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Will Saudi Arabia run out of money?

"They talk the talk, but can they walk the walk?"

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Abstract

We examine when and if Saudi Arabia run out of money in order to predict if Saudi Arabia will change their oil policy due to the low oil price we are facing today. This is done by running different static analyses, time series analysis and an analysis on the effects of cutting production based on elasticity of supply.

We find that Saudi Arabia run out of money if they continue without financial and strategic adjustments. However, our findings show that other analysts overestimate when Saudi Arabia run out of money, since they do not account for return on their foreign reserves. Furthermore, we find that Saudi Arabia will decrease the possibility of running out of money as long as they introduce a stricter budget policy. Lastly, we find that Saudi Arabia has something to gain from reducing their production. However, exclusively focusing on production cuts will not solve the initial problem with running out of money. Therefore, we find that Saudi Arabia will have their primary focus on adjusting expenditures, and production cuts will only be used as a secondary measure.

We conclude that Saudi Arabia will not run out of money as they will adjust their expenditures and tighten their budget policies. We also believe that Saudi Arabia will try to delay the usage of production cuts as long as possible. Our findings indicate that the over-supply of oil will continue and that we will observe a persisting low oil price.

Preface

This thesis was written in the fall of 2015 as part of our Master of Science degree in Finance at Norwegian School of Economics. First, we want to thank our supervisor Carsten Bienz for helpful guidance and comments during the process. We also want to thank Jonas Andersson. His input and guidance on the time series analysis has been very helpful.

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1. Introduction

The recent months, analysts worldwide have tried to predict when Saudi Arabia will run out of money, due to today's low oil prices. All the analyses predict that Saudi Arabia will run out of money within the next five years, and it has been speculated that Saudi Arabia will need to change their oil policy. However, we believe their predictions are wrong.

The drastic fall in oil prices has affected the world economy. Countries that import oil benefits from the fall in oil prices, but countries with large dependency of oil face higher unemployment rates and significantly drop in revenues. For instance, the unemployment rate in Norway has risen to 4.6% in August 2015, up with 1.3% since June 2014. Governments and people affected by this are hoping for a quick recovery for the oil prices, but the question is when and if this will happen.

Since June 2014, the Brent Oil price has fallen from USD114 to approximately USD44 in the middle of November. There are various reasons for the reduction in oil price, whereas supply and demand had a significant role. However, supply factors explains most of the drop. There has been an increased supply from US production, which have reduced their imports from 9 million barrels a day to 5 million barrels a day (OPEC, 2015). In addition, Saudi Arabia has actively chosen to maintain their production levels to protect their market shares, and there is uncertainty over OPEC future production quotas. This combined with lower oil-demand and lowered growth expectations, has led to a drop in oil prices.

Since the drop in oil prices is primarily caused by over-supply of oil, we have decided to analyse Saudi Arabia´s situation. Saudi Arabia is the main participant in OPEC, and a lot of attention is given to the kingdom, as they to great extent can, and have historically affected the global oil market. The kingdom is the largest producer and exporter of oil, and they have the largest proven oil reserves in the world. In 2014, their reserves were 266.6bn. barrels of oil. This is 48.5 times the reserves controlled by Norway and 7.3 times the reserves controlled by USA.

Saudi Arabia is known for having a low marginal cost of producing oil, and many believe that they have no problem with the current oil prices. However, oil generates 80 – 90% of their total revenues, and their breakeven is therefore higher if you include their state budgets. The implication of this is that Saudi Arabia is losing money with today's oil price. During

the first half of 2015 they withdrew USD73 bn. from their foreign reserves (Kerr, Financial Times, 2015). Saudi Arabia is currently in possession of large foreign reserves, and they can tolerate budget deficits for a period. However, the question is how long time it will take before they run out of money. We define running out of money as the time when net financial assets equals zero. This is of high interest, as this will give an indication on how Saudi Arabia will respond to the low oil price. A situation where Saudi Arabia risk running out of money increases the possibility of a strategic change in oil policy, such as a production cut. This will reduce the over-supply of oil and increase the price, which leads to an increased revenue for Saudi Arabia.

This thesis may give a vital answer regarding the future of the oil market. An indication that Saudi Arabia, together with OPEC, will reduce their production will lead to an increase in the oil price. This can be a crucial development for a so far ailing oil price, and can bring the oil price back to historical high levels. The implications of this is increased revenues and a more stable economy with lower unemployment and better future prospects for the oil exporting countries. On the other hand, if Saudi Arabia leave the market to itself, affected governments, businesses and individuals will have to adjust to today's situation and prepare for persisting low oil prices.

Analysis done on the topic find different timelines on when Saudi Arabia will run out of money. IMF project that the kingdom will run out of money within five years if they keep doing what they are doing now. Another analysis done by CNBC find that Saudi Arabia will run out of money in under three years. Lastly, Trond Omdal at Pareto predicts that they will run out of money in the beginning of 2021. All the analyses assume no debt build-up, that deficit only draw on the reserve assets, current crude oil production and no change in macro-economic factors. We question that these analyses do not account for future return on their current foreign assets, and that they underestimate Saudi Arabia´s ability to adjust their expenditures. Therefore, we believe that their predictions are incorrect. They overestimate the likelihood of Saudi Arabia running out of money and the time when they do so.

We find that including expected return to the foreign reserves pushes the time when Saudi Arabia run out of money. We find that Saudi Arabia will run out of money somewhere between the beginning of 2020 and the beginning of 2027, if they make no financial or strategic adjustments, and continue as they have done in the past. However, we find that they

have both the opportunity and the ability to do the adjustments required, in order to prevent them from running out of money.

Based on our findings we conclude that Saudi Arabia will not run out of money. They will acknowledge a persistent low oil price, adjust their expenditures relatively to their revenues and tighten their budget policies. Saudi Arabia has the opportunity to cut their production and may benefit from this. However, we believe Saudi Arabia will try to delay this for as long as possible as part of their long term strategy, and avoid subsidizing high cost oil producers such as American shale oil. As an effect of this, we will continue to observe over-supply of oil, as it is unlikely that Saudi Arabia will change their oil production. Therefore, governments, businesses and individuals affected by the low oil price, have to adjust to today's situation and prepare for a persisting low oil price.

2. Theory

2.1 Saudi Arabia

2.1.1 Saudi Arabia and oil

Saudi Arabia is the world's largest producer and exporter of oil. In 2014, the kingdom produced 9.7 million barrels of oil per day, accounting for approximately 13% of the world production (OPEC, 2015). Figure 1 shows a graph of world production in percentage. The Saudi Arabian government has also stated that they will try to increase their production capacity up to 12 million barrels of oil per day (OPEC, 2015). In addition to being the largest producer and exporter of oil, Saudi Arabia is one of few producers that have spare capacity that can be used to balance the markets in short term. They are also the only country with an official policy to maintain spare capacity (Fattouh & Sen, The Oxford Institute For Energy Studies, 2015).

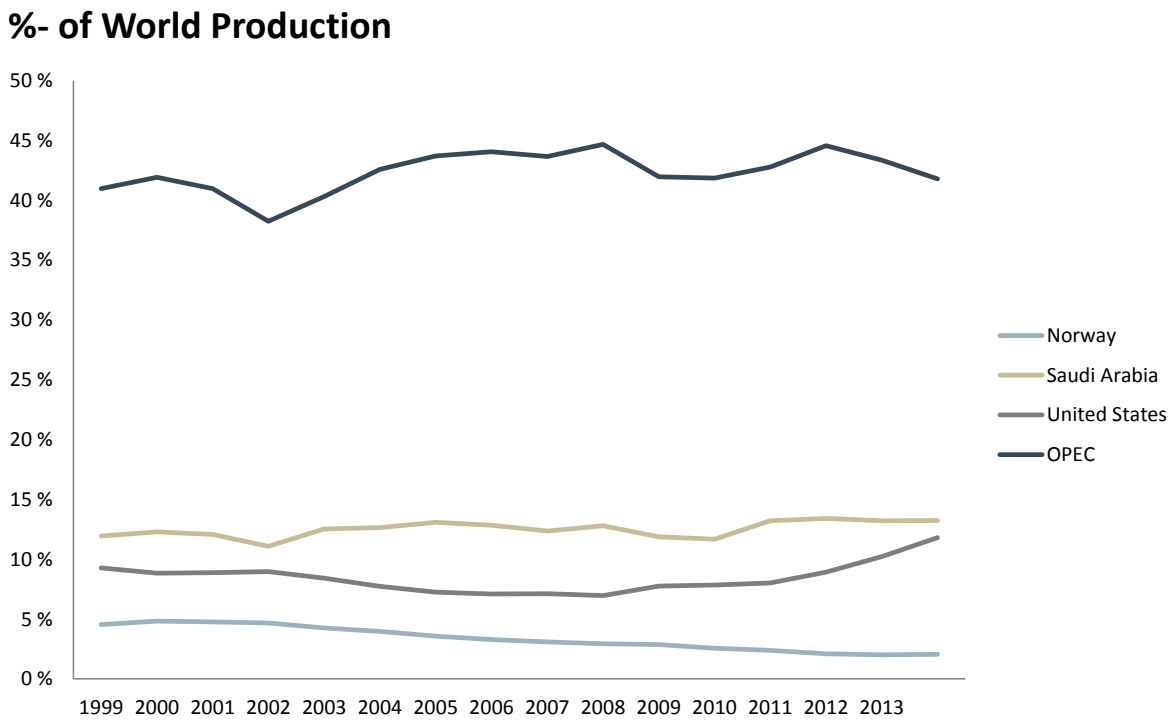

Figure 1: % of world oil production for different producers and OPEC *(OPEC, 2015)*

Saudi Arabia exports a large fraction of their production. You can see in the graph below that since the beginning of the 90s their export has stabilized between 2000 and 2500 billion barrels per year.

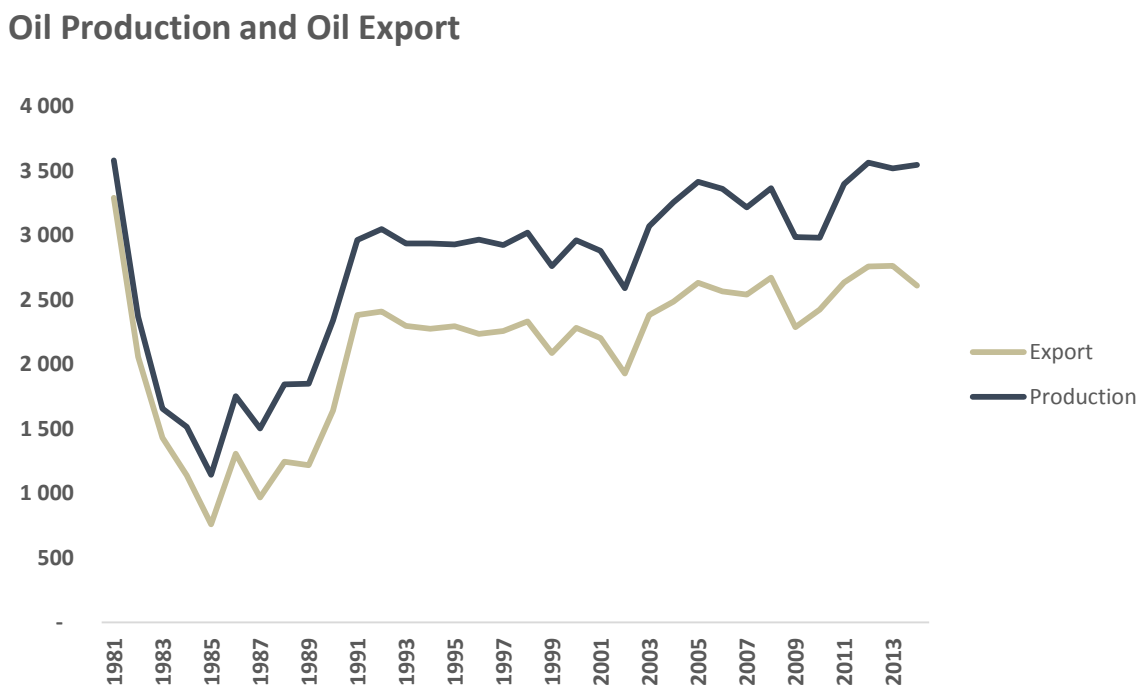

Figure 2: Annual Oil production and Export, million barrels *(Ministry of Petroleum and Mineral Resources, 2015)*

In addition to being the world's biggest oil producer, Saudi Arabia control approximately 17.9% of the world's proven crude oil reserves. This is the biggest oil reserve controlled by a country in the world. In 2014, their proven crude oil reserves were 266.6bn. barrels. This is 48.5 times the reserves controlled by Norway and 7.3 times the reserves controlled by USA (OPEC, 2015).

All of the oil production in Saudi Arabia is located onshore. As an effect of this, their marginal cost of producing oil is low, especially compared to the other countries. In 2014, their marginal cost of producing oil was estimated to USD3 per barrel. This is significantly lower than for instance US shale oil production, where the marginal cost of producing oil was USD73 in 2014. The same also applies if you compare to other production methods and countries. You can find a comprehensive list in the appendix.

Their domestic consumption is also a big part of the Saudi Arabian oil production. Figure 3 shows that the kingdom has experienced big economic growth since 1980, with GDP

increasing from USD145 bn. in 1980 to USD746 bn. 2014. This substantial increase in GDP has led to an increase in domestic consumption of oil and other refined products, from 695 b/d in 1980 to 4156 b/d in 2014 (SAMA, 2015).

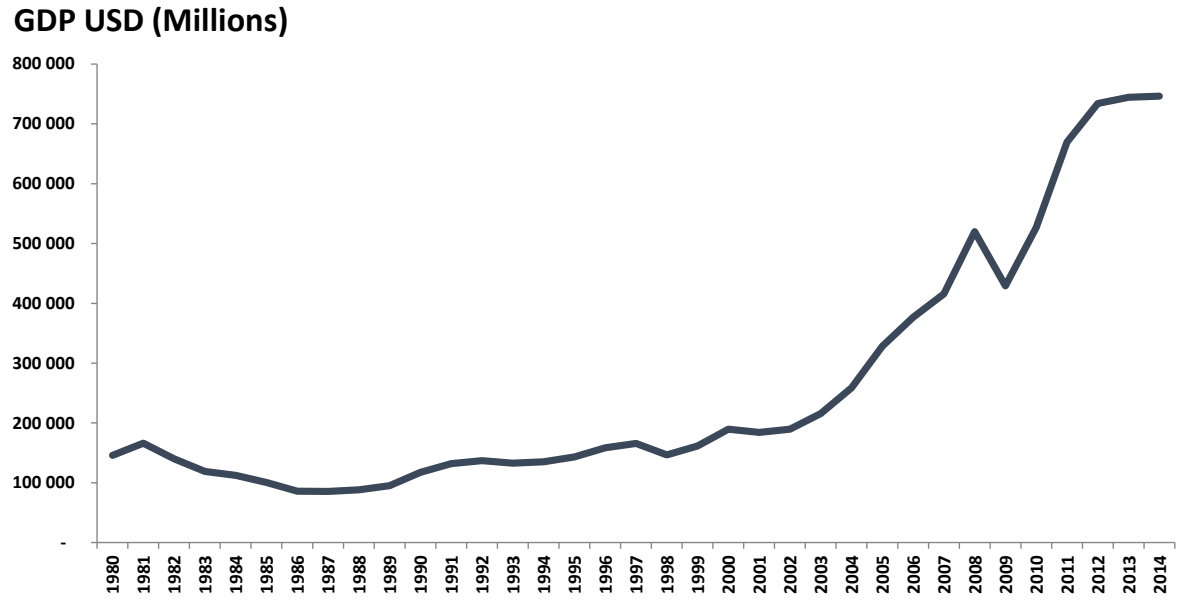

Figure 3: Growth in GDP measured in USD million *(IMF, 2015)*

A large portion of Saudi Arabia's revenues come from oil. Figure 4 shows oil revenues as a fraction of total revenues. As we can see, oil revenues have since 1990 made up 78% – 93% of Saudi Arabia´s total revenues. This has varied since the beginning of the 1970s, and the past ten years' oil revenues have been stable at around 84 – 93%. (SAMA, 2015).

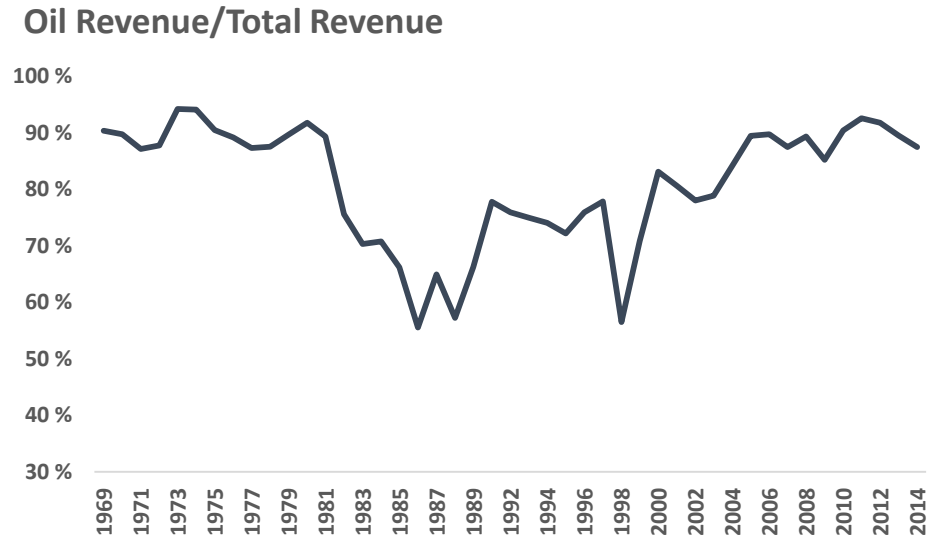

Figure 4: Oil revenues as fraction of total revenues *(SAMA, 2015)*

It is interesting to look at how the kingdom´s expenditures have developed together with the development in revenues, as shown in figure 5. The government expenditures have increased as their revenues have increased. It seems to be a strong correlation between their expenditures and revenues.

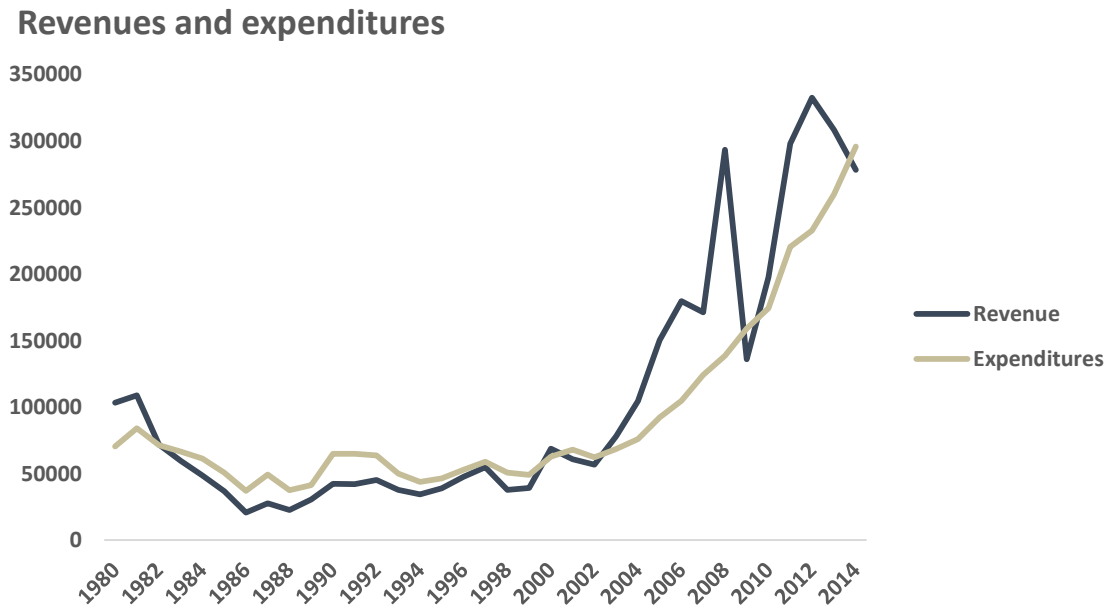

Figure 5: Development in revenues and expenditures (SAMA, 2015)

Figure 6 illustrates actual vs. budgeted revenue. We can see that they have exceeded their expectations the past 15 years, which implies a conservative budgeting.

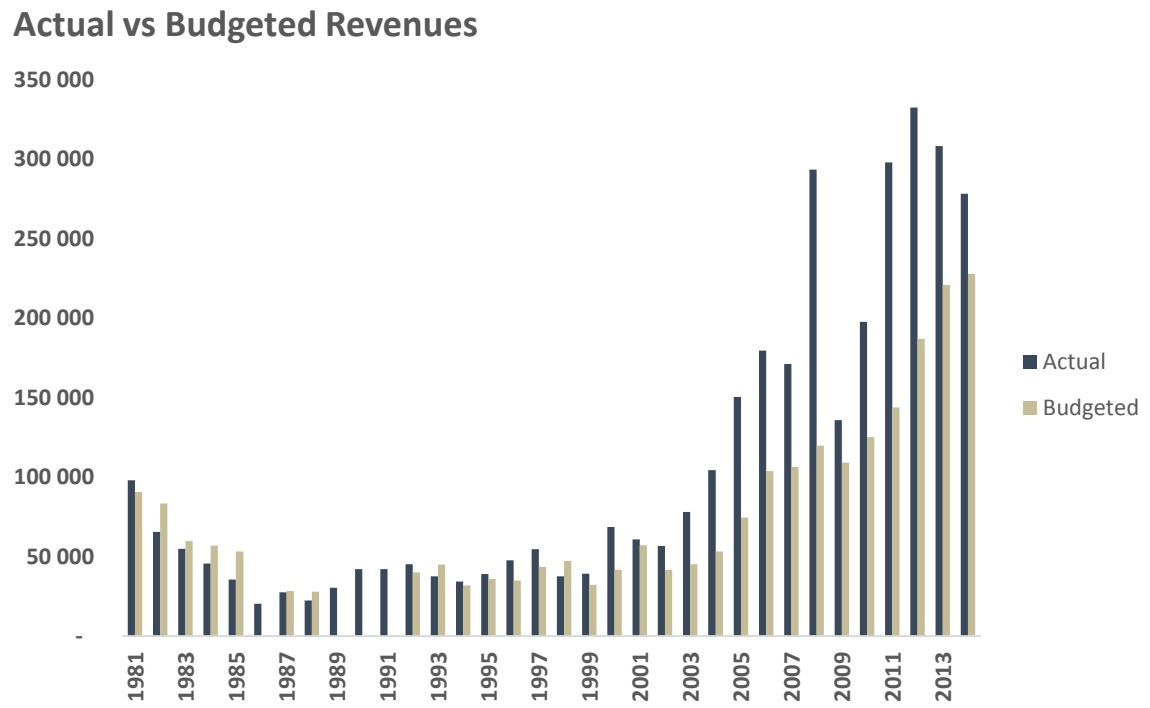

Figure 6: Actual vs budgeted revenue in million USD (SAMA, 2015)

Figure 7 illustrates actual vs budgeted expenses. We observe that they have exceeded their expenditures budgets the past 15 years.

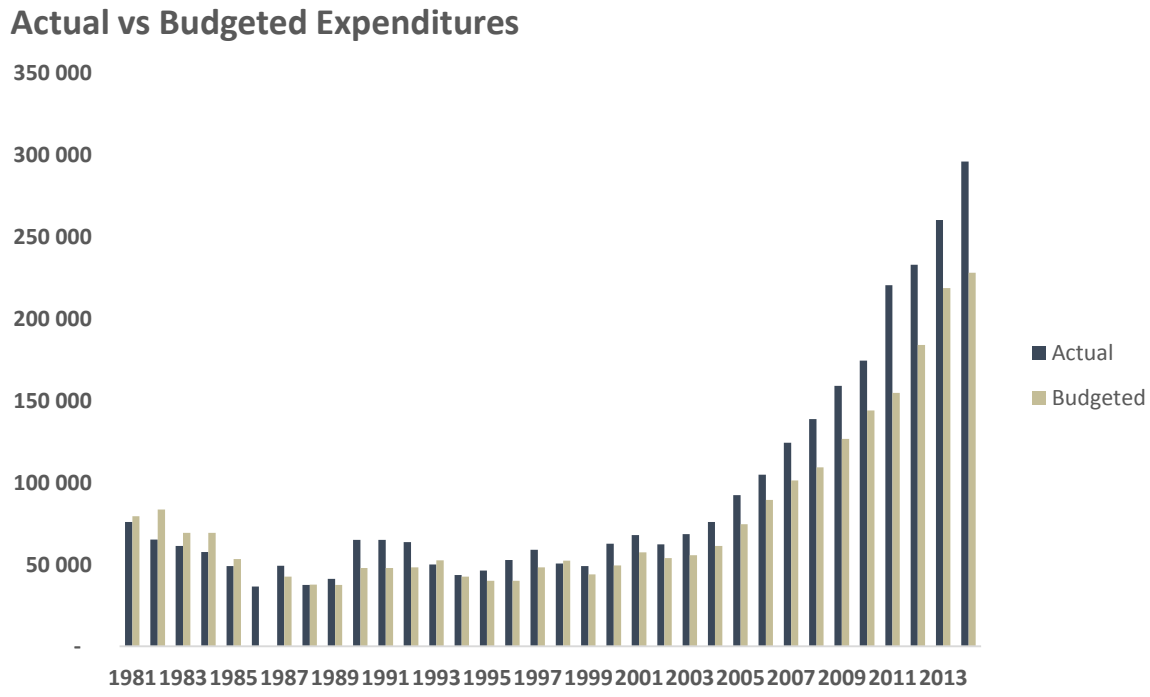

Figure 7: Actual vs budgeted expenses in million USD (SAMA, 2015)

Figure 8 shows that Saudi Arabia´s performance has varied, as measured by budget surplus/deficit as a percentage of GDP. In 2014, they had a budget deficit of -2.3% of GDP (SAMA, 2015). It is interesting to see that Saudi-Arabia has experienced a situation similar as today, with large budget deficits measured as a fraction of GDP. During the oil-price collapse in the late 80s, Saudi-Arabia faced budget deficits up to 25% of GDP. During the 80s Saudi Arabia reduced their production in order to stabilize the oil market, which turned out to be a unsuccessful strategy (Reuters, 2014). In a recent report, IMF prognoses a budget deficit of 19.5% of GDP in 2015 (IMF, 2015). This is less than what they faced in the 80s.

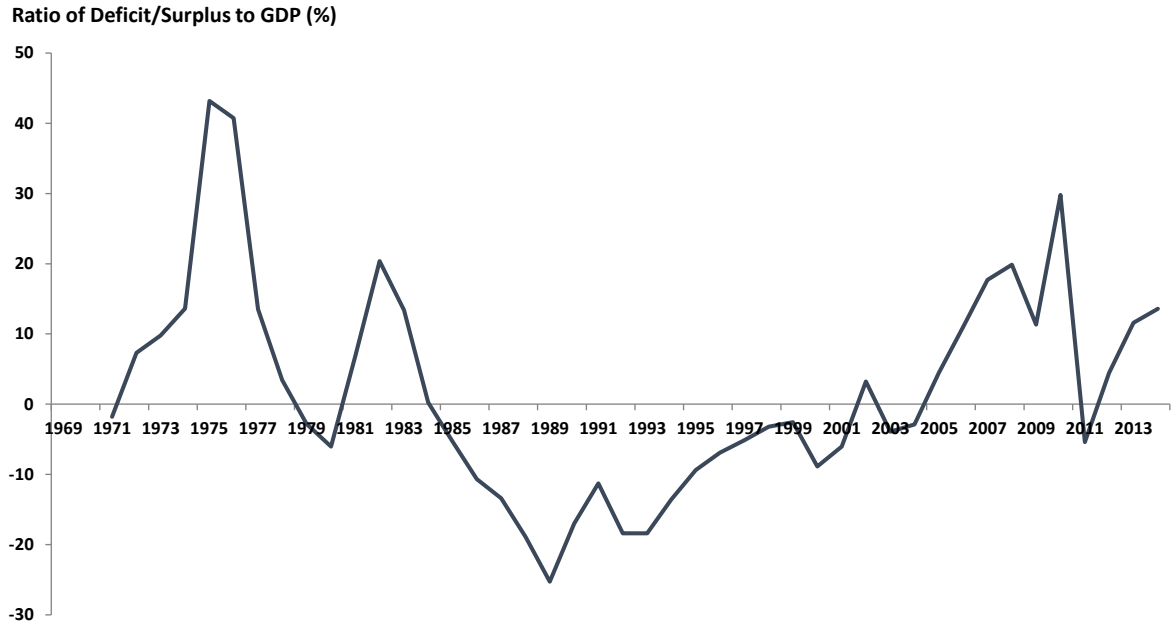

Figure 8: Ratio of Deficit/Surplus to GDP (%) (SAMA, 2015)

Another important issue is the public debt in Saudi-Arabia. Figure 9 shows the development of public debt. In brief, Saudi Arabia per today has a small fraction of public debt. By the end of 2014 the Kingdom had public debt of USD11.8bn. (SAMA, 2015). This was a debt to GDP ratio of 1.6% and is very low. Saudi Arabia has since 2004, decreased their amount of debt with USD110.8 bn., and in 2004 they had a debt to GDP ratio of 37.3%.

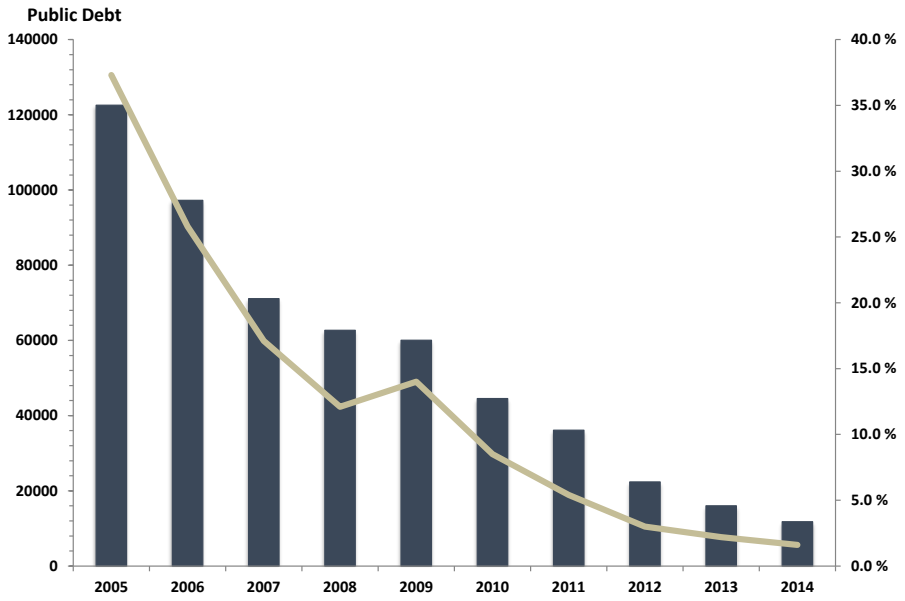

Figure 9: Public debt, amount and % of GDP *(SAMA, 2015)*

It is important to look at how they choose their oil policy. The best way is to separate short-term and long term policy. Saudi Arabian short term oil policy is shaped by a trade-off between volume and revenues. The essential here is to adjust output and signalling to the market in the short term (Fattouh & Sen, The Oxford Institute For Energy Studies, 2015).

The long term policy will be determined by the kingdom´s reserves, the high reliance on oil revenues and the difficulties of diversifying the economy away from oil. For instance, their goal is to balance the need for domestic consumption and ability to affect the oil markets. As earlier mentioned, Saudi Arabia has experienced a significant increase in domestic consumption of refined products. Their long term investment and output policy is therefore depending on balancing the need for spare capacity and to be able to meet domestic demand. If they fail to do so, a low spare capacity will for instance reduce their ability to calm oil markets, while a failure to meet domestic demand for oil will decrease their economic growth. This will also affect their long term investments in new reserves (Fattouh & Sen, The Oxford Institute For Energy Studies, 2015).

2.1.2 SAMA Foreign Holdings

SAMA Foreign Holdings is the sovereign wealth fund of Saudi Arabia. The fund manages the Saudi Arabian foreign reserves that primarily come from oil revenue. As a fund, they are highly secretive regarding its holdings and investment strategies.

Saudi Arabia established their fund SAMA Foreign Holdings in 1953. The fund managed a small amount of assets until 2005, when they started to invest more money into foreign securities (Sovereign Wealth Fund Institute, 2015). According to the latest report from SAMA, SAMA Foreign Holdings had approximately USD745 bn. in foreign holdings in Q3-14. This is up from USD100 bn. in 2005. In Q2-15, their foreign holdings have reduced with USD73 bn. from its peak in Q3-14 to total foreign holdings of USD672 bn.

Their foreign holdings are composed of Monetary Gold, Special Drawing Rights (SDR), reserve positions in the IMF, foreign currency, deposits and investment in foreign securities (SAMA, 2015). You can see the quarterly change since 2005 in Figure 10 below.

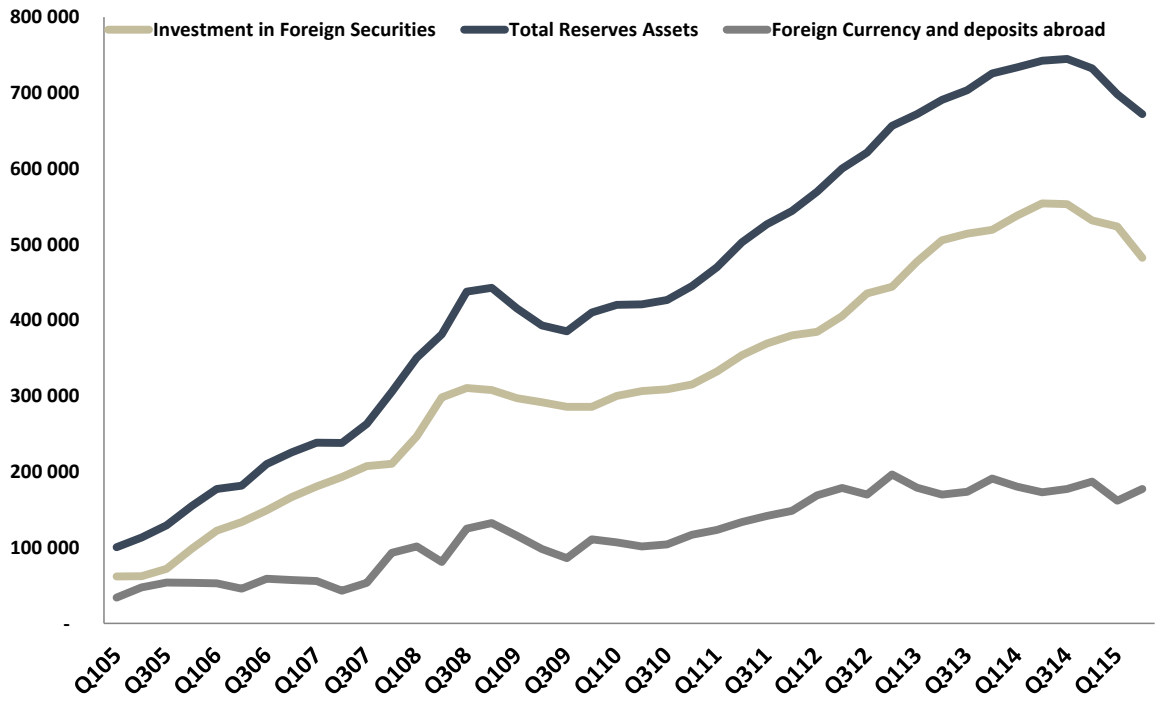

Figure 10: Quarterly change in foreign reserves *(SAMA, 2015)*

We assume that changes in the fund comes from two sources: 1) return from the different investments and 2) inflow or outflow from their annual budget surplus/deficit.

Since SAMA do not share information regarding their fund, it is hard to find information regarding their investment strategy, asset allocation, returns and associated risks. We know however that it is a sovereign wealth fund. This indicates that the fund, to some extent, will look similar to for instance the Norwegian Pension Fund Global run by Norges Bank Investment Management (NBIM). We will use their estimated expected return as a benchmark and proxy for the performance of SAMA´s fund in the future.

2.2 Oil price development

This paragraph describes the development in the oil price since 2014 until today, and gives a brief explanation of why the oil price has dropped. It is important to know the development in oil price and the reasons why we have experienced a drop in oil prices to get an overview of the situation Saudi Arabia is facing right now.

In 2014, Brent oil price fell from USD108 per barrel to USD57 per Barrel. During the first six months of the year, the oil price remained stable within a USD10 per barrel range. The oil price reached its peak on June 19 reaching USD115.06 per barrel. Drastic fall characterized the following six months, and the price fell to USD57.33 per barrel on December 31 (EIA, 2015). The graph below shows the development in 2014:

Figure 11: Development in crude oil prices for 2014 *(EIA, 2015)*

In 2015, the oil price has ranged between USD43 and USD67 per barrel, and seems to have stabilized at a low level.

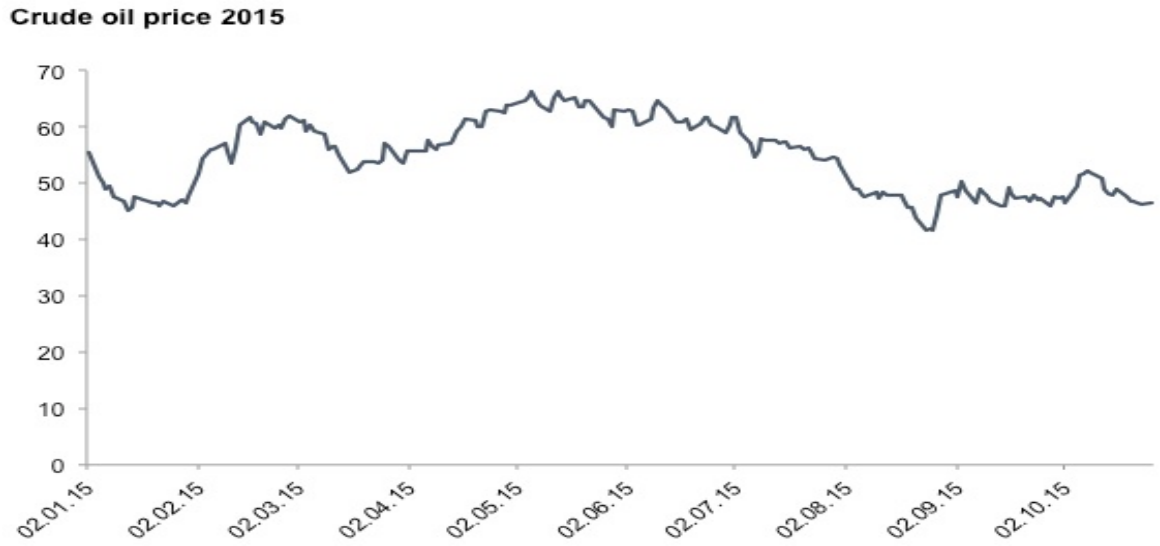

Figure 12: Development in crude oil prices for 2015 *(EIA, 2015)*

There are different reasons for the drastic fall in the oil price. Both supply and demand factors have had impact on the drop in oil prices. According to U.S Energy Information Administration (EIA), the first part of the fall was an outcome of potential disruption in Iraq Oil Production and lowered economic growth expectations for 2014 and 2015. These factors brought the oil price down to about USD80 per barrel.

There are additional factors that brought the oil price to an even lower level. According to EIA, increased U.S oil production and uncertainty over OPEC future production quotas explain most of this drop (EIA, 2015). U.S oil production has increased drastically the recent year, as an effect of the country's ability to extract shale oil. Stable high oil prices in recent years have made it possible to develop new technology and shale oilfields in the US. This has led to an increase in the U.S production, which again have lowered their import of oil. The reduction in U.S import have had a direct effect on the global demand for oil. As can be seen in figure 1, the United States has increased their share of the world oil production.

It has been argued that supply factors have played a larger role than demand factors in driving the oil prices down (Husain, Arezki, & Breuer, 2015). Most of the OPEC-members face budget deficit when oil prices are as low as this. This could have been avoided if they reduced their supply in order to keep the oil prices at a higher level. However, this is not something OPEC, with Saudi Arabia as a major player did. Following the decision by OPEC

in late November not to curtail oil production, which took markets by surprise, prices fell quickly by about 20% as markets fundamentally changed expectations about future OPEC supply (Husain, Arezki, & Breuer, 2015).

In March 2015, The Saudi Arabian oil minister Ali al-Nami commented on the fact that OPEC did not cut their supply of oil in November 2014. He stated, "Saudi Arabian quest for market share is simply an effort to satisfy rising customer demand. We seek calm markets, because this benefits everyone" (Ferro, 2015). This indicates that Saudi Arabia is interested in maintaining their market share. He further says, "Today, it is not the role of Saudi Arabia, or certain other OPEC nations, to subsidize higher cost producers by ceding market share" (Ferro, 2015). This statement indicates that Saudi Arabia is not interested in reducing production and increase the oil price, thus subsidies for instance US shale oil companies. To summarize, Saudi Arabia is willing to face the consequences of a low oil price in order to maintain their market share and power, and outcompete high cost oil companies that will not be able to endure today's oil prices.

2.3 Oil price theory

To get an overview of the future oil price and be able to use reasonable estimates in our model, it is vital to see how theory explains the pricing of oil.

Oil price theory builds on the assumptions that rational actors try to take advantage of imbalanced markets in order to gain profits. Different oil-related assets such as oil futures, shares of oil companies and oil reserves is used in oil market speculation (Knittel & Pindyck, 2013). Of these assets, we will focus on *storage arbitrage* and *the role of future contracts,* along with *price elasticity*. *Price elasticity* is a measure of the relationship between a change in demand of a commodity and the change in its price. In this section, we will discuss the three factors that plays a central role in the oil price development. James D. Hamilton has analysed all these factors in a paper published in the "The Energy Journal, International Association for Energy Economics", and we will use this paper as a basis.

2.3.1 Storage Arbitrage

Storage arbitrage relates to an investor´s choice of either buying today or in the future. If there is an expectation that the price will increase in the future and become higher than today's price plus storage costs, there is an expected profit with buying today, storing the oil and selling in the future. The outcome of this is that the demand for oil today will increase, and the prices will push upwards. At the same time, the fact that many investors have bought today in order to sell in the future will create an expectation of a supply surplus in the future. The effect of this is sales pressure and a followed price reduction. Investors will exploit the mismatch in the market until there is equilibrium between today's price and expected price in the future. Formally, you can write this as (Hamilton, 2008):

1) $$E_t(P_t + 1) = P_t + C_t^*$$

$E_t\,(P_{t+1})$ is todays expectation for the price one period ahead, P_t is todays price and C_t^* is the storage costs (including interest rate) for a period. It is worth mentioning that we are talking about speculating and not arbitrage, as the future price is based on expectations and is not certain.

The theory of storage arbitrage implies that the oil price is forward-looking. This means that all information regarding an expected future oil price is already priced in today's spot price. A change in the oil price will only occur in the event of new information, which also changes the expectations of the future prices. If we are facing an efficient oil market, the oil price development will be impossible to predict, as all the information is already priced. Based on this, one can argue that the oil price follows a random walk, where the best prediction of a future oil price is today's oil price, for all periods of time (Hamilton, 2008).

2.3.2 Futures Markets

This theory addresses the possibilities of buying future contracts on oil, and that there have to be equilibrium between expected future price and the futures price for the same period. As in the case of storage, arbitrage investors will try to take advantage of any disequilibrium. If today's futures price for a period ahead is lower than the expected spot price for a period ahead, the demand for futures will increase. The reasoning for this is that investors want to buy cheap today and sell expensive in one period. This behaviour will lead to an expectation of supply surplus a period ahead, and therefore reduces the expectations of the future spot price. There has to be equilibrium, and this is can be written as (Hamilton, 2008):

2) $$F_t = E_t(P_{t+1}) + H_t^*$$

F_t is today's futures price with delivery in one period, $E_t(P_{t+1})$ is today's expectation on the spot price in one period and H_t^* is a form of risk premium. This is also speculation and not arbitrage, since it builds on expectations.

Equilibrium involves that the futures prices to large extent follows the spot price. Therefore, the futures price will also be forward-looking and reflect all the available information. By putting equation 1) and 2) together, you can see that the futures price should equal to the spot price (plus storage cost and risk premium). If you ignore C_t^* and H_t^* the equation will be (Hamilton, 2008):

3) $$S_t = F_t$$

The spot price should therefore be equal to the futures price with delivery in one day. This seems to be consistent with the reality. The variables correlate to large extent, and there are only small differences. These differences are most likely caused by C_t^* and/or H_t^*. However, futures tend to react less on news the further out in time the delivery is (Hamilton, 2008).

2.3.3 Price Elasticity

You can divide price elasticity into price elasticity of demand and price elasticity of supply. Since our thesis focus on Saudi Arabia and the supply-factors in the oil market, we will only discuss price elasticity of supply.

Price elasticity of supply

An oil producer wanting to increase its production can do this either by accelerating the extraction from an existing reserve or by finding a new oil field. It is obvious that finding a new field and starting production will take long time. Increased production from existing oilfields can only be done to some extent, as many of them usually are fully utilized (Hamilton, 2008). These factors indicated that price elasticity of supply should be low in the short term. This is consistent with the analysis done by Hamilton, which concludes with a low price elasticity of supply in the short run (Hamilton, 2008). In the long run, there is more production flexibility, and the price elasticity of supply evolves to be more elastic. This however, depends on the ability of the participants to adjust their production (Hamilton, 2008).

2.4 Future Oil price outlook:

Predicting future oil price proves itself very difficult, as there are many determinates affecting the oil price and based on theory random walk can apply.

It is interesting to see what key analysts and organizations predict for the future oil price. According to Regional Economic Outlook Report published by IMF, they expect the 2015 oil price to be USD52, increasing gradually to about USD63 in 2020. According to the IMF there are considerable uncertainty surrounding these figures (IMF, 2015).

Goldman Sachs has tried to project the future oil price, and they have estimated that the oil price will be USD65 in 2017 (Goldman Sachs, 2015).

The Wall Street Journal also conducted a survey where they asked ten of the most reputable investment banks in the world on their oil price outlook. Most of the analyst predicted the oil price to stay in the USD53 – USD64 range when we enter 2017, and only three of the banks see the price rising above USD70 a barrel in 2016 (Wall Street Journal, 2015).

There are clearly uncertainties regarding the outlook of oil prices. However, it seems to be consensus that the oil price is expected to stay below USD80 in the near future. This is also confirmed when we look at the future curve for the oil price. As we can see in the figure below, the future curve indicates that the oil price will stay below USD65 in the nearest future:

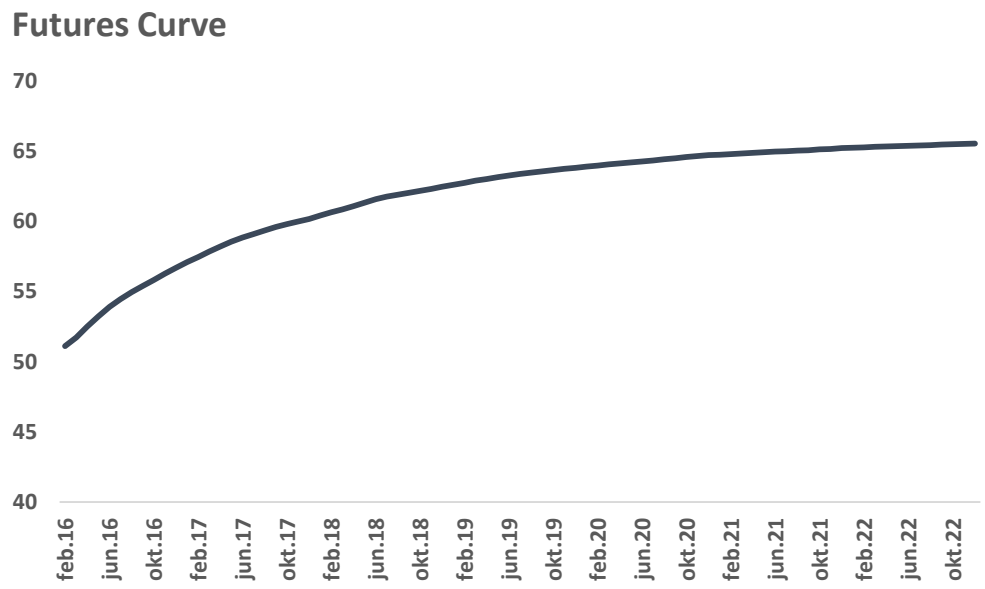

Figure 13: Futures Cure Oil Price *(CME Group, 2015)*

To summarize, it seems that the oil price we will observe in the future will be between USD40 and USD80 in the coming years. This underlines the importance of the topic, as a change in Saudi Arabian oil policy might lead to changes in the estimated future spot prices.

3. Analysis

We start by presenting what other analysts have done in their analyses. We then present our data set before we conduct three separate static analyses. We base the first analysis on the same assumption of what the other analysts have done. In analysis two, we want to see how the estimates change if we include expected return on the foreign reserves, and in analysis three, we run an analysis with 2015-budgeted expenditures. Furthermore, we discuss the probability of Saudi Arabia reducing their expenditures. In addition, we conduct an empirical analysis based on historical data, and predict the changes in reserves based on the oil price. We then summarize the results of the analyses and look at the differences. Lastly, we look at the possibility Saudi Arabia have to increase their revenue through reducing their production, based on price elasticity of supply.

3.1 What have other analysts done?

The drop in oil prices has led to a lot of attention lately, as it has had a large impact on the global economy. Since Saudi Arabia is a large participant in the oil market, and their decision affects the oil market, other analysts have tried to predict when Saudi Arabia will run out of money. They do this in order to give an indication of when, and if, they will adjust their current oil policy.

In a recent report, IMF estimates that Saudi Arabia will run out of money within five years under current policies (IMF, 2015). They define running out of money as the time where gross government assets turn negative. Furthermore, the analysis assumes no fiscal adjustment (for instance, non-oil primary balance to non-oil GDP remains at the 2014-level) and government borrowing. It also assumes that deficit only draw on the reserve assets.

According to an article published at CNBC, Saudi Arabia will run out of money on August 28 2018 (Welss, 2015). This analysis assumes current crude oil production and a crude oil price of USD40. Furthermore, it assumes no changes in macro-economic factors. We conclude based on the linearity of their graph, that they do not include future return on the reserves. The reason for this is that including return on their fund would lead to non-constant decline in reserves. Figure 14 shows the result of their analysis:

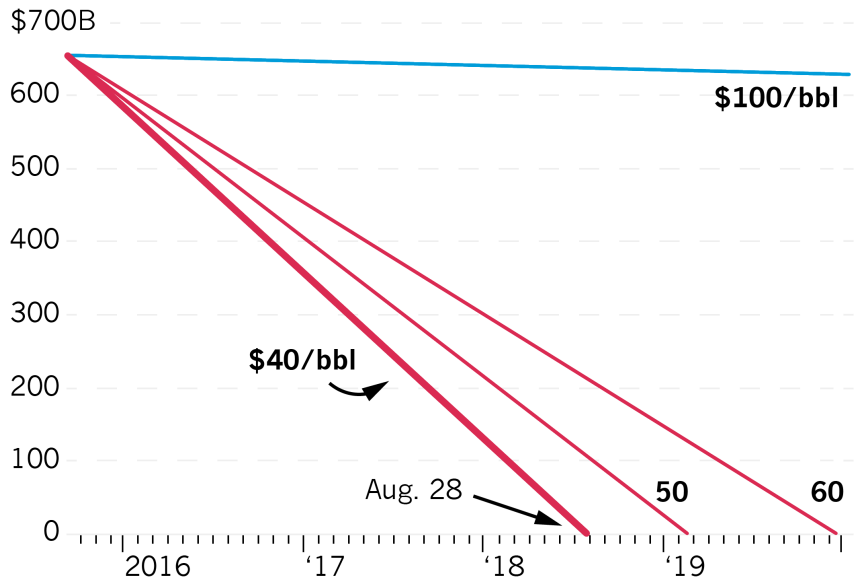

Figure 14: Analysis done by CNBC *(Welss, 2015)*

In an article published on dn.no, Pareto´s Trond Omdal estimates that Saudi Arabia lose USD10 bn. per month (Laustsen, 2015). He assumes a constant production level and an oil price of USD50. Since he finds a constant loss, we conclude that his figures do not consider return on their current financial assets. A quick calculation of our own shows that given these numbers Saudi Arabia will run out of money in the beginning of 2021.

In the different analysis, we see the analysts predict that Saudi Arabia run out of money within a relatively short period. It seems that the analyses do not account for return on the foreign reserves. Saudi Arabia had USD672 bn. in foreign reserves in Q2-2015, and we believe that they are able to generate significant return per year. A 4% annual return yields USD27 bn., which is approximately 10% of their total revenue in 2014. In addition, neither analyses discusses the possibility and ability for Saudi Arabia to adjust their expenditures. These simplifications overestimate the time of when Saudi Arabia will run out of money. By including return and discussing the expenditures, we are able to provide a more comprehensive analysis on the topic.

3.2 Description of data set

We base our analysis on published data from Saudi Arabian Monetary Agency (SAMA), which consist of historical data from 1969 to 2014. SAMA record the data on an annual basis and includes actual income, expenditures, surplus/deficit, oil- production and export. Furthermore, they divide revenues into oil-revenues and other revenues, and expenditures into current expenditures and capital expenditures. Oil-production and export are denominated in barrels per day.

SAMA also publishes quarterly data on the Saudi Arabian foreign reserves. The latest published version consists of historical data from Q1 2005 to Q2 2015. As mentioned earlier, SAMA divides their reserve assets into five different categories, Monetary Gold, SDR, Reserve Position in the IMF, Foreign Currency and Deposits Abroad, Investment in Foreign Securities.

All the data collected from SAMA is denominated in Saudi Arabian currency Saudi Riyals. Saudi Arabia peg their currency at an official rate of 3.75 against US dollar. We have used this exchange rate to change all the data into US dollars in our analyses.

We have collected the historical oil price used in our analysis from U.S Energy Information Administration and OPEC. This includes annual, quarterly and daily oil prices.

3.3 Analysis 1: No return on foreign assets

In this analysis, we want to find out when Saudi Arabia run out of money, if we do not account for return on their foreign reserves. We base this analysis on static data and use the same assumptions as the other analysts.

3.3.1 Approach

We have used 2014 figures for all static variables in the model. In 2014, Saudi Arabia had total expenditures of USD296 bn. In order to get quarterly figures, we divided this with equal portions into quarterly expenditures of USD74 bn. Other income accounted for USD35.6 bn., which equals to USD8.9 bn. quarterly.

We assume a constant financial structure, same level of production and no strategic changes. Saudi Arabia exported 2611 million barrels in 2014. This equals to 652.75 million barrels per quarter, or 7.15 million barrels per day. We multiply this with the given oil prices in order to estimate their oil revenue.

Furthermore, we have assumed no return on their fund and that deficit draw on reserve assets, which accounted to USD672 bn. in Q2 2015.

We only adjust the income through different oil prices, and use different oil prices for different scenarios. As described in the theory part it is hard to predict what oil price we will observe in the coming years, and running scenarios covers different prices and gives us a fair estimate. The oil prices we use are USD40, USD50, USD60, USD70 and USD80 respectively. These oil prices reflect what is believed to be the most likely oil prices in the future. With basis in the different oil prices, we are able to calculate the different inflows/outflows in the fund for each quarter.

We use the following equation to estimate change in reserves:

$$\Delta\, Reserves = (Oil\ price\ x\ Oil\ Export) + Other\ Income - Expenditures_{2014}$$

3.3.2 Results

The graph below shows the results based on the given scenarios:

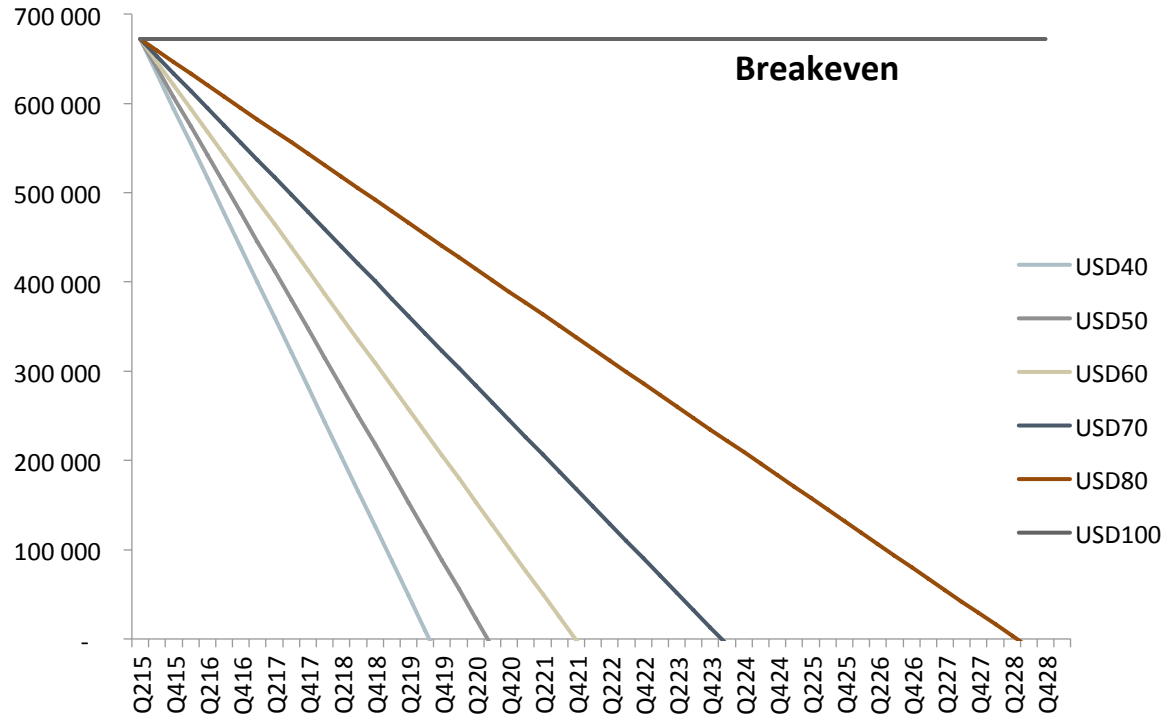

Figure 15: Results from analysis 1. Assuming no return on fund and *Expenditures, other income and oil-export kept at 2014-level.*

We observe that Saudi Arabia will run out of money in the second half of 2019 if the oil price is USD40 and during Q3-2020 if the oil price is USD50. Adjusting the oil price to USD60 or USD70, delays the time when Saudi Arabia run out of money to late 2021 and late 2023. We observe that this analysis corresponds to what the other analysts have done.

In this analysis, we estimate the break-even to be USD100. At this oil price, Saudi Arabia will not experience any changes in their foreign reserves.

The model is a simplification and have some weaknesses. One of these weaknesses is that they leave expected return out of the equation. The effect of this is that it gives a simple linear decrease in their reserves and they exclude a factor that potentially can be a large fraction of their total revenues.

3.4 Analysis 2: Static analysis with return

In this analysis, we want to see how the result changes if we include expected return on their foreign reserves. The return of the fund will affect the value of the fund and will therefore be crucial for how long it will take Saudi Arabia to run out of money.

3.4.1 Approach

In order to estimate the return of their fund we use the expected return for NBIM as a proxy. NBIM has an annual expected return of 4% (Norges Bank Investment Management, 2015), which is equal to 0.99% on a quarterly basis.

We use the following equation to estimate change in reserves:

$$\Delta\, Reserves = (Reserves_{t-1} x\ (1 + E(r)_t)) + (Oil\ price\ x\ Oil\ Export) + Other\ Income - Expenditures_{2014}$$

3.4.2 Results

The graph below shows the results of when Saudi Arabia will run out of money, given an expected return on their foreign reserves:

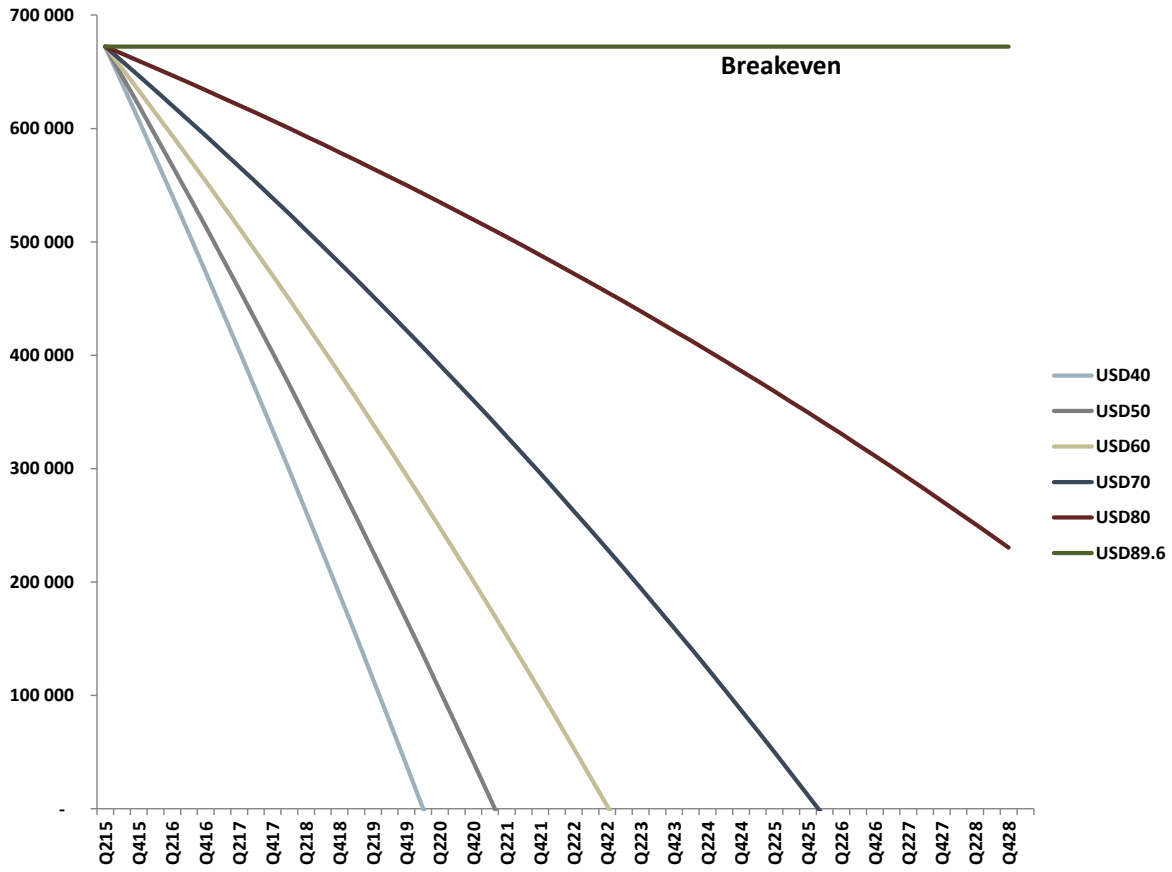

Figure 16: Results from analysis 2. Expenditures, other income and oil-export kept at 2014-level. 4 % expected return on foreign reserve.

We observe that we no longer have a linear reduction in reserves. We notice a higher effect of compound interest for higher oil prices. This implies that the effect of including return increases exponentially as the budget deficit decreases. Furthermore, the significance of the return decreases at lower oil prices, in comparison to the previous analysis. By including the return, we delay when Saudi Arabia run out of money by six months at oil price of USD40, compared to two years at oil price of USD70.

In the scenario where we use USD40 as the future oil price, we observe that the quarterly outflow from their reserves will be approximately USD38.9 bn. If this is the case, Saudi Arabia will run out of money during Q1-20, just over four years from now.

With a constant oil price of USD50, the quarterly outflow from their reserves is slightly lower, approximately USD32.4 bn. With this oil price, we estimate that Saudi Arabia will run out of money during Q2-21, just over five years from now.

An oil price of USD60 reduces the quarterly outflow from the foreign reserves to approximately USD24.6 bn. With this quarterly outflow, we estimate that Saudi Arabia will run out of money during Q1-23, under seven years from now.

In the scenario with an oil price of USD70, we get a quarterly outflow of USD17.8 bn. With this oil price, Saudi Arabia will run out of money in the beginning of Q1-26.

The last scenario we run, is a scenario where the oil price is USD80. This oil price reduces the quarterly outflow to USD11 bn. on a quarterly basis. This will affect their reserves, but it will take a long time before they run out of money. We estimate that they will run out of reserves late in 2038.

In this analysis, we find a break-even oil price of USD89.6. We observe a significantly lower break-even compared to the break-even we find in analysis 1. By including a 4% expected return, we reduce the break-even by 10.4%.

The static analysis gives a good indication on how long Saudi Arabia can withstand the different oil prices. In addition, it confirms that including return on their foreign assets delays the time when Saudi Arabia will run out of money, and that the other analysts overestimate their prognosis.

3.4.3 Weaknesses with the analysis

Our analysis builds on the assumption that there will be no changes in the variables. We find it unlikely that the figures will stay the same for the next 5-10 years. The question is to what extent the variables will change and how this will affect our results.

Export

As we saw in figure 2, the export has been relatively constant for the past 20 years. In addition, Saudi Arabian officials have stated that they will keep the same production level in the coming years. Therefore, we find it unlikely that we will observe drastic changes in this variable. However, we have already seen that the average export level for Q1 2015 and Q2 2015 has increased to 675 million barrels each quarter, in comparison to 652 million barrels in Q4 2014. These increases do not have a significant impact on our model, as it pushes the timeline by a quarter.

Other revenue

If we look at historical numbers, we see that the average annual increase in "other revenue" have been 6.13% over the past 34 years. This indicates that "other revenue" most likely will increase in the future. However, the variable consists of a small fraction of total revenue, and will therefore not have a significant impact on the results.

Funds return

We believe it is fair to say that the most reasonable estimate of the Saudi Arabian wealth fund's return is similar to the expected return as the Norwegian pension fund. It is mentioned in an article by Reuters that Saudi Arabia has a very conservative approach on their fund and it is speculated that most of their assets are in treasury bonds (Reuters, 2014). NBIM has a 60/40 ratio in equity and bonds, whereas 70% of the bonds are treasury bonds. We therefore believe this is a fair proxy to use. We also assume in our model that Saudi Arabia will be able to withdraw assets on a quarterly basis. This might be questionable as a fund of this size will probably be illiquid to some extent.

Expenditures

Keeping expenditures constant is a strict assumption. Their expenditures have more than quadrupled from USD75 bn. in 2004 to USD296 bn. in 2014, which indicates that we might observe increased expenditures in the future. However, we can see in figure 5 that the expenditures correlate with revenues and it seems that the expenditures have increased as an effect of higher revenues. If this trend continues, expenditures will decline as an effect of reduced revenues. Other factors such as population growth can also lead to an increase in expenditures, which is not accounted for in our model. Overall, there is high uncertainty regarding the expenditures and this variable will deviate the most in our model.

Debt

We assume in our model that they are not able to finance their budget deficit with debt. This is a simplification as Saudi Arabia can use debt as a measure to finance their budget deficits, and might temporary delay a situation where they run out of money. In regards of our research question, our perspective is that they run out of money when their net financial assets equals to zero. In other words, they will be out of money if their public debt equals their foreign reserves.

Overall, our model has some weaknesses. Despite this, we believe that the model is valuable for understanding the situation Saudi Arabia is facing, as it gives a fair estimate to when they will run out of money.

3.5 Analysis 3: Static analysis with 2015 budgeted expenditures

Due to large uncertainty regarding the expenditures, we want to figure out when Saudi Arabia run out of money if they manage to stick to their budgets.

3.5.1 Approach

We base this analysis on the same assumptions as the previous analysis, but change the expenditure according to their budget for 2015. In 2015, Saudi Arabia have budgeted with expenditures of USD229 bn.

We use the following equation to estimate change in reserves:

$$\Delta\, Reserves = (Reserves_{t-1} x\ (1 + E(r)_t)) + (Oil\ price\ x\ Oil\ Export) + Other\ Income - Expenditures_{2015B}$$

3.5.2 Results:

The graph below illustrates the effect of using 2015-budgeted expenditure:

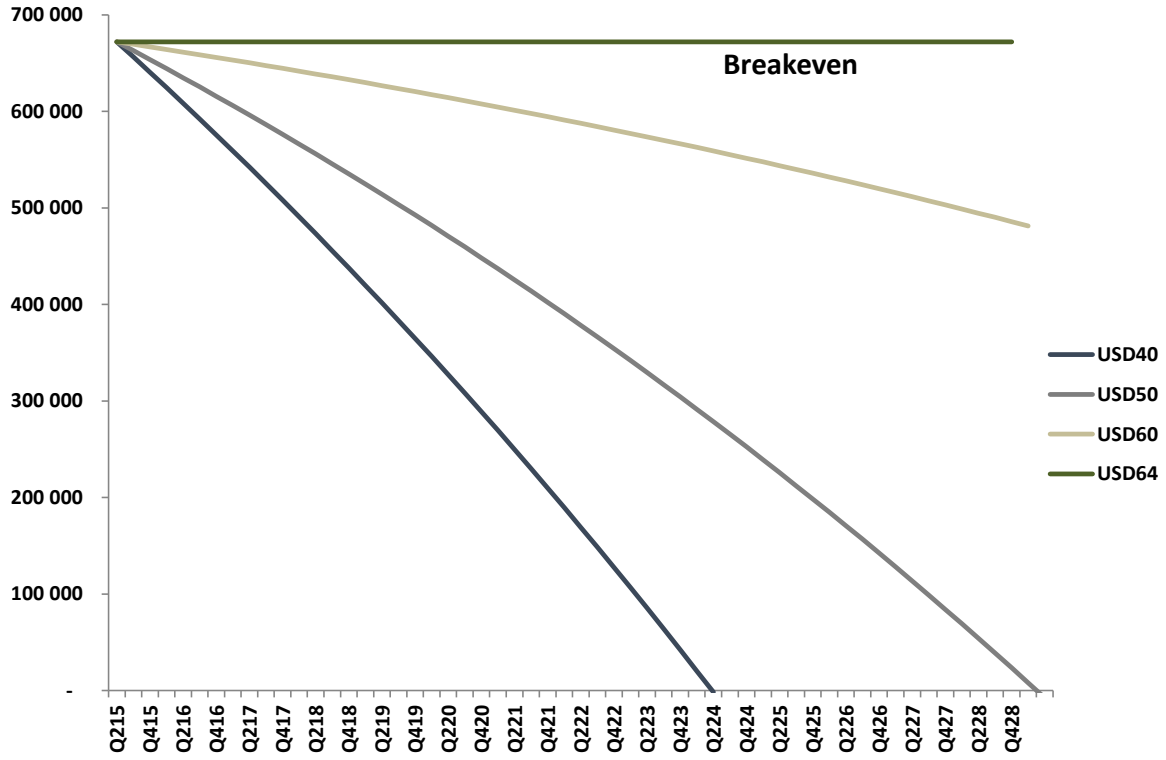

Figure 17: Scenario analysis 2. 2015-budgeted expenditures and 4% expected return on foreign reserves.

The change in expenditures pushes the time when Saudi Arabia will run out of money back substantially. An oil price of USD40 pushes the time back with approximately five years, from Q1-20 to Q2-25. We also observe that an oil price of USD50 pushes the time from Q2-21 to Q2-29, approximately eight years. We observe a substantial change in break-even, when we use budgeted expenditures for 2015 in our model. The break-even is reduced from USD89.6 to USD64.

The findings in this analysis illustrates that by introducing a stricter budget policy, Saudi Arabia decreases the possibility of running out money significantly.

3.6 Change in Expenditures

We want to estimate how much the expenditures have to change in order to reach a breakeven equal to the oil price. Furthermore, we want to discuss if it is realistic or not. We believe that the Saudi Arabian ability to adjust their expenditures to the decreasing revenues will affect their future oil policy.

3.6.1 Estimations

We base the calculations on the same assumptions as in analysis 2. We estimate the required cut in expenditures in order to reach a state where inflow/outflow will be equal to the expected return on the fund. $\Delta\, Reserves = 0$, and we solve the following equation for expenditures based on different oil price scenarios.

$$\Delta\, Reserves = (Reserves_{t-1} x\ (1 + E(r)_t)) + (Oil\ price\ x\ Oil\ Export) + Other\ Income - Expenditures_x$$

The following figures shows the results:

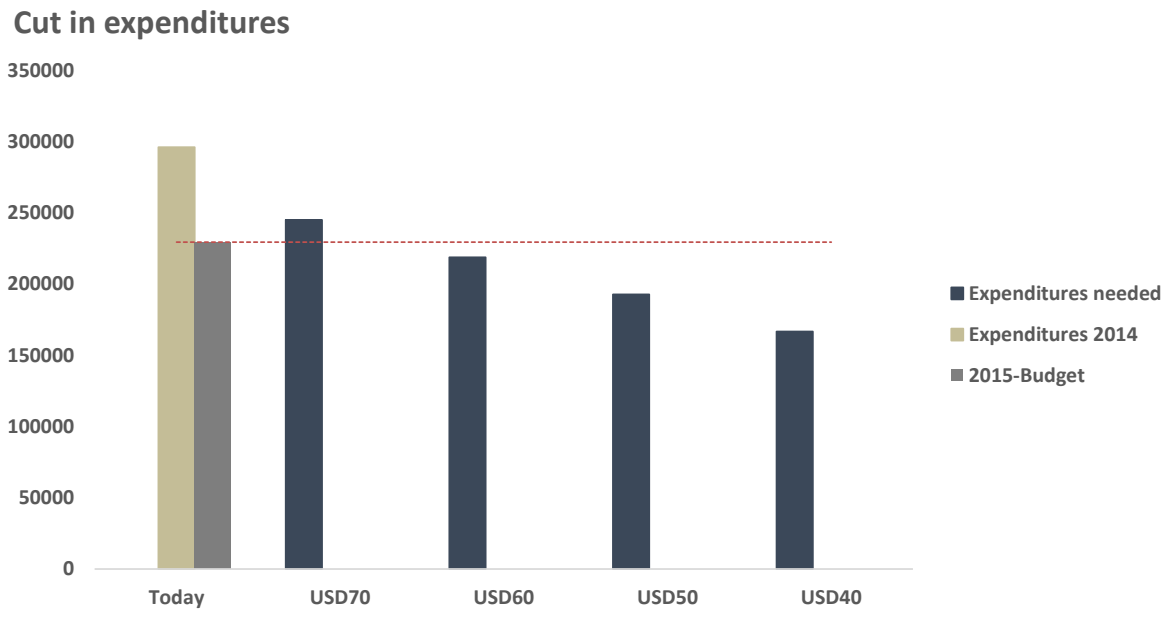

Figure 18: Actual and budgeted expenses vs needed expenses

Figures in USD	USD70	USD60	USD50	USD40
Expenditures 2014	295 974	295 974	295 974	295 974
Expenditures needed	244 915	218 804	192 694	166 584
2015-Budget	229 333	229 333	229 333	229 333
Difference from 2014-expenditures	51 060	77 170	103 280	129 390
Difference from 2015-budget	- 15 581	10 529	36 639	62 749
% Reduction	17 %	26 %	35 %	44 %

Figure 19: Actual and budgeted expenses vs needed expenses and cuts

We observe that Saudi Arabia need to cut between USD51bn to USD129bn in annual expenditure in order for the reserves to remain at the same level in the coming years. The needed cuts in expenditures amounts to between 17% and 44% of their 2014 expenditures.

In the case of an oil-price of USD40 and USD50, Saudi Arabia need to reduce their expenditures by USD63 bn. and USD37 bn., compared to their 2015 budgets. In the case of an oil-price of USD60 Saudi Arabia only need to reduce the costs by USD 11bn under what they have budgeted for 2015. If the oil price stays over USD70, they can exceed their budgets with approximately USD16 bn.

3.6.2 Likelihood

The estimated cuts in expenditures are large when you look at them isolated. This especially account for the scenarios where we have an oil price of USD40 and USD50. However, we observe that the necessary cuts needed in expenditures leads to a situation close to what they have budgeted.

One can question Saudi Arabia´s ability to stick to their budgets. As we saw in figure 7, Saudi Arabia has exceeded their budgeted expenses every year since 2004. However, we do not believe that Saudi Arabia is uneducated in budgeting and that they miscalculated their budgets by 20-40% (*Appendix 2*) during the past ten years. The fact that they from 1980-2000 were able to stick to their budgets supports this. We believe they have exceeded their budgets deliberately as an effect of increased revenue. In previous years, it seems that they used a very conservative approach to their oil price estimates (approximately USD70 per barrel for 2014). We believe that if the oil price exceeds their expectations, hence a higher revenue than expected, they realise that they are able to take on more expenditures than budgeted. This explains why they have had such a noticeable deviation in the budget for the past ten years, because the oil revenue has exceeded their expectations by 71% (*Appendix 3*)

on average. The graph in figure 6 supports this, as we can clearly see a correlation between revenues and expenditures, implying that they adjust their expenditures according to their revenues.

These findings imply that Saudi Arabia has to be more consequent in their decisions regarding their expenditures and to greater extent stick to their budget. We believe this is likely to happen. The fact that Saudi Arabia has budgeted with an increase in their expenditures of 0.58% for 2015 supports this. This is a minor change compared to the past ten years, where they have increased the budgeted expenditures by 14% annually (SAMA 2014). According to a recent published article in Financial Times, Saudi Arabian officials are working on a more sustainable strategy to curtail spending. Part of this strategy is to delay infrastructure projects, such as the Riyadh underground, and enforcing a spending squeeze across government departments (Kerr, Khalaf, & Barber, Financial Times, 2015). We are in other words witnessing that Saudi Arabia are implementing measures to decrease their expenditures and follow a stricter budget policy.

3.7 Analysis 4: Empirical analysis

In this analysis we want to find out if the oil price can explain the inflow/outflow in foreign reserves, and whether this can be used to predict when Saudi Arabia run out of money. The empirical analysis is based on historical data and reflects what Saudi Arabia have done in the past. Therefore, this analysis will correct for the uncertainty regarding the future outlook of the variables in our static analyses, and will supplement these analyses by introducing a more dynamic aspect.

3.7.1 Approach

We believe that the oil price can be used to explain the changes in the foreign reserves, because the reserves consist of excess return from oil revenue. Therefore, we run an empirical analysis with the intention of finding a correlation between the dependent variable "changes-in-reserves" and the independent variable "Oil-Price".

We control the variables for stationarity by using a Dicky Fuller's test, in order to avoid spurious results. We then look at the residuals for our regression and check for autocorrelation, and control for efficiency of our regression.

Lastly, we summarize our results and calculate when they will run out of money based on different scenarios.

3.7.2 Empirical strategy

We use quarterly data from Q1-2005 to Q2-2015, which consist of 42 observations. This implies that we do not have any measurement errors or sample error, as we are looking at actual data and not a sample. Furthermore, we control that the variables are stationary before we run the regression. A variable is non-stationary if the variables have means, variance and covariance that change over time, and are unpredictable and useless for modelling. The result will be spurious if the variables are non-stationary.

There are several ways to define a non-stationary variable: we have used the (AR1) for both our variables, which implies random walk with a non-zero drift, formally written as:

$$Y_t = \alpha + \beta * y_{t-1} + \varepsilon_t$$

There are two reasons why we use drift for "change-in-reserves". The main reason is that Saudi Arabia in the past ten years have had a constant increase in expenditures, which causes a negative drift for our variable. The second reason is due to the return of the fund. As the fund increases, the return increases additionally as an effect of compound interest, resulting in a larger change in returns for period $t + 1$ than in period t. This results in a positive drift in our regression. In regards of oil price, Hamilton finds it likely that the oil-price follows a random walk. The change in oil price from the period before cannot explain the change in the next period. This suggests a random walk with drift. We include a time variable in our regression in order to correct for drift in our variables.

Furthermore, we do a Dickey Fuller test, by running a regression on the variable in period $t - 1$ and see how it affects the variable in the period t. Based on AR1 we subtract Y_{t-1} on both sides of the equation, which leads to the following equation:

$$\Delta Y_t = a + \beta * Y_{t-1}$$

Where $\beta = y - 1$

Our null hypothesis is that the variable is non-stationary, and we test if $\beta \neq 0$, consequently $y = 1$. If we reject the null hypothesis, and $\beta = 0$,we have stationary variable that follows a random walk.

The results are as shown in Figure 17. We observe that both our variables are significant and we conclude that the variables are stationary correcting for drift.

	Z-value	p-value
Oil_Price	-2.51	0.0082
Changeinreserves	-2.53	0.0079
No. of obs	40	

Figure 20: Dickey-Fuller test with drift

Furthermore, we decided to use a level-level model because "change-in-reserves" has both positive and negative value, and therefor unapproachable for a log-log model. We believe that a level-level model would be the most intuitive model in comparison to a level-log

model, because we are interested in knowing the numerical changes in reserves based on certain static oil price.

Furthermore, there cannot be elements in the error term that vary with the explanatory and the explained variables. This may cause a biased estimate of the oil price coefficient. For instance, the fund managers' ability to produce additional return would probably be a variable that affect the explained variable "Change-in-reserves". However, this would doubtfully have any effect on the explanatory variable "Oil-price", and therefore not cause a biased estimate of our coefficient. Another possibility would be the US dollar price, which have had a consistent historical correlation with the oil price (Holodny, 2014). It is questionable however if a change in US dollar will affect the change in reserves.

It is in general difficult to know what other variables we should include in our regression. We could have run a kitchen sink regression, and find other independent variables that explains the variance in our dependent variable. However, most of the macro-figures that could possibly affect the "changes-in-reserves" is non-stationary, because they are seasonal and would not be valid in our regression.

We conclude that we might miss some variables in our regression. We believe this will affect our results to some extent, and therefore consider this as a weakness in our model.

In regards of the models efficiency, we first check the correlogram of the residuals. This is shown in the *appendix 4* and shows that we are not facing an autocorrelation problem.

We consequently ran a robust regression in order to correct for possible heteroscedasticity.

3.7.3 Results

The figure below shows the result of the regression:

	Coefficient	Std.error	t-stat	p-value
Observations	-996.98***	147.91	-6.74	0.000
Oil_Price	859.56***	122.65	7.01	0.000
_cons	-34723.29***	8327.06	-4.17	0.000
No. of obs	41			
F-test	29.61			
R^2	0.7175			

Figure 21: Result of the regression

We find a coefficient for oil price of 859.56. The variable "observations" is our time-variable and we find this coefficient to be -996.98. Furthermore, we observe a constant of minus -34 723.29. The coefficients are significant on a 1% level. In addition, we observe a high explanatory power of 71.75%. The equation is as follows:

$$Changinreserves = -34\,723.29 - 996.98 * obs + 858.56 * oil\_price$$

We use this equation to calculate when they will run out of money. The graph below shows the results:

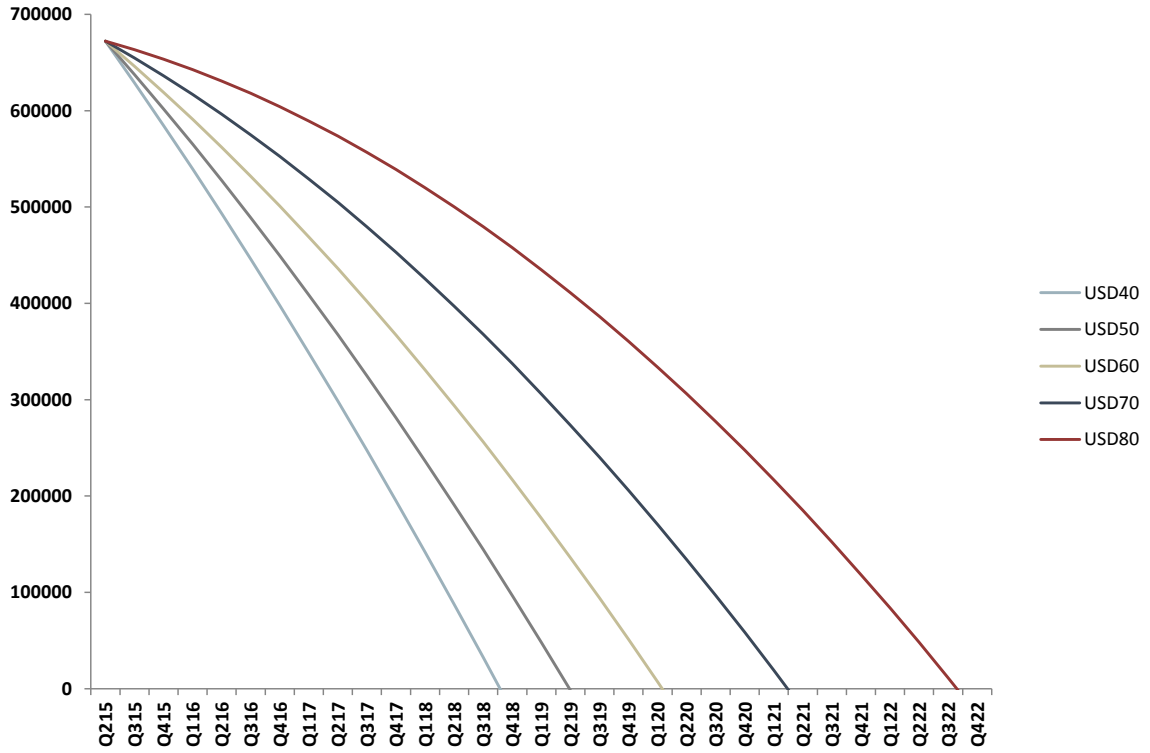

Figure 22: Scenario analysis based on the output from the regression analysis

We observe that an oil price of USD40 lead to a situation where Saudi Arabia run out of money during Q4-2018. If the oil price is USD50 Saudi Arabia will experience the same during Q2-2019. Given an oil price of USD60 and USD70 the time is pushed back to Q2-2021 and Q4-2022 respectively.

We notice that the breakeven for Q3-2015 gives us an oil price of 90.3, which is nearly the same we get in analysis 2. What is interesting to see is that the breakeven increases by approximately 1% for every quarter. This makes sense, as this reflects the drift effect in our regression. The drift is primarily caused by the constant increase of expenditures, which is the reason why there is no proportional relationship between oil price and change in reserves. As an effect of this, our regression assumes that Saudi Arabia will continue with the same constant increase in expenditures. As the results shows, they will run out of money fairly fast with this development. The interpretation of this is that it is meaningless what Saudi Arabia does regarding their oil production as long as they continue to increase their

expenditures. The analysis shows that Saudi Arabia needs to adjust their expenditures to a sustainable level in the future.

3.7.4 Weaknesses

There are some weaknesses with our analysis. First of all, our dataset consists of only 41 observations, something that can decrease the quality of the regression. The reason for the few observations is that Saudi Arabia started to build their foreign reserves in 2005.

The main weakness in our analysis is that our dataset does not include a period where the changes in expenditures fluctuate with a zero-mean. The regression is built on data where Saudi Arabia has had an upswing, and do not include a period where expenditures decreases. The interpretation of this is that the drift variable is overestimated, and that our regression only predicts what will happen if they continue as they have the past ten years.

We do not separate between the changes in fund coming from return and changes coming from inflow/outflow, as we did in the previous analysis. The reason for this is that the historical return is not public information. We could have used historical return for NBIM as a proxy, but we feel that the uncertainty whether this is consistent with the actual historical performance of the fund leads to errors in our regression. Nevertheless, our drift variable captures the effect of the fund's return.

It is reasonable to think that the inflow/outflow of the fund has some correlation to the change in debt. A weakness in our model is that we do not including debt in our model, which might cause an omitted variable bias. Figure 7 shows that they have decreased their debt constantly the past ten years, which implies that the variable does not have a constant mean. This is one of the requirement for stationary variables. We could have solved this issue by looking at the change in debt, which would give us a variable with a constant negative mean. This would have been acceptable if we blindly base this on the data we have. However, Saudi Arabia had close to zero debt in 2014, which implies that a future change in debt would not return to its negative mean, as they have no more debt to pay. Therefore, including the variable for change in debt would give us a spurious result.

Another weakness is that the regression is run on a period where the surplus generated has been divided between repayment of debt and inflow into the fund. Saudi Arabia does no longer have any debt, which means that the surplus is no longer used to repay debt, but

exclusively generate inflow into their foreign reserves. This implies that our "Oil-price" coefficient is underestimated.

Overall there are some weaknesses with the analysis, and we should interpret the results carefully.

3.8 Summary of results

Figure 18 summarises the results from the analyses. As we can see, the time when Saudi Arabia run out of money differ depending on the different assumptions.

Oilprice	Analysis 1 2014- Exp	Analysis 2 4 % Return	Analysis 3 2015-Budget	Analysis 4 Empirical
USD 40	Q4-2019	Q1-2020	Q2-2025	Q4-2018
USD 50	Q3-2020	Q2-2021	Q2-2029	Q2-2019
USD 60	Q4-2021	Q1-2023	Q3-2047	Q2-2020
USD 70	Q1-2024	Q1-2026	-	Q2-2021
USD 80	Q3-2028	Q4-2033	-	Q4-2022

Figure 23: Summary of results

In analysis 1, we assume no return on their foreign reserves and 2014-expenditures and export. Given these assumptions, we find that Saudi Arabia run out of money between Q4-2019 and Q3-2028

In analysis 2, we add a 4% expected return to the foreign reserves and find that Saudi Arabia will run out of money between Q1-2020 and Q4-2033.

In analysis 3, we adjust the expenditures to 2015 budgeted expenditures and assume a 4% return on the foreign reserves. We find that Saudi Arabia run out of money between Q2-2025 and Q3-2047, with an oil price between USD40 and USD60.

In analysis 4, we use empirical methods and find that Saudi-Arabia run out of money between Q4-2018 and Q4-2022.

3.9 Will Saudi Arabia benefit from cutting their supply?

One possible measure for Saudi Arabia is to cut their production in order to try to stabilize the markets. We want to figure out what Saudi Arabia can gain by reducing their oil production in order to stabilize the markets and get a higher oil price. Hamilton finds that the price elasticity of supply is low in the short run. In the long run, there is more production flexibility, and the price elasticity of supply is less inelastic (Hamilton, 2008). He points out that there are uncertainties regarding the exact number and emphasises that it is hard to measure. However, we use his findings, through scenarios of inelasticity, to calculate the effects of reducing their production. This analysis will give an indication on Saudi Arabian future production quotas.

3.9.1 Approach

We split the analysis in two parts. In the first part, we use different levels of elasticity, 0.1, 0.2 and 0.3 respectively, to see the effect of lowering the supply. We assume that these levels of elasticity correspond to the low short-term elasticity, which Hamilton finds. We choose to use three different elasticity due to the uncertainty regarding the actual level. Given the different elasticity, we calculate how much OPEC has to cut in oil production in order to maximize their aggregated revenue. We assume that OPEC unify in order to cut the production and that the OPEC-countries are the only ones who change their current production.

In order to extract the effect for Saudi Arabia, we divide the output from OPEC into proportional parts depending on the fraction of production each country has within OPEC. We have used production figures, expenditures and other income for 2014.

In the second analysis, we choose different levels of production cuts. We have used cuts of 10% and 20% and observe the effect when the elasticity is 0.1, 0.2 and 0.3 respectively. We do this to see the effect of cuts lower than the cuts that maximize their revenue, as it is likely to believe that production cuts will be done gradually.

In both our analyses we separate between surplus and revenue. They might benefit by reducing their production level in form of increased revenue, but at the same time have a budget deficit. In addition, we assume no changes in demand in the analyses.

3.9.2 Results

The graph below shows the result of the first analysis:

OPEC	Elastisity			
Elasticity	0.1	0.2	0.3	0.43
Reduction in World Production	15.9 %	10.9 %	5.9 %	0
Reduction OPEC Production	38.0 %	26.1 %	14.1 %	0
% Change in price	159 %	54 %	20 %	0
Oil price 19-11-2015	44	44	44	44
New Oil Price	113.94	67.97	52.65	44
Revenue per day before	1 350 046	1 350 052	1 350 052	1 350 052
Revenue per day after	2 166 273	1 541 801	1 387 480	1 350 052

Saudi Arabia	Elastisity			
Elasticity	0.1	0.2	0.3	0.43
Reduction in World Production	15.9 %	10.9 %	5.9 %	0
Reduction Saudi Arabian Production	12.0 %	8.3 %	4.5 %	0
% Change in price	159 %	54 %	20 %	0
Oil price 19-11-2015	44	44	44	44
New Oil Price	113.9	68.0	52.6	44
Revenue per day before	427 359	427 359	427 359	427 359
Revenue per day after	**973 418**	**605 690**	**488 508**	**427 359**
Annual Oil Revenue	355 297 629	221 076 880	178 305 304	155 985 962
Other Income (2014 level)	34 939 000	34 939 000	34 939 000	34 939 000
Expenditures	295 974 000	295 974 000	295 974 000	295 974 000
Surplus	94 262 629	- 39 958 120	- 82 729 696	- 105 049 038

Figure 24: Analysis showing necessary production cuts for OPEC and Saudi Arabia given low elasticity of supply

We observe that the revenue per day increases in all the scenarios. This implies that Saudi Arabia has something to gain from cutting and optimizing their production as long as the elasticity is below 0.43. In the scenarios, their daily revenue increases to USD973M, USD606M and USD489M, up from USD427M. The elasticity of 0.43 equals the maximum level of elasticity where production cuts results in increased revenue.

When looking at the surplus, we observe that the only scenario that gives a budget surplus is the scenario where the elasticity equals to 0.1. This gives a surplus of USD94.2 bn. In this scenario, OPEC have to cut their production with 38%, which correspond to a production cut of 12% by Saudi Arabia. The new observed oil price is USD113.9. In the scenarios with

elasticity of 0.2 and 0.3, the necessary cuts for Saudi-Arabia (OPEC) are 8.3% (26.1%) and 4.5% (14.1%) respectively.

The graph below shows the results from our second analysis:

OPEC	10 % Cut	20 % Cut	10 % Cut	20 % Cut	10 % Cut	20 % Cut
Elasticity	0.1	0.1	0.2	0.2	0.3	0.3
Reduction in World Production	4.2 %	8.4 %	4.2 %	8.4 %	4.2 %	8.4 %
Reduction OPEC Production	10.0 %	20.0 %	10.0 %	20.0 %	10.0 %	20.0 %
% Change in price	42 %	84 %	21 %	42 %	14 %	28 %
Oil price 19-11-2015	44	44	44	44	44	44
New Oil Price	62.39	80.78	53.19	62.39	50.13	56.26
Revenue per day before	1 350 052	1 350 052	1 350 052	1 350 052	1 350 052	1 350 052
Revenue per day after	1 722 828	1 982 763	1 468 937	1 531 402	1 384 307	1 380 949

Saudi Arabia	10 % Cut	20 % Cut	10 % Cut	20 % Cut	10 % Cut	20 % Cut
Elasticity	0.1	0.1	0.2	0.2	0.3	0.3
Reduction in World Production	4.2 %	8.4 %	4.2 %	8.4 %	4.2 %	8.4 %
Reduction Saudi Arabian Production	3.2 %	6.3 %	3.2 %	6.3 %	3.2 %	6.3 %
% Change in price	42 %	84 %	21 %	42 %	14 %	28 %
Oil price 19-11-2015	44	44	44	44	44	44
New Oil Price	62.4	80.8	53.2	62.4	50.1	56.3
Revenue per day before	427 359	427 359	427 359	427 359	427 359	427 359
Revenue per day after	**586 775**	**734 884**	**500 303**	**567 593**	**471 479**	**511 830**
Annual Oil Revenue	214 172 861	268 232 679	182 610 534	207 171 565	172 089 758	186 817 861
Other Income (2014 level)	34 939 000	34 939 000	34 939 000	34 939 000	34 939 000	34 939 000
Expenditures	295 974 000	295 974 000	295 974 000	295 974 000	295 974 000	295 974 000
Surplus	- 46 862 139	7 197 679	- 78 424 466	- 53 863 435	- 88 945 242	- 74 217 139

Figure 25: Analysis showing the effect of a 10% and 20% cut in OPEC production at different levels of elasticity of supply

We also observe an increased revenue per day in this analysis, which indicates that Saudi Arabia has some to gain from reducing their production. However, we only observe surplus in the scenario where there is a 20% cut in OPEC production and an elasticity of 0.1. This cut correspond to a 6.3% cut in Saudi Arabian oil production and gives a new oil price of USD80.8.

Both analyses show that Saudi Arabia will decrease their budget deficits, by adjusting their production and increasing their revenues. These findings indicate that this is a potential measure for Saudi Arabia. However, we observe that only two out of nine scenarios leads to a surplus. This indicates that exclusively adjusting their production might not be the sufficient solution for Saudi Arabia.

Hamilton argues that the elasticity is low in the short run, but will increase in the longer run (Hamilton, 2008). The implications of this is that Saudi Arabia will benefit in the short term from reducing their supply. However, it may not be as beneficial for them in the long run, because we do not know whether the long term elasticity will increase above 0.43. Not

knowing the exact long term effect of cutting their production is a risk factor Saudi Arabia, may not be willing to take.

Our findings indicate that there is uncertainty and risk associated with reducing the oil production. We observe that Saudi Arabia has the opportunity to reduce their oil production, as this will reduce their risk of running out of money and send a positive signal to the market. However, exclusively reducing their production do not solve the initial problem regarding running out of money. This implies that Saudi Arabia has to initiate additional measures.

4. Conclusion

This thesis examines when and if Saudi Arabia will run out of money, and may give an indication on how Saudi Arabia will react to the low oil price. Their response will give an indication on how the oil market will develop, due to the large impact Saudi Arabia has on the global oil market.

We find that Saudi Arabia will run out of money within a short period of time, if they make no financial or strategic adjustments, and continue as they have done in the past. This is consistent with what other analysts find. However, our findings differ from the other analyses since we include expected return to the foreign reserves. Including an expected return, delays the time when Saudi Arabia run out of money, which suggests that the other analysts overestimate when Saudi Arabia run out of money.

Furthermore, we find that Saudi Arabia will decrease the possibility of running out of money as long as they introduce a stricter budget policy. Saudi Arabia has shown handling power by being conservative with their 2015-budget and initiating spending curtails. In addition, we believe, based on historical data, that Saudi Arabia have exceeded their budgets deliberately as an effect of higher revenues than expected. This suggests that Saudi Arabia will adjust their expenditures to the reduced revenues.

There is a possibility that Saudi Arabia can avoid adjusting their expenditures by reducing their oil production, hence increase the oil price. This is consistent with what we find in our elasticity analysis, which shows that Saudi Arabia will likely benefit from cutting their oil production. However, the increase in revenue is hardly enough to solve their initial issue regarding running out money. The implication of this is that they must change their expenditure policy first, before initiating a production cut. This is also supported by our empirical analysis, which shows that the constant increase in expenditures is not sustainable over time, regardless of what the future oil price will be.

We conclude that Saudi Arabia will not run out of money. They will acknowledge a persistent low oil price, adjust their expenditures relative to their revenue and tighten their budget policies. As a supplement, Saudi Arabia has the possibility to cut their production to some extent. However, we believe Saudi Arabia will try to delay this for as long as possible as part of their long term strategy, and avoid subsidizing high cost oil producers such as US

shale oil companies. As an effect of this, we will continue to observe over-supply of oil in the oil market, as it is unlikely that Saudi Arabia will change their oil production. Therefore, governments, businesses and individuals affected by the low oil price, have to adjust to today's situation and prepare for a persisting low oil price.

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6. Appendix

Country		Marginal production cost 2014
Russia	Arctic	120.00
	Onshore	18.00
Europe	Biodiesel	110.00
	Ethanol	103.00
Canada	Sand	90.00
Brazil	Ethanol	66.00
	Offshore	80.00
United States	Deep-water	57.00
	Shale	73.00
Angola	Offshore	40.00
Ecuador	Total	20.00
Venezuela	Total	20.00
Kazakhstan	Total	16.00
Nigeria	Deep-water	30.00
	Onshore	15.00
Oman	Total	15.00
Qatar	Total	15.00
Iran	Total	15.00
Algeria	Total	15.00
UAE	Total	7.00
Iraq	Total	6.00
Saudi Arabia	Onshore	3.00

Appendix 1: Marginal production cost 2014 *(Knoema, 2015)*

Revenue	Actual	Budgeted	Diff
2005	150 489	74 667	102 %
2006	179 649	104 000	73 %
2007	171 413	106 667	61 %
2008	293 598	120 000	145 %
2009	135 948	109 333	24 %
2010	197 764	125 333	58 %
2011	298 078	144 000	107 %
2012	332 639	187 200	78 %
2013	308 363	221 067	39 %
2014	278 498	228 000	22 %
		Average	71 %

Appendix 2: Average overestimation of revenues

Expenditures	Actual	Budgeted	Diff
2005	92 393	74 667	24 %
2006	104 886	89 333	17 %
2007	124 333	101 333	23 %
2008	138 685	109 333	27 %
2009	159 049	126 667	26 %
2010	174 369	144 000	21 %
2011	220 453	154 667	43 %
2012	232 881	184 000	27 %
2013	260 270	218 667	19 %
2014	295 974	228 000	30 %
		Average	26 %

Appendix 3: Average overestimation of expenditures

```
. corrgram residuals_reg

                                                -1       0       1 -1       0       1
LAG       AC       PAC       Q      Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------------
1       0.0606   0.0606   .16167  0.6876
2      -0.0963  -0.1005   .58119  0.7478
3      -0.0014   0.0126   .58127  0.9007
4       0.4450   0.4516   10.019  0.0401
5       0.0139  -0.0541   10.028  0.0744
6      -0.2763  -0.2769   13.874  0.0311
7      -0.1018  -0.0428   14.412  0.0443
8       0.1215  -0.0862   15.201  0.0554
9      -0.1420  -0.2317   16.312  0.0606
10     -0.2868  -0.0567   20.991  0.0212
11     -0.0413   0.1201   21.091  0.0324
12      0.0058  -0.1422   21.093  0.0490
13     -0.1991  -0.2381   23.589  0.0351
14     -0.2634  -0.2885   28.119  0.0137
15     -0.1218  -0.4557   29.125  0.0155
16      0.0453  -0.2052    29.27  0.0222
17     -0.0210   0.0160   29.302  0.0318
18     -0.1246  -0.3131   30.492  0.0329
```

Appendix 4: Correlogram of Residuals