BI Norwegian Business School - campus Oslo

GRA 19502

Master Thesis

Component of continuous assessment: Forprosjekt, Thesis MSc

Risk Premium of Financial Wealth Fund

Navn:	Heidi Dahle, Gine Andrea Granheim

Start:	01.01.2018 09.00
Finish:	15.01.2018 12.00

ID number:

Gine Andrea Granheim

Heidi Dahle

Preliminary Thesis Report

- Risk Premium of Financial Wealth Fund -

Hand-in date:

15.01.2018

Campus:

BI Oslo

Examination code and name:

GRA 19502

Master Thesis

Thesis supervisor

Espen Henriksen

Program:

Master of Science in Business

Table of content

Preliminary abstract

This paper investigates how much risk reduction Norway can benefit from, by transferring the nation's wealth from petroleum reserves to financial fund. We will look at two different alternatives. The first is the one Norway currently are perusing; to extract the oil fast, and deposit the revenues of the sales into the fund. The second scenario will be to look at how the risk would be affected if we perused a slower extraction of the oil, and instead stored the oil below the ground. As the risk of the fund is well measured by Norges Bank Investment Management, we want to create a second scenario with risk measures that successfully can be compared to the risk of the fund.

Introduction

In November 2017, Norges Bank proposed to remove oil and gas stocks from the benchmark index for which the Government Pension Fund Global is measured against. The fund provided a note "Petroleum wealth and oil price exposure of equity sectors" where they explain the reasons for the suggestion. The note states "even though the oil and gas sector's total return are strongly correlated with the total market, the sector return in comparison to the market is very sensitive to changes in the oil price". Because the oil is so important for the Norwegian economy, they want to remove the funds double exposure to oil by selling the oil and gas stocks. The proposal has gotten great attention all over the world considering it is the world's largest fund that wants to back out of the oil and gas sector.

In light of the proposal from Norges Bank to sell out of their stocks in the oil and gas sector, several new interesting questions have arisen regarding this topic. The focus on double risk exposure on gas and oil stocks, awoke the interest on analyzing the risk exposure of the entire fund. Initially, we wanted to replicate the methods used to calculate the different equity sector's relationship with oil price volatility inspired by Norges Bank Investemnt Management's, (hereafter NBIM) report "Petroleum wealth and oil price exposure of equity sectors". After further discussions with our supervisor, we found a more interesting question yet to be answered: "How large is the risk reduction premium of transferring assets from petroleum reserves to financial wealth fund?". In depth, analyzing the comparison between the risk of extracting the oil and transferring the value of petroleum revenues into the Norwegian Pension fund, and the risk of keeping the value of petroleum beneath the surface and only extracting what is needed to cover the nation's yearly consumption. Therefore, the following will be our research question:

"How large is the risk reduction premium of transferring assets from petroleum reserves to financial wealth fund?"

The Norwegian Government Pension Fund

To be able to answer our research question properly, it is crucial to understand the history and concept of the Norwegian Pension Fund.

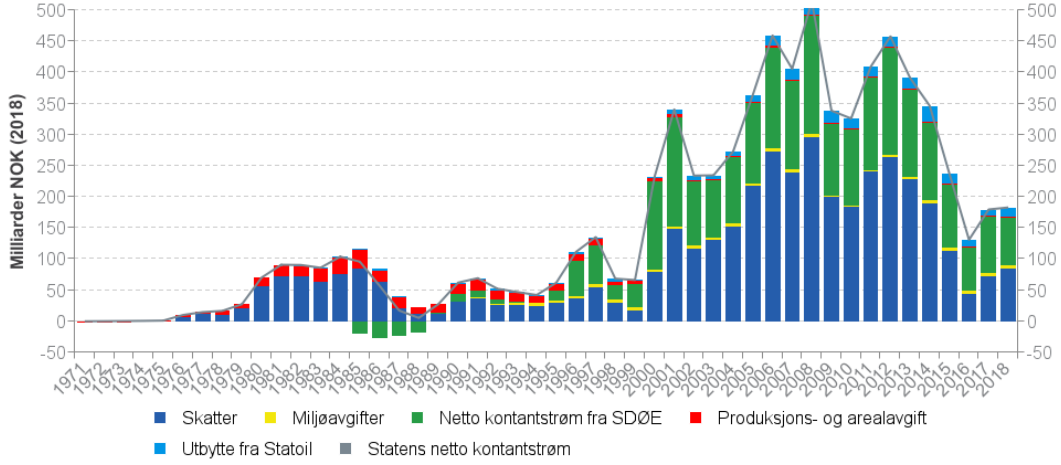
At December 23rd, 1969, Phillips Petroleum found the first oil at Ekofisk in the Northern sea and this was the beginning of a new era in Norwegian economy and welfare. Petroleum activities are today Norway's largest industry, measured in value creation, government revenue, investment and export value.

In May 1996, the first deposit was transferred into the fund and amounted approximately 1981 million NOK. Ever since, the fund has grown rapidly and has today exceeded 8000 billion NOK. The fund was originally set up to give the government room to maneuver in fiscal policy if the oil price would drop. It also serves as a tool to manage the financial challenges of an ageing population as well as for an expected drop in the petroleum revenues. The fund is designed for a long-term investment, but is also available for withdrawals when needed. Despite the name of the fund, it does not include any formal pension liabilities, and it has not been made any decisions as to when the fund will be used to cover future pension costs.

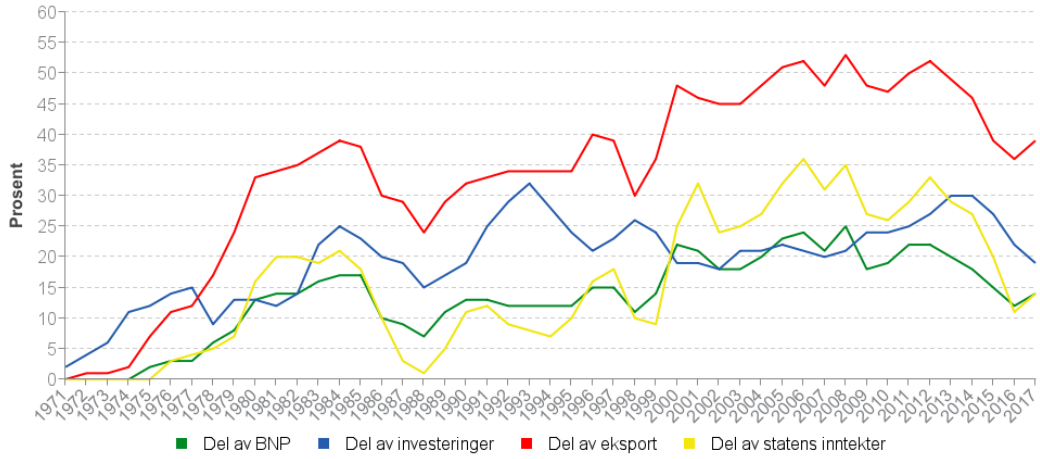
Norges Bank Investment Management manages the fund on behalf of the Ministry of Finance, which is the formal owner of the fund on behalf of the Norwegian people. The Ministry of Finance decides the investment strategies for the fund, based on advice from Norges Bank Investment Management and the parliament. The management mandate defines the investment universe and the strategic reference index of the fund. The Ministry of Finance has transferred capital to the fund from the Norwegians state`s petroleum revenues on a regular basis. The capital of the fund is invested abroad in order to avoid the effect of oil price fluctuations and to avoid overheating of the Norwegian economy. The fund has invested in many different markets, countries and currencies to get a broad exposure to the global growth, and the investments are in both international equity, fixed-income and real estate. The goal of these investments is to produce high long-term returns greater than the growth in the global economy, at an acceptable level of risk.

Revenues from the Government's operations are transferred to the Government Pension Fund Global. Through the action plan, transfers from the Government Pension Fund to the state budget allow us to finance public goods without reducing the fund's capital. By 2017, about every seventh krone used over the state budget will come from the Government Pension Fund Global.

Lastly, according to Norsk Petroleum the current oil reserve will only last for approximately 60 more years if the extraction continues in the same pace as today. This could be an important factor to consider in our research.



The government's net cash flow from the petroleum activities, 1971-2018 (NBIM,2018)



Macroeconomic indicators for the petroleum sector, 1971-2017 (NBIM, 2018)

Literature

As there is very little literature on this particular research question, we do not have one particular research paper we can base our question solely upon. However, we will be dependent on reports published by NBIM and their calculation on the fund's risk exposure. In the theory part, we will explain more about basic risk and NBIM's different risk analyzing models. On the other hand, we have found a selection of articles that might have useful information, helping us in our attempt to model the second scenario's risk exposure. Topics like oil price volatility and risk exposure, fund size vs performance etc. are discussed and analyzed in the following three research papers:

"Oil Volatility Risk" written by Lin Gao, Steffen Hitzemann, Ivan Shaliastovich, and Lai Xu shows empirical evidence that oil price variance captures significant information concerning economic growth and asset prices. Further, the research provides a two-sector macro model which explains the empirical findings; In periods of high uncertainty, oil producers tend to increase their inventories to alleviate the probability of stock-outs. As a consequence, the amount of oil available for the general macro sector is reduced, and production, consumption and investments decrease.

"Mutual fund performance: does fund size matter?" written by Indro, D. C. et al describes how Fund size (net assets under management) affects mutual fund performance. Mutual funds must attain a minimum fund size in order to achieve sufficient returns to justify their costs of acquiring and trading on information. Furthermore, there are diminishing marginal returns to information acquisition and trading, and the marginal returns become negative when the mutual fund exceeds its optimal fund size. In addition, it found that value funds and blend (value-and-growth) funds have more to gain than growth funds from these information activities.

"Oil price risk exposure and the cross-section of stock returns: The case of net exporting countries" written by Demirer, Rıza, Shrikant P. Jategaonkar, and Ahmed AA Khalifa. This paper examines whether oil price risk is systematically priced in the cross-section of stock returns in net oil-exporting countries even after controlling for market and firm-level risk factors. The research found that stocks that are more sensitive to oil price changes, yield significantly higher returns. Further, it suggests that oil price exposure can serve as a return predictor in these stock markets. They also found that it is the absolute exposure of a stock that drives returns, suggesting fluctuations in the oil price as a source of stock return premium in these markets. The tests further suggest that a portfolio strategy based on a stock's absolute exposure to oil price risk yields significant positive subsequent returns as well, suggesting an investment strategy based on the absolute oil price risk exposure of stocks in net exporting nations.

Theory

How to measure the risk of the fund vs risk of petroleum reserves?

The different measures of risk discussed below, is taken directly from the Return and Risk report for the Government Pension Fund, 2016. We take out some of the most important parts for the different methods used to calculate risk, and comment on some of their findings. The report states, "no single method or analysis can capture the overall risk of the fund", and therefore many different methods presented in the paper. It will be important for us to understand the measures used to evaluate the risk of the fund, in order to answer our research question.

Market risk: is defined as the risk of decrease in the market value of the portfolio as a result of changes in financial market variables. Financial market variables can include equity prices, exchange rates, interest rates, credit spreads and real estate prices. In the report the market risk of the fund is measured many ways, such as absolute exposure, systematic factor risk, volatility, correlation risk and liquidity risk.

Asset allocation: is the main driver of the fund`s overall risk, which is dictated by strategic benchmark for the fund set out by the Ministry of Finance. By plotting out a hypothetical portfolio consisting of 60% equities and 40% fixed income, the maximum loss since 1900 for such a portfolio has been 30% for a single year. Analysis show that these fluctuations has mainly been driven by equity volatility. The management mandate requires the fund`s equity exposure to be between 50-70%, and at the end of 2016 the equity exposure was 62,5%.

Expected Absolute risk: The fund`s absolute risk is driven mostly by the asset allocation. At the end of 2016, the expected absolute volatility of the fund was 10,6%. The expected absolute volatility is based on the statistical concept of standard deviation and it shows how much the annual return of the fund is expected to fluctuate. It also takes into account the correlation between different investments in the portfolio.

From the graph above we can see the funds expected absolute volatility in percent. The volatility is annualized using the square root of time rule. They use a range of different time periods in the report to calculate the volatility, using historical simulations. The report also specifies how much each sector contributes to the absolute volatility of the portfolio.

Relative risk: Deviations from the benchmark are sources of relative risk. The report looks at different ways to measure relative risk in the fund.

Expected relative volatility: There is a restriction set out in the management mandate laid down by the Ministry of Finance. This restriction sets a limit for the expected relative volatility, which is how much the fund`s equity and fixed-income investments can deviate from the return of the benchmark index. Using a three-year pricing history, the expected relative volatility was 0,28 percentage points at the end of 2016. While the average expected relative volatility for the last 17 years was 0,40 percentage points. The relative risk can also be further decomposed, and used to calculate the risk for the different parts of the fund as well as for different investments strategies.

Expected shortfall: The expected relative volatility measure, is an estimate of what happens under normal market conditions. The limitations of the measure as stated in the report, are that it does not tell us anything about the distribution or the magnitude of less probable outcomes (tail risk). The expected shortfall is also called the conditional value at risk, and is a popular method for measuring the tail risk. It provides us with the average expected loss for the worst "q" percent of the observations. In this case the probability "q" is the tail probability, which is equal to 1 minus the confidence level specified in the analysis. As of March 2016, Norges Bank`s executive board has set a limit for the expected shortfall for both equity and fixed-income to 3,75%.

Benchmark overlap: This is an important part of the measure of relative risk. It measures how closely the fund's portfolio matches the benchmark indices. Norges Bank`s executive board has set a limit for minimum overlap for the portfolios of both equities and fixed-income and their benchmarks to 60%. At the end of 2016, the overlap for equities and the fixed-income were respectively 82,8% and 72%.

Distribution of relative return: This is another approach suggested by the report, to measure the relative risk, where you analyze the distribution of the fund`s realized relative return. Measured over the last five years the standard deviation of the realized monthly relative returns has been 0,11%. Over longer sample periods it is even lower. From their calculations we experience excess

kurtosis, which indicates that there is a higher probability of large deviations from the fund`s benchmark compared to what would be the case if we had normal distribution. Over the last five years the excess kurtosis has been lower, compared to longer sample periods.

Methodology

To be able to answer or research question we will try to construct a model which can compare the risk exposure of two scenarios. The first scenario is the one Norway actually has been perusing; to extract the oil fast, and deposit the revenues of the export sale into the fund. The second scenario will be to look at how the risk would be affected if we perused a slower extraction of the oil, and instead stored the oil below the ground. In this scenario, we would only take into account the exact yearly amount of oil needed to cover the contribution to the national budget. NBIM has already modelled the first scenario considering this is the actual risk exposure of the fund today. Thus, to find the risk exposure for the second scenario we will, as far as it is possible, use the same method as NBIM, with this scenario's corresponding factors/variables.
Roughly, we will pursue the following steps:

- First, we will start by finding numbers on Norway's yearly oil and gas consumption, production and export revenues.
- Secondly, we will estimate this amount in million cubic meters of oil and gas (Sm^3) in order to estimate how much petroleum Norway would have to extract each year to cover the nation's consumption.
- Thirdly, we will try to develop a model which measures the risk of stocking oil compared to the risk of keeping the oil beneath the surface.
- Lastly, we will try to translate this risk into NOK in order to answer our research question on how large the premium from transferring the revenue from our petroleum reserves to the welfare fund is.

The exact method on how we should compare and calculate the measures for comparison between the two alternatives, is not completely determined as there is very little previous work we can use as a framework. We see from NBIM`s reports that they measure the fund's risk with familiar measures presented in previous classes, and we aim to use many of the same models for simplicity.

Below we have presented NBIM's different risk-adjusted performance measures for portfolios.

Jensen`s alpha: Is the average return on the portfolio over and above that predicted by the CAPM, given the portfolio`s beta and the average market return (Investments, 2014). Under the assumptions of the CAPM, beta explains the differences in expected return. Beta measures systematic risk and from the report it is estimated using a regression of the portfolio returns in excess of the risk-free rate on the benchmark excess returns. Jensen's alpha is the residual average return after correcting for the portfolio's beta and it assumes the only relevant risk is the risk that we can't diversify away.

$$\alpha_p = \bar{r}_p - \left[\bar{r}_f + \beta_p(\bar{r}_M - \bar{r}_{f)}\right]$$

Sharpe ratio: The Sharpe ratio measures the absolute risk adjusted performance. It also ranks the different portfolios based on estimated trade-off between return and total risk. The difference between Jensen`s alpha and Sharpe ratio, is that the Sharpe ratio assumes that total risk is the relevant measure. As Sharpe ratio is good for ranking portfolio performance, the numerical value is not easy to interpret (Investments, 2014). An alternative measure to this can be the M^2 measure by Leah and Franco Modigliani. The M^2 measure also focuses on the total volatility as a measure of risk, but its risk adjustment leads to an easy-to-interpret differential return relative to the benchmark index (Investments, 2014)

Sharpe ratio: $(\bar{r}_p - \bar{r}_f)/\sigma_p$

$$M_p^2 = r_{P*} - r_M$$

Information ratio: Divides the alpha of the portfolio by the non-systematic risk of the portfolio, called "tracking error" (Investments, 2014).
From the report, we know that in comparison with the Sharpe ratio, the information ratio substitutes the benchmark for the risk-free rate and divides the mean of the portfolio return relative to the benchmark by the standard deviation of that relative return. Hence, the information ratio measures the risk by using deviations from the benchmark.

Information ratio: $\alpha_p/\sigma(e_p)$

The process of making a realistic scenario for the second alternative will be a tedious process, where we probably will have to try and fail until we reach a satisfying result. This process will require a good dialog with our supervisor, which hopefully can bring useful insights based on his broad expertise on this field.

Data

We will need data on the amount of oil revenue contributing to the annual national budgets, in order to see how much it would be necessary to extract each year to cover this amount. The numbers needed to this research is available several places such as Statistisk Sentralbyrå (SSB.no), Bloomberg, Oljedirektoratet.no, Regjeringen.no, Nbim.no and Reuters Eikon. We will mainly use Eikon and data conducted from 1996 (when the first deposit was transferred into the fund) until today 2018. For this period, we will need data on the following:

- Total production of oil produced each year in Norway (Sm^3)
- Numbers on yearly deposits in the pension fund.
- Numbers on the national account's yearly consumption of petroleum revenues in both in (Sm^3) and NOK
- Data on the monthly/quarterly oil price and volatility
- Data on the monthly/quarterly return and volatility on invested fund capital

In need of non-public information, we can contact SSB or NBIM directly.

References

Articles:

Langved, Åshild (November 2017) Derfor vil Oljefondet selge seg ut av oljeaksjer, Dagens Næringsliv https://www.dn.no/nyheter/2017/11/28/1000/Finans/derfor-vil-oljefondet-selge-seg-ut-av-oljeaksjer

Letters:

Norges Bank letter to Ministry of Finance (November 2017). Norges Bank anbefaler å ta oljeaksjer ut av referanseindeksen for statens pensjonsfond utland

Research papers:

Gao, L., Hitzemann, S., Shaliastovich, I., & Xu, L. (2016). Oil Volatility Risk.

Indro, D. C., Jiang, C. X., Hu, M. Y., & Lee, W. Y. (1999). Mutual fund performance: does fund size matter?. Financial Analysts Journal, 55(3), 74-87.

Demirer, R., Jategaonkar, S. P., & Khalifa, A. A. (2015). Oil price risk exposure and the cross-section of stock returns: The case of net exporting countries. Energy Economics, 49, 132-140.

Reports:

Norges Bank Investment Management (2016) Return and Risk Government Pension Fund Global, page 64-66

Norges Bank Investment Management (2017) Petroleum Wealth and Oil Price Exposure of Equity Sectors

Websites:

Norsk Petroleum Homepages: http://www.norskpetroleum.no/

Norges Bank Investment Management Homepages: https://www.nbim.no/

Books:

Brooks, C. (2014). Introductory econometrics for finance. Cambridge university press.

Bodie, Z., Kane, A., & Marcus, A. J. (2014). Investments, 10e. McGraw-Hill Education.