. They need to be orthogonalised, and order them recursively using Cholesky decomposition. When employing recursive ordering the first variable does not react contemporaneously to any shocks in the other variables, but a shock in the first variable will affect the others. Hence, the restriction applies to the contemporaneous relation between the variables. After one period, all variables will react to all shocks (Bjørnland, 2009).

With our ordering: $Z_t = [Q_{oil}, Y_w, p_{oil}, sp, fi]'$ we imply the following restrictions on the B_0 matrix:

[1] We are still unsure on what data we will use, and will discuss it in the next section.

$$\begin{bmatrix} Q_{oil} \\ Y_w \\ p_{oil} \\ sp \\ fi \end{bmatrix} = \begin{bmatrix} B_{11} & 0 & 0 & 0 & 0 \\ B_{21} & B_{22} & 0 & 0 & 0 \\ B_{31} & B_{32} & B_{33} & 0 & 0 \\ B_{41} & B_{42} & B_{43} & B_{44} & 0 \\ B_{51} & B_{52} & B_{53} & B_{54} & B_{55} \end{bmatrix}_0 \begin{bmatrix} v^{Q_{oil}} \\ v^{Y_w} \\ v^{p_{oil}} \\ v^{sp} \\ v^{fi} \end{bmatrix}_t + \sum_{i=1}^{\infty} B_i \, v_{t-i}$$

Where $v_t = \left[v^{Q_{oil}}, v^{Y_w}, v^{p_{oil}}, v^{sp}, \ v^{fi}\right]_t'$ is the vector of structural shocks.

We will estimate the VAR model in E-views, and analyze the shocks through impulse response functions.

3.2 Data

We intend to use monthly data from 1990Q1 – 2016Q4. We will start in 1990 since Mohaddes and Pesaran (2016) found that from 1990 there was a statistically significant negative correlation between oil prices and stock markets for almost 10 years, before shifting to positive in 2008.

An issue we need to address is how to measure the amount of investments in financial assets, mainly stocks, that stems from oil companies and sovereign wealth funds (SWF). If we are to investigate the connection between asset inflation and abundance of "oil money", we have to find a way to measure how much they invest. This might turn out to be difficult, and we have yet to find any literature of similar nature. Although some of the SWF, particularly in western democratic are very transparent, this is not necessarily the case for all SWF (Truman, 2009).

If it is the case that we are not able to find quality data on investments from oil producers, we have to search for a suitable proxy. We could look at corporate bond losses after 2008, as the decline in oil prices has been followed by substantial bond losses in the oil sector. If investors take heavy losses in the bond market when oil prices are falling, it is natural to believe this will affect investments in other assets as well. Also, valuations of US energy companies have been falling dramatically, which leads to more losses for investors (Mohaddes & Pesaran, 2016). If investors were heavily invested in oil companies when the collapse occurred, and took big losses, then this could have multiplied the effect

of less investment in assets by oil producers. There are other proxies we also need to look into, such as: oil company profits, oil exporters deficits and bankruptcies in oil and oil related companies.

Data will be collected either through data stream at BI, or through Bloomberg.

Chapter 4
Considerations and plan forward

4.1 Considerations

We have now presented an overview of our proposed hypothesis and main area of interest in our thesis. However, it should be mentioned that our path might change during the course of the examination if we find issues we are not able to resolve, or find other questions we deem more important.

Our model is one example of something that might be re-specified during our research. We have a lot of literature we have looked at, but we have yet to get a full picture. Especially the most recent articles need a closer look, and we might find some results that will alter either our model or our data. Furthermore, it is also very likely that we need to include, or exclude, more variables in our model, and change the ordering. Also, as mentioned we are not sure what variable to use to measure oil producer investment, and solving this problem is surely going to lead to changes in our model and data.

If our progress is satisfactory, we will consider looking into the evolution of the correlation between oil prices and the stock market in Norway. Norway showed statistically significant correlation between the oil price and stock market between 1986-2005, which was not the case for 13 other European countries (Park & Ratti, 2008) and it would be interesting to see what has happened after 2005.

4.2 Path forward

January 15th: hand in preliminary thesis.
January 15th - February 17th: Prepare for presentation and collect data.

February 17th - 24th: Consider thesis based on feedback from presentation.

February 25th - March 6th: Find preliminary results and present to supervisor.

March 6th - April 6th: Complete thesis draft and get feedback from supervisor.

April 7th - May 7th: Revise thesis based on feedback.

May 7th through June: Complete and deliver thesis.

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