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The Cost of the Oil Fund's Socially Responsible Investing

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Abstract

Based on violations of ethical guidelines, a number of companies are excluded from the Norwegian Government Pension Fund Global's investment universe. There are both sector-based and norm-based reasons for exclusions. Among other things, exclusions can be due to excessive contamination, child labour, and production of nuclear weapons.

In this paper, we are constructing a portfolio that captures the returns of the excluded firms. This portfolio will be examined through an empirical analysis. If these exclusions represent a major cost for the oil fund, the return of the portfolio will show superior performance. We predict that the returns of the excluded firms are higher than the comparable portfolios. Excluding these companies therefore may reduce the returns of the oil fund's portfolio. We will test this prediction by executing several regressions, including the Capital Asset Pricing Model and the Carhart 4-factor model.

We implement a number of tests for superior performance of the constructed portfolios and we find a performance effect, although for the equal-weighted portfolio it is not significant. These findings suggests that by investing in unethical companies, it doesn't seem to have a sufficiently high effect on the financial returns, but we don't have enough evidence to give a definite conclusion.

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Preface

This master's thesis completes a five-year degree in Business Administration, and marks the end of the master's program in Applied Finance at the University of Stavanger Business School.

The theme of the thesis is ethical investment regarding the Norwegian Government Pension Fund Global, because it is a highly debated topic nowadays. The GPFG is one of the largest Sovereign Wealth Funds in the world and invests a great deal of capital. We would like to find out if an ethical investment strategy has a positive impact on financial gain. If it has a positive effect, it could help alleviate human rights issues, environmental damage and corruption, among other things. We find this topic very interesting and it is something we are passionate about.

We would like to express our gratitude to our supervisor, Professor Bernt Arne Ødegaard at the University of Stavanger. He provided us with great guidance, constructive feedback and useful remarks throughout the process of writing this thesis. We would also like to thank our friends and family for all of their support.

University of Stavanger, June 15th, 2020

1 Introduction

The Norwegian Government Pension Fund Global (GPFG) is one of the world's greatest Sovereign Wealth Funds (SWF), owning almost 1,5% of all listed companies in the world. Over the last years, socially responsible investing has had a great impact on the GPFG's investment strategy. In 2004, the Ministry of Finance established the Ethics Council to make sure that the GPFG's investments are socially responsible. The Ethics Council then excluded companies due to ethical guidelines. A combination of both financial gain and ethical considerations are essential when investing. This study addresses the question: Does the change in investment strategy come at the cost of financial gain?

Previous research show several different findings regarding SRI. Some papers conclude that there is statistically significant outperformance of the sin stocks, while others find no significance. Renneboog, Horst and Zhang (2008) find an underperformance relative to the benchmark, and Adamsson and Hoepner (2015) don't find any significant difference in performance effect. The paper by Atta-Darkua (2019) discusses the issue of sin stocks becoming undervalued when being excluded from a large investor. From Richardson's (2011) article, we can see that other global asset owners tends to follow the GPFG's and other SWF's investment decisions. This may be one of the reasons for the tendency of the sin stocks becoming undervalued.

Our contribution is to see if the oil fund is losing money by making ethical investment decisions. While previous research have compared the unethical portfolio to a market benchmark, we also include the oil fund's portfolio and it's reference index. Through this empirical analysis, we want to figure out if there is a cost of the GPFG's socially responsible investing and if it significant enough to consider changing their investment strategy.

In this study we will create a portfolio based on the excluded companies in order to find out if it differs from the market, the oil fund's portfolio and/or it's reference index. We implement two different alternative portfolio constructions, representing an equal-weighted and a value-weighted portfolio where the companies are given different weights.

We aim to find an answer to our research question by testing the following hypotheses:

Hypothesis 1:
H_0: The return of the exclusion portfolios does not differ from the market.
H_1: The return of the exclusion portfolio differ from the market.

Hypothesis 2:
H_0: The return of the exclusion portfolios does not differ from the oil fund's reference index.
H_1: The return of the exclusion portfolios differ from the oil fund's reference index.

Hypothesis 3:
H_0: The return of the exclusion portfolios does not differ from the oil fund's portfolio.
H_1: The return of the exclusion portfolios differ from the oil fund's portfolio.

This paper will discuss three main research questions regarding the exclusion portfolios. Trying to find out if excluding certain firms has a positive, negative or no effect on performance. By excluding these funds, are Norway missing out on an extraordinary return?

The rest of the paper contains some background information about socially responsible investing, the Norwegian Government Pension Fund Global and the Ethics Council. Further on, some previous literature regarding SRI will be presented. In chapter four we will explain the methods used for the analysis needed. In the fifth and sixth chapter, we are presenting our data and results, respectively. There will be a presentation and interpretation of the results, before it will be concluded in the last and seventh chapter.

2 Background

2.1 Socially Responsible Investing

Social, environmental and ethical aspects of investments have increased in popularity in the recent years. Investors seems to increase the employment of SRI investment strategies. SRI (Socially Responsible Investing) is ethical, environmental and social investments where you invest in companies and funds with positive social consequences (Renneboog et al., 2008). The main goals of SRI are social impact and financial gain, but they do not necessarily correlate. Although the investment is socially responsible, it does not mean that it automatically gives financial gain, and vice versa. Therefore, one must evaluate both options against each other before making an investment.

According to Eurosif (2016), SRI screening can be divided into seven different categories or methods that is used by investors. The strategies are ESG integration, sustainability themed investing, impact investing, engagement, best-in-class screening (positive), exclusionary screening (negative) and norm-based screening. In our text we will mainly focus on the two latter.

The largest global investment strategy of the previously mentioned strategies are exclusionary screening. It is also called sector-based screening, and as the name imply companies are excluded due to the type of sector they operate in. Examples of commonly excluded sectors are tobacco, coal or coal-based energy, or production of nuclear weapons. On norm-based screening the exclusion is not based on how well the company perform, but rather on how they behave or is perceived to behave. Unethical behaviour that gives rise for exclusion are violation of human rights, corruption or environmental damages. When excluding companies, investors not only look at past behaviour, but also on believes that they will continue with unethical behaviour (Atta-Darkua, 2019).

ESG (Environmental, Social and Governance) investments are closely connected to the term sustainability and is about a company's business model, and how their products encourage sustainable development. Another term closely related to SRI and ESG is Corporate Social Responsibility (CSR). CSR can be described as the responsibility behind corporate actions and influence. This implies the integration of social and environmental considerations, as well as complying with existing laws and regulations in the respective country (Ioannou & Serafeim, 2015).

2.2 GPFG

The Government Petroleum Fund was established after they found oil in the North Sea in 1969. The first amount of money was deposited in 1996 after the Law of Petroleum was implemented. The fund is governed by Norway's Bank Investment Management (NBIM). In 2006 the name was changed to The Government Pension Fund Global. The purpose of the fund is to invest responsible and secure future generations and Norway's economy. Its market value is affected on its return on investment, and how much is used by the state. The funds' value is transferred straight from oil reserves, which then have increased in size due to investments in stocks, real estate and interest. The portfolio is highly lucrative. Their purpose is to act in the best interest of the Norwegian citizens (NBIM, 2019).

To create a well-diversified portfolio having a great asset allocation strategy is crucial. It is important to decide the share of bonds, stocks, real estate, etc. of which the portfolio should include. How much of each sector and how much risk one is willing to take, affects the expected return of the portfolio.

The GPFG's investment strategy has developed over time. Their aim is to achieve highest possible return on a moderate amount of risk. The strategy bears characteristics of great diversification, cost efficiency, receiving risk premium over a longer period and having a reliable and competent management (Regjeringen, 2018). Ethical investing is also a big part of their strategy and will be discussed more closely later.

In 1997 the parliament decided that 40 percent of the fund assets should be invested in stocks. Prior to this, the fund was mainly invested in foreign treasuries. Later, in 2007 the Ministry of Finance determined to increase the share of assets invested in stocks to 60 percent (NBIM, 2019b). As of today, the share have increased to 70 percent. Five emerging economies are included in the funds benchmark (NBIM, 2019a).

2019 was a historical year for the fund. On October 25th 2019 it reached a net worth of over NOK 10 000 billions. Its value increased with NOK 1832 billions in the same year, which is a new record. The fund beat the benchmark it is measured against with a return of 19,9 percent, which is 0,23 percent higher. This is also the year where Yngve Slyngstad resigned as CEO after eleven years in service, when the fund reached NOK 10 000 billions (Linderud & Langved, 2020. p.15).

2.3 Ethics Council

The Ethics Council´s main task is to give advice to the Bank of Norway on which companies to place under observation or exclude from the fund's investment universe. The Ethics Council have been given a set of guidelines to follow from the Ministry of Finance, and they can be found in the annual report. Among other things, the guidelines include exclusions because of unethical business models, gross corruption and violations of norms. Due to high threshold for exclusion, companies can only be excluded if they will represent an unacceptable ethical risk to the fund in the future. After a company has been excluded, it can be reinstated if the conditions change for the better. In some cases, the exclusion decisions affects companies in a positive ethical direction, and leads to socially responsible improvements (Etikkrådet, 2019). In 2005, there were only 15 excluded stocks. While in 2019 the number had increased to 134. The reason for this might be due to the public's increasing awareness of ESG investing, as previously mentioned.

The SRI strategies most frequently used by the Ethics Council are exclusionary screening (sector-based) and norm-based screening. With these strategies, they exclude companies that violates human rights, sell/produce addictive products and weapons, is engaged in environmental pollution and/or gross corruption. There is also a newly added exclusion of coal production or coal-based energy that was implemented in 2016.

3 Literature

Many researchers have studied socially responsible investing and the relationship between SRI funds and financial performance. Some of these research papers will be presented in the following paragraphs.

The expectations of Sovereign Wealth Funds and the tension that emerge between the public demands for both ethical and financial investments is discussed by Richardson (2011). SWF are expected to deliver an increasing return but at the same time do it in a responsible and ethical way. Increasing prosperity in a country should not be done at the cost of other human beings, which might be why this is a highly debated topic. The paper studies two sovereign wealth funds, the GPFG and the New Zealand Superannuation Fund (NZSF). Both funds are encouraged to invest ethical, but are not obligated to do so. Richardson points out similarities and differences in the fund's investment policy, and how they are governed/managed. He also addresses the need for change. Supporting or investing in companies who is complicit in human violation and environmental damage is no longer called for. Sovereign Wealth Funds can therefore help alleviate these problems by implementing an ethical investment strategy.

Capelle-Blancard and Monjon (2014) focused their study on the French SRI mutual funds. Their study examined if the mutual funds are related to the screening process and if they have an impact on the financial performance. Their findings show that a higher screening intensity reduces the risk-adjusted return, but only for sector-based screening. The norm-based screening does not have an impact on the financial performance of the portfolio. Like Capelle-Blancard and Monjon's (2014) research, Barnett and Salomon (2006) finds that the screening-performance relationship depends on the type of screen as well as the screening intensity. On the other hand, Lobe and Walkshäusl (2011) and Humphrey and Lee (2011) don't find any significant evidence that either sin stocks or SRI stocks out- or underperform. In addition to this finding, Humphrey and Lee (2011) find that positive screening reduces funds' risk, and negative screening increases risk and reduces performance. In later research by Humphrey and Tan (2014), it is concluded that a typically SRI fund will not gain or lose from screening its portfolio.

Renneboog, Horst and Zhang's (2008) paper discusses the question whether investors must pay a price to invest in SRI funds or whether it results in risk-adjusted return. The paper includes all SRI funds in the world and they make a comparison with conventional funds in order to answer their problem. They found that there is a tendency for the SRI funds to underperform their benchmark by -2,2% to -6,5%. However, the difference from the conventional funds' performance is not statistically significant in most instances, with the exception of France, Japan and Sweden.

In "The Price of Sin" article by Hong and Kacperczyk (HK) in 2009, sin stocks and companies involved with tobacco, alcohol and gaming production are being studied. They look at the impact social norms have, and if divesting from these types of companies come at a cost. In their paper concerning the U.S. market, Hong and Kacperczyk found evidence of outperformance of the sin stocks compared to the non-sin stocks. Several studies explain this as a result of systematically under-pricing the sin stocks where there is a lack of willing investors. Adamsson and Hoepner (2015) takes on the global- and U.S. market, also looking at the price of sin as HK did in their paper. Constructing both an equal-weighted and a value-weighted portfolio with sector control variables, the outperformance disappear. They conclude that there is no significant difference in performance effect. Among others they also find evidence of a stronger sin effect in more restrictive market. Investors also differs in the extent of which they shun companies.

In Blitz and Fabozzi's (2017) article, the discussion about the performance of sin stocks continues. They use global data and have divided the study into four different samples; Japan, U.S., Europe and global. Among others they look at the explanation for outperformance of sin stock as a result of the companies being undervalued. When looking at the performance, Blitz and Fabozzi apply the two new factors of Fama and French; investment and profitability, in addition to the CAPM's alpha. As a result, the outperformance of sin stocks disappear.

In recent years, there have been an increase in research regarding the Scandinavian SRI market. This includes the papers by Bengtsson (2008), Scholtens and Sievänen (2013), Jensen (2016) and Du Rietz (2016). While Scholtens and Sievänen also includes Finland in their study, Jensen have an additional paper only concerning Norway. In Jensen's (2016a) article similarities and differences in the Scandinavian SRI market is discussed. In particular, the Scandinavian model is described. Investment strategies, including ethical excursions and screening plays a central part. Scholtens and Sievänen (2013) looks at the differences of SRI investments between Norway, Sweden, Denmark and Finland. Their findings show that the four countries differ when it comes to SRI in composition and size, and that the results are significant. More closely related to our study, we have Hoepner and Schopohl's (2016) study about the GPFG and the Swedish AP-funds, and Atta-Darkua's (2019) paper about the GPFG's ethical exclusions.

Atta-Darkua (2019) studies how sin stocks become undervalued due to divestment because of unethical behaviour. This paper is closely related to our study given that they also uses the GPFG's excluded companies in their analyses. An attempt has been made to find out if equity value will be affected by that a large investor excludes a company from their portfolio because of unethical behaviour. There is evidence of a demand-driven mechanism, and the results show that a reduced investor base have pushed the prices down, and therefore the stocks becomes undervalued. Around the exclusion announcements, 1.48% of equity value is lost, on average. This loss is not reversed in the short term. The conclusion of the study is that unethical firms fall out of favour when being excluded by large investors, and that their exclusion decisions are sometimes being mimicked by ethics sensitive investors.

Hoepner and Schopohl's study in 2016 analyses the Socially Responsible Investment strategy of two Sovereign Wealth Funds and the performance implications this strategy results in. It consist of the Norwegian Government Pension Fund Global and the Swedish AP-Funds. They create an exclusion portfolio based on how the companies are run or behave. Their findings suggests that the exclusions does not generally harm the funds' performance. This finding is also supported by previous research as mentioned above (e.g. Lobe and Walkshäusl 2011; Humphrey and Lee 2011; Humphrey and Tan 2014). Hoepner and Schopohl conclude that asset owners can make ethical investments without the cost of financial returns.

Our portfolio construction differ from a lot of previous research. Instead of several portfolios containing different countries and wealth funds, we have chosen to only focus on the Ethics Council's list of excluded companies in order to constrict our paper around the GPFG. To further narrow down the research, we haven't divided the excluded companies based on the type of reason for exclusion, but combined all of them in a single portfolio. In an extension to prior literature we have not only compared our portfolio to a market benchmark, but also included both the oil fund's portfolio and it's reference index.

4 Method

In this section we will present different measures of performance in order to test whether the return of the exclusion portfolio is higher than the return of the comparable portfolios. The first part will contain analyses of traditional performance measures like Sharpe ratio, Treynor ratio, Information ratio and M^2. The next sections consists of both the Capital Asset Pricing Model and the Carhart 4-factor model. We aim to find an answer to our prediction through these analyses. All of the tests are executed in R and Microsoft Excel.

Further on, the robustness of our results need to be tested. This is done by executing another robustness test in addition to an interpretation of the adjusted R^2. The robustness test we will use is a sub-sample analysis.

4.1 Performance measures

As the CAPM model measures systematic risk, other performance measures that has been developed, captures unsystematic risk. Such measures are Jensen's alpha, Sharpe ratio, Information ratio, Treynor ratio and M^2. Jensen's alpha will be adequately explained later, and we will therefore focus on the other four in this section. A brief explanation of the performance measures will be given below.

4.1.1 Sharpe ratio

Sharpe ratio is one of the most common risk/return measures to analyse the performance of an investment. It describes how much excess return you receive for holding an asset with higher risk compared to similar stocks. Sharpe ratio is calculated by taking the portfolio's excess return and divide it by the standard deviation of the portfolio. The highest possible Sharpe is sought after, meaning when comparing two assets the one with the highest Sharpe has a better risk-adjusted performance. Receiving a negative ratio does not necessarily give meaningful results, but rather that the risk free rate is higher, or a negative portfolio return is expected (Bodie, Kane & Marcus, p. 134).

$$Sharpe\ ratio = \frac{R_p - R_f}{\sigma_p}$$

4.1.2 Treynor ratio

Treynor ratio measures how much excess return is obtained when an investor takes on an extra unit of risk. The only difference between Sharpe ratio and Treynor ratio is that Sharpe ratio uses the volatility of the portfolio as a basis, and Treynor ratio uses systematic risk (the portfolio beta). The ratio is computed by taking risk premium divided by beta. The higher the Treynor ratio turns out to be, the better. If we get a negative ratio, it means that a risk-free investment would perform better than the investment tested, because the extra amount of risk does not pay off (Bodie et al., 2014, p. 840).

$$Treynor\ ratio = \frac{R_p - R_f}{\beta_p}$$

4.1.3 Information Ratio

The information ratio (IR) measures how much return the portfolio receive in excess compared to a benchmark and its risk or volatility. A positive and high IR means that the portfolio is beating the benchmark with a level of consistency. To calculate the information ratio we take the return of the portfolio and subtract the return of the benchmark, divided by the standard deviation of the two. The denominator of the formula is often referred to as the tracking error. If the tracking error is low, it means that over time, the portfolio is constantly beating the benchmark (Bodie et al., 2014, p. 275).

$$Information\ ratio = \frac{R_p - R_b}{\sigma(R_p - R_b)}$$

4.1.4 M² measure

The M^2 measure (or Modigliani measure) is an extension of the Sharpe ratio and measures the risk-adjusted return of a portfolio. It was developed in 1997 by Franco Modigliani and his granddaughter Leah Modigliani, hence the name M^2. It is calculated by taking the Sharpe ratio multiplied by the benchmark's standard deviation and the risk-free rate added to it. The M^2 measure is known to be a more useful tool than, for example, the Sharpe ratio because it measures percentage return. This makes the result easier to interpret and compare with other investments (Bodie et al., 2014, p. 841).

$$M^2\ measure = \frac{R_p - R_f}{\sigma_p} * \sigma_m + R_f$$

4.2 Capital Asset Pricing Model

The Capital Asset Pricing Model, also called CAPM, shows the relationship between expected return and systematic risk. The CAPM will be the base for the 1-factor regression.

We express the CAPM model in the following way:

$$r_{p,t} - r_{f,t-1} = \alpha_p + \beta_p(r_{m,t} - r_{f,t-1}) + u_{p,t}$$

Where $r_{p,t}$ is the return on either the value weighted or the equal weighted portfolio return, $r_{f,t-1}$ is the risk free rate, $(r_{m,t} - r_{f,t-1})$ is the market risk premium, $u_{p,t}$ is the disturbance term. β_p is the systematic risk of portfolio p and α_p is Jensen's alpha which measures the abnormal return.

There are several advantages to the CAPM model. It is easy to use and only require a simple calculation and can be stress-tested. This might be one of the reasons why it is widely used. The model is based on the assumption that investors hold diversified portfolios. This gives base for the second advantage where unsystematic risk is eliminated, due to diversification. Another great reason to use the Capital Asset Pricing Model is that it takes the market risk, the beta, into account. Systematic risk is often neglected by other models, but it is an important factor due to its unexpectedness (Bodie et al., 2014, p. 291).

Jensen's alpha is the same alpha as in CAPM. Also referred to as just alpha, is in conjunction with CAPM, one of the most used measures of performance and was developed by Jensen (1968). It shows how much return an investor receives for a given amount of risk, and measures the difference. If two assets have the same expected return, but different level of risk one would choose the asset with the lowest amount of risk (Bodie et al., 2014. p. 840).

Alpha is calculated by subtracting the risk free rate and the market risk premium multiplied with beta to the return of the portfolio.

$\alpha_p = r_{p,t} - [r_{f,t-1} + \beta_p(r_{m,t} - r_{f,t-1})]$

When the alpha is positive it is safe to conclude that the investment performed better than the market.

4.3 Carhart 4-factor model

The Carhart 4-factor model is an extended version of the Fama French 3-factor model, which again is an extended version of the Capital Asset Pricing Model explained above. Fama and French's 3-factor model expands by adding size risk and value risk factors to the market risk factor already used in CAPM.

The extended version, the Carhart 4-factor model, measures the expected return of a portfolio. This model includes a fourth factor, momentum, as well as market risk, value and size. The momentum factor shows if an already rising (declining) stock continues to rise (decline). Mark Carhart (1997), who added the factor, claimed in his paper that the measurement of portfolio returns became more accurate by adding momentum. The momentum factor can be calculated by taking the average of the highest performing firms and subtracting the average of the lowest performing firms, lagged one month. If a stock's prior 12-month return average is positive, we can say that the stock is showing momentum (Bodie et al., 2014, p. 432).

$$r_{p,t} - r_{f,t-1} = \alpha_p + \beta_p(r_{m,t} - r_{f,t-1}) + \gamma_i SMB_i + \delta_i HML_i + \varphi_i WML_i + u_{i,t}$$

Where SMB_i is small minus big, HML_i is high minus low and WML_i is winners minus losers.

4.4 Matching pair analysis/Paired t-test

A method to study the performance of funds is done by conducting a matching pair analysis. This consists of two tests, a paired t-test and a 1-factor regression. The tests will be run on the value-weighted and the equal-weighted portfolios matched to the reference index, the oil fund's portfolio and the MSCI index.

A t-test is often used to see if there is statistically significant differences in performance of two groups. It looks at the means of the two groups and check if there is a difference. T-test is a great tool for hypothesis testing, it allows us to test the returns of the portfolios and see if they differ or not. Significant results indicates that the excluded portfolio do perform better or worse compared to the reference index, the oil fund's portfolio and/or the market. As previously described in the CAPM section, we will use the 1-factor model to study the performance of the different portfolios.

4.5 Portfolio level analysis: Carhart 4-factor model

To compare the performance of our equal-weighted portfolio and the value-weighted portfolio to the benchmarks, we will execute a portfolio level analysis based on the Carhart 4-factor model. This is done by doing several regressions, where the portfolio return will be the dependent variable. In all of the regressions, we will use the benchmark, SMB, HML and WML as the independent variables. We will use the results from the analysis to compare our portfolios to the MSCI index, the oil fund's portfolio and it's reference index.

4.6 Robustness tests

For each regression, the adjusted R^2 will be observed, where a value of over 0,7 is considered strong explanatory power. R^2 is a statistical measure that represents the proportion of the variation in the dependent variable explained by the independent variables in a linear regression. The adjusted R^2 is a modified version of R^2 that has been adjusted for the number of independent variables in the model. The adjusted R^2 therefore gives us a more accurate result, and that is why we choose to focus on the adjusted version of R^2 further on in the study.

To further check the robustness of our results we perform a sub-sample analysis. This method is used to see if our findings suffer from individual company effect. At the beginning when the Ethics Council started to exclude companies from the investment universe, the number of exclusions was low. In an effort to rule out the possibility that this has an effect on our findings, we restrict our sample to the last decade (Hoepner & Schopohl, 2016).

5 Data

The Ethics Council have constructed a list of all the companies that are excluded from the GPFG's investment universe and they are listed on the NBIM website. We construct our portfolio by collecting monthly historical data for all of the excluded stocks for the last 14 years, from 2005 to 2019. In order to answer our three hypotheses, we have collected the following data: historical monthly data of each excluded company, MSCI index, the oil funds return, the reference index of the oil fund, risk free rate and the factors needed in Carhart's 4-factor model. In addition, we used the data source Thomson Reuters Eikon to find the market capitalization and the number of outstanding shares of each company. All of the prices and numbers are stated in USD. We have used the date of exclusion as 01.01. for every year, as we are lacking the exact date.

First, we found the historical monthly data from 2005 to 2019 for each company on Yahoo Finance. Further on, we used these values to calculate the monthly return of each month by inserting them into the following formula:

$$Monthly\ return = \frac{P_{i,t}}{P_{i,t-1}} - 1$$

where $P_{i,t}$ is the stock price of company *i* at the beginning of month *t* and $P_{i,t-1}$ is the same company's stock price at the beginning of the previous month *t-1*.

As mentioned, we will construct a portfolio with both equal weight and value weight. For the equal-weighted portfolio, we apply equal weights to each companies, summing each of the months for every company. If a company has been delisted for a period of time, if there is no information to be found or it has been reincluded, it is given a weight of zero, giving the remaining companies a higher equal weight. The value-weighted portfolio is constructed by using different weights on how they represent the share of the market. Companies with a higher share is given a higher weight and vice versa.

The following formula is used to calculate the equal-weighted portfolio:

$$r_{ew,t} = \frac{1}{k}\sum_{i=1}^{k} \frac{P_{i,t}}{P_{i,t-1}} - 1$$

where $r_{ew,t}$ is the equal-weighted portfolio return over month *t*, and *k* is the total number of companies in the portfolio.

The following formula is used to calculate the value-weighted portfolio:

$$r_{vw,t} = \sum_{i=1}^{k} (\frac{P_{i,t}}{P_{i,t-1}} - 1 * \frac{MCap_{i,t-1}}{\sum_{i=1}^{k} MCap_{i,t-1}})$$

where $r_{vw,t}$ is the value-weighted portfolio return over month *t* and $MCap_{i,t-1}$ is the market capitalization of company *i* at the beginning of month *t-1*.

5.1 Index benchmarks

As a benchmark for the market, we will use the MSCI All Country World Index, which we found on their own website. We have chosen not only to compare our results to this index, but also use this as a tool for calculating and achieving the results needed for our analyses. Our study focuses on Norway's Government Pension Fund Global, and we therefore compare our portfolio to the oil fund's portfolio return and their reference index, as well as the MSCI. Both the portfolio and the reference index is presented in the Ethics Council's annual report of 2019. As well as the mentioned indices, we use three additional factors in the Carhart 4-factor model: SMB (small minus big), HML (high minus low) and WML (winners minus losers). These factors are found in the Kenneth R. French data library.

5.2 Risk-free rate

The US 1-month Treasury bill will be used as an estimate for the risk-free rate of return in both the 1-factor model and the 4-factor model. The US risk-free rate is obtained from Kenneth R. French's homepage.

6 Results

6.1 Traditional performance measures

In an effort to strengthen our portfolio performance analysis, we implemented some of the most commonly used performance measures. The once we estimated are Sharpe ratio, Treynor ratio, information ratio and M^2 measure.

6.1.1 Sharpe ratio

The results from the Sharpe ratio shows that all the portfolios receive a positive Sharpe. The value-weighted portfolio received the highest ratio, while the MSCI index received the lowest. These results indicates that when adjusting for risk, the value-weighted portfolio delivers a better return. From an investors perspective, a Sharpe ratio of 1 or more is considered good. Our results showed that every portfolio received a Sharpe below 1. This might mean that the return is lower than the risk taken.

6.1.2 Treynor ratio

All of the portfolios gives us a positive Treynor ratio which means that the excess return is decreasing by taking on an extra unit of risk. In other words, portfolios with negative Treynor ratio perform worse than a risk-free investment. The portfolio with the lowest ratio is the equal-weighted portfolio with a ratio of 0,0046. The portfolio with the highest ratio is the MSCI index, which is in contrast to the results from Sharpe ratio.

Traditional performance measures: Sharpe ratio and Treynor ratio

	Sharpe ratio	Treynor ratio
Equal-weighted	0,0946	0,0046
Value-weighted	0,1429	0,0115
MSCI	0,0862	0,0443
Reference index	0,1198	0,0053
Oil fund	0,1234	0,0051

Table 6.1.2.1: Traditional performance measures: Sharpe ratio and Treynor ratio

6.1.3 Information ratio

The equal-weighted and the value-weighted portfolio both received a positive information ratio compared to the oil fund. Compared to the MSCI only the equal-weighted portfolio received a positive ratio, and compared to the reference index, only the value-weighted portfolio received a positive ratio. For the most part, this means that both portfolios exceeded the benchmark, with the exception for value-weighted compared to MSCI and equal-weighted compared to the reference index.

6.1.4 M^2 measure

All of the M^2 measure results are positive, which means that the return received is greater than the risk taken. The value-weighted portfolio received the highest percentage return for all of the benchmarks. Although the results are positive, the values are fairly low with the highest being only 0,78%.

Traditional performance measures: Information ratio and M^2

	Information ratio		M^2 measure	
	Equal-weighted	Value-weighted	Equal-weighted	Value-weighted
MSCI	0,2122	-0,1604	0,0052	0,0073
Reference index	-2,1065	0,0436	0,0054	0,0076
Oil fund	2,8433	0,0647	0,0055	0,0078

Table 6.1.4.1: Traditional performance measures: Information ratio and M^2 measure

6.2 CAPM model

In this section we will present the results from the CAPM model. We measure the risk-adjusted performance of the value-weighted and the equal-weighted portfolios. Table 6.1.1 presents the performance results from the regression where the dependent variable is the return of either the equal- or value-weighted portfolio. We ran three regressions on each where the independent variable is either MSCI, the oil fund or the oil fund's reference index.

Of the regression results, we are most interested in the alpha estimates. This is because a positive alpha implies that the exclusion portfolio outperforms the market, while a negative alpha implies the opposite, that the portfolio underperforms compared to the market.

Table 6.2.1 shows significant positive alphas for MSCI, the reference index and the oil fund compared to the value-weighted portfolio. This indicates that the portfolio outperforms the benchmarks. The equal-weighted portfolio shows positive alpha and outperformance compared to the MSCI, and negative alphas and underperformance compared to the reference index and the oil fund. On the other hand, these results are not statistically significant, thus the out- and underperformance is weak.

The adjusted R^2 is fairly high for all of the regressions. Table 6.2.1 shows the equal regression R-squared of 0,81, 0,81 and 0,90 for MSCI, reference index and the oil fund, respectively. The value-weighted regression shows a lower R^2 of 0,64, 0,63 and 0,62 for the same benchmarks. This means that the regressions have great explanatory power, but we still need to be careful to draw to final conclusions based on these results alone.

CAPM 1-factor model: Equal-weighted portfolio

	Independent variables		
	MSCI	Reference index	Oil fund's portfolio
Alpha	0,0000791	-0,000615	-0,000796
Rm-Rf	0,965663***	0,909890***	0,895376***
Observations	180	180	180
Adjusted R^2	0,810617	0,807773	0,817265

CAPM 1-factor model: Value-weighted portfolio

	Independent variables		
	MSCI	Reference index	Oil fund's portfolio
Alpha	0,003479***	0,002886***	0,002832***
Rm-Rf	0,421185***	0,393123***	0,382610***
Observations	180	180	180
Adjusted R^2	0,638137	0,623871	0,617327

Table 6.2.1: CAPM 1-factor model: Performance results.

Significance levels: *** 1%, ** 5%, * 10%.

6.3 Matching pair analysis/Paired t-test

The results from the t-test are presented in table 6.3.1. The data indicates that the exclusion portfolios outperforms compared to the MSCI and underperforms compared to the oil fund and the reference index, on average. The pair with the largest, and negative, difference is the equal-weighted portfolio and the oil fund's portfolio. The mean difference is negative, and this means that the equal-weighted portfolio underperforms the oil fund's portfolio by -0,001405, on average. The pair with the largest, and positive, difference is the value-weighted portfolio and the MSCI index with a mean difference of 0,001307. This means that the value-weighted portfolio outperforms the market.

Paired t-test

Pairs	Equal-weighted MSCI	Equal-weighted Reference index	Equal-weighted Oil fund
Mean difference	0,000662	-0,001113	-0,001405

Pairs	Value-weighted MSCI	Value-weighted Reference index	Value-weighted Oil fund
Mean difference	0,001307	-0,000468	-0,000760

Table 6.3.1: Paired t-test results.

6.4 Portfolio level analysis: Carhart 4-factor model

To be able to compare our portfolios with the benchmarks, we ran regressions based on the Carhart 4-factor model. The dependent variable is either the equal-weighted portfolio or the value-weighted portfolio with MSCI, the reference index or the oil fund's portfolio as the independent variable in addition to SMB (small minus big), HML (high minus low) and WML (winners minus losers).

The results from the six different regressions are shown in table 6.4.1. For the equal-weighted portfolios, only the regressions with MSCI serving as the independent variable, is positive, but yet not significant. Both the equal-weighted regressions with the oil fund's portfolio and it's reference index as independent variable, is negative and not statistically significant. Negative alphas means that our portfolio underperform the benchmark. All of the alphas in the value-weighted regressions are positive and statistically significant. This means that the value-weighted portfolio is outperforming all of the benchmarks. We get a positive alpha that is statistically significant at 1% level when comparing the value-weighted portfolio with the MSCI index. The other two statistically significant alphas, the value-weighted portfolio compared to the oil fund and the reference index, is only significant at 5% level.

Regarding the adjusted R^2 results, we find some similarities to the Capital Asset Pricing Model.
Also for the Carhart model, the adjusted R^2 is very high for the equal-weighted regressions. The adjusted R^2 in the value-weighted regressions is lower than for the equal-weighted, and slightly below 0,7 with an adjusted R^2 of 0,65, 0,63 and 0,63 for MSCI, reference index and oil fund as independent variable, respectively.

Carhart 4-factor model: Equal-weighted portfolio

	Independent variables		
	MSCI	Reference index	Oil fund's portfolio
Alpha	0,001256	-0,000152	-0,000358
Rm-Rf	0,958809***	0,903174***	0,889217***
SMB	-6,22E-06	7,73E-05	7,12E-06
HML	-0,000941	-0,000904	-0,000893
WML	-0,002106	-0,002045*	-0,001945*
Observations	180	180	180
Adjusted R^2	0,813608	0,810428	0,819569

Carhart 4-factor model: Value-weighted portfolio

	Independent variables		
	MSCI	Reference index	Oil fund's portfolio
Alpha	0,002880***	0,002272**	0,002211**
Rm-Rf	0,431134***	0,402510***	0,392002***
SMB	8,25E-04*	8,61E-04*	8,27E-04*
HML	-0,000395	-0,000374	-0,000365
WML	0,001888**	0,001898**	0,001920**
Observations	180	180	180
Adjusted R^2	0,648150	0,633784	0,627124

Table 6.4.1:Carhart 4-factor model: Performance results.

Significance levels: *** 1%, ** 5%, * 10%.

6.5 Robustness of results

6.5.1 Adjusted R^2

The results from the 1-factor CAPM model shows fairly high R-squared values. The relationship between variables are considered strong when its R-value is over 0,7. All of the regressions with the equal-weighted portfolio as the dependent variable, has an adjusted R^2 close to 0,7. The value-weighted portfolio received a lower value compared to the equal-weighted. The equal-weighted regressions all received an adjusted R^2 that shows strong explanatory power. On the other hand, the value-weighted regression shows weaker, but not poor, explanatory power with the highest R^2 being 0,648. The results from the 4-factor model shows similarities to the CAPM. The Carhart 4-factor model shows that approximately 81% of the equal-weighted portfolio's return is explained by the independent variables. While the value-weighted portfolio is explained by approximately 64%. Even though we for the most part received a high R^2 on both the 1-factor and the 4-factor model, it is not a given that our model is a good one, and we therefore intend to do another robustness test as well.

6.5.2 Sub-sample analysis

The results from the sub-sample analysis are shown in appendix 7 and 8, and the alpha estimates are shown in the tables below. The majority of the results remain fairly unchanged. The regression with the equal-weighted portfolio compared to the MSCI had a positive alpha, and got a negative alpha after the sub-sample analysis. Yet, the difference is not great, and not significant. The analysis gives an indication that our results from the 1-factor model and 4-factor model are not likely to be affected by the low number of excluded companies in the first years of the sample.

Sub-sample analysis: CAPM 1-factor model

	Equal-weighted	Value-weighted
MSCI	-0,000383	0,003208**
Reference index	-0,001184	0,002783**
Oil fund	-0,001262	0,002747**

Table 6.5.2.1: Alpha estimates for sub-sample analysis for the CAPM 1-factor model.
Significance levels: *** 1%, ** 5%, * 10%.

Sub-sample analysis: Carhart 4-factor model		
	Equal-weighted	Value-weighted
MSCI	-0,000358	0,002887**
Reference index	-0,001157	0,002461**
Oil fund	-0,000126	0,002410**

Table 6.5.2.2: Alpha estimates for sub-sample analysis for the Carhart 4-factor model.
Significance levels: *** 1%, ** 5%, * 10%.

6.6 Interpreting the results

In this section we will interpret and discuss the results from sections 6.1 to 6.5 in order to answer the following research questions:

1) Does the return of the exclusion portfolio differ from the market?
2) Does the return of the exclusion portfolio differ from the oil fund's reference index?
3) Does the return of the exclusion portfolio differ from the oil fund's portfolio?

As previously mentioned, the value-weighted portfolio is constructed by giving the companies a weight based on their market share. In contradiction to the value-weighted portfolio, the equal-weighted treats every company the same regardless of the market share. By giving equal weights to each company you assume that each stock is equally likely to have excess performance. When interpreting the results, it is important to keep in mind that the value-weighted portfolio is closer to the fund, and therefore more relevant when discussing the oil fund's effect of the exclusions.

From the results, we can see that all of the alphas from the value-weighted regressions are positive and this is in contrary to previous research. The company with the largest weight in the exclusion portfolio is Walmart which was excluded from 2006-2018. Because of their increasing returns after the Financial Crisis of 2008, the value-weighted portfolio receives a substantially higher return. This might be an explanation for the positive, significant alphas. In the following, a more detailed interpretation of the hypotheses will be presented.

6.6.1 Hypothesis 1

H_0: The return of the exclusion portfolios does not differ from the market.

H_1: The return of the exclusion portfolio differ from the market.

In order to get an answer to the first research question, we ran two different regressions. The results from the 1-factor and 4-factor model shows positive alphas for both the equal- and value-weighted portfolios. We find strong evidence of significance with the alphas being statistically significant at 1% level. The results indicates that the excluded companies perform better compared to the market, here being the MSCI index. For the equal- and value-weighted portfolio, the received R-values shows that our model is explained by approximately 81% and 64%, respectively. This indicates that the return of the exclusion portfolio significantly differs from the market, and we can reject the null hypothesis. By having an ethical investment strategy, you can end up losing a potentially higher return.

6.6.2 Hypothesis 2

H_0: The return of the exclusion portfolios does not differ from the oil fund's reference index.

H_1: The return of the exclusion portfolios differ from the oil fund's reference index.

For the second hypothesis we ran the same regressions as before, but with the oil fund's reference index as the independent variable. The value-weighted portfolio received a significantly positive alpha. In contrast, a not significantly negative alpha was the result of the equal-weighted portfolio regression. This expresses conflicting results. The outperformance of the value-weighted portfolio is significant at 1% level in CAPM and 5% level in the Carhart 4-factor model, while the underperformance of the equal-weighted regression showed no significance. Here suggesting that the exclusion portfolio shows tendencies of outperformance compared to the oil fund's reference index. On the other hand, we don't have enough solid evidence to reject the null hypothesis with certainty because of contradictory results.

6.6.3 Hypothesis 3

H_0: The return of the exclusion portfolios does not differ from the oil fund's portfolio.

H_1: The return of the exclusion portfolios differ from the oil fund's portfolio.

The results from this part of the analysis shows great similarities to the second hypothesis. Also here, we received a positive alpha for the value-weighted regression and a negative alpha for the equal-weighted regression. In addition, the outperformance is significant and the underperformance is not. Because of a significant outperformance, it is usual to draw the conclusion that the exclusion portfolio is performing better. As we can see in appendix 9, if Walmart weren't excluded, it would have had a large weight in the oil fund's portfolio, and contributed to a higher return. Since the Ethics Council have decided to exclude these unethical companies, the GPFG may end up losing a potentially higher return from not investing in them. It is therefore important for the oil fund, when deciding on an investment strategy, to consider whether they should focus on a higher return or ethics. Also in this case, with the results received from our analysis we don't have enough grounds to reject the null.

7 Conclusion

As already stated, this study aims to find out if a change in investment strategy come at the cost of financial gain. Previous papers have come to different conclusions regarding the performance of ethical investments. Yet, we can find a slight recurring in these studies, which is that the performance effect is not significant regardless of whether there is a out- or underperformance.

The Norwegian Government Pension Fund Global is, as mentioned, one of the world's largest Sovereign Wealth Funds, and there is a tendency for investors to follow their investment decisions. Ethical considerations plays a great part of the GPFG's investment strategy. The perspective of previous research have mostly been on comparing an exclusion portfolio to a market benchmark. Our contribution is therefore to also compare the portfolio to the oil fund's portfolio and it's reference index to figure out if the oil fund is losing out on an extraordinary return.

The hypotheses shows contradictory results regarding the performance and significance of the exclusion portfolio. This argues that the performance of the GPFG is neither harmed nor enhanced by an ethical investment strategy. The equal-weighted portfolio's explanatory power indicates that this result is more reliable than the result for the value-weighted portfolio. This is due to the R-values from the equal-weighted regressions being higher and above 0,7. The results received from the regressions with the value-weighted portfolio serving as dependent variable is not in consistency with previous research. Combining these results, the contradictory performance and the R-values, we can conclude that there is a lack of evidence in order to give a definite answer to our research question.

There are some limitations to our study. Using daily historical data in addition to having the exact exclusion date for the companies, could have made an impact on the results. Even though we didn't have enough evidence to draw to a final conclusion, we think that our paper could be a good foundation for further research on the financial impact of investment strategies.

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Appendices

Appendix 1: Regression output: CAPM 1-factor model: Equal-weighted portfolio

Regression statistics						
Multiple R	0,900929845					
R-squared	0,811674586					
Adjusted R-squared	0,810616578					
Standard error	0,020295985					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,316019069	0,316019069	767,1724872	1,94E−66	
Residuals	178	0,073323008	0,000411927			
Total	179	0,389342077				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-RF	0,000790823	0,001518419	0,520820234	0,603139286	−0,002205596	0,003787243
MSCI-Rf	0,965662611	0,034864136	27,69787875	1,94E−66	0,896862391	1,03446283

This output shows the results from the CAPM regression with the equal-weighted portfolio as the dependent variable and the MSCI index as the independent variable.

Regression statistics						
Multiple R	0,899359245					
R-squared	0,808847052					
Adjusted R-squai	0,807773159					
Standard error	0,02044778					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,314918191	0,314918191	753,1914977	7,32E−66	
Residuals	178	0,074423886	0,000418112			
Total	179	0,389342077				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-RF	−0,000614592	0,001535063	−0,400368963	6,89E−01	−0,003643856	0,002414672
RI-Rf	0,909889951	0,033154018	27,44433453	7,32E−66	0,844464446	0,975315455

This output shows the results from the CAPM regression with the equal-weighted portfolio as the dependent variable and the reference index as the independent variable.

Regression statistics						
Multiple R	0,904591284					
R-squared	0,818285391					
Adjusted R-squa	0,817264523					
Standard error	0,019936577					
Observations	180					

Analysis of variance

	df	SS	MS	F	Significance-F
Regression	1	0,318592933	0,318592933	801,5580063	8,03E−68
Residuals	178	0,070749143	0,000397467		
Total	179	0,389342077			

	Coefficients	Standard error	t-Stat	P-value	Lower 95%	Upper 95%
Equal-RF	−0,000796387	0,001497338	−0,531868148	0,595480502	−0,003751206	0,002158432
Oil fund-Rf	0,895375975	0,031625541	28,31179977	8,03E−68	0,832966738	0,957785213

This output shows the results from the CAPM regression with the equal-weighted portfolio as the dependent variable and the oil fund's portfolio as the independent variable.

Appendix 2: Regression output: CAPM 1-factor model: Value-weighted portfolio

Regression statistics						
Multiple R	0,800099169					
R-squared	0,64015868					
Adjusted R-squai	0,6381371					
Standard error	0,013778638					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,060118647	0,060118647	316,6624809	2,32E−41	
Residuals	178	0,033793454	0,000189851			
Total	179	0,093912101				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-RF	0,003478578	0,001030832	3,374534544	0,000907561	0,001444354	0,005512802
MSCI-Rf	0,421185459	0,023668736	17,79501281	2,32E−41	0,374478028	0,46789289

This output shows the results from the CAPM regression with the value-weighted portfolio as the dependent variable and the MSCI index as the independent variable.

Regression statistics						
Multiple R	0,791184086					
R-squared	0,625972258					
Adjusted R-squai	0,623870978					
Standard error	0,014047618					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,05878637	0,05878637	297,900528	7,33E−40	
Residuals	178	0,035125731	0,000197336			
Total	179	0,093912101				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-RF	0,002886241	0,001054588	2,736842717	0,006832484	0,000805137	0,004967344
RI-Rf	0,393122876	0,022776798	17,25979513	7,33E−40	0,348175577	0,438070174

This output shows the results from the CAPM regression with the value-weighted portfolio as the dependent variable and the reference index as the independent variable.

Regression statistics						
Multiple R	0,787060812					
R-squared	0,619464722					
Adjusted R-squai	0,617326883					
Standard error	0,014169295					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,058175233	0,058175233	289,7621503	3,42E−39	
Residuals	178	0,035736867	0,000200769			
Total	179	0,093912101				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-RF	0,002832381	0,001064186	2,661546368	0,008490009	0,000732336	0,004932426
Oil fund-Rf	0,382610105	0,022476858	17,02240143	3,42E−39	0,338254702	0,426965507

This output shows the results from the CAPM regression with the value-weighted portfolio as the dependent variable and the oil fund's portfolio as the independent variable.

Appendix 3: Regression output: Carhart 4-factor model: Equal-weighted portfolio

Regression statistics						
Multiple R	0,904308159					
R-squared	0,817773246					
Adjusted R-squared	0,813608063					
Standard error	0,02013505					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,318393534	0,079598383	196,3354924	1,46E−63	
Residuals	175	0,070948543	0,00040542			
Total	179	0,389342077				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-Rf	0,001255936	0,001540241	0,815415056	0,415943168	−0,001783903	0,004295774
MSCI-Rf	0,958808741	0,035107058	27,31099619	5,28E−65	0,889521013	1,028096469
SMB	−6,22E−06	0,000705429	−0,008822471	0,992970827	−0,001398468	0,00138602
HML	−0,000940889	0,000607299	−1,54930162	0,123115776	−0,002139461	0,000257683
WML	−0,002106119	0,001101398	−1,912223431	0,057481033	−0,004279851	6,76E−05

This output shows the results from the Carhart 4-factor model regression with the equal-weighted portfolio as the dependent variable and the MSCI index, SMB, HML and WML as the independent variables.

Regression statistics						
Multiple R	0,902587559					
R-squared	0,814664302					
Adjusted R-squared	0,810428057					
Standard error	0,020306084					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,317183091	0,079295773	192,308139	6,39E−63	
Residuals	175	0,072158986	0,000412337			
Total	179	0,389342077				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-Rf	−0,000151999	0,001560281	−0,097417909	0,922506006	−0,003231389	0,00292739
RI-Rf	0,903174309	0,033417845	27,02670687	2,32E−64	0,837220433	0,969128185
SMB	7,73E−05	0,000711499	0,108612659	0,913634154	−0,001326945	0,0014815
HML	−0,000903661	0,000612377	−1,475661674	0,141831721	−0,002112255	0,000304933
WML	−0,002044938	0,001111135	−1,840404264	0,067402488	−0,004237889	0,000148012

This output shows the results from the Carhart 4-factor model regression with the equal-weighted portfolio as the dependent variable and the reference index, SMB, HML and WML as the independent variables.

Regression statistics						
Multiple R	0,907524404					
R-squared	0,823600544					
Adjusted R-squared	0,819568556					
Standard error	0,019810492					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,320662346	0,080165587	204,266638	8,55E−65	
Residuals	175	0,06867973	0,000392456			
Total	179	0,389342077				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-Rf	−0,000358033	0,001523121	−0,235065556	0,814432682	−0,003364085	0,002648018
Oil fund-Rf	0,889217046	0,03191462	27,862373	3,06E−66	0,826229954	0,952204138
SMB	7,12E−06	0,000694068	0,010251849	0,991832029	−0,001362706	0,001376937
HML	−0,000893281	0,000597396	−1,495291969	0,136639374	−0,002072309	0,000285747
WML	−0,001944782	0,001084417	−1,793389411	0,074637456	−0,004085002	0,000195437

This output shows the results from the Carhart 4-factor model regression with the equal-weighted portfolio as the dependent variable and the oil fund's portfolio, SMB, HML and WML as the independent variables.

Appendix 4: Regression output: Carhart 4-factor model: Value-weighted portfolio

Regression statistics						
Multiple R	0,809946276					
R-squared	0,65601297					
Adjusted R-squared	0,648150409					
Standard error	0,013586663					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,061607556	0,015401889	83,43502777	1,64E−39	
Residuals	175	0,032304545	0,000184597			
Total	179	0,093912101				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,002879581	0,001039319	2,770643266	0,006199064	0,000828369	0,004930794
MSCI-Rf	0,431124356	0,023689425	18,19902174	3,22E−42	0,384370612	0,4778781
SMB	8,25E−04	0,000476007	1,733390548	0,084787634	−0,000114347	0,00176456
HML	−0,000394721	0,000409791	−0,963226131	0,336763154	−0,00120349	0,000414047
WML	0,001887913	0,000743198	2,54025768	0,011946721	0,000421129	3,35E−03

This output shows the results from the Carhart 4-factor model regression with the value-weighted portfolio as the dependent variable and the MSCI index, SMB, HML and WML as the independent variables.

Regression statistics						
Multiple R	0,801228582					
R-squared	0,64196724					
Adjusted R-squared	0,633783634					
Standard error	0,013861274					
Observations	180					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,060288492	0,015072123	78,44552205	5,31E−38	
Residuals	175	0,033623609	0,000192135			
Total	179	0,093912101				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,002271564	0,001065074	2,132776144	0,034337145	0,000169521	0,004373607
RI-Rf	0,40251024	0,022811582	17,64499494	1,08E−40	0,357489019	0,447531462
SMB	8,61E−04	0,000485681	1,771926947	0,078146867	−9,80E−05	0,001819137
HML	−0,000373957	0,000418019	−0,894593502	0,372233158	−0,001198963	0,00045105
WML	0,001897642	0,00075848	2,501902822	0,013270594	0,000400697	0,003394587

This output shows the results from the Carhart 4-factor model regression with the value-weighted portfolio as the dependent variable and the reference index, SMB, HML and WML as the independent variables.

Regression statistics	
Multiple R	0,797155479
R-squared	0,635456858
Adjusted R-squared	0,627124443
Standard error	0,013986731
Observations	180

Analysis of variance

	df	SS	MS	F	Significance-F
Regression	4	0,059677089	0,014919272	76,26323014	2,55E−37
Residuals	175	0,034235012	0,000195629		
Total	179	0,093912101			

	Coefficients	Standard error	t-Stat	P-value	Lower 95%	Upper 95%
Value-Rf	0,002211062	0,001075364	2,056105868	0,041257162	8,87E−05	0,004333414
Oil fund-Rf	0,392001997	0,022532565	17,39713159	5,25E−40	0,347531446	0,436472548
SMB	8,27E−04	0,00049003	1,687988411	0,093194775	−0,000139964	0,001794296
HML	−0,000364509	0,000421777	−0,864221371	0,388649309	−0,001196934	0,000467916
WML	0,001920274	0,000765627	2,508105722	0,013047997	0,000409223	0,003431325

This output shows the results from the Carhart 4-factor model regression with the value-weighted portfolio as the dependent variable and the oil fund's portfolio, SMB, HML and WML as the independent variables.

Appendix 5: Output: T-test: Equal-weighted portfolio

	Equal-weighted portfolio	*MSCI Index*	Difference
Average	0,005470315	0,004808333	0,000661982
Variance	0,002177896	0,001896406	
Observations	180	180	
Pearson-correlation	0,901066329		
Estimated deviations between averages	0		
df	179		
T-stat	0,437631545		

This output shows the results from the t-test between the equal-weighted portfolio and the MSCI index.

	Equal-weighted portfolio	*Reference index*	Difference
Average	0,005470315	0,006582929	−0,001112613
Variance	0,002177896	0,002128875	
Observations	180	180	
Pearson-correlation	0,899511748		
Estimated deviations between averages	0		
df	179		
T-stat	−0,717333505		

This output shows the results from the t-test between the equal-weighted portfolio and the reference index.

	Equal-weighted portfolio	*Oil fund*	Difference
Average	0,005470315	0,006875556	−0,00140524
Variance	0,002177896	0,002224269	
Observations	180	180	
Pearson-correlation	0,904745225		
Estimated deviations between averages	0		
df	179		
T-stat	−0,920440908		

This output shows the results from the t-test between the equal-weighted portfolio and the oil fund's portfolio.

Appendix 6: Output: T-test: Value-weighted portfolio

	Value-weighted portfolio	*MSCI Index*	Difference
Average	0,00611507	0,004808333	0,001306737
Variance	0,000521798	0,001896406	
Observations	180	180	
Pearson-correlation	#I/T		
Estimated deviations between averages	0		
df	179		
T-stat	0,611087166		

This output shows the results from the t-test between the value-weighted portfolio and the MSCI index.

	Value-weighted portfolio	*Reference index*	Difference
Average	0,00611507	0,006582929	−0,000467858
Variance	0,000521798	0,002128875	
Observations	180	180	
Pearson-correlation	#I/T		
Estimated deviations between averages	0		
df	179		
T-stat	−0,200624905		

This output shows the results from the t-test between the value-weighted portfolio and the reference index.

	Value-weighted portfolio	*Oil fund*	Difference
Average	0,00611507	0,006875556	−0,000760485
Variance	0,000521798	0,002224269	
Observations	180	180	
Pearson-correlation	#I/T		
Estimated deviations between averages	0		
df	179		
T-stat	−0,315489965		

This output shows the results from the t-test between the value-weighted portfolio and the oil fund's portfolio.

Appendix 7: Sub-sample analysis: CAPM 1-factor model

Regression statistics	
Multiple R	0,900401327
R-squared	0,81072255
Adjusted R-squai	0,809118504
Standard error	0,015995346
Observations	120

Analysis of variance	*df*	*SS*	*MS*	*F*	*Significance-F*
Regression	1	0,129313142	0,129313142	505,4234466	1,81E−44
Residuals	118	0,030190429	0,000255851		
Total	119	0,159503571			

	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-RF	−0,000382767	0,001475318	−0,259447349	0,7957422	−0,0033043	0,002538765
MSCI-Rf	0,863178245	0,038394834	22,48162464	1,81E−44	0,787146021	0,93921047

This output shows the results from the sub-sample analysis for the CAPM 1-factor model with the equal-weighted portfolio as the dependent variable and the MSCI index as the independent variable.

Regression statistics	
Multiple R	0,898584276
R-squared	0,8074537
Adjusted R-squai	0,805821952
Standard error	0,016132876
Observations	120

Analysis of variance	*df*	*SS*	*MS*	*F*	*Significance-F*
Regression	1	0,128791749	0,128791749	494,8396138	4,99E−44
Residuals	118	0,030711822	2,60E−04		
Total	119	0,159503571			

	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-RF	−0,001183651	0,001493646	−0,79245743	0,429684336	−0,004141478	0,001774175
RI-Rf	0,807505185	3,63E−02	22,24499076	4,99E−44	0,735620232	0,879390138

This output shows the results from the sub-sample analysis for the CAPM 1-factor model with the equal-weighted portfolio as the dependent variable and the reference index as the independent variable.

Regression statistics						
Multiple R	0,898706064					
R-squared	0,807672589					
Adjusted R-squai	0,806042696					
Standard error	0,016123703					
Observations	120					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,128826663	0,128826663	495,5370898	4,67E−44	
Residuals	1,18E+02	0,030676909	0,000259974			
Total	119	0,159503571				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-RF	−0,001262443	0,001493386	−0,845355853	0,399623048	−0,004219753	0,001694868
Oil fund-Rf	0,796318527	0,035772454	22,26066238	4,67E−44	0,725479329	0,867157726

This output shows the results from the sub-sample analysis for the CAPM 1-factor model with the equal-weighted portfolio as the dependent variable and the oil fund's portfolio as the independent variable.

Regression statistics						
Multiple R	0,864462666					
R-squared	0,747295702					
Adjusted R-squai	0,74515414					
Standard error	0,012101467					
Observations	120					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,051101997	0,051101997	348,9489233	4,80E−37	
Residuals	118	0,017280568	0,000146445			
Total	119	0,068382565				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,00320761	0,001116169	2,873766412	0,004811957	0,000997291	0,00541793
MSCI-Rf	0,542622865	0,029048062	18,68017461	4,80E−37	0,485099794	0,600145935

This output shows the results from the sub-sample analysis for the CAPM 1-factor model with the value-weighted portfolio as the dependent variable and the MSCI index as the independent variable.

Regression statistics						
Multiple R	0,843086512					
R-squared	0,710794868					
Adjusted R-squai	0,708343977					
Standard error	0,012945973					
Observations	120					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,048605976	0,048605976	290,0148889	1,41E−33	
Residuals	118	0,019776589	1,68E−04			
Total	119	0,068382565				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,002783424	0,00119859	2,322248313	0,021933879	0,000409889	0,005156959
RI-Rf	0,496073622	0,029129698	17,02982351	1,41E−33	0,438388889	0,553758356

This output shows the results from the sub-sample analysis for the CAPM 1-factor model with the value-weighted portfolio as the dependent variable and the reference index as the independent variable.

Regression statistics						
Multiple R	0,840194956					
R-squared	0,705927563					
Adjusted R-squai	0,703435424					
Standard error	0,013054458					
Observations	120					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	1	0,048273138	0,048273138	283,2616802	3,78E−33	
Residuals	1,18E+02	0,020109428	0,000170419			
Total	119	0,068382565				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,002747329	0,001209111	2,272189695	0,024885997	0,000352961	0,005141698
Oil fund-Rf	0,487457443	0,02896295	16,83037968	3,78E−33	0,430102917	0,544811969

This output shows the results from the sub-sample analysis for the CAPM 1-factor model with the value-weighted portfolio as the dependent variable and the oil fund's portfolio as the independent variable.

Appendix 8: Sub-sample analysis: Carhart 4-factor model

Regression statistics	
Multiple R	0,900837397
R-squared	0,811508017
Adjusted R-squared	0,804951774
Standard error	0,016168984
Observations	120

Analysis of variance

	df	*SS*	*MS*	*F*	*Significance-F*
Regression	4	0,129438427	0,032359607	123,7763806	1,02E−40
Residuals	115	0,030065145	0,000261436		
Total	119	0,159503571			

	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Equal-Rf	−0,000357928	0,001506073	−0,237656311	8,13E−01	−0,003341169	0,002625313
MSCI-Rf	8,63E−01	0,03887343	22,1904077	2,27E−43	0,78561648	0,939618047
SMB	2,07E−05	0,000722373	0,028715814	0,977141018	−0,001410138	0,001451626
HML	−0,000279488	0,000663783	−0,421053061	0,674502209	−0,001594313	1,04E−03
WML	−0,000588667	0,001120862	−0,525191631	0,600461082	−0,002808879	0,001631544

This output shows the results from the sub-sample analysis for the Carhart 4-factor model with the equal-weighted portfolio as the dependent variable and the MSCI index, SMB, HML and WML as the independent variables.

Regression statistics						
Multiple R	0,898919014					
R-squared	0,808055394					
Adjusted R-squai	0,80137906					
Standard error	0,016316396					
Observations	120					
Analysis of variance						
	df	SS	MS	F	Significance-F	
Regression	4	0,128887721	0,03222193	121,0327976	2,88E−40	
Residuals	115	0,03061585	0,000266225			
Total	119	0,159503571				
	Coefficients	Standard error	t-Stat	P-value	Lower 95%	Upper 95%
Equal-Rf	−0,001156989	1,53E−03	−0,758337897	0,44980006	−0,004179088	0,00186511
RI-Rf	0,806923699	0,036773894	21,94284103	6,45E−43	0,734081694	0,879765705
SMB	9,42E−06	0,00072894	0,012924288	0,989710592	−0,001434468	0,00145331
HML	−0,000235421	0,000669805	−0,351476652	0,725873939	−0,001562175	0,001091333
WML	−0,000529086	0,001131223	−0,467711216	0,640876239	−0,00276982	0,001711649

This output shows the results from the sub-sample analysis for the Carhart 4-factor model with the equal-weighted portfolio as the dependent variable and the reference index, SMB, HML and WML as the independent variables.

Regression statistics						
Multiple R	0,899012848					
R-squared	0,808224101					
Adjusted R-squai	0,801553635					
Standard error	0,016309224					
Observations	120					
Analysis of variance						
	df	SS	MS	F	Significance-F	
Regression	4	0,128914631	0,032228658	121,1645629	2,74E−40	
Residuals	115	0,030588941	0,000265991			
Total	119	0,159503571				
	Coefficients	Standard error	t-Stat	P-value	Lower 95%	Upper 95%
Equal-Rf	−1,26E−03	0,001525803	−0,823889707	0,411707658	−0,004279415	0,001765228
Oil fund-Rf	0,79588701	0,036251171	21,95479466	6,13E−43	0,724080418	0,867693603
SMB	2,45E−05	0,000728649	0,033572613	0,973276163	−0,00141885	0,001467775
HML	−0,000274787	0,000669537	−0,410414006	0,682265911	−0,001601011	0,001051436
WML	−0,000439996	0,001130941	−0,389053331	0,697956139	−0,002680172	0,00180018

This output shows the results from the sub-sample analysis for the Carhart 4-factor model with the equal-weighted portfolio as the dependent variable and the oil fund’s portfolio, SMB, HML and WML as the independent variables.

Regression statistics						
Multiple R	0,872150062					
R-squared	0,760645731					
Adjusted R-squared	0,752320366					
Standard error	0,011930108					
Observations	120					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,052014906	0,013003727	91,36484136	8,82E−35	
Residuals	115	0,016367659	0,000142327			
Total	119	0,068382565				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,002886697	0,00111124	2,597726579	0,010611181	0,000685545	0,005087848
MSCI-Rf	0,546569798	0,028682335	19,05597315	2,22E−37	0,489755614	6,03E−01
SMB	0,000799553	0,000532995	1,500112764	0,136325649	−0,000256208	0,001855313
HML	−0,000205636	0,000489765	−0,4198661	0,675366659	−0,001175765	0,000764494
WML	0,002025165	0,000827016	2,448762077	0,015844233	0,000387006	0,003663324

This output shows the results from the sub-sample analysis for the Carhart 4-factor model with the value-weighted portfolio as the dependent variable and the MSCI index, SMB, HML and WML as the independent variables.

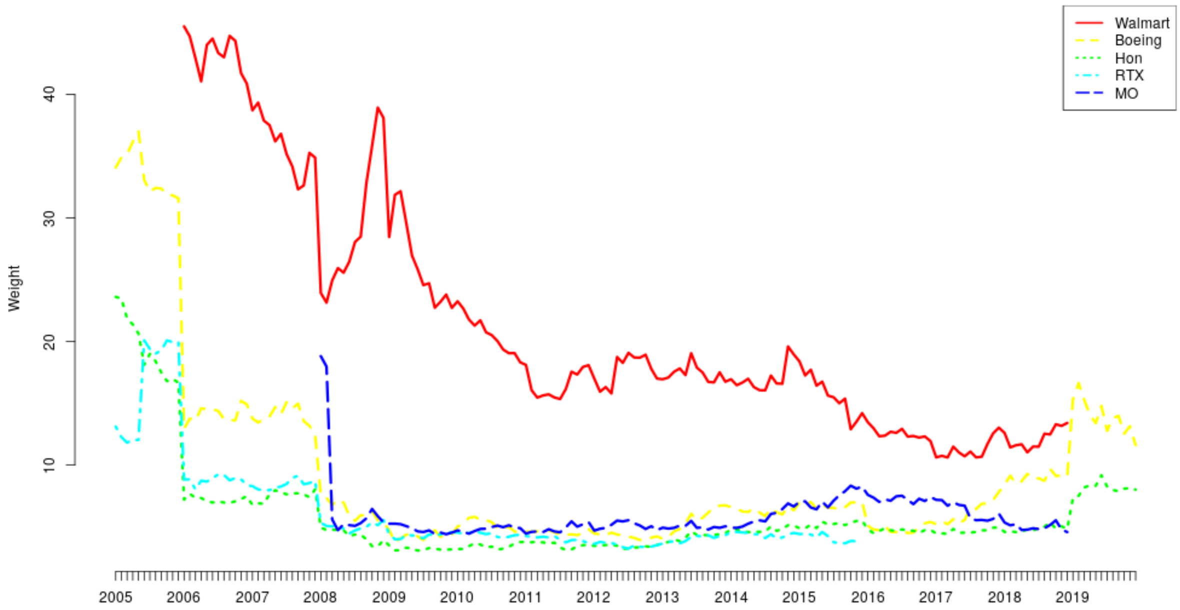
Regression statistics						
Multiple R	0,851008602					
R-squared	0,724215641					
Adjusted R-squai	0,714623142					
Standard error	0,012805855					
Observations	120					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,049523723	0,012380931	75,49811664	2,90E−31	
Residuals	115	0,018858842	0,00016399			
Total	119	0,068382565				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,002461453	0,001197432	2,055610349	0,042084444	8,96E−05	0,004833335
RI-Rf	0,499877426	0,028861837	17,319668	7,83E−34	0,442707683	0,55704717
SMB	0,000782741	0,000572105	1,368177353	0,173923852	−0,000350489	0,001915972
HML	−0,000174908	0,000525693	−0,332718921	0,739952223	−0,001216205	0,000866389
WML	0,002044909	0,000887835	2,303251977	0,023061953	0,000286278	0,00380354

This output shows the results from the sub-sample analysis for the Carhart 4-factor model with the value-weighted portfolio as the dependent variable and the reference index, SMB, HML and WML as the independent variables.

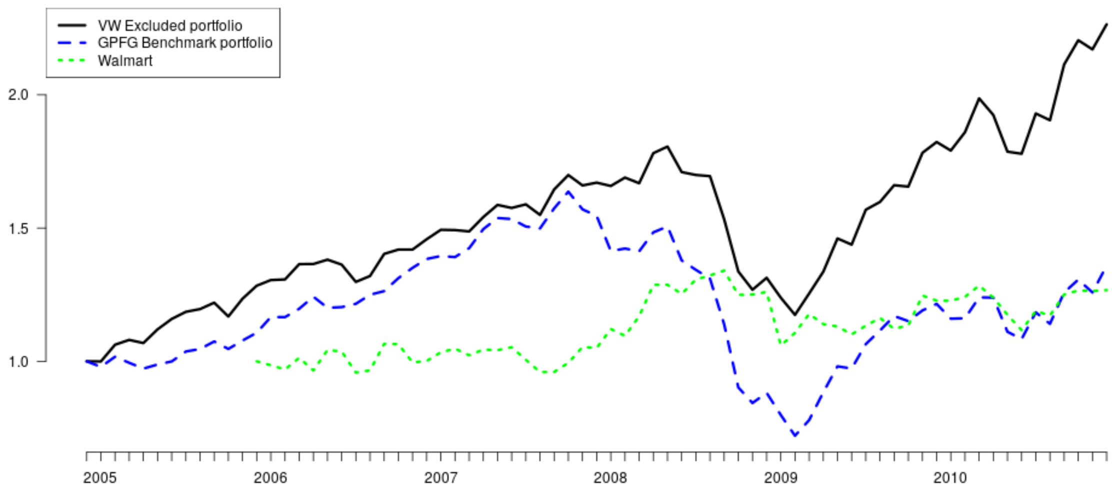
Regression statistics						
Multiple R	0,84856034					
R-squared	0,720054651					
Adjusted R-squai	0,710317422					
Standard error	0,0129021					
Observations	120					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance-F*	
Regression	4	0,049239184	0,012309796	73,94861652	6,83E−31	
Residuals	115	0,019143381	0,000166464			
Total	119	0,068382565				
	Coefficients	*Standard error*	*t-Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Value-Rf	0,002410288	0,001207051	1,996841101	0,048204325	1,94E−05	0,004801223
Oil fund-Rf	0,491560768	0,028678018	17,14068105	1,86E−33	0,434755132	0,548366403
SMB	0,000790764	0,000576428	1,371833945	0,17278549	−0,00035103	0,001932557
HML	−0,000198853	0,000529665	−0,375431179	0,708031394	−0,001248018	0,000850312
WML	0,002097564	0,000894678	2,344489172	0,020768591	0,000325378	0,00386975

This output shows the results from the sub-sample analysis for the Carhart 4-factor model with the value-weighted portfolio as the dependent variable and the oil fund's portfolio, SMB, HML and WML as the independent variables.

Appendix 9: Graphs



This graph shows the largest weights in the value-weighted portfolio.



This graph shows the returns of Walmart together with the value-weighted portfolio in the 2004-2010 timeframe.

Appendix 10: List of excluded companies

Excluded companies	Exclusion time period
General Dynamics Corp.	2005-2018
Lockheed Martin Corp.	2005-2014 & 2016-2019
Raytheon Co.	2005-2015
Thales S.A.	2005-2008
BAE Systems Plc.	2005-2011 & 2017-2019
Boeing Co.	2005-2019
Finmeccanica Sp. A.	2005-2012
Honeywell International Group	2005-2019
Northrop Grumman Corp.	2005-2019
Safran S.A.	2005-2019
Singapore Technologies Engineering	2005-2015
Poongsan Corp.	2006-2018
Airbus SE	2006-2019
Wal-Mart Stores Inc.	2006-2018
Wal-Mart de Mexico S.A.	2006-2018
Freeport McMoRan Copper & Gold Inc.	2006-2019
Hanwha Corp.	2007-2018
Aerojet Rocketdyne Holdings Inc.	2007-2019
Serco Group Plc.	2007-2019
DRD Gold Ltd.	2007-2008
Textron Inc.	2008-2018
Dongfeng Motor Group Co. Ltd.	2008-2013
Barrick Gold Corp.	2008-2019
Rio Tinto Plc.	2008-2018
Rio Tinto Ltd.	2008-2018
MMC Norilsk Nickel	2009-2019
Altria Group Inc.	2009-2019
British American Tobacco BHD	2009-2019
British American Tobacco Plc.	2009-2019

Gudang Garam Tbk. Pt.	2009-2019
Imperial Tobacco Group Plc.	2009-2019
ITC Ltd.	2009-2019
Japan Tobacco Inc.	2009-2019
KT&G Corp.	2009-2019
Philip Morris Int. Inc.	2009-2019
Philip Morris CR AS	2009-2019
Swedish Match AB	2009-2019
Universal Corp. VA	2009-2019
Vector Group Ltd.	2009-2019
Elbit Systems Ltd.	2009-2019
Grupo Carso SAB de CV	2011-2018
Shanghai Industrial Holdings Ltd.	2011-2019
FMC Corp.	2011-2012
Nutrien Ltd.	2011-2018
Shikun & Binui Ltd.	2012-2019
Jacobs Engineering Group Inc.	2013-2019
BWX Technologies Inc.	2013-2019
Zuari Agro Chemicals Ltd.	2013-2019
Ta Ann Holdings Berhad	2013-2019
Volcan Compania Minera SAA	2013-2019
WTK Holdings Berhad	2013-2019
Zijn Mining Group Co. Ltd.	2013-2019
Huabao International Holdings Ltd.	2013-2019
Schweitzer-Mauduit International Inc.	2013-2019
Vedanta Ltd.	2014-2016 & 2018-2019
Orbital ATK	2015-2017
Genting Bhd.	2015-2019
IJM Corp. Bhd.	2015-2019
POSCO	2015-2019
Posco Daewoo Corp.	2015-2019
ZTE Corp.	2015-2019
Duke Energy Corp.	2016-2019

Caim Energy Plc.	2016-2017
Kosmos Energy Ltd.	2016-2017
San Leon Energy Plc.	2016-2019
Aboitiz Power Corp.	2016-2019
AES Corp/VA	2016-2019
AES Gener SA	2016-2019
Allete Inc.	2016-2019
Alliant Energy Corp.	2016-2019
Ameren Corp.	2016-2019
American Electric Power Co. Inc.	2016-2019
Capital Power Corp.	2016-2019
CESC Ltd.	2016-2019
China Coal Energy Co. Ltd.	2016-2019
China Power Int. Development Ltd.	2016-2019
China Resources Power Holdings Co. Ltd.	2016-2019
China Shenhua Energy Co. Ltd.	2016-2019
9Chugoku Electric Power Co. Inc/The	2016-2019
CLP Holdings Ltd.	2016-2019
Coal India Ltd.	2016-2019
Consol Energy Inc.	2016-2019
Datang Int. Power Generation Co. Ltd.	2016-2019
DMCI Holdings Inc.	2016-2019
Drax Group PLC	2016-2019
DTE Energy Co.	2016-2019
Electric Power Development Co. Ltd.	2016-2019
Electricity Generating PCL	2016-2019
Emera Inc.	2016-2019
Exxaro Resources Ltd.	2016-2019
FirstEnergy Corp.	2016-2019
Guangdong Electric Power Developement	2016-2019
Gujarat Mineral Development Corp. Ltd.	2016-2019
Hokkaido Electric Power Co. Inc.	2016-2019
Hokuriku Electric Power Co.	2016-2019

Huadian Power Int. Corp. Ltd.	2016-2019
Huaneng Power Int. Inc.	2016-2019
Idacorp Inc.	2016-2019
Inner Mongolia Yitai Coal Co. Ltd.	2016-2019
Jastrzebska Spolka Weglowa SA	2016-2019
Lubelski Wegiel Bogdanka SA	2016-2019
MGE Energy Inc.	2016-2019
New Hope Corp. Ltd.	2016-2019
NRG Energy Inc.	2016-2019
NTPC Ltd.	2016-2019
Okinawa Electric Power Co. Inc./The	2016-2019
Peabody Energy Corp.	2016-2019
PNM Resources Inc.	2016-2019
Public Power Corp. SA	2016-2019
Reliance Infrastructure Ltd.	2016-2019
Reliance Power Ltd.	2016-2019
Shikoku Electric Power Co. Inc.	2016-2019
Tata Power Co. Ltd.	2016-2019
Tenaga Nasional Bhd.	2016-2019
TransAlta Corp.	2016-2019
WEC Energy Group Inc.	2016-2019
Whitehaven Coal Ltd.	2016-2019
Xcel Energy Inc.	2016-2019
Yanzhou Coal Mining Co. Ltd.	2016-2019
AECOM	2017-2019
Huntington Ingalls Industries Inc.	2017-2019
Fluor Corp.	2017-2019
Atai SA	2017-2019
Bharat Heavy Electricals Ltd.	2017-2019
CEZ AS	2017-2019
Eneva SA	2017-2019
HK Electric Investments	2017-2019
Korea Electric Power Corp.	2017-2019

Otter Tail Corp.	2017-2019
PGE Polska Grupa Energetyczna SA	2017-2019
SDIC Power Holdings Co. Ltd.	2017-2019
Luthai Textile Co. Ltd.	2018-2019
Texwinca Holdings Co.	2018-2019
Pyxus International Inc.	2018-2019
JBS SA	2018-2019
Engie Energia Chile SA	2018-2019
Evergy Inc.	2018-2019
PacifiCorp	2018-2019
Evergreen Marine Corp. Taiwan Ltd.	2018-2019
Korea Line Corp.	2018-2019
Precious Shipping PCL	2018-2019
Thoresen Thai Agencies PCL	2018-2019
G4S Plc	2019
Halcyon Agri Corp. Ltd.	2019

This table shows all of the excluded companies in the period 2005-2019, with the exclusion period for all of the companies.