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Should the Government Pension Fund Global Invest in Oil & Gas Companies?

Master's thesis in Financial Economics
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Preface

This Thesis concludes our MSc in Financial Economics at the Norwegian University of Technology and Science. We would like to thank Knut Anton Mork for guiding us through the process of writing this thesis, and providing valuable feedback. We would also like to thank Halvor Hoddevik of Rann Rådgivning AS for his input, and help with our analysis. This thesis is written in cooperation by Hanna Marisela Eap and Magnus Eskedal Haraldsen.

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Abstract

The matter of whether or not the Norwegian Government Pension Fund Global (GPFG) should invest in Energy companies has been up for discussion in recent years. Norway is highly dependent on the petroleum industry, and is thus vulnerable to the risks related with this industry. Some argue removing such companies from the GPFG will reduce Norway's concentration risk, and that Energy companies and the Norwegian petroleum reserves are closely related. To examine these relations, we have constructed a comprehensive data-set in order to calculate the weighted operating cash flows of each ICB-industry. These industry cash flows are compared to the Norwegian government's petroleum cash flows (GPCF). Our results indicate that the Energy industry and the GPCF are closely related, both in absolute terms, and compared to other industries. In addition, we have analyzed the relation between the subsectors of the Energy industry and the GPCF. We find that both the subsectors Exploration & Production and Integrated Oil & Gas (86% of the Energy industry) are highly correlated with the GPCF. As a result of this, we recommend removing these two subsectors from the Government Pension Fund Global to reduce Norway's concentration risk.

Sammendrag

Et aktuelt tema de siste årene, har vært om Statens pensjonsfond utland (SPU) skal være investert i Energi selskaper. Petroleumsindustrien utgjør en stor del av Norges økonomi. Derfor er Norge sterkt ekspontert mot risiko tilknyttet denne industrien. Noen argumenterer for at Norges konsentrasjonsrisiko vil bli redusert ved å eliminere disse selskapene fra SPU, grunnet Norges petroleumsreservers nære relasjon til Energisektoren. For å undersøke disse forholdene, har vi konstruert et omfattende datasett for å beregne de vektede operasjonelle kontantstrømmene til hver ICB-sektor. Disse kontantstrømmene sammenlignes med Norges netto kontantstrøm fra petroleumsindustrien (GPCF). Våre resultater viser en tydelig relasjon mellom Energisektoren og GPCF, også i forhold til andre sektorer. I tillegg har vi analysert forholdet mellom Energi-undersektorene og GPCF. Vi finner at undersektorene Exploration & Production (oppstrømsselskaper) og Integrated Oil & Gas (integrerte olje og gass selskaper) er begge sterkt korrelert med GPCF. Som et resultat av dette, anbefaler vi å ta ut disse undersektorene fra Statens pensjonsfond utland, og dermed redusere Norges konsentrasjonsrisiko.

Contents

1 Introduction

Since Philips Petroleum Company discovered the oil field ”Ekofisk” on the Norwegian continental shelf (NCS) the 23rd of December 1969, the revenue stream from the petroleum industry has completely transformed the Norwegian society, economy and national wealth. The majority of the government’s revenue stream from petroleum has been saved and invested in the global financial markets through the Norwegian sovereign wealth fund, the Government Pension Fund Global (GPFG). This has proved to be a huge success. As of 24th May 2019, the value of the GPFG is just shy of 9.000 billion NOK. This is roughly 2.5 times the size of Norway’s GDP in 2018.[1] If paid out to each of the 5.33 million Norwegian citizens (as of 31.12.2018), every Norwegian would receive 1.68 million NOK. This is in large, thanks to the politician’s long-term views and willingness to take on financial risk by investing in the global bond and equity markets. The large wealth created by extracting petroleum from the NCS belongs to the Norwegian people, both current and future generations. Hence, the way in which this wealth is invested and managed is of great importance to future generations.

The aim of this paper is to contribute to the ongoing discussion as to whether the Government Pension Fund Global should invest in companies classified as part of the Energy industry, or not.[2] This discussion was triggered by a letter of advice from Norway’s central bank ”Norges Bank” to the Ministry of Finance (MoF) in November 2017. Norges Bank (2017) concluded that the vulnerability of the government wealth to depressed oil and gas prices will be reduced by excluding Energy companies from the GPFG, and thus advised removing such assets from the GPFG. This letter led to the MoF appointing a group of experts (Thøgersen Uvalget) which provided an analysis on the issue, published as NOU 2018:12.[3] In conclusion the Thøgersen report (Norwegian Ministry of Finance, 2018b) argues that the GPFG should continue to invest in Energy stocks. The main reasoning behind this is that Norway’s need to reduce oil price risk, is historically small, and that removing energy companies from the GPFG will provide only a limited risk reduction. There have been public hearings of both the letter of advice from Norges Bank to the MoF and NOU 2018:12,

[1] Norway’s GDP in 2018 was 3.535 NOKbn (SSB).

[2] FTSE Russell will change the name of industry 0001 from Oil & Gas to Energy, effective from 01.07.2019

[3] NOU 2018:12 will often be referred to as the Thøgersen report, as the expert group was headed by the President and professor of Norwegian School of Economics (NHH) Øystein Thøgersen.

to which a number of institutions were invited to comment. Our supervisor, Knut Anton Mork, and Rann Rådgivning AS through Halvor Hoddevik were among those who responded to the public hearing of NOU 2018:12. Much of our work is inspired by their efforts.

In this thesis we attempt to answer the following research question: **Should Oil & Gas companies be removed from the Government Pension Fund Global?**

There are several ways to approach this issue, in terms of data analysis and the context in which the GPFG is viewed. The context in which one views and makes decisions regarding the GPFG is of paramount importance to which decision seems the most reasonable. Viewed as a single financial portfolio with the aim of efficiency through diversification, one would unlikely consider removing an entire industry as an optimal strategy.[4] However, when viewed as part of Norway's national wealth, including large oil reserves, removing the Energy industry may make sense.

For simplicity consider only the Norwegian petroleum wealth, consisting of; (1) the oil fund, and (2) the remaining petroleum reserves on the Norwegian continental shelf. The value of the remaining petroleum reserves, is calculated as the present value of the future net cash flows from the petroleum industry to the Norwegian state.[5] The most recent estimate of the value of the petroleum reserves was 5,100 NOKbn, presented in the revised national budget 2019. So, the total value of Norway's petroleum wealth is approximately 14,100 NOKbn.[6] The present value of future petroleum cash flows is heavily dependent on the profitability of the petroleum companies operating on the NCS. In other words, more than 36% of Norway's estimated petroleum wealth is directly exposed to the same risk factors faced by petroleum companies. In this context including Energy companies in the GPFG does not seem to increase portfolio diversification, rather the opposite. However, oil exporters typically ignore below-ground assets when allocating above-ground funds, such as the Norwegian oil fund (Van den Bremer et al., 2016).

Ideally, we would analyze the relationship between Energy stock prices and the value of the Norwegian petroleum reserves directly. Unfortunately, the value of the petroleum reserves is not observable, and thus we do not have time-series data enabling such an analysis. Both the Thøgersen

[4]Efficiency in this context refers to achieving the highest portfolio return for a given level of risk, or the least risk for a given return (Markowitz, 1952)

[5]We will refer to these cash flows as the government's petroleum cash flows (GPCF) throughout this thesis.

[6]GPFG (9000 NOKbn) plus the value of the remaining petroleum resources (5100 NOKbn)

report and Norges Bank have used oil prices to analyze the relation between energy stock returns and the petroleum reserves. Their studies have found that Energy stock returns are closely correlated with the development of the stock market as a whole. This is likely due to discount rate variation, which affects the stock prices of all industries. According to financial theory, asset prices (and thus returns) are simply expected future cash flows discounted to today's value.

Both NBIM (2017a) and the Thøgersen report attempt to decompose the sensitivity of industry returns to oil prices, into cash flow and discount rate components. This approach is based on the ideas of Campbell (1991) and Henriksen and Kværner (2018). NBIM (2017a) finds a clear relation between the cash flows of the Energy industry and oil prices, while the results presented in Norwegian Ministry of Finance (2018b) are inconclusive[7]. Kang et al. (2017), stated that the reason for oil price changes can have an impact on how energy stock returns are affected. Additionally, Smyth and Narayan (2018) found that only part of the risk of investing in energy stocks can be tied to oil price changes, and this relation seems to vary over time.

Thus, one can argue that using the oil prices as an intermediary between Energy stocks and the petroleum reserves only distorts the link between the two variables. Both are affected by more than oil prices alone. Toews et al. (2015) found that a third of oil price changes are counteracted by cost changes for petroleum production. If oil prices fall, so will the revenues of oil companies, but if costs fall with equal amounts, the cash flows of oil companies would remain unchanged. The same can be said for the production volume. A fall in prices may be offset by increased oil production, and thus have a reduced impact on the cash flows to both the Norwegian state from petroleum, and to oil and gas companies.

In this thesis, we are concerned with the close relation between the Norwegian petroleum reserves and Energy stocks. Our approach is to analyze the relationship between the cash flows from these assets directly. The advantage of this approach is that we do not rely on oil prices as an intermediary, and discount rate effects do not have any impact. Asset prices are functions of future *expected* cash flows, not the *realized* cash flows, but with rational expectations this difference should be white noise.

[7]The results presented in table 1.5 in the appendix of NOU 2018:12 are similar to the findings of NBIM (2017a)

The Norwegian government published a Report to the Storting (white paper) with their opinion on the question of whether energy stocks should be part of the GPFG or not, the 8th of March 2019. They propose removing companies classified as upstream companies, the subsector 0533 Exploration & Production (upstream companies) in the FTSE Russell classification scheme, from both the benchmark index and investment universe. This decision will be discussed in the Norwegian Parliament the 12th of June 2019. We will therefore also investigate the relation between the cash flows of the Energy subsectors and the government's petroleum cash flows, in order to discuss the government's proposal.

2 The Norwegian National Wealth

The Government Pension Fund Global is a substantial part of Norway's wealth, but it is only a piece of the larger puzzle that is a country's national wealth. Norway's national wealth is measured by the MoF every three years, most recently in 2017, with the purpose of illustrating the most important income sources for Norway in the future. Norway's gross domestic product (GDP) does not account for the fact that the major income from the petroleum industry will decay as the oil reserves are depleted. Thus, the national wealth helps clarify this. The national wealth consists of four elements: (1) Human Capital, (2) Physical Capital, (3) Natural Resources and (4) Financial Capital.

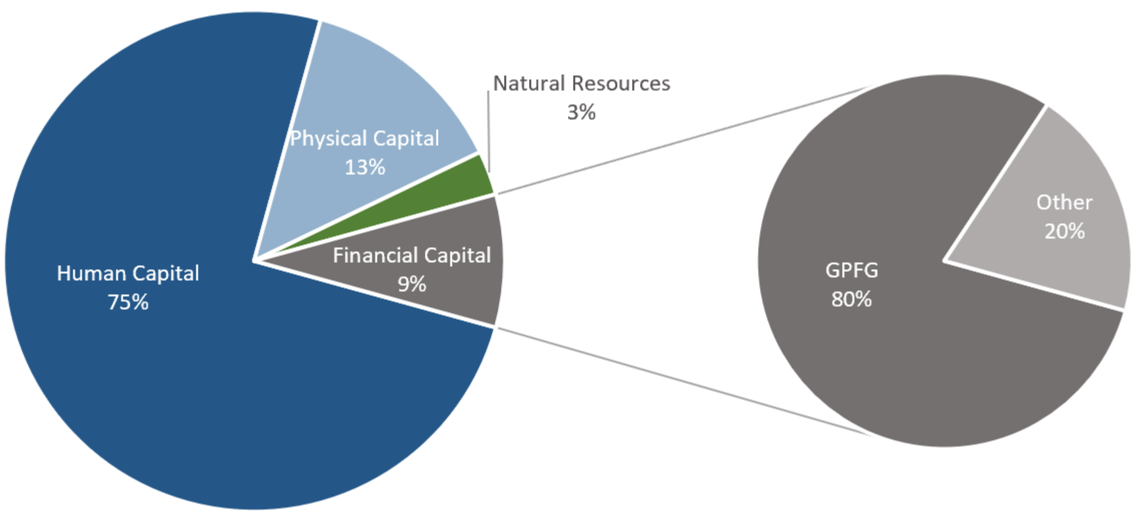

Figure 2.1: The four elements of the Norwegian national wealth, Human Capital, Physical Capital, Natural Resources and Financial Capital, mainly consisting of the Government Pension Fund Global. Source: Norwegian Ministry of Finance (2017)

Figure 2.1 displays the importance (in terms of size) of the four elements of the Norwegian national wealth. Human Capital is the main contributor, followed by Physical Capital and Financial Capital. Norway's Financial Capital mainly consists of the Government Pension Fund Global.

Human Capital is an estimate of the present value of future income from labour to the state, and is the main contributor to the national wealth. The MoF estimates the Human Capital using an income-based approach, calculated as the present value of lifetime labour income per capita.

With this approach, the labour income each year is found by multiplying the total number of hours worked with the hourly wages for mainland-Norway. This figure is then divided by the population size and discounted with a real discount rate of 3%. This approach assumes a constant number of hours worked (workforce is unchanged), constant wages and constant productivity. Hence, the Human Capital is calculated as a perpetual, stationary production input. The Value of the Human Capital was estimated to be 10.5 NOKm per capita in 2017. It should be noted that this estimate is highly sensitive to the current wage level, which is strongly influenced by the level of the petroleum activity on the NCS.

Physical Capital is capital objects resulting from a production-process, in other words, produced capital, which are used multiple times or continuously over a time period exceeding one year. This includes physical capital such as housing, buildings, machinery, transport, production equipment, etc. It also includes intellectual property products such as mineral exploration, R&D, etc. The physical capital is measured as the cost of replacement for this capital. The Physical Capital was measured to be 1.9 NOKm per capita in 2017.

Natural resources includes petroleum reserves and other natural resources such as agriculture, forestry, fish farming etc., where petroleum reserves is the largest contributor. Natural resources are estimated as the present value of the future resource rent. The resource rent is defined by the MoF as the expected return exceeding the normal return from physical capital and labor. Since the collective resource rent in other natural resources has been close to zero the past years, the MoF expect this to remain unchanged in the future. Thus, the estimation of natural resources is the present value of the expected resource rent in the petroleum industry. The estimation follows these steps:

1. The net cash flow from the oil and gas industry in current prices is estimated based on production estimates, extraction costs and oil and gas prices for each year up to 2085. The estimates up to 2050 are derived from figures from the Norwegian Petroleum Directorate and the Ministry of Petroleum and Energy. Oil and gas prices are estimated in the Norwegian Ministry of Finance (2017). From 2025 and onwards, the oil price is estimated at an average of 510 NOK per barrel, and gas prices averaging 12 NOK per barrel of oil equivalents (boe),

in 2017 prices[1].

2. The net cash flow is adjusted annually by adding net investment cost and subtracting the estimated normal return to the physical capital. This normal return is estimated to be 6%, which equals the average return of the sector in Norway from 1984-2014.

3. As a rough approximation, half the sectors' costs of labour are counted as part of the resource rent.

4. The nominal resource rent is deflated by the deflator for net domestic purchases of goods and services in the national accounts.

5. The present value is found by discounting the future resource rent with a real discount rate of 3 percent.

$$P_t = \sum_{t=1}^{T} \left(\frac{R_t + I_t - iK_t + 0.5L_t}{(1+r)^t} - \frac{K^{T+1}}{(1+r)^{T+1}} \right) / N_0 \tag{2.1}$$

where P_t = the discounted resource rent per capita at time t, r = the real rate, R_t = the cash flow of the sector at time t, I_t = the investments in oil and gas at time t, K_t is the sectors stock of capital at time t, i is the normal return. L_t is the sum of wages in the sector in fixed terms, T is number of years with oil and gas production, and N_0 is number of inhabitants at time 0. The first fraction of the formula is the net cash flow generated from the petroleum industry at time t, discounted to today's value. The second fraction is the sectors stock of capital, discounted to one period ahead value. The sum of all discounted cash flows is divided by the number of inhabitants at time zero. This gives the net present value of the petroleum wealth. The most recent estimation was 0.4 NOKm per capita, estimated by the MoF in 2017. Note that these calculations are highly uncertain, and based on assumptions reaching far into the uncertain future.

Financial Capital is the government's net financial assets. The GPFG is the main contributor and represents approximately 80% of this wealth. The financial capital is estimated by Statistics Norway on behalf of the Norwegian Government. The remaining 20% of the financial capital is other net assets. The Financial Capital was measured to be 1.2 NOKm per capita in 2017.

[1] 1 Sm^3 equals 6.29 boe (Norwegian Petroleum Directorate, 2019)

2.1 The Government Pension Fund Global

The Government Pension Fund Global (GPFG) is the Norwegian sovereign wealth fund. A sovereign wealth fund (SWF) is an investment fund or entity owned by a state Sovereign Wealth Fund Institute (2019). The fund is managed by Norges Bank Investment Management (NBIM), by appointment from the government, which act as the owners of the fund on behalf of the Norwegian population. The Government Pension Fund Global was established with the passing of the Government Pension Fund Act in 1990, and the first deposit was made from the MoF in 1996 (NBIM, 2019b). Today, the entire net cash flow to the Norwegian State from the petroleum industry, is transferred to the GPFG. Thus, these cash flows are not directly injected into the national budget. Instead, the GPFG is integrated in the National Budget through the Fiscal rule. This rule ensures that the petroleum wealth will be consumed at a sustainable rate, securing the value created from extracting petroleum today will also benefit future generations. The Norwegian Government has decided that a percentage portion of the fund equal to its expected real rate of return, can be used in the National budget. The expected real return is currently estimated to be 3%.

The GPFG was a result of the Tempo Committee (Norwegian Ministry of Petroleum and Energy, 1983), chaired by Hermod Skånland, in 1983. The purpose of the committee was to examine all matters that are of particular importance for the assessment of future development of the petroleum activity. Their recommendation was to leave the pace of the development to the oil industry, and for the government to establish long-term guidance for the spending of petroleum revenues. To separate, timewise, the earning and the spending of the government's oil revenues, the Tempo Committee proposed an equalisation fund, to which the government's petroleum cash flows would be transferred. This framework would shield the fiscal budget from the volatility of the petroleum industry. Furthermore, this would make room for the long term planning to be based on a preferred level of spending. There is not a single, specified purpose of the fund, but it is designed to invest with a long-term perspective with the possibility of withdrawals when required.

2.1.1 Current investment strategy

The objective of the GPFG is to ensure high long-term return after costs, given an acceptable level of risk. Through investing in different asset classes, markets and currencies, the GPFG aim to achieve a broad exposure to global economic growth. The GPFG invest in equities, fixed-income and real estate. The investment strategy of the GPFG is specified through the Investment Mandate, which is determined by the Ministry of Finance subject to approval by the Parliament. The Investment Mandate specifies the investment universe of the fund, and limits the shares allocated to equities and fixed-income. The GPFG's investment universe is a broad range of countries, markets and instruments. Norway is excluded from this investment universe to avoid inflating the Norwegian financial market. The GPFG is also invested in listed and unlisted real estate, to take advantage of the risk-return profile of these assets.

NBIM's investment strategy aims to exploit the fund's characteristics as a large, global investor with limited short-term liquidity requirements, in order to achieve a high return with acceptable risk. This is achieved using a strategy largely consisting of index replication, with a small portion being actively managed. According to the *strategic* benchmark decided by the Ministry of Finance, the GPFG aim to have an equity share of 70% and a fixed-income of 30% (Norwegian Ministry of Finance, 2016). Investments in unlisted real estate can at most account for 7% of the fund. The GPFG uses indices from Bloomberg Barclays and FTSE Group as benchmark indices. ”The benchmark index is based on broad, global indices from leading providers which largely reflect the investment opportunities in the global equity and fixed income markets” (Norwegian Ministry of Finance, 2018a).

The fixed-income benchmark index is provided by Bloomberg, and consists of the three indices; Global Treasury GDP, Global Inflation-linked and Global Aggregate. The benchmark is made up of 70% government bonds in 21 different currencies, and 30% corporate bonds in 7 different currencies. The government bonds are weighted according to each country's GDP, and corporate bonds are weighted based on each company's outstanding debt.

The FTSE Global All Cap Index (GEISAC) is used as the equity benchmark index of the Government Pension Fund Global. This benchmark index is market-weighted and includes large, mid and small cap stocks in both Developed and Emerging markets. The GEISAC index contains around 8,000 stocks from 49 different countries. The index was launched by FTSE Russell in 2003, and was developed to be used for index tracking funds, derivatives, and as a performance benchmark for funds and such as the GPFG.

2.1.2 The actual benchmark index

The actual benchmark index is based on the benchmark indices presented, with some modifications. Firstly, some regions are purposely over- and under-weighted, and Norway is removed. Europe (ex. Norway) is weighted 2.5x it's actual market cap, and USA and Canada are weighted 1x their market cap. Both the remaining developed markets and emerging markets (EM) are weighted 1.5x their market cap, effectively over-weighting Europe at the cost of under-weighting USA and Canada according to market weights. Also, the GPFG invests in the equity markets of twenty countries not included in the GEISAC index, such as local Chinese equity (China A), Croatia, Saudi Arabia and Morocco. Finally, the Government Pension Fund Global cannot invest in companies and sectors in violation of the ethical/environmental guidelines for the fund. This includes tobacco, coal and oil-sand companies.

Due to sudden movements in the market the GPFG can deviate from the strategic benchmark decided by the MoF with a maximum deviation of an expected relative volatility of 1.25 percentage points. The expected realized volatility is a measurement on how much the return on the GPFG is expected to deviate from the benchmark index return in a normal year (NBIM, 2018). NBIM must rebalance the equity allocation in the GPFG if the equity share deviates significantly from the *strategic* benchmark index.

Table 2.1: The weights, and number of companies of each ICB industry in the GPFG and FTSE GEISAC, in addition to their market value in the GPFG. All figures as of 31.12.2018. Sources: NBIM (2017b) and FTSE Russell (2018).

	GPFG equity holdings			**FTSE Global All Cap**	
ICB Industry	No.	NOKm	Weight %	No.	Weight %
0001 Energy	341	320,756	5.9	320	5.9
1000 Basic Materials	659	271,304	5.0	614	4.6
2000 Industrials	1966	708,762	12.9	1651	13.4
3000 Consumer Goods	1204	653,764	11.9	1009	11.0
4000 Health Care	723	626,847	11.4	544	11.2
5000 Consumer Services	1204	589,709	10.8	1008	11.5
6000 Telecommunications	130	163,344	3.0	129	2.8
7000 Utilities	252	155,333	2.8	286	3.3
8000 Financials	1859	1,299,103	23.7	1659	21.9
9000 Technology	809	689,838	12.6	644	14.4
Total	9158	5,478,760	100	7864	100

Table 2.1 displays the actual weights in both the Government Pension Fund Global and the FTSE Global All Cap index (the funds equity benchmark). The GPFG deviates from GEISAC due to the modifications determined through the Investment Mandate, but with limited amounts.

3 Basic Theory & Litterature

In this section we will present theory and research papers of importance to our thesis. This includes efficient management of sovereign wealth funds, and asset pricing.

3.1 Managing Sovereign Wealth Funds

A sovereign wealth fund (SWF) is an investment fund or entity owned by a sovereign state. The number of such funds has increased significantly in recent years. According to the Sovereign Wealth Fund Institute (2019), 40 SWFs have been created since 2005. The funding source of such state-owned funds varies from country to country, but typically, funding comes from sales of below-ground resources as oil, gas, copper and diamonds. Van den Bremer et al. (2016) state that two thirds of sovereign wealth funds (by size) are a result of the extraordinary wealth created by extracting and selling such natural resources. Such funds are often referred to as oil funds. In this thesis we are concerned with the Norwegian Sovereign Wealth Fund (the GPFG), which is an example of such an oil fund, and is the largest fund of its kind.

Van den Bremer et al. (2016) is concerned with how countries with both sovereign wealth funds and below-ground assets (such as oil), should optimally manage these assets. They argue that the investment strategies of such funds do not take sufficient consideration of oil price volatility and subsoil reserves, and that existing theories of optimal oil extraction do not consider the volatility of financial markets. Considering that commodity prices are notoriously volatile, and that below-ground assets can be of higher value than the above-ground fund, above-ground investment strategies are of great importance for resource exporters such as Norway. The purpose of most such funds is to smooth the consumption of the wealth over generations, as the oil reserves are finite, and as the income may vary between periods. Thus, the below-ground assets should be taken into account when making investment decisions.

Van den Bremer et al. (2016) further suggest a new asset allocation strategy for the GPFG: ”Norway's asset allocation should vary over time to hedge as much of the volatility of remaining subsoil oil as possible”. The first, and in their opinion best approach, is to offset subsoil risk with above-ground investment positions. This may involve taking large, long positions in industries negatively correlated with oil prices, and large short positions in positively correlated industries. Further, as oil (and gas) is extracted, these positions should be reversed as the need to offset concentration risk is reduced. However, there are important implications with this method. If systematic shocks occur, highly leveraged positions exposes the investor (Norway) to significant risk. Such leveraged positions may also become illiquid in times of distress, violating the assumption of exogenous prices. These positions also rely on constant correlations between oil prices and each sector. Since the correlations may vary over time, and are estimated with historical data, there may be large basis risk between oil and the hedging portfolio. Additionally, reversing these positions as oil is extracted, will cause significant transaction costs, especially for a fund as large as the GPFG.

The second best approach introduced by Van den Bremer et al. (2016), is to vary only the equity/bond mix in the fund. This approach does not require leveraging the fund, has lower transaction costs, and does not rely on the time-varying correlation matrix of the market assets. The only risky asset in the GPFG is the FTSE Global All Cap Index. If the market is significantly correlated with oil, the demand to hedge against oil risk will exceed the demand for leveraging. In such a case, the GPFG should hold less equities and more fixed assets to hedge the vulnerability of subsoil reserves to the risk in oil prices. As oil is extracted, Norway's exposure to oil prices decreases. Thus, Norway can increase the equity portion of the GPFG.

With regards to the spending rate, Van den Bremer et al. (2016) conclude that the consumption rate should be a constant share of the total petroleum wealth, including both the above-ground fund and the remaining oil reserves. "This stabilizes the mean and variance of spending as total wealth evolves steadily whilst oil reserves are replaced by financial assets, but relies on the degree to which the oil price can be hedged by components of the above-ground portfolio" (Van den Bremer et al., 2016). Other research papers have discussed alternative spending policies, such as Lindset and Mork (2019), but we will not pursue this discussion as it goes beyond the research question of this thesis.

3.2 Asset Pricing

In the introduction of this thesis we argue that analyzing the relationship between cash flows is a more precise way to compare the Norwegian government's remaining petroleum resources, and the equity holdings in the GPFG. To more clearly explain why cash flows are of particular interest, we will present the basic insights of asset pricing. The present-value of an asset is the sum of expected future cash flows of the asset, discounted to today's value with an appropriate discount rate. This is the basic insight of asset pricing, and a vital part of the theoretical framework in which we will discuss our research question.

Although asset pricing is often utilized to explain returns and prices of equities or other financial assets of which prices are observable. The same tools can be applied to value assets without observable prices. As stated in the Preface of Cochrane (2005): "We can apply the theory to establish what the prices of these claims (unobserved prices of assets or claims to uncertain cash flows) *should* be as well; the answers are important guides to public and private decisions". The remaining petroleum resources on the NCS, expected to yield a future cash flow to the Norwegian state, is an example of such an asset without observable prices.

Asset prices can be presented by:

$$P_t = E_t \sum_{j=1}^{\infty} \left(\frac{1}{1+r} \right)^{t+j} C_{t+j} \tag{3.1}$$

where P_t = the present value of an asset at time t, r = the discount rate, and C_{t+j} = the cash flow from the asset at time $t + j$.

According to equation 3.1, asset prices are a function of two components: discount rates, and expected future cash flows. Discount rate variation affects the prices of all companies, no matter which industry they belong to. Hence, discount rates do not capture industry (or company) specific events, such as sudden oil price changes. Consequently, discount rates will not give any insight into how the various industries move in conjunction to Norway's petroleum reserves. On the contrary, cash flows *are* company specific. This means that changes to the expected future cash flows of company A (or industry A) will not necessarily affect the expected cash flows of company B (or industry B). Hence, using cash flows to compare assets is a more sufficient method, capturing their unique co-movements. If the cash flows of two assets are expected to move in conjunction with one another, the value of these assets should be closely related. Hence, if the cash flows of the Energy companies part of the GPFG, and the government's petroleum cash flows are closely related, the value of these two assets should also be closely related.

4 Data

The empirical aim of this thesis is to investigate the relationship between the weighted operating cash flows of each ICB industry, and the Norwegian government's petroleum cash flows. This requires a data-set not readily available from any financial database we could access, forcing us to create a comprehensive data-set of our own, collected from various sources. In this chapter we present and explain the data used in our analysis, consisting of annual observations from 2003 to 2018. We were limited to this time period as the equity benchmark for the Government Pension Fund Global, the FTSE Global All Cap index, was launched in 2003. The data-sources we have used are Statistics Norway, FTSE Russell, Capital IQ, NBIM and Macrobond. In this chapter we will present and explain the government's petroleum cash flow (GPCF), the weighted operating cash flows the ICB industries, and how these were calculated.

4.1 The Government's Petroleum Cash Flow (GPCF)

Since oil was discovered on the Norwegian continental shelf in the late 1960s, the petroleum industry has become the most important sector for the Norwegian economy in terms of value added, government revenues, investments and export value. This industry is estimated to have generated a real (2019) value of 14,000 NOKbn to Norway's GDP since production commenced in the 1970s (Norwegian Petroleum, 2019). The government's total net cash flow from the petroleum industry consists of four parts: (1) Taxes, (2) Environmental Taxes and Area Fees, (3) Net Cash Flow from the State's Direct Financial Interest (SDFI) and (4) Equinor dividend, the Norwegian state owns 67% of the shares in Equinor (Equinor, 2019). Figure 4.1 displays the annual GPCF from 1971 to 2018, and Figure 4.2 shows how much each part has contributed to the GPCF the last ten years. The annual figures for the GPCF are publicly available from Statistics Norway.

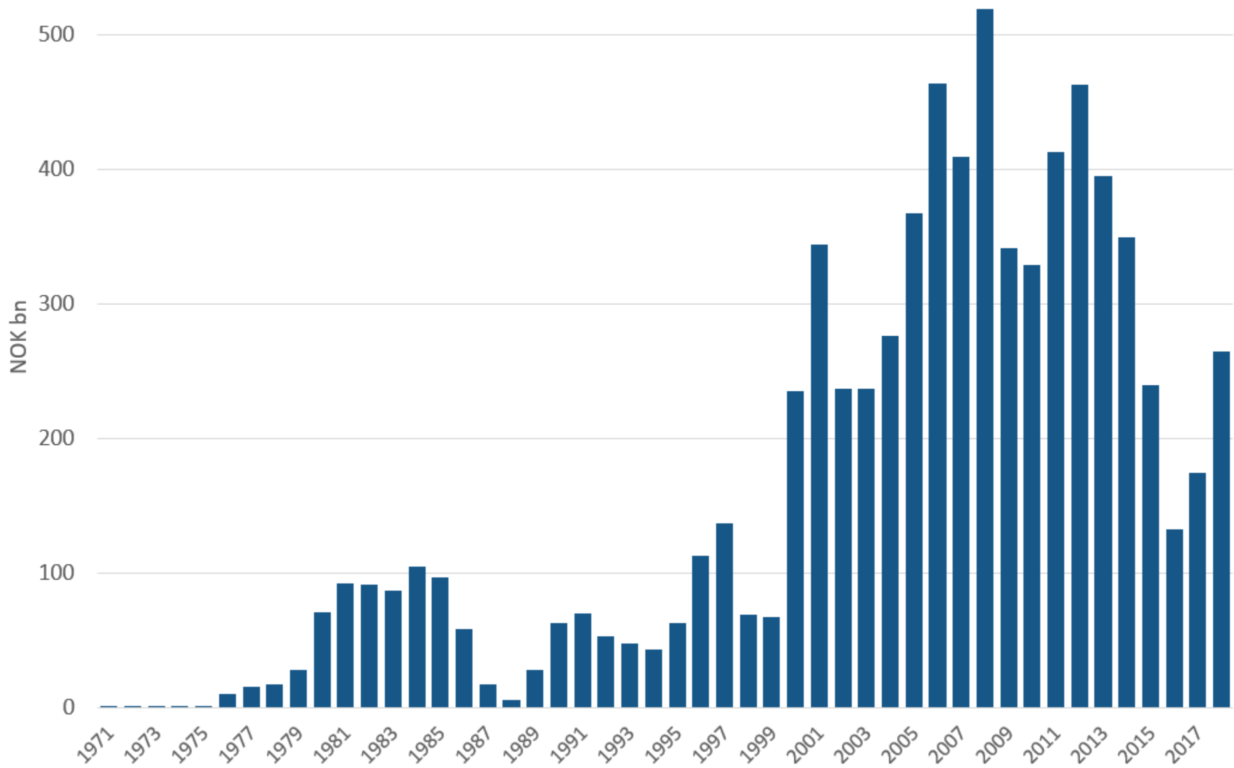

Figure 4.1: The annual cash flows to the Norwegian state from the petroleum industry (GPCF) from 1971-2018 (in 2019 kroner) Source: Norwegian Petroleum (2019)

As shown in the figure above, the government's petroleum cash flows vary substantially over time. Particularly visible in the sharp decline from 2014 to 2016, during which the price of one barrel of Brent crude oil fell from USD 114.25 to USD 27,88[1]. This illustrates the need to reduce Norwegian national wealth's vulnerability to the petroleum sector. Although the value of Norway's remaining petroleum reserves is not easily observable, as the value of the GPFG is, this does not mean that the value of these reserves does not fluctuate over time. There is also a significant difference between the average cash flows for the period before and after year 2000, as the production volumes on the Norwegian Continental Shelf increased significantly after the turn of the century. However, this will not have an impact on our analysis as we use the cash flows from 2003-2018.[2]

[1]Brent crude oil price was USD 114.25 on the 18th of June 2014, and had fallen to USD 27.88 by the 20th January 2016.

[2]Beginning in 2003 as the FTSE index used to retrieve cash flow data was launched in 2003.

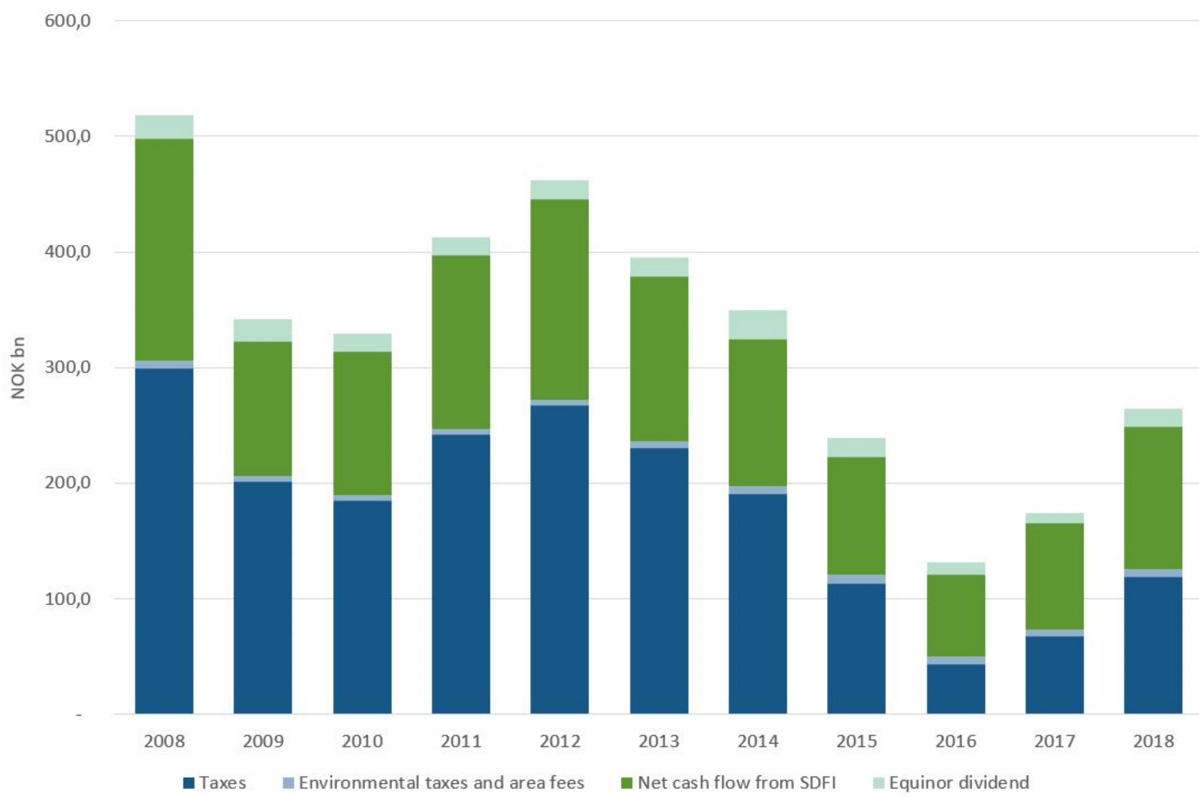

Figure 4.2: The government's petroleum cash flow the last 10 years (in 2019 kroner). The annual cash flows have been broken down to display the contribution from the four cash flow sources, Taxes, Environmental taxes and area fees, Net cash flows from the SDFI and Equinor dividend. Source: Norwegian Petroleum (2019)

4.1.1 Taxes

The taxes paid by oil companies operating on the Norwegian continental shelf (NCS) is the main contributor to the government's petroleum cash flow. On average, since 1976, contributions from taxes have amounted to 62.8% of the GPCF. The Norwegian petroleum tax system is based on the ordinary company tax rules and was defined in the Petroleum Taxation Act from 1975. The main difference from the ordinary tax scheme, is that in addition to the normal tax rate of 22%, petroleum production is charged a special tax rate of 56%, increasing the total tax rate to 78%. The tax scheme is constructed so that, in an approximate sense, the government receives the resource rent. The taxes on petroleum production are expected to be 156 NOKbn in 2019 (Norwegian Petroleum, 2019).

As the ordinary company tax system, the petroleum tax system is designed to be both profitable for investors and secure tax revenues for the Norwegian society. Only the net profit of a company is taxable, hence a profitable project will be profitable to the company both pre- and post taxation. In addition, a reimbursement system for exploration costs was introduced in 2005. The aim of the reimbursement system is to encourage exploration activity on the NCS by lowering the barriers of entry. Discovering (or attempting to discover) petroleum is a costly venture, and often investors will not receive return on such investments for more than 10 years. Companies that are not yet making a net profit can choose between requesting an immediate tax refund (78%) for the exploration costs incurred, or carry forward the tax benefits, reducing taxes when in a tax position (positive net profit).

4.1.2 Environmental taxes and area fees

The environmental taxes and area fees have been the smallest contributor to the GPCF since year 2000. The average contribution from 1976 has been 3%. The area fees have been very stable, at around 1.7 NOKbn for the last 10 years. The environmental taxes have increased over time, and are estimated to contribute 5.6 NOKbn to the GPCF in 2019. These environmental taxes consist of a carbon tax and a NOx tax, in addition to the emissions trading system. Companies holding licenses on the NCS must purchase emission allowances if their emissions are larger than the allocated amount for a given year. The carbon tax applies to all petroleum-product combustion on the NCS, and on CO_2 and natural gas emissions. Environmental taxes and area fees are estimated to contribute 7.2 NOKbn to the government's petroleum cash flow in 2019.

4.1.3 Net cash flow from SDFI

The Norwegian State's Direct Financial Interest (SDFI) is the Norwegian state's direct holdings in oil and gas fields, onshore facilities and pipelines. The oil and gas ownership varies from field to field, and is determined when licenses on the NCS are awarded through the APA rounds (awards in predefined areas). In January 2019, 33 companies were offered ownership interests in 83 different production licenses. Of those awarded, the SDFI received ownership in 14 licenses, bringing the total number of licenses in which the SDFI has ownership to 198. At year end 2018 the SDFI portfolio consisted of 38 fields, 4 of which are in the development phase, and 15 terminals and pipelines. This portfolio represents approximately one third of the state's total petroleum reserves, and yielded a cash flow of 120 NOKbn in 2018. This makes the SDFI the second largest contributor to the GPCF, averaging 41.4% of the GPCF since year 2000. The remaining reserves of the SDFI were estimated to 5,544 million barrels of oil equivalent (mboe) at the end of 2018.

Before the SDFI scheme was established, all of the Norwegian state's ownership interests on the NCS was through Equinor, previously Statoil, which was then 100% state-owned. The new scheme meant splitting the ownership interests in two parts, the SDFI and Equinor. Equinor was responsible for managing the SDFI until Equinor's IPO in 2001, when a new company called Petoro was established.[3] Petoro AS is a wholly state-owned company tasked with managing the SDFI. The company's objective is to generate the highest possible financial value of the SDFI portfolio.

4.1.4 Equinor dividend

As explained above, Equinor (Statoil) was wholly owned by the Norwegian state until the company was listed on the Oslo stock exchange in 2001. One third of the company was sold to other investors, and the state kept a 67% ownership of the shares. The state still owns this portion of Equinor, and hence is entitled to 67% of the dividends paid to investors. Since the listing of Equinor in 2001, dividends from the company have, on average, constituted 4.57% of the government's petroleum cash flow. Equinor dividend is expected to total 16.6 NOKbn in 2019, a 5.81% share of the total GPCF.

The government's petroleum cash flows used in our analysis are presented in Appendix A.

[3] Initial puclic offering (IPO).

4.2 Industry Weighted Operating Cash Flows

One of the main contributions of this thesis will be the data-set we have collected. Sector-wise weighted operating cash flow data is not readily available from any of the financial databases we have gained access to, so we have constructed these time-series ourselves, with data from several databases. Operating cash flow is basically a company's cash net income, but does not account for non-cash items such as depreciation, amortization and stock-based compensations. Equation 4.1 displays how operating cash flows are calculated. Operating cash flows are not direct cash flows to equity holders. They can be reinvested in the company through fixed asset investments, used to reduce debt, or be paid out directly to owners as dividends. However, they will benefit equity holders regardless. Reinvesting will increase future expected dividends to equity holders. As will repaying debt, as less of the future cash flows are paid to the debt holders as interest.

$$\text{Operating Cash Flow} = \text{Net Income} + \text{Non-Cash Expenses} - \text{Increase in Working Capital} \tag{4.1}$$

On the company level we have gathered the operating cash flow for each year. These cash flows are reported in each company's local currency, resulting in 41 individual currencies. In order to find the aggregated weighted cash flows for each sector all cash flows were converted to one currency, USD. Thus, we have gathered annual foreign exchange rates between 40 individual currencies and the US Dollar from 2003 to 2018. We have written a Python script which imports all the cash flow data points and converts them to USD. These are then added up for each industry and every year. Finally, the industry cash flows are multiplied with each industry's weight in the Government Pension Fund Global, resulting in time-series data for the industries' weighted cash flows from 2003 to 2018.

We want to analyze the similarity between owning petroleum reserves, and owning equity in various industries. More specifically, we compare the cash flows to the Norwegian state from these assets. The cash flows to the state from the GPFG depends on the weighting of the various industries part of the index.[4] A higher weight in one industry relative to another, implies that the cash flows from this

[4]Operating cash flows are not paid out directly to stock holders, but are reinvested in the company, paid out as dividends or used to repay debt.

sector will have a relatively larger impact on the cash flows to the state from the total portfolio. The cash flow of a company does not necessarily move in perfect relation to it's market capitalization. Hence, weighting the cash flows will capture these deviations. We weight the operating cash with the following formula:

$$\begin{aligned} &\text{Weighted } \mathrm{C}_{j,t} = \sum_{i=1}^{N} \mathrm{C}_{i,t} * \text{Weight}_{j,t}, \\ &\qquad j = Energy, BasicMaterials, ..., Technology, \\ &\qquad i = 1, 2, ..., N, \end{aligned} \tag{4.2}$$

where Weighted $\mathrm{C}_{j,t}$ = the weighted operating cash flow of industry j at time t, $\mathrm{C}_{i,t}$ = the operating cash flow of company i at time t, N = the number of companies within industry j, and $\text{Weight}_{j,t}$ = the weight of industry j at time t.

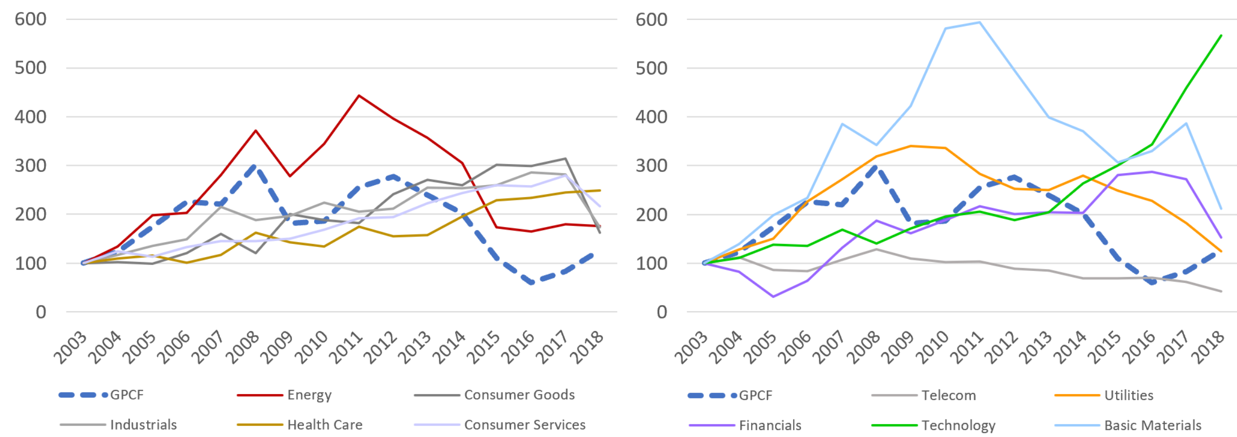

Figure 4.3: Indexed weighted operating cash flows and the government's petroleum cash flow (GPCF) over time, from 2003 to 2018. All time-series included are set to begin at 100 (indexed) in order to display the development of the variables in relation to each other.

Figure 4.3 displays the weighted operating cash flows of the ICB industries, all indexed to 100. This enables a visual comparison of the industries' cash flows and the GPCF. Energy (red) seems to move similarly to the GPCF, showed in the left graph.

Table 4.1 shows the weighted operating cash flows for each ICB industry in USDbn. This data, along with the government's petroleum cash flow, is what we will base our empirical analysis on. The Industry Classification Benchmark (ICB) system is a global standard developed by FTSE Russell and Dow Jones in 2005. This is the classification scheme used by NBIM in their reports, and is the scheme we use in our analysis. The ICB scheme categorizes companies into four different classification levels: (1) Industry, (2) Supersector, (3) Sector, (4) Subsectors. The highest level classification category, Industry, consists of 10 different industries: Energy, Basic Materials, Industrials, Consumer Goods, Health Care, Consumer Services, Telecommunications, Utilities, Financials and Technology. These ten industries are further divided into 19 supersectors, 41 sectors and finally 114 subsectors.

Table 4.1: The operating cash flows for each ICB industry (USDbn) from 2003 to 2018, weighted according to the industry weights of the GPFG.

Year	Energy 0001	Basic Mat. 1000	Indu-strials 2000	Cons. Goods 3000	Health Care 4000	Cons. Services 5000	Tele. 6000	Util. 7000	Fin. 8000	Tech. 9000
2003	20.5	6.3	31.6	31.3	13.8	21.9	19.7	4.6	123.4	13.3
2004	27.6	8.7	37.0	31.9	15.1	27.0	22.1	5.8	101.4	14.8
2005	40.7	12.5	42.9	30.8	16.0	24.7	17.1	6.9	38.4	18.4
2006	41.8	14.7	47.1	37.6	14.0	28.9	16.5	10.4	79.7	18.0
2007	57.6	24.2	68.0	49.9	16.2	31.7	21.1	12.4	163.4	22.4
2008	76.3	21.5	59.5	37.9	22.4	31.8	25.4	14.5	231.3	18.7
2009	57.1	26.6	62.3	62.6	19.8	32.7	21.5	15.6	199.8	22.8
2010	70.6	36.5	70.8	59.1	18.5	36.9	20.3	15.3	232.3	26.0
2011	90.9	37.3	65.0	57.1	24.2	41.9	20.5	12.9	268.1	27.4
2012	81.3	31.1	67.1	75.4	21.4	42.5	17.6	11.5	248.0	25.0
2013	73.3	25.1	80.5	84.7	21.8	48.7	16.7	11.4	252.8	27.2
2014	62.5	23.3	80.3	81.1	27.0	53.2	13.7	12.8	250.5	35.1
2015	35.6	19.3	82.3	94.4	31.6	56.7	13.7	11.4	347.0	40.0
2016	33.9	20.8	90.6	93.6	32.3	56.3	13.8	10.4	354.0	45.6
2017	36.9	24.3	89.2	98.1	33.9	61.0	12.1	8.3	336.0	61.0
2018	36.2	13.4	54.8	50.7	34.4	47.3	8.4	5.7	189.1	75.3

4.2.1 Company codes and Energy subsector weights - FTSE Russell

The benchmark index for the equity portfolio of the Government Pension Fund Global is based on the FTSE Global All Cap Index. We have retrieved historical data directly from FTSE Russel on the FTSE GEISAC index. This data contains company-specific codes, CUSIP for North American companies and SEDOL for all other companies, which we have used to retrieve operating cash flows. The FTSE-data also contains the market capitalization and index-weight for each company which has been part of the index from 2003 to 2018, along with information on which industry and subsector each company belongs to.[5] This is used to calculate the weighted operating cash flows of the subsectors within the Energy industry, as equity-holdings data from NBIM does not include this. The weighting follows the same reasoning as in section 4.2. The total data-set we have obtained from FTSE Russell consists of 121,581 observations on 17,117 individual companies.

Table 4.2: The number of companies, and the weights, of each Energy subsector in the GPFG and FTSE GEISAC, as of end-of-year 2018. Sources: NBIM (2019a) and FTSE Russell (2018)

	GPFG benchmark index			**FTSE Global All Cap**	
ICB Subsector	No.	NOKm	Weight %	No.	Weight %
0533 Exploration & Production	134	70,276	20.52	138	25.08
0537 Integrated Oil & Gas	61	223,066	65.13	62	57.88
0573 Oil Equipment & Services	73	20,227	5.91	78	6.98
0577 Pipelines	16	22,546	6.58	16	8.64
0583 Renewable Energy Equipment	23	6,287	1.84	23	1.39
0587 Alternative Fuels	3	87	0.03	3	0.03
Total	310	342,489	100	320	100

Table 4.2 shows which subsectors make up the Energy industry, and the size of each subsector. Integrated Oil & Gas is the largest by far, accounting for 65% and 58% of the Energy industry with GEISAC and reference index weights, respectively. This subsector contains the oil majors such as Royal Dutch Shell, ExxonMobil, BP and Chevron. These companies are involved in all parts of petroleum production, from exploration and drilling to refining and distribution. Exploration & Production (E&P) companies are engaged in exploration, drilling, production, refining and supply of oil and gas products (FTSE Russell, 2019). E&P and Integrated Oil & Gas combined constitute 86% and 83% of the Energy industry with GPFG and GEISAC weights, respectively. The Pipelines subsector was established in 2006 when ICB scheme was introduced. And the subsectors Renewable Energy Equipment and Alternative Fuels were created in 2009. Therefore, we do not have data for these subsectors until 2006 and 2009, respectively.

[5]The FTSE GEISAC industry weights are included in Appendix B.

4.2.2 Operating cash flows - Capital IQ (WRDS)

The FTSE consituent data does not contain fundamental financial data, so we have used NTNU's access to the Wharton Research Data Services (WRDS), which includes the S&P database Capital IQ, to retreive operating cash flows. The data we have obtained from FTSE Russell include two types of company codes, SEDOL and CUSIP, which are unique to each company. These codes can be uploaded to the Capital IQ database, and we were able to obtain the fundamental data required for our analysis. Ideally we would enter all the companies actually part of the GPFG to the database, but to do this we must have company-codes. The holding reports from NBIM only contain company names, and these cannot be uploaded to the WRDS online database. All North American (Canada and USA) companies were found with CUSIP codes, while the remaining companies were found with SEDOL codes. Of the 121,581 data points we have from FTSE, we are able to find the net cash flow from operations for 86,622 of them (71.2%).

There were 88 instances in which we had multiple observations for a company's operating cash flow within the same year. A number of Asian companies have reported annual figures for different time periods than the western January to December year. Some of these companies have published annual figures in March, February or June. As an example, the figure we use for operating cash flow for Keyence Corp in 2017 is reported in March 2018. For a few cases, the companies have switched from March to December as the end-of-period, resulting in two separate figures for the same calender year. In these cases we have used the figures reported in accordance with the following years, in order to match the reporting scheme for the following years. Typically these companies have switched from reporting in June to March.

4.2.3 Industry weights - Government Pension Fund Global equity holdings

Norges Bank Investment Management publish spreadsheets with the exact company holdings at the end of the year. These reports can be downloaded from the NBIM web-page, and contain which country and industry each company belongs to, along with the value of NBIM's holdings in both NOK and USD (NBIM, 2019a). With these reports we were able to calculate the weight of each company in the GPFG equity holdings, and add up the weights of all companies within the 10 ICB industries. These weights are then multiplied with the total operating cash flows of each industry.

Table 4.3: The weight of each ICB industry in the Government Pension Fund Global, from 2003 to 2018. Source: NBIM (2019a)

Time-period	Energy 0001	Basic Mat. 1000	Indu-strials 2000	Cons. Goods 3000	Health Care 4000	Cons. Serv. 5000	Tele. 6000	Util. 7000	Fin. 8000	Tech. 9000
2003	7.9 %	4.8 %	10.3 %	10.8 %	10.6 %	11.2 %	6.9 %	3.0 %	25.3 %	9.2 %
2004	8.3 %	4.6 %	10.8 %	9.8 %	9.9 %	11.6 %	7.0 %	3.4 %	26.7 %	7.9 %
2005	9.4 %	5.5 %	10.8 %	9.9 %	9.6 %	10.3 %	5.1 %	3.7 %	27.1 %	8.7 %
2006	8.0 %	5.6 %	11.1 %	10.7 %	8.0 %	9.6 %	4.7 %	4.8 %	29.3 %	8.1 %
2007	10.1 %	7.5 %	12.4 %	11.8 %	7.7 %	8.7 %	5.3 %	5.2 %	23.2 %	8.3 %
2008	11.0 %	6.3 %	11.4 %	12.1 %	10.3 %	8.6 %	6.1 %	6.0 %	21.1 %	7.1 %
2009	10.8 %	8.0 %	12.0 %	11.3 %	8.6 %	8.3 %	5.1 %	4.8 %	22.8 %	8.3 %
2010	10.8 %	9.1 %	13.7 %	11.6 %	7.7 %	8.5 %	4.5 %	4.7 %	21.5 %	7.9 %
2011	11.6 %	7.8 %	13.1 %	12.7 %	9.5 %	9.0 %	4.4 %	4.3 %	19.8 %	7.9 %
2012	9.9 %	7.5 %	13.1 %	13.6 %	8.7 %	9.3 %	3.9 %	3.8 %	23.0 %	7.3 %
2013	8.3 %	6.3 %	14.3 %	13.9 %	8.7 %	10.2 %	3.8 %	3.4 %	23.6 %	7.4 %
2014	6.9 %	5.7 %	13.6 %	13.8 %	9.6 %	10.4 %	3.3 %	3.7 %	24.5 %	8.4 %
2015	5.4 %	5.1 %	13.5 %	14.4 %	10.7 %	10.9 %	3.4 %	3.2 %	24.5 %	9.0 %
2016	6.4 %	5.6 %	14.0 %	13.6 %	10.1 %	10.2 %	3.2 %	3.1 %	24.3 %	9.4 %
2017	5.6 %	6.0 %	14.3 %	13.5 %	9.8 %	10.1 %	2.8 %	2.6 %	24.3 %	11.1 %
2018	5.9 %	5.0 %	12.9 %	11.9 %	11.4 %	10.8 %	3.0 %	2.8 %	23.7 %	12.6 %

Table 4.3 displays the acutal weights of each ICB industry in the GPFG, from 2003 to 2018. These are the weights used to calculated the weighted operating cash flows of the industries, used in our analysis.

4.2.4 Foreign exchange rates - FRED & Macrobond

In order to calculate the aggregated weighted operating cash flows for each ICB industry, all the cash flows were converted to the same currency. We chose USD, as most of our data is on American companies and exchange rates between USD and most other currencies are easily accessible. The Federal Reserve Economic Data (FRED) have large amounts of data publicly available, including a number of foreign exchange (FX) rates. Of the 42 FX rates we needed, we obtained 23 from the FRED databases, and the remaining 19 from the Macrobond database. The FRED publish daily, monthly and annual FX rates, where monthly and annual data is calculated as the daily average rate for each month or year. Macrobond's default annual rates were end-of-year data, so we extracted daily figures and averaged these to obtain the annual rates. We have used annual rates since we are converting annual cash flows. The annual cash flows do not necessarily occur at the end of a given year, hence averaging the daily FX rates for each year is chosen rather than using the end-of-year rates.

4.3 Data Quality

There are three main weaknesses with the quality of our data-set: (1) We find cash flow data based on the FTSE GEISAC constituents, not the GPFG constituents, due to the lack of company codes from the GPFG holding reports. Thus, all companies in the GPFG, not part of the FTSE GEISAC are left out of our analysis. (2) Not all companies part of the FTSE GEISAC index were found in the Capital IQ database (accessed via Wharton Research Data Services). Additionally, even if the companies were found, the observations of operating cash flow were not necessarily available for all companies found. To improve our data quality, we collected cash flows manually for a number of companies from their historical annual reports. To be efficient, this was done by sorting the companies by market capitalization, and making sure our data-set included all 300 largest companies for each year. (3) The time period for which we have operating cash flow data is very short, only 16 years, from 2003 to 2018. The short time period is the main issue with our data-set. We aim to identify *long-term* correlations between industry cash flows and the government's petroleum cash flows, in accordance with the long-term horizon of the GPFG. The correlations we find will not yield results from which we can draw firm conclusion, but they do give indications of the relationships between the various industries' cash flows and the GPCF.

Table 4.4 shows the number of companies (No.) we were able to retrieve data for, and the total weight of these, compared to the actual constituents of FTSE GEISAC. The table is divided into two parts: the data quality for all industries and the data quality for the energy industry alone. To explain the table below more clearly, consider the information for 2010. The No. column shows that we found cash flow data for 5,615 companies, while the FTSE GEISAC index actually included 7,301 companies, so we found data for 76% of all companies part of the GEISAC index. The weight column shows that the companies we found cash flow data for amount to 87.4% of the total GEISAC index, in terms of the market capitalization of the companies. For the Energy industry specifically we found cash flows for 322 of the 393 Energy companies in 2010. The market capitalization of these companies amounted to 93.3% of the total market capitalization of the Energy companies in the GEISAC index.[6] Variations to the data-quality (how many, and the weight of the companies we actually find data for) from year to year, may affect the weighted operating cash flows of the industry. However, we believe the quality of our data to be satisfactory to find indicative results of the relationships between industry weighted cash flows and the GPCF.

Table 4.4: This table shows the number of companies we were able to find cash flow data for, and the weight of these, in all industries and the Energy industry specifically. The number of companies, and weights, within the FTSE GEISAC are displayed for comparison.

	All industries				**Energy**			
	Dataset		**GEISAC**		**Dataset**		**GEISAC**	
Year	No.	Weight	No.	Weight	No.	Weight	No.	Weight
2003	4053	76.1 %	6959	100 %	130	6.0 %	206	6.6 %
2004	4806	79.1 %	7595	100 %	157	6.6 %	231	7.3 %
2005	5293	79.8 %	8080	100 %	199	7.7 %	286	8.5 %
2006	5436	80.5 %	8116	100 %	246	8.2 %	334	8.8 %
2007	5743	84.7 %	7920	100 %	268	9.8 %	343	10.4 %
2008	5735	87.7 %	7756	100 %	284	10.0 %	366	10.6 %
2009	5572	87.5 %	7304	100 %	316	9.8 %	391	10.4 %
2010	5615	87.4 %	7301	100 %	322	9.7 %	393	10.4 %
2011	5785	89.1 %	7408	100 %	340	10.5 %	414	11.0 %
2012	5469	86.6 %	7197	100 %	328	9.1 %	395	9.7 %
2013	5535	87.5 %	7241	100 %	327	8.5 %	384	8.9 %
2014	5838	87.8 %	7580	100 %	352	7.1 %	418	7.3 %
2015	6037	88.9 %	7747	100 %	335	5.7 %	381	5.8 %
2016	6088	89.8 %	7725	100 %	306	6.8 %	336	7.0 %
2017	6231	90.0 %	7788	100 %	303	5.8 %	319	6.0 %
2018	3386	68.5 %	7864	100 %	219	5.2 %	320	5.9 %
Average	5414	84.4 %	7599		277	7.9%	345	8.4%

[6] Weight of Energy in our dataset (9.7%) divided by the weight of Energy in the GEISAC index (10.4%).

5 Methodology

In this section we will present the empirical approaches we have used to answer our research question. We will focus our analysis to estimating correlations between the government's total net cash flow from the petroleum industry and the weighted operating cash flow of each industry. Additionally, we use the same approach for the subsectors of the Energy industry, to discuss the government's proposal to remove Exploration & Production companies.

5.1 Correlations

The first method we will use to answer our research question is to calculate the correlation between the government's petroleum cash flow and the operating cash flows from different sectors. Correlation is a simple, statistical measurement of which direction, and how strong, two variables move in relation to each other.

There exist different types of correlation methods, though the most widely used measure (within finance) is the correlation coefficient developed by Karl Pearson in 1895, based on earlier work of Sir Francis Galton (Rodgers and Nicewander, 1988). The Pearson product-moment correlation coefficient is what is commonly referred to as correlation, and is often denoted as r. The Pearson correlation coefficient is simply a measurement of the linear relationship between two variables. In this case we will be analyzing the linear relationship between the government's petroleum cash flow (GPCF) and the operating cash flows of the various industries categorized according to the ICB scheme. The correlation coefficient can have a value between -1 and 1, where -1 means that the variables have a perfect negative linear relationship, 0 that the variables are independent of each other, and 1 that the variables have a perfect linear relationship. The formula for calculating the correlation coefficient as developed by Karl Pearson:

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 \sum(Y_i - \bar{Y})^2]}} \tag{5.1}$$

where r is the correlation coefficient, X_i is a score of the first variable and $\bar{X}$ is the mean of variable X. Similarly, Y_i is a score of the second variable and $\bar{Y}$ is its mean. The numerator is the sum of cross-products between the two variables, and the denominator adjusts the variables to the same scale (Rodgers and Nicewander, 1988). Equivalently, the correlation coefficient can be interpreted (and calculated) as the standardized covariance between two variables:

$$r = \frac{\sigma_{XY}}{\sqrt{\sigma_X^2 \sigma_Y^2}} \tag{5.2}$$

Where σ_{XY} is the covariance between the two variables, and σ_X^2 & σ_Y^2 are their variances.

In chapter 6 we present the results of the correlation coefficients we have calculated, along with the t-values and hence significance levels of the correlations. The variables used, as explained, are the weighted operating cash flows for each company summarized for the ten industries according to the ICB classification scheme, and the government's petroleum cash flow. As an example, the correlation between the operating cash flow of the Energy industry and the GPCF is calculated as the following:

$$Corr(Energy, GPCF) = \frac{Cov(Energy, GPCF)}{\sqrt{Var(Energy)Var(GPCF)}} \tag{5.3}$$

We can test the statistical of correlation coefficients, with a two-sided t-test. The null hypothesis is that the correlation coefficient is equal to zero, and the alternative hypothesis is that the correlation coefficient is not equal to zero. So, if H_0 is rejected, the correlation coefficient is statistically different from zero.

$$H_0 : r = 0 \quad \text{and} \quad H_1 : r \neq 0$$

To perform this test we need a test statistic t and a critical value c. The formula we use for the test statistic:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \tag{5.4}$$

Where t is the test statistic, r is the correlation coefficient, n is the sample size and $n - 2$ is the sample's degrees of freedom. The critical value used in this test depends on the chosen significance level, and is found by using a t-distribution, which is a continuous probability distribution. The conventional levels of significance are 1%, 5% and 10%, with critical values ± 2.576, ± 1.960 and ± 1.645.[1] If the t-statistic is less than the critical value we fail to reject H_0, and there is no

[1]When the number of observations, and hence degrees of freedom, approach infinity.

statistically significant relationship between the variables X and Y. Contrary, if the absolute value of the t-statistic is greater than the critical value, we reject H_0 and there may be a statistically significant relationship between the variables.

5.1.1 Testing for stationarity

Financial time-series data often suffer from non-stationarity (unit root) issues, rendering correlations and t-statistics invalid. Stationarity implies: (1) that the *mean* of x_t is constant over time t, (2) the *variance* of x_t is constant over time t, and (3) the *covariance* between x_t and x_{t+h} is a function of the distance between them, h, *not* time, t. These three criteria must be satisfied in order to apply the law of large number (LLN) and central limit theorem (CLT) to sample averages, which are necessary to perform inference such as t-tests.

A common non-stationary process in financial data is a unit root process. Wooldridge (2015) defines a unit root process as: "A unit root process is a highly persistent time series process where the current value equals last period's value, plus a weakly dependent disturbance." This can be shown as:

$$x_t = \alpha_1 x_{t-1} + \epsilon_t, \qquad \alpha_1 = 1 \tag{5.5}$$

where x_t is the current value of variable x, x_{t-1} is the past value of variable x, and ϵ_t is a weakly dependent disturbance term. If equation 5.5 holds, the variable is non-stationary, and the normal central limit theorem does not apply, hence we cannot perform inference.

To test if a variable x_t, such as the GPCF, suffers from these issues, we use Dickey-Fuller tests. This test is a method to analyze whether variables are stationary, and to which order the variables are integrated. If the variables are integrated of order zero, I(0), the variables are stationary. Since, x_t may not be stationary, we cannot test the coefficient α_1 in equation 5.5 directly. Instead, we reparameterize the equation with the following,

$$\begin{aligned} x_t - x_{t-1} &= (\alpha_1 - 1)x_{t-1} + \epsilon_t \\ \Delta x_t &= \theta x_{t-1} + \epsilon_t, \qquad \text{where } \theta = (\alpha_1 - 1) \end{aligned} \tag{5.6}$$

We are now able to test the following hypotheses:

$$H_0 : \theta = 0 \quad \text{and} \quad H_1 : \theta < 0$$

To perform this test we need a test statistic and a critical value c. Under the null hypothesis, the variable (x_t) is a unit root, hence we cannot use the normal t-distribution. Instead, we must use the asymptotic distribution, known as the Dickey-Fuller Distribution.

The relevant test statistic is given by:

$$\tau = \frac{\hat{\theta} - 1}{se(\hat{\theta})} \tag{5.7}$$

The critical values c from the Dickey-Fuller distribution are -3.43, -2.86 and -2.57 for the significance levels 1%, 5% an 10% respectively[2]. If τ is greater than c, we fail to reject the null hypothesis, and conclude that the data does not present strong evidence against H_0 (fail to reject that x_t follows a unit root process). Contrary, if τ is less than c, the null hypothesis is rejected, and we conclude that variable x_t is stationary. Hypothesis tests can be carried out directly, by comparing the p-value to a significance level, typically 1%, 5% or 10%. According to Wooldridge (2015): "The p-value is the smallest significance level at which the null hypothesis can be rejected. Equivalently, the largest significance level at which the null hypothesis cannot be rejected". Hence, a p-value of 0.009 means that the null hypothesis can be rejected at all significance levels *higher* than 0.009.

If we fail to reject H_0, we cannot reject that the variable x_t is integrated of order one, but it may also by integrated of a higher order. To test if x_t is integrated of order two, I(2), we check if the first difference of x_t, Δx_t, is I(1). However, since the Δx_t is I(1) under H_0 we must again reparameterize the equation by subtracting Δx_{t-1} from both sides:

$$\begin{aligned} \Delta x_t - \Delta x_{t-1} &= (\gamma_1 - 1)\Delta x_{t-1} + \epsilon_t \\ \Delta^2 x_t &= \theta \Delta x_{t-1} + \epsilon_t \end{aligned} \tag{5.8}$$

To test which order the variables are integrated of, we need to continue to test the differenced variables $(\Delta^2 x_t, \Delta^3 x_t, ...)$ until the null hypothesis is rejected.

[2]These are the critical values when number of observations is close to infinity.

We suspect that our data suffers from the presence of unit roots. However, if we find our variables to be integrated of order one, taking first differences will remove the issue of non-stationarity. To take the first difference of a time-series variable such as x_t, we simply subtract the previous observation (x_{t-1}) from the current. Mathematically, $\Delta x_t = x_t - x_{t-1}$. Doing this will make the LLN and CLT applicable, and enable us to perform inference on our data. In other words, if the industries' weighted cash flows, and the GPCF, are found to be I(1), we can correct for this issue by taking first differences, and then perform inference (calculate correlations and perform t-tests).

5.1.2 Rolling correlations

To analyze how the relationship between variables has developed over time, one can calculate the correlation coefficients on a rolling basis. Although simple, rolling correlations enable us to identify significant changes in the correlation coefficients which are not captured with the correlation measure for the entire sample period (2003-2018). Rolling correlations are simply the correlation coefficients calculated over a sub-period within the full set of observations, moving the sub-period one unit forward at a time. We will calculated the correlation between each industries' weighted operating cash flows and the GPCF, over sub-periods of seven years. The first time period is from 2003 to 2009 over which we calculate correlations, the next is from 2010 to 2009, again calculating the correlation coefficient, and so on. We continue in this manner until we reach the final sub-period of our data-set. In the case of the seven-year periods this is the sub-period 2012 to 2018.

Shorter sub-periods (for instance five-year periods) allows a more granular analysis of the correlation coefficient's dynamics over time, but does so at the cost of less accuracy and more noisy estimates. When using shorter sub-periods, large outliers will have a significant impact on the calculated correlation coefficients. Thus, we expect that the correlation coefficients between the same industry and the GPCF will vary significantly from time-period to time-period. Longer sub-periods will yield more precise estimates of the relationship between variables but give less insight to which sub-periods the variables are more or less correlated.

6 Results

In this chapter we present and discuss the results of our analysis. We will show the correlations between the weighted operating cash flows of each industry, and the government's petroleum cash flow. In addition, we take a closer look at the subsectors of the Energy industry. Lastly, we present the results of our rolling correlation analysis for seven-year time-periods.

6.1 Correlation Analysis

The basic idea of our analysis is that if the cash flows of the Energy industry are highly linked to the GPCF, and substantially more so than the other industries, the value of Energy stocks and the Norwegian petroleum reserves will also be closely related[1]. If so, removing the Energy industry from the GPFG will reduce the concentration risk of the Norwegian state towards the petroleum industry. As stated in section 5.1, we suspect our data to be non-stationary. In Table 6.1 and Table 6.2, the results of Dickey-Fuller tests on all variables are presented.

Table 6.1: P-values from the Dickey-Fuller test on the GPCF and each weighted operating cash flows in the ICB industries.

Industry	**I(1)**	**I(2)**
GPCF	0.427	0.021**
Energy	0.443	0.030**
Basic Materials	0.393	0.141
Industrials	0.264	0.173
Consumer Goods	0.483	0.015**
Health Care	0.914	0.001**
Consumer Services	0.576	0.017**
Telecommunications	0.916	0.008**
Utilities	0.596	0.672
Financials	0.579	0.302
Technology	1.000	0.574
All ex Energy	0.5534	0.5436
GEISAC	0.5000	0.5095

[1] ***p<0.01, **p<0.05, *p<0.10

[1]The industries are classified according to the ICB scheme explained in Chapter 4.

Table 6.1 presents the p-values for the Dickey-Fuller tests for each ICB industry. We use a significance level of 5%, hence, if the p-value is less than 0.05, we reject the null hypothesis that the variable in question is integrated of order one (I(1)), or two (I(2)), according to Table 6.1. As displayed in the second column of Table 6.1, all our variables failed to reject the null hypothesis that the data is stationary. Hence, all the variables above, are at least integrated of order one. Five variables are found to be integrated of order one (reject I(2)), including GPCF, Energy, Basic Materials, Industrials, Consumer Goods and Health Care. Although we fail to reject that some of the variables are integrated of a higher order, we suspect this is due to our short time-series data. Also, as stated by (Enders, 2015, p.222): ”As a rule of thumb, economic series do not need to be differenced more than two times”. However, as our data-set is very limited in length, we cannot afford to remove more observations. Thus, we will neglect that some variables may be integrated of a higher order, and assume that taking first-differences will solve the non-stationarity issues.

Table 6.2: P-values from the Dickey-Fuller test on the weighted operating cash flows in each subsector in the Energy industry

Subsector	**I(1)**	**I(2)**
Exploration & Production	0.445	0.045**
Integrated Oil & Gas	0.410	0.011**
Oil Equipment & Services	0.590	0.050*
Pipelines	0.835	0.000***
Renewable Energy Equipment	0.362	0.291
Alternative Fuels	0.084*	0.000***
Energy ex E&P	0.415	0.0132**

***p<0.01, **p<0.05, *p<0.10

Table 6.2 presents the p-values for Dickey-Fuller tests Energy subsector. Again, we fail to reject that each subsector is stationary (I(0)). As displayed in the I(2) column, we only fail to reject that the Renewable Energy Equipment subsector is not integrated of order two. However, as for the ICB industries, we will neglect this fact and assume that taking first-differences will correct for non-stationarity. The correlations between the GPCF and each industry’s (and each Energy subsector’s) weighted operating cash flows *whithout* taking first-differences, are presented in Appendix C.

6.1.1 Industry correlations

In the following, we present the correlations, and their t-statistics, between each industry's weighted operating cash flows, and the government's petroleum cash flows, *after* taking first-differences of each variable.

Table 6.3: Correlations between the weighted operating cash flows of each industry and the GPCF. The industry cash flows are weighted with GPFG industry weights. The correlations are calculated after taking first differences of the data, in order to avoid non-stationarity issues.

Industry	**ICB code**	**Correlations**	**t-value**
ΔEnergy	0001	0.79***	4.66
ΔBasic Materials	1000	-0.08	-0.27
ΔIndustrials	2000	-0.34	-1.32
ΔConsumer Goods	3000	-0.50*	-2.10
ΔHealth Care	4000	0.19	0.70
ΔConsumer Services	5000	-0.19	-0.68
ΔTelecommunications	6000	0.20	0.75
ΔUtilities	7000	0.05	0.17
ΔFinancials	8000	-0.14	-0.49
ΔTechnology	9000	-0.19	-0.68
ΔFTSE GEISAC		-0.12	-0.44
ΔAll ex energy		-0.25	-0.93

***p<0.01, **p<0.05, *p<0.10

Table 6.3 shows that the weighted operating cash flows of the Energy industry is highly correlated with the Norwegian government's net cash flow from the petroleum industry (GPCF). The correlation coefficient between the two variables is 0.79. With a t-value of 4.66, the relation is statistically significant at the 1% significance level.[2] Furthermore, Energy is the only industry with a correlation coefficient statistically different form zero at both the 1%, and 5% significance level. The Health Care, Telecommunications and Utilities industries do have positive correlation coefficients with the GPFC, though at a significantly lower level. Additionally, none of the three correlations are statistically different from zero, even at the 10% level.

The weighted operating cash flows of the Basic Materials, Industrials, Consumer Goods, Consumer

[2]With 13 degrees of freedom the critical values of two-sided t-test is ±3.012 at the 1% level, ±2.160 at the 5% level and ±1.771 at the 10% level.

Services, Financials and Technology industries are all found to be negatively correlated with the GPCF. Only Consumer Goods has a correlation coefficient statistically different from zero at the 10% significance level, the correlation coefficient being -0.50 with a t-value of -2.10. The operating cash flow of the FTSE Global All Cap Index (GEISAC) as a whole is slightly negatively correlated with the GPCF, though with a t-value of -0.44 the correlation is not statistically significant. When excluding the Energy industry, the correlation coefficient of the GEISAC drops to a negative value of -0.25, though the correlation is not statistically different from zero.

Although the results presented seem convincing, the high correlation between the Energy industry and the GPCF is based on imperfect data, and measured over a short period of time. However, we believe our results are strongly indicative of a close relation between the Energy industry and the GPCF. Especially, when considering that this correlation is significantly higher than for any other industry, and that only Energy's correlation with the GPCF is significant at both the 1%, and 5% levels.

6.1.2 Energy subsector correlations

In this section we present results of the correlation analysis between the weighted operating cash flows of the Energy industry's subsectors, and the government's petroleum cash flows, *after* taking first-differences of each variable. The aim of this analysis is to discuss the precision of the Norwegian government's proposal to remove only the Exploration & Production (E&P) subsector from the GPFG.

The weighted subsector cash flows used in this section have been calculated in two steps: (1) Add up the unweighted operating cash flows for each company part of the subsectors of the Energy industry. (2) Multiply each subsectors's total unweighted cash flow, with the subsector's weight in the FTSE GEISAC index. Preferably, we would use GPFG weights, but the data retreived from NBIM does not contain subsector information. The correlation between these weighted cash flows and the GPCF are presented in table 6.4.

Table 6.4: Correlations between the weighted operating cash flows of the Energy subsectors and the government's petroleum cash flow, and their t-values. The subsector operating cash flows are weighted according to FTSE GEISAC index weights, and the correlations are calculated with first differenced data.

Subsector	**ICB code**	**Correlation**	**t-value**
ΔExploration & Production	0533	0.52**	2.18
ΔIntegrated Oil & Gas	0537	0.88***	6.67
ΔOil Equipment & Services	0573	0.10	0.37
ΔPipelines	0577	0.21	0.69
ΔRenewable Energy Equipment	0583	-0.59*	-1.95
ΔAlternative Fuels	0587	-0.09	-0.23
ΔEnergy ex E&P		0.88***	6.60

***p<0.01, **p<0.05, *p<0.10

Table 6.4 shows that the weighted operating cash flows for four out of the six Energy subsectors are positively correlated with the government's petroleum cash flows. Unsurprisingly, the two subsectors, Integrated Oil & Gas and E&P, are most closely correlated with the GPCF. Companies part of these subsectors are directly involved in petroleum production, from which the entire GPCF originates. However, it is surprising to find that the subsector the Norwegian government has proposed to remove, E&P, is much less correlated with the GPCF than Integrated Oil & Gas. The correlation coefficient from the E&P subsector is 0.52, while the correlation between Integrated Oil & Gas and the GPCF is 0.88. Furthermore, the correlation of E&P is barely statistically significant at the 5% level, while Integrated Oil & Gas is statistically significant at all conventional levels[3].

Renewable Energy Equipment is negatively correlated with the GPCF, with a correlation coefficient of -0.59, though the relationship is significant only at the 10% level[4]. The correlation between the operating cash flows of Alternative Fuels and the GPCF is slightly negative, though the coefficient is not statistically different from zero. It should be noted that the data quality is especially poor for the Pipelines, Renewable Energy Equipment and Alternative Fuels subsectors, as these subsectors consists of few companies, and make up a small part of the Energy industry in terms of market capitalization. Also, Pipleines as a subsector was launched in 2006, while Renewable Energy and Alternative Fuels were not launched before 2009. Thus, the time-series used to calculate the

[3]Df=13, critical values; 1% level=±3.012, 5% level=±2.160 and 10% level=±1.771.

[4]For Renewable Energy and Alternative Fuels; n=9, df=7, the critical value of a two-sided t-test is ±3.499 at the 1% level, ±2.365 at the 5% level and ±1.895 at the 10% level.

correlations for these subsectors is very short, and the correlations calculated are less reliable. Due to this, one should not put too mcuh emphasis on the results for these subsectors.

We have also included the weighted operating cash flows of all subsectors within the Energy industry, except for E&P. It is interesting to note that the correlation coefficient of Energy ex E&P with the GPCF is 0.88, the same as for Integrated Oil & Gas. The correlation is statistically significant at the 1% level with a t-value of 6.60. This is not surprising, as Integrated Oil & Gas has, on average, from 2003 to 2018, made up 61% of the market capitalization of the Energy industry (according to FTSE GEISAC weights).

6.1.3 Rolling correlations

In Table 6.5 we present the correlation coefficients between the weighted operating cash flows of each industry, and the GPCF, both in first-differences, calculated over of seven-year rolling time-periods. The correlation coefficients calculated for the full time-period in the previous section, clearly show that the Energy industry's operating cash flow is closely related to the GPCF, and much more so than any of the other industries. In this section we will present whether this remains the case when calculating the correlation coefficients, over sub-periods of our data-set.

Table 6.5: Correlations between the weighted operating cash flows of each industry and the GPCF, calculated of 7-year rolling periods. The cash flows are weighted according to the GPFG equity holdings, and the correalations are calculated with differenced data.

Time-period	Energy 0001	Basic Mat. 1000	Indu-strials 2000	Cons. Goods 3000	Health Care 4000	Cons. Serv. 5000	Tele. 6000	Util. 7000	Fin. 8000	Tech. 9000	FTSE GEISAC
$\Delta 04/\Delta 10$	0.79	-0.48	-0.28	-0.86	0.60	-0.06	0.37	0.37	0.28	-0.65	0.18
$\Delta 05/\Delta 11$	0.82	-0.53	-0.38	-0.87	0.65	0.06	0.36	-0.04	0.33	-0.63	0.21
$\Delta 06/\Delta 12$	0.71	-0.44	-0.41	-0.77	0.60	0.27	0.52	-0.05	0.58	-0.66	0.35
$\Delta 07/\Delta 13$	0.79	-0.25	-0.48	-0.79	0.73	-0.01	0.57	-0.23	0.60	-0.66	0.38
$\Delta 08/\Delta 14$	0.86	-0.23	-0.57	-0.69	0.57	-0.07	0.77	-0.29	0.80	-0.65	0.68
$\Delta 09/\Delta 15$	0.85	-0.02	-0.29	-0.58	0.18	0.27	0.39	-0.61	0.01	-0.54	0.12
$\Delta 10/\Delta 16$	0.81	0.25	-0.45	-0.21	-0.11	0.11	-0.11	-0.41	-0.36	-0.62	-0.17
$\Delta 11/\Delta 17$	0.85	0.32	-0.58	-0.16	-0.07	0.15	-0.14	-0.52	-0.46	-0.11	-0.29
$\Delta 12/\Delta 18$	0.72	-0.27	-0.61	-0.48	-0.60	-0.54	-0.77	-0.51	-0.86	0.37	-0.76
Min	0.71	-0.53	-0.61	-0.87	-0.60	-0.54	-0.77	-0.61	-0.86	-0.66	-0.76
Max	0.86	0.32	-0.28	-0.16	0.73	0.27	0.77	0.37	0.80	0.37	0.68

As predicted, Table 6.5 shows that the correlation coefficients vary significantly across different time-periods. For example, the correlation between ICB industry 6000 (Telecommunications) and the GPCF varies from 0.77 in the periods Δ2008-Δ2014 to -0.77 in the period Δ2012-Δ2018. The Financials industry varies even more from 0.80 in Δ2008-Δ2014 to -0.86 in Δ2012-Δ2018. There are large variations between the time-periods for all industries, but the correlation between the Energy industry (0001) and the GPCF varies significantly less than for the other industries. The correlation coefficient for the Energy industry stays equal to, or above 0.71, for all 9 time-periods. The variation across time periods may be due to the data quality, with 2003 and 2018 being the two years with the least percentage of the total FTSE market capitalization being covered. We have cash flow data for 76% and 68% of the GEISAC index for these two years. Specifically for the Energy industry, we have data for 5.95% and 5.18% of the GEISAC in 2003 and 2018, while in reality the Energy industry amounted to 6.65% and 5.85% of the total index in these two years. Also, periods of distress such as the financial crisis in the late 2000's may distort the relationship between the cash flows of various sectors, and the government's petroleum cash flow, causing large variations across time periods.

The fact that the Energy industry remains highly correlated across all the time-periods, strengthens the idea that the operating cash flows of the Energy industry is closely related to the GPCF. And, that removing this sector (or parts of it) will decrease the concentration risk of Norway's national wealth. Figure 8.1 in Appendix C gives a visual representation of how the correlation coefficients for the Energy industry varies across the seven-year time-periods, compared to the FTSE Global All Cap index (GEISAC) as a whole.

7 Robustness

In this chapter we will examine the robustness of the results presented in chapter 6. First, we present the correlations between the industries' operating cash flows and the government's petroleum cash, if the cash flows are weighted with different methods, and if the cash flows are not weighted at all. Secondly, we do the same robustness checks for the Energy subsectors, calculating correlations with the GPCF with a different weighting methodology, and with unweighted cash flows. Finally, we will present a time series regression model with the GPCF as the explained variable, and each industry's cash flows as explanatory variables, and a distributed lag model to test if Energy has a lagged relation with the GPCF.

7.1 Industry Correlations

In this section we will present additional correlation results between the GPCF and industry operating cash flows. We first present the results with two different approaches to weighting the operating cash flows, with FTSE GEISAC weights. Furthermore, we present results without weighting the cash flows.

7.1.1 Weighting-method 1 with GEISAC weights

Weighting-method 1 refers to the same methodology to weight the cash flows as presented in chapter 4. With this methodology we first add up each companies' operating cash flows within the same industry. The unweighted cash flows for each industry is then multiplied by that industry's weight in the FTSE Global All Cap index. The only difference from the results presented in section 6.1, is that the cash flows are weighted with GEISAC weights instead of GPFG weights. As explained, the GPFG weights deviate from the GEISAC index due to over-weighting Europe and under-weighting North America, in addition to including additional markets and actively managing a small portion of the portfolio.

Table 7.1: Correlations between each industry's weighted operating cash flows and the GPCF. The industry cash flows have been weighted using method 1, and the correlations have been calculated with first-differenced data.

Industry	ICB code	Correlations	t-value
ΔEnergy	0001	0.80***	4.81
ΔBasic Materials	1000	-0.11	-0.40
ΔIndustrials	2000	-0.30	-1.12
ΔConsumer Goods	3000	-0.52**	-2.20
ΔHealth Care	4000	0.13	0.48
ΔConsumer Services	5000	-0.04	-0.14
ΔTelecommunications	6000	0.35	1.33
ΔUtilities	7000	0.02	0.05
ΔFinancials	8000	-0.15	-0.54
ΔTechnology	9000	-0.21	-0.76
ΔFTSE GEISAC		-0.12	-0.43
ΔAll ex energy		-0.25	-0.93

***p<0.01, **p<0.05, *p<0.10

Table 7.1 shows that the correlations when weighting the operating cash flows of each industry with GEISAC weights are very similar to the correlations presented in Table 6.3. This is no surprise, as the industry weights in the GPFG are fairly similar to the industry weights in the FTSE GEISAC index.[1] Again the Energy industry is the most correlated industry with the GPCF, with a coefficient of 0.80, significant at all conventional significance levels. The Basic Materials industry is the only other industry with a correlation coefficient statistically different from zero, now also at the 5% significance level (in Table 6.3 BM is only significant at the 10% level). None of the other industries' weighted cash flows have statistically significant correlations with the GPCF.

7.1.2 Weighting-method 2 with GEISAC weights

With weighting-method 2 we have first multiplied each company's operating cash flow with it's weight in the FTSE GEISAC index. The weighted company-level cash flows are then added up for each industry. Thus, instead of weighting the total industry cash flows, we first weight company-level cash flows and then add these up for each industry. Since we were not able to retrieve cash flows for all 121,581 observations, the weights of the companies we have cash flow data for, does

[1]The GPFG industry weights were presented in Table 4.3 in chapter 4, and the FTSE GEISAC weights are included in table 8.2 in Appendix B.

not add up to 100%. To correct for this, we scaled up these weighted cash flows to match the actual weight of each industry in the FTSE GEISAC index.

The method we used to scale the cash flows is easiest to explain mathematically:

$$\text{Scaled CF}_{i,t} = \frac{\text{CF}_{i,t}}{\text{Data weight}_{i,t}/\text{FTSE weight}_{i,t}} \tag{7.1}$$

where Scaled $\text{CF}_{i,t}$ = the weighted cash flow of industry i at time t *after* scaling, $\text{CF}_{i,t}$ = the weighted cash flow of industry i at time t *before* scaling, Data $\text{weight}_{i,t}$ = the weight of all companies within industry i at time t for which we were able to retrieve cash flow data, and FTSE $\text{weight}_{i,t}$ = the actual weight of industry i in the FTSE Global All Cap index at time t.

Table 7.2: Correlations between each industry's weighted operating cash flows and the GPCF. The industry cash flows have been weighted using method 2, and the correlations have been calculated with first-differenced data.

Industry	ICB code	Correlations	t-value
ΔEnergy	0001	0.88***	6.82
ΔBasic Materials	1000	0.10	0.38
ΔIndustrials	2000	0.29	1.11
ΔConsumer Goods	3000	-0.20	-0.75
ΔHealth Care	4000	0.44	1.77
ΔConsumer Services	5000	0.36	1.38
ΔTelecommunications	6000	0.38	1.50
ΔUtilities	7000	0.25	0.91
ΔFinancials	8000	-0.33	-1.28
ΔTechnology	9000	-0.06	-0.23
ΔFTSE GEISAC		0.26	0.96
ΔAll ex energy		-0.17	-0.63

***p<0.01, **p<0.05, *p<0.10

Table 7.2 shows that the Energy industry remains the industry most closely related to the government's petroleum cash flows, when calculating the weighted operating cash flows of each industry with method 2. The correlation coefficient between Energy and the GPCF is 0.88 and with a t-statistic of 6.82, the relation is statistically significant at the 1% significance level[2].

[2] With 13 degrees of freedom the critical values of two-sided t-test is ± 3.012 at the 1% level, ± 2.160 at the 5% level and ± 1.771 at the 10% level.

7.1.3 Correlations with unweighted operating cash flows

In order to further strengthen the results of our analysis, we will present the correlations between each industry's operating cash flows and the GPCF, without weighting the cash flows. In other words, we simply sum up the operating cash flow of each company within the ICB industries. All correlations presented are calculated using first-differenced data.

Table 7.3: Correlations between the government's petroleum cash flows and the unweighted operating cash flows of each ICB industry, using differenced data

Industry	ICB code	Correlation	t-value
ΔEnergy	0001	0.80***	4.86
ΔBasic Materials	1000	0.20	0.72
ΔIndustrials	2000	-0.27	-1.00
ΔConsumer Goods	3000	-0.61**	-2.80
ΔHealth Care	4000	-0.27	-1.01
ΔConsumer Services	5000	-0.14	-0.52
ΔTelecommunications	6000	-0.02	-0.07
ΔUtilities	7000	-0.46*	-1.87
ΔFinancials	8000	-0.01	-0.03
ΔTechnology	9000	-0.13	-0.46
ΔGEISAC		-0.04	-0.15
ΔAll ex energy		-0.21	-0.79

***p<0.01, **p<0.05, *p<0.10

Table 7.3, Energy remains the industry most closely related to the government's petroleum cash flows. The correlation coefficient between the operating cash flows (unweighted) of the Energy industry and the GPCF is 0.80. With a t-statistic of 4.86 the relation is statistically significant at the 1% significance level[3]. The Consumer Goods and Utilities industires are both negatively correlated with the GPCF, with coefficients of -0.61 and -0.46, respectively. The correlation between Consumer Goods and the GPCF is significant at the 5%, while Utilities is only significant at the 10% level.

[3]Df=13, critical values of two-sided t-tests; 1% level=±3.012, 5% level=±2.160 and 10% level=±1.771.

7.2 Energy Subsector Correlations

As a robustness analysis we include the results of the subsector correlations when the subsector weighted cash flows are calculated with a different methodology, and without weighting the cash flows at all.

7.2.1 FTSE GEISAC weights, weighting-method 2

In this section we will present the results when the operating cash flows for each company are first multiplied by the company's weight in the FTSE GEISAC. These weighted company-level cash flows are then added up according to which Energy subsector each company is part of, the same methodology as explained in section 7.1.2. The table below shows the correlation coefficients, and their t-values, for each Energy subsector when the cash flows are weighted with this methodology.

Table 7.4: Correlations between the weighted operating cash flows of the Energy sub-sectors and the GPCF. The weighted cash flows have been calculated by weighting each cash flow at the company level with GEISAC weights, and then adding up the weighted cash flows for each subsector. The correlations have been calculated using differenced data.

Subsector	**ICB code**	**Correlation**	**t-value**
ΔExploration & Production	0533	0.74***	3.94
ΔIntegrated Oil & Gas	0537	0.89***	7.11
ΔOil Equipment & Services	0573	0.23	0.84
ΔPipelines	0577	0.37	1.27
ΔRenewable Energy Equipment	0583	-0.74**	-2.88
ΔAlternative Fuels	0587	0.19	0.51
ΔEnergy ex E&P		0.89***	7.16

***$p<0.01$, **$p<0.05$, *$p<0.10$

For the most part, the same conclusions as from section 6.1.2 are true for the Energy subsectors, when weighting the cash flows with the methodology presented above. Integrated Oil & Gas remains the most correlated subsector, with E&P as the second most correlated subsector. The correlations of both subsectors with the GPCF are now statistically significant at the 1% significance level. [4] Renewable Energy Equipment remains negatively correlated with the GPCF with a corre-

[4] Pipelines: n=12, df=10, critical values; 1% level=±3.169, 5% level=±2.228 and 10% level=±1.812.

lation coefficient of -0.74, and the relationship is significant at the 5% level.[5] As explained previously the time-period and number of companies within Pipelines, Renewable Energy Equipment and Alternative Fuels is considered too small/short to draw any firm conclusions. The correlation between the Energy industry excluding E&P and the GPCF remains high with, and statistically significant at the 1% level.

7.2.2 Energy subsector correlations with unweighted cash flows

As a final analysis of the robustness of the correlations presented in chapter 6, we also include the correlations between the unweighted cash flows of the Energy subsectors, and the GPCF.

Table 7.5: Correlations between the unweighted operating cash flows of the Energy sub-sectors and the GPCF, using first-differenced data.

Subsector	ICB code	Correlation	t-value
ΔExploration & Production	0533	0.69***	3.48
ΔIntegrated Oil & Gas	0537	0.83***	5.30
ΔOil Equipment & Services	0573	0.48*	1.99
ΔPipelines	0577	0.01	0.02
ΔRenewable Energy Equipment	0583	-0.29	-0.81
ΔAlternative Fuels	0587	0.04	0.10
ΔEnergy ex E&P		0.83***	5.36

***p<0.01, **p<0.05, *p<0.10

Integrated Oil & Gas has the highest correlation with the GPCF (0.83), followed by E&P (0.69), both coefficients being significant at the 1% level. None of other subsectors' unweighted cash flows have significant correlations, positive or negative, with the GPCF. The Energy industry excluding E&P remains closely correlated (0.83) to the GPCF, significant at the 1% level.

[5]Renewable and Alternative Fuels: n=9, df=7, critical values; 1% level=±3.499, 5% level=±2.365 and 10% level=±1.895.

7.3 Time Series Regression

To further investigate the results in chapter 6, we estimate a time-series regression with the GPCF as the dependent variable, and the GPFG-weighted operating cash flows of each ICB-industry, as explanatory variables. All variables have been first-differenced to correct for non-stationarity. The model we estimate:

$$\begin{aligned}\Delta GPCF_t = {} & \alpha_0 + \alpha_1 \Delta Energy_t + \alpha_2 \Delta ConsumerGoods_t + \alpha_3 \Delta ConsumerServicses_t \\ & + \alpha_4 \Delta BasicMaterials_t + \alpha_5 \Delta Industrials_t + \alpha_6 \Delta HealthCare_t + \alpha_7 \Delta Tele_t \\ & + \alpha_8 \Delta Tech_t + \alpha_9 \Delta Utilities_t + \alpha_{10} \Delta Financials_t + \epsilon_t\end{aligned} \tag{7.2}$$

We are interested in the variables (industries) with significant relations to the government's petroleum cash flows. To do this, we perform two-sided t-tests on each estimated parameter (α_j), to see which varibles (industries) are statistially significant at a 5% significance level. The null hypothesis is that the variable is not related to the GPFG, and the alternative, that the variable is related to the GPFG.

Table 7.6: Regression output: Regression with the GPCF as the explained variable, and the GPFG-weighted operating cash flow from each industry as explanatory variables. All variables have been first-differenced.

	Model 1
Δ Energy	1.382**
	(0.317)
Δ ConsumerGoods	0.526
	(0.747)
Δ ConsumerServices	0.254
	(0.325)
Δ BasicMaterials	-1.816
	(0.774)
Δ Industrials	-0.522
	(0.352)
Δ HealthCare	-1.400
	(1.091)
Δ Tele	-1.300
	(1.271)
Δ Tech	0.607
	(0.732)
Δ Utilities	1.954
	(1.528)
Δ Financials	0.075
	(-2627.654)
Constant	-2627.654
	(3914.713)
Observations	15
R-Squared	0.9220

[1] Standard errors in parentheses
[2] ***p<0.01, **p<0.05, *p<0.10

Table 7.6 shows that the only significant coefficient, is the one related to the the weighted operating cash flow from the Energy industry. This coefficient is statistically significant at the 5% level, with an estimated parameter of 1.382, indicating a positive relationship between the GPCF and the weighted operating cash flow from the Energy industry. This provides additional support to the results presented in chapter 6, as the Energy industry is once again the only industry with a significant relation to the GPCF. Since our data-set only contains 15 observations, and we are estimating 11 parameters, the model estimated is left with only 4 degrees of freedom. Thus, the results in table 7.3 are only indicative, and should not be used to draw any firm conclusions.

7.3.1 Distributed lag model

Furthermore, we want to investigate whether the weighted operating cash flows of the Energy industry may affect the government's petroleum cash flows with a delayed (lagged) effect. Ttaxes paid to the Norwegian state by petroleum companies operating on the NCS may be be transferred to the state at a later time than at which they were earned. And, Equinor will likely pay larger dividends to it's owners following profitable periods yielding large operating cash flows. Since, the weighted operating cash flow from the Energy industry has been found to be closely correlated with the GPCF, and was the only significant variable in the previous regression model, we only investigate a possible lagged effect of this variable. To do this, we use a distributed lag model with the GPCF as the dependent variable. All variables are in first-differences. The model we estimate:

$$\Delta GPCF_t = alpha_0 + \alpha_1 \Delta Energy_t + \alpha_2 \Delta Energy_{t-1} + \epsilon_t \tag{7.3}$$

The result we are interested in is the strength of the relationship between the lag of the weighted operating cash flow from the Energy industry and the GPCF (α_2), and whether or not this effect is statistical significant. We measure the statistical significance by performing two-sided t-test presented earlier. If the null hypothesis that $\alpha_2 = 0$ is rejected, there is a statistical significant relationship between the two variables, and vice versa.

Table 7.7: Regression Output: Regression with the GPCF as the explained variable, and the GPFG-weighted operating cash flow from the Energy industry, and one lag, as explanatory variables.

	Model 3
ΔEnergy	0.766***
	(0.169)
L.ΔEnergy	0.292
	(0.168)
Constant	-761.579
	(2354.741)
Observations	14
R-Squared	0.7030

[1] Standard errors in parentheses
[2] ***p<0.01, **p<0.05, *p<0.10

Table 7.7 presents that there is a positive, linear relationship between both the contemporaneous, and lagged operating cash flow from the Energy industry, and the GPCF, with $\alpha_1 = 0.766$ and $\alpha_2 = 0.292$, respectively. With standard errors of 0.169 and 0.168, only α_1 is statistically significant at all conventional significnace levels. We do not find convincing evidence that the lag of the Energy industry's weighted operating cash flow has a significant impact on the government's petroleum cash flows.

8 Conclusion

The aim of this thesis has been to contribute to the discussion of whether or not, oil and gas companies should be removed from the Norwegian Government Pension Fund Global. In accordance with Norges Bank, we view the GPFG as part of Norway's national wealth, and argue that other assets (especially below-ground oil and gas reserves) should be considered in the management of the GPFG. Our main contribution, has been to collect data and construct a data-set with the operating cash flows for (almost) all companies part of the FTSE Global All Cap index, from 2003 to 2018.

Empirically, we have examined the relationship between Norway's below-ground assets and above-ground fund, by comparing the government's petroleum cash flow (GPCF) to the weighted operating cash flows of each ICB industry, and the FTSE GEISAC as a whole. We calculated correlations between the GPCF and the industry cash flows, and found evidence of a strong relationship between the Energy industry and the GPCF. This was further strengthened by the rolling-correlation analysis, which showed that the close relationship between the Energy industry and the GPCF has been very stable over time compared to the other industries. Furthermore, we calculated the correlation between the GPCF and the subsectors of the Energy industry, and found positive, statistically significant correlations with both E&P and Integrated Oil & Gas. These findings were confirmed with robustness tests, proving that no matter the method used to weight cash flows, or if they are weighted at all, Energy remains the industry most correlated with the GPCF.

In conclusion, we have shown that the operating cash flows of the Energy industry are closely linked to the cash flows to the Norwegian state from the petroleum industry. Based on this, we argue removing Energy companies will reduce Norway's exposure to the petroleum industry, and result in a more diversified portfolio of risky assets than the current situation. The Government has proposed removing only Exploration & Production companies. However, this subsector accounts for only a small part of the Energy industry. The largest part of this industry is Integrated Oil & Gas, and we found these companies to be even closer related to the Norwegian petroleum reserves. Hence, if the aim of the Government is to reduce the Norwegian concentration risk, excluding only the Exploration & Production is not enough. More specifically, we advise removing the subsectors Exploration & Production and Integrated Oil & Gas from the GPFG.

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Appendices

A: The government's net cash flow from the petroleum industry

Table 8.1: The Norwegian Government's Petroleum Cash Flows from 1991-2018 in NOKbn

Year	Taxes	Environmental Taxes & Area Fees	Cash Flows From The SDFI	Equinor Dividends	Government's Petroleum Cash Flows (GPCF)
1991	22	10	6	2	**39**
1992	15	11	4	1	**31**
1993	16	11	0	1	**28**
1994	15	9	0	1	**26**
1995	19	9	9	2	**39**
1996	23	10	35	2	**70**
1997	35	10	40	2	**87**
1998	20	8	15	3	**45**
1999	12	7	26	0	**45**
2000	53	9	98	2	**161**
2001	106	6	125	6	**243**
2002	85	5	74	5	**169**
2003	98	3	67	5	**174**
2004	114	4	80	5	**203**
2005	165	4	99	8	**276**
2006	212	6	126	13	**355**
2007	187	5	111	14	**316**
2008	240	6	154	17	**416**
2009	165	4	95	15	**280**
2010	156	4	104	13	**276**
2011	206	4	128	13	**351**
2012	229	4	149	14	**395**
2013	202	5	124	14	**345**
2014	170	6	113	23	**312**
2015	104	6	93	15	**218**
2016	41	7	66	11	**125**
2017	65	6	88	8	**168**
2018	110	7	119	15	**251**

B: FTSE GEISAC industry weights

Table 8.2: The FTSE GEISAC industry weights from 2003 to 2018.

Time-period	Energy 0001	Basic Mat. 1000	Indu-strials 2000	Cons. Goods 3000	Health Care 4000	Cons. Serv. 5000	Tele. 6000	Util. 7000	Fin. 8000	Tech. 9000
2003	6.6 %	5.1 %	13.1 %	10.0 %	10.5 %	10.6 %	5.1 %	3.6 %	24.3 %	11.2 %
2004	7.3 %	5.3 %	13.6 %	9.8 %	9.4 %	10.4 %	5.1 %	4.0 %	25.0 %	10.1 %
2005	8.5 %	5.7 %	14.0 %	9.4 %	9.1 %	9.4 %	4.3 %	4.1 %	25.6 %	9.9 %
2006	8.8 %	6.0 %	12.6 %	10.3 %	7.9 %	9.8 %	4.5 %	4.3 %	26.8 %	9.0 %
2007	10.4 %	7.8 %	13.3 %	10.6 %	7.4 %	8.5 %	5.1 %	4.7 %	23.1 %	9.1 %
2008	10.6 %	6.2 %	12.8 %	11.6 %	9.9 %	9.3 %	5.5 %	5.5 %	20.0 %	8.6 %
2009	10.4 %	8.2 %	12.7 %	11.3 %	8.2 %	8.9 %	4.4 %	4.4 %	21.5 %	10.2 %
2010	10.4 %	9.1 %	13.5 %	11.6 %	7.3 %	9.2 %	4.2 %	3.9 %	21.0 %	9.8 %
2011	11.0 %	7.8 %	12.8 %	12.4 %	8.4 %	9.9 %	4.3 %	4.0 %	19.4 %	10.1 %
2012	9.7 %	7.3 %	13.1 %	12.9 %	8.3 %	10.2 %	3.8 %	3.5 %	21.9 %	9.3 %
2013	8.9 %	5.9 %	13.8 %	12.8 %	9.2 %	10.8 %	3.6 %	3.2 %	22.1 %	9.7 %
2014	7.3 %	5.1 %	13.3 %	12.5 %	10.5 %	11.0 %	3.2 %	3.5 %	22.6 %	10.8 %
2015	5.8 %	4.3 %	13.1 %	13.4 %	11.5 %	11.5 %	3.3 %	3.2 %	22.6 %	11.3 %
2016	7.0 %	5.0 %	13.6 %	12.6 %	10.1 %	10.7 %	3.2 %	3.2 %	23.0 %	11.5 %
2017	6.0 %	5.0 %	14.1 %	12.4 %	10.1 %	10.7 %	2.7 %	3.0 %	22.9 %	13.0 %
2018	5.9 %	4.6 %	13.4 %	11.0 %	11.2 %	11.5 %	2.8 %	3.3 %	21.9 %	14.4 %

C: Additional correlation results

Table 8.3: Correlations between the weighted operating cash flows of each ICB Industry and the government's petroleum cash flow. The industry cash flows are weighted according to GPFG weights.

Industry	ICB code	Correlation	t-value
Energy	0001	0.85***	6.04
Basic Materials	1000	0.48*	2.03
Industrials	2000	-0.08	-0.30
Consumer Goods	3000	-0.25	-0.95
Health Care	4000	-0.38	-1.55
Consumer Services	5000	-0.29	-1.13
Telecommunications	6000	0.52**	2.26
Utilities	7000	0.57**	2.63
Financials	8000	-0.17	-0.65
Technology	9000	-0.47*	-1.97
FTSE GEISAC		-0.07	-0.24
All sectors ex Energy		-0.18	-0.67

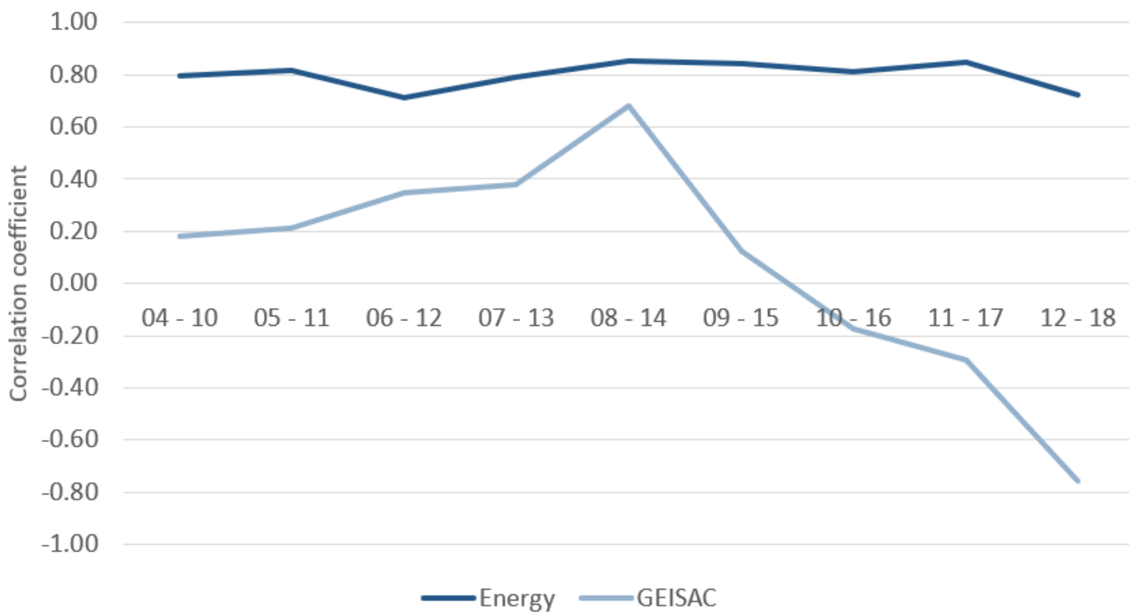
***p<0.01, **p<0.05, *p<0.10

Table 8.4: Correlations between the weighted operating cash flows of the Energy subsectors and the government's petroleum cash flow. The subsector operating cash flows are weighted according to FTSE GEISAC index weights.

Subsector	ICB code	Correlation	t-value
Exploration & Production	0533	0.57**	2.57
Integrated Oil & Gas	0537	0.95***	11.54
Oil Equipment & Services	0573	0.72***	3.88
Pipelines	0577	-0.55*	-2.10
Renewable Energy Equipment	0583	-0.44	-1.40
Alternative Fuels	0587	-0.26	-0.77
Energy ex E&P		0.95***	11.29

***p<0.01, **p<0.05, *p<0.10

Figure 8.1: 7-year rolling correlations



D: Industry Operating Cash Flows with GPFG country factors

Table 8.5: Weighted Operating Cash flows per ICB Industry with country factors to replicate GPFG weights more closely

Year	Oil & Gas 0001	Basic Mat. 1000	Indu-strials 2000	Cons. Goods 3000	Health Care 4000	Cons. Services 5000	Telecom. 6000	Util. 7000	Fin. 8000	Tech. 9000
2003	1428	100	598	594	620	271	932	125	1550	546
2004	1771	125	636	553	564	265	972	170	1599	484
2005	1910	183	596	545	546	222	695	176	4	470
2006	1945	228	485	633	496	246	714	234	1173	418
2007	2133	379	647	661	513	241	983	310	2288	518
2008	2983	336	573	594	728	364	1187	346	2118	531
2009	1500	452	365	827	646	296	892	347	2250	603
2010	1661	616	450	770	561	275	803	273	2049	710
2011	2282	637	431	697	714	327	880	222	2651	1024
2012	2124	489	426	1093	664	343	729	186	1771	1148
2013	1784	399	475	1103	735	342	628	158	2442	1127
2014	1605	347	446	1002	811	387	580	174	1618	1467
2015	846	219	402	1074	796	425	636	153	2400	1758
2016	778	223	316	1032	726	475	595	139	2582	1825
2017	1019	254	359	1133	753	551	505	121	1722	2230
2018	1771	297	373	952	1126	520	616	166	1605	2817