Norwegian School of Economics
Bergen, Fall 2021

The Government Pension Fund Global: How are the bets distributed, and where is the active return created?

A holdings-based analysis of The Government Pension Fund Global's investments in equities from 2014 to 2021.

Jonas K. Løbersli and Rasmus N. Vonen

Supervisor: Trond M. Døskeland

Master Thesis in Financial Economics

Norwegian School of Economics

Abstract

The Management of the Government Pension Fund Global (hereafter the "Fund") is a heated topic. The Fund is managed actively to outperform the benchmark and generate a positive active return. The literature is skeptical of this possibility, but the Fund advocates that the active management has yielded a positive active return. This thesis studies the active management of the equities portfolio of the Fund. Therefore, a holdings-based analysis is conducted for the time period from 2014 to 2021.

First, we investigate how actively the Fund has been managed. The Fund's active management has been low, and we find indications of a decreasing degree of active management during the time period. Second, we identify how the Fund's bets can be divided into overweights and underweights, regions, and industries. We find that the Fund's overweights have a larger variation in size than the underweights. Additionally, the distribution of bets between regions and industries is largely determined by their market capitalization. This distribution is somewhat affected by different degrees of active management in the regions and industries. Third, we investigate the contribution to the active return from the different groups of overweights and underweights, regions, and industries. We did not find statistically significant contributions to the active return from any regions. This was the case for industries as well, without the exception of a significantly positive contribution to the active return in Utilities. This positive return was mainly caused by good performance in security selection. We found a significantly positive contribution from the 20 largest underweights. We also found indications of a positive contribution to the active return from all underweights and a negative contribution from all overweights. These results were not statistically significant, and we cannot conclude this was caused by poor or well performance and not a coincidence.

Acknowledgments

This thesis was written as a part of our Master of Science in Economics and Business Administration at the Norwegian School of Economics, with Financial Economics as our major. We want to extend our gratitude to our supervisor, Trond M. Døskeland, who provided insightful feedback, and advice to keep us moving in the right direction. Additionally, we want to thank the PhD students André Sjuve and Andreas Ørpetveit for valuable data support. Finally, we would like to thank Halvor Hoddevik for valuable ideas and input for our thesis.

Contents

List of Figures

List of Tables

1 Introduction

The Government Pension Fund Global (hereafter the "Fund") is a major participant in the global market and contributor to the Norwegian economy. Therefore, it is not surprising that the management of the Fund is highly debated and of great interest to the Norwegian population. The Fund is managed actively to outperform the benchmark and generate a positive active return. The Fund claims that active management has successfully contributed with a positive active return. However, the literature is skeptical of this management style, and several experts question if the Fund should be managed actively or not. This discussion makes the recent hire of Nicolai Tangen as the Fund's CEO more interesting. As a former hedge fund manager, his appointment was considered controversial by politicians and experts, who feared the Fund would become more active. As a former hedge fund manager, his appointment was considered controversial by politicians and experts, who feared the Fund would become more active. At the same time, there are political discussions about the Fund, with newly elected prime minister Jonas Gahr Støre wanting the Fund to become more politically governed (Melgård, 2021).

The global influence and domestic contribution of the Fund cannot be underestimated. According to NBIM (2021*e*), the Fund holds on average 1.4% of all listed equities and is the largest sovereign wealth fund in the world by asset under management(Statista, 2021). In Norway's National Budget for 2021, 371 billion NOK was transferred from the Fund to cover its deficit (Finansdepartementet, 2020). This withdrawal accounts for about 25% of total expenditures. The Fund's global influence and domestic contribution are some of the main motivational factors for our thesis. The ongoing debate about the Fund's management and political landscape is intriguing. Therefore, We would like to contribute to this discussion by studying the Fund's active management.

We are conducting a holdings-based analysis of the Fund's equities. A holdings-based analysis is a "bottom-up" approach, where a fund is defined after the characteristics of a fund's individual securities (Kaplan, 2003). More specifically, we are analyzing the performance of the equity portfolio using portfolio weights, benchmark weights, and return data of the individual equities in the Fund. This style contrasts with the returns-based style, where the analysis is based on the portfolio's historical returns. The holdings-based angle enables us to rely primarily on publicly available data. This is methodically interesting because we can assess the possibility of evaluating the Fund's management for outsiders of the Fund. This is done by analyzing the precision of our findings. We examine investments in equities because equities make up the largest share of the Fund's

total assets, and there is more publicly available data for this asset class.

The Fund has been evaluated several times, with the latest review published in 2018. We do not wish to reproduce previous evaluations and need another point of view for our thesis. In the latest review, Dahlquist and Ødegaard (2018) evaluated the Fund's performance using holdings. This was not the main focus of their evaluation, and we believe our holdings-based analysis is more thorough. Our thesis overlaps with their evaluation with an active share analysis and an attribution analysis. However, we have extended their research by analyzing different groups' contribution to the active return and a different time period.

1.1 Research Question

In the thesis, we answer the main research question: How does the Fund distribute their bets, and where is the Fund's active return created? This implies we investigate active bets taken by the Fund. An active bet (or simply a "bet") is a position in a security that differs from the benchmark position in the same security. There are several ways of answering the main research question. Therefore, it is necessary to narrow it down and explain in detail what we will study in our thesis.

First, we want to assess how actively the Fund has been managed. This is important since active management is a condition for generating an active return. Additionally, it is interesting to analyze if the Fund has become more or less active during the time period.

Second, a holdings-based analysis enables us to identify the Fund's bets. Therefore, we will map how the Fund distributes their bets between size, overweights and underweights, and geographical and industrial affiliation. Consequently, we can determine where the Fund is most active. The purpose of mapping the Fund's bets is to analyze systematical differences in how the Fund distributes their bets.

Third, we will study how different groups of bets have contributed to the Fund's active return. We investigate how bets of varying size, overweights and underweights, regions, and industries have contributed to the active return. The purpose of analyzing different groups' contribution to the active return is to extend the research of where the Fund's active return is created.

The main research question can be decomposed into three different sub-questions.

1. How actively has the Fund been managed?
2. How have the Fund distributed their bets?
3. Where is the Fund's active return created?

The rest of the paper is structured as follows to answer the research questions. First, we make a brief introduction of the Fund and relevant theories in chapter 2. The data and methodology is presented in chapter 3, and our findings are presented in chapter 4. Next, we discuss the precision of our estimations in chapter 5. Lastly, we present our conclusion and raise suggestions for further research in chapter 6.

2 Context

In this chapter, we put our thesis in context. This chapter aims to provide the necessary background and knowledge, to answer the research questions. First, we make a brief introduction about the Fund in section 2.1. Second, we present theory and concepts about portfolio management in section 2.2. Third, we present performance measures needed to evaluate the management of the Fund in section 2.3. Lastly, we present necessary measures to assess how active the Fund is managed in section 2.4.

2.1 The Government Pension Fund Global

In this section, we present the Fund. We briefly introduce the Fund's history, strategy, investment universe, benchmark, risk, and organization. The purpose of this section is to better understand the Fund.

2.1.1 History

The Fund, originally named The Government Petroleum Fund, was founded in 1990 by the Norwegian parliament. It was set up to shield the Norwegian economy from fluctuations in petroleum revenue and manage revenues in the long term (NBIM, 2021*c*). Additionally, the Fund was created to give the government possibilities in the fiscal policy when the mainland economy contracts. The Fund was designed for long-term investments to manage the financial challenges of an aging population and to withdraw funds when required (Dahlquist and Ødegaard, 2018). The Ministry of Finance is responsible for the Fund's management and has tasked the Norwegian Central Bank with this assignment (NBIM, 2019*b*).

The first capital was transferred to the Fund in 1996 by the Ministry of Finance (NBIM, 2021*c*). The Fund was initially invested in the same manner as the Norwegian Central Bank's foreign exchange assets; outside of Norway and in government bonds. Several significance changes have occurred since the establishment of the Fund. The Ministry of Finance changed the composition of assets in 1997 and determined that 40% of the assets were invested in equities. Norges Bank Investment Management(NBIM) was established as an entity of the Central Bank in 1998 to manage the Fund on behalf of the Ministry of Finance (NBIM, 2021*d*). The composition of assets in the Fund has changed several times since the establishment. The first emerging markets were added to the equity benchmark in 2000, corporate and securitized bonds were included in the fixed-income benchmark in 2002, and real estate was added as an asset class in 2008. In 2004, ethical guidelines were

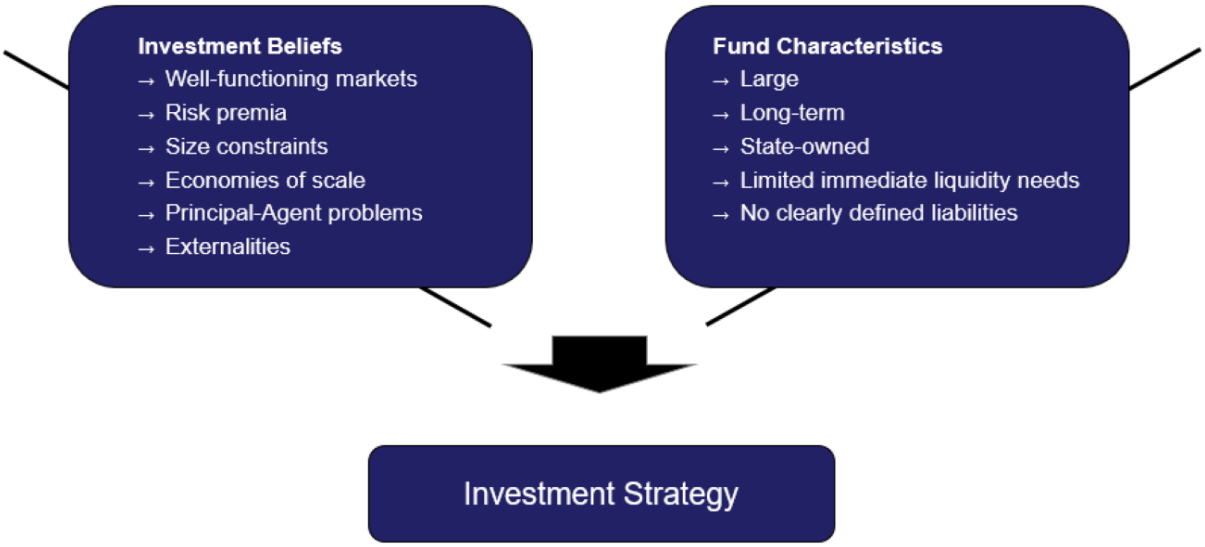
established, and the Fund officially changed their name to the Government Pension Fund Global in 2006.

Since the establishment of the Fund, withdrawals of capital have gradually increased. To maintain the long-term value of the Fund, the fiscal policy called *Handlingsregelen* was introduced in 2001 (Finansdepartementet, 2019). This rule states that capital withdrawals are limited to the Fund's expected real return. This expectation was initially set to 4% of the Fund's assets and later adjusted to 3%. *Handlingsregelen* allows for flexibility, and withdrawals are adjusted to the business cycle of the economy. E.g., withdrawals were not limited to 3% during the covid crisis.

2.1.2 Strategy

The Fund's investment universe is based on a long-developed strategy by the Ministry of Finance. The strategy is based on expected return and risk in the long term, unique characteristics of the Fund, advantages for the asset manager, and beliefs about financial markets (Finansdepartementet, 2021*b*). See figure 2.1.1 for the investment beliefs and characteristics of the Fund. The strategy is communicated through restrictions in the investment universe, a strategic benchmark, risk limits, and other determinants set by the Ministry of Finance.

Figure 2.1.1: Investment beliefs and characteristics of the Fund



*Data source: (Finansdepartementet, 2021*b*)*

2.1.3 Investment Universe

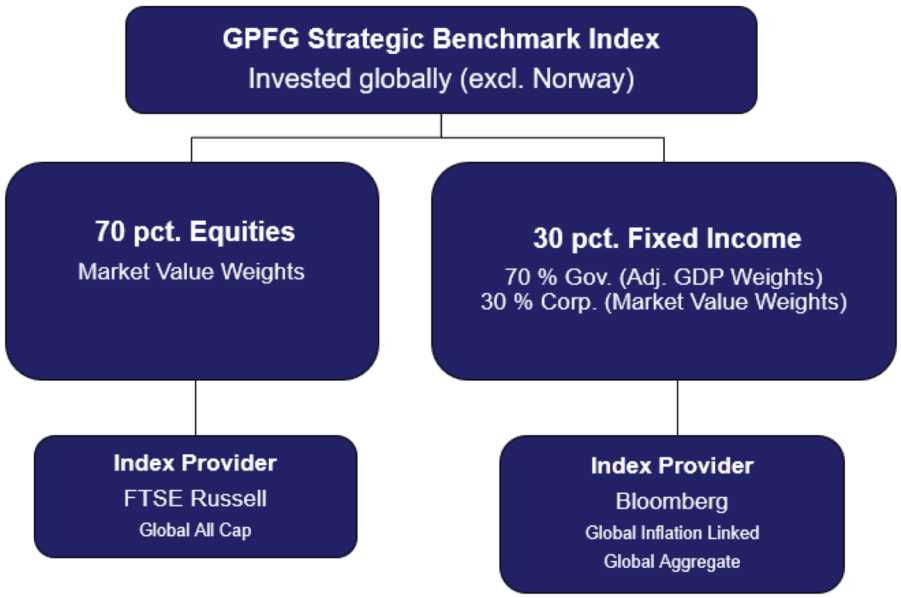
The Fund's investment universe is restricted to listed equities, tradeable debt instruments, unlisted real estate, and unlisted renewable energy infrastructure (Finansdepartementet, 2021*c*). It is allowed to invest in unlisted equities if the company intends to list in the near future. The possibility to invest in unlisted equities was evaluated in 2018 with recommendations of opening for such investments (Døskeland and Strömberg, 2018). The Fund's assets cannot be invested in Norway or securities excluded by Norges Bank. An independent ethics counsel, appointed by the Ministry of Finance, advises the Central Bank about companies to observe or exclude from the Fund because of ethical violations. The Executive Board of Norges Bank may choose to exclude a company from the Fund based on the recommendations of the ethics counsel. See appendix 7.2.3 for information about excluded companies.

2.1.4 Benchmark

The Fund's investments are measured against a benchmark index determined by the Ministry of Finance. The strategic Benchmark index determines the proportion of equities and bonds in the Fund. Currently, the strategic benchmark index consists of 70% equities and 30% bonds, and there are separate benchmark indices for each asset class. The equity index and the bond index are global indices and reflect investment possibilities in the global market (Finansdepartementet, 2021*b*). Real estate investments are not a part of the strategic benchmark, but the portfolio of real estate may have a weight of 0-7% of the total portfolio (Dahlquist and Ødegaard, 2018).

The strategic benchmark for equities is based on FTSE Global All Cap, an index provided by FTSE Russell (Finansdepartementet, 2021*d*). FTSE Global All Cap includes all countries FTSE Russell categories as developed markets, advanced emerging markets, and secondary emerging markets (Finansdepartementet, 2021*c*). The benchmark weights within different regions are distributed after the size of the listed equity market in the country, adjusted for free flow of capital. See figure 2.1.2 for the strategic benchmark index for 2020.

Figure 2.1.2: Strategic Benchmark Index for 2020



*Data source: (Finansdepartementet, 2021*d*)*

The benchmark index for equities will depend on criteria set by the index providers for which regions and countries to include. Therefore, The Ministry of Finance has made geographical adjustments to the index. These adjustments are made to spread the risk of the Fund and the wealth of the nation. This is achieved by assigning adjustment factors to different regions. The factors are determined by the Ministry of Finance in *Management Mandate for the Government Pension Fund Global, section 2-3 (3)* (Finansdepartementet, 2010). The geographical adjustment results in the Fund having larger ownership in developed markets in Europe and smaller ownership in the USA and Canada, compared to FTSE Global All Cap. See table 2.1.1 for the adjustment factors, and appendix 7.2.1 for a regional classification of countries. The Ministry of Finance intends to change the adjustment factors to assign a lower weight to developed markets in Europe and a larger weight to the USA and Canada (Finansdepartementet, 2021*c*). The Fund is prohibited from investing in excluded companies and Norwegian companies. Their benchmark weights are therefore distributed amongst all remaining companies in the benchmark.

Table 2.1.1: Regional Classification

Regional classification	Factor
Developed Markets in Europe	2.5
Developed Markets in North America	1
Other Developed and Emerging Markets	1.5
New Markets	0

The table displays adjustment factors for the regional classification. These are determined in Mandate for the Government Pension Fund Global, section 2-3 (3) (Finansdepartementet, 2010) .

The return of the equity and bond portfolio are not perfectly correlated, and the actual benchmark is therefore allowed to differ from the strategic benchmark. E.g., by the end of 2020, the actual benchmark index consisted of 73% equities and 27% bonds, while the Strategic Benchmark index consisted of 70% equities and 30% bonds (Finansdepartementet, 2021*c*). The Ministry of Finance has determined rules to rebalance the Actual Benchmark to the Strategic Benchmark. See appendix 7.2.2 for the Actual Benchmark for 2020.

2.1.5 Risk

The Fund's level of risk will depend on its risk tolerance. The Fund has a high capacity to bear risk because the Fund does not face the same liquidity requirements as regular mutual funds. The most important determinant of risk is the composition of equities, bonds, and real estate (Finansdepartementet, 2021*a*). The Fund's total risk is measured in volatility, while the active risk is measured in tracking error (relative volatility). The active risk budget is currently set to a tracking error limit at 1.25%.

2.1.6 Organization

The Fund organizes its investment actions into four different strategy groups (Fund allocation, security-selection, asset-management, and real estate) (Finansdepartementet, 2021*d*). Investments in equities are managed by internal and external managers and across the different strategy groups. Investments in emerging markets are primarily managed by external managers located in their local markets. NBIM uses external managers because local knowledge is particularly important and valuable in less transparent markets. Additionally, local presence is important for NBIM's ethical mandate and role as a responsible investor (Dahlquist and Ødegaard, 2018). At the end of 2020, the Fund had 4.7% of its assets under external management (NBIM, 2021*a*).

2.2 Portfolio Management

This section presents theory and concepts within portfolio management. We discuss passive and active management before introducing the concept of active bets. The purpose of this section is to present relevant theories and concepts for a holdings-based analysis.

2.2.1 Passive Management

It is common to distinguish between active management and passive management. Sharpe (1991) defines a passive investor as someone who believes in the Efficient Market Hypothesis and holds every security in the market portfolio, with the same weight as the market. Until the 1970s, passive management was expensive. It was costly to replicate a market portfolio (or a benchmark index) because transaction costs were high before data delivery systems and computer technology arrived (Lettau and Madhavan, 2018). The modern passive strategy of fund management emerged in the 1970s and has increased in size together with the growth of Exchange Traded Funds. Since the passive investor believes in the Efficient Market Hypothesis, this theory will be further explained.

The Efficient Market Hypothesis (EMH) states that markets are efficient when all available and relevant information is reflected in the price of a security (Sharpe, 1970). The EMH has been a dominant and generally accepted financial theory since security markets are believed to be highly efficient (Malkiel, 2003). When markets are efficient, outperforming the mean will not be possible because securities are always priced correctly. This does not mean that no investors will outperform the market in a given year. The EMH argues that some market participants will outperform the mean in the short term due to luck and probability laws.

An efficient market is conditioned on a large number of market participants trading on new information, which immediately gives the correct price to a security. When markets are efficient, it is not possible to obtain an active return as a result of skills. If market participants believe markets are efficient, there would be no incentive to trade on new information. When there are no incentives to trade actively, securities would not be priced correctly. This would lead to inefficient financial markets and is known as the Grossmann-Stiglitz paradox (Grossman and Stiglitz, 1980). The paradox argues against the possibility of efficient markets.

2.2.2 Active Management

After the EMH was presented, several studies came to the same conclusion in the following period. There were few, if any, studies finding that actively managed funds have consistently outperformed the benchmark (Carhart, 1997; Jensen, 1968). The EMH has been a dominant theory, but it is not undisputed. Research argues that market efficiency is variable over time (Ito et al., 2014), and that fund performance is conditional on the state of the economy (Ferson and Qian, 2004). The collective decision-making of market participants will sometimes fail, and some market participants are certainly not rational (Malkiel, 2003). Inefficient markets will lead to asset prices deviating from fair value, and predictable patterns may appear. Skilled and well-informed managers can exploit this. A study of the Norwegian market showed that actively managed Norwegian mutual funds have outperformed the market over the last ten years (Eidem, 2021). This supports the research finding that market efficiency is variable over time, and it will be possible to outperform the market in certain periods.

The purpose of this thesis is not to provide an extensive discussion of the overall results of passive and active funds but rather to study the active management of the Fund. Therefore, we will depart from this discussion and focus on defining and characterizing active management.

Sharpe (1991) defines an active investor as someone who is not a passive investor. Following Sharpe's definition of active and passive investors, active management should be understood as investing in a portfolio that differs from the market portfolio. Actively managed funds trade on information to outperform the market. This involves buying undervalued securities and selling overvalued securities. Because fund managers' perception of correct prices changes frequently, actively managed funds may trade regularly.

2.2.3 Active Bets

An active bet (or simply a "bet") is a position in a security that differs from the benchmark position in the same security. I.e., the fund portfolio holds a different share of a security than the benchmark portfolio. If Fund A holds 60% of its assets in Apple, while the benchmark holds 50%, Fund A has a 10% bet in Apple. Sharpe (1991) defined active management as investing in a portfolio that differs from the benchmark portfolio. This implies that an actively managed fund must take bets to be managed actively.

When a fund holds a larger share, we call this an overweight or a bull-bet. When a fund holds a lower share, we call this an underweight, a negative overweight, or a bear-bet. When the fund share equals the benchmark share, there is no bet in that security. Table 2.2.1 shows an example of a fund portfolio and a benchmark portfolio with holdings in two companies. The example shows the corresponding bets and overweights and underweights to the fund's holdings.

Table 2.2.1: Holdings of Fund A

Company	**Fund share**	**Benchmark share**	**Bet**	**Overweight/ Underweight**
Apple	60%	50%	$\|60\% - 50\%| = 10\%$ bull-bet	10% overweight
Volvo	40%	50%	$\|40\% - 50\%| = 10\%$ bear-bet	10% underweight

The example shows that Fund A has a 10% overweight in Apple and a 10% underweight in Volvo. Bets, overweights, and underweights can be expressed in monetary terms as well. If the total market value of Fund A's portfolio is equal to 1000 NOK, the Fund will have a 100 NOK overweight in Apple and 100 NOK underweight in Volvo. Total bets in a fund are calculated as the sum of all bets. In the example in table 2.2.1, fund A has placed 200 NOK in total bets.

Within active management, it is common to divide between two types of bets to generate an active return. The first type of active management can be called security selection or alpha-bets. This involves analyzing and utilizing mispricings of companies (Høegh-Krohn, 2004). The second type of active management can be called timing, allocation, or beta-bets. This management strategy involves allocating the fund portfolio to different asset classes, sectors, regions, or securities with different exposure against risk factors (Høegh-Krohn, 2004). The purpose of this strategy is to allocate funds in order to "time" the market. E.g., when the market performs well, the manager wants assets with higher market exposure. When the market performs poorly, the manager wants assets with lower market exposure. In section 2.3.3, we will discuss how active return can be decomposed into selection and allocation.

Indexation is a strategy of a passive investor and involves replicating the benchmark. Changes in the fund portfolio will only occur when the benchmark index changes (Høegh-Krohn, 2004). Since there are no deviations from the benchmark (or bets), this strategy cannot gain an active return. However, indexation is easy and less costly than active strategies. Active indexation is the strategy of adjusting to the benchmark index in a cost-efficient manner. In practice, this implies minimizing costs and enhancing returns in the rebalancing of the portfolio when the index changes. Active indexation should be considered passive management and should not be confused with active management.

2.3 Performance Measures

This section introduces measures needed to evaluate the management of a fund. We present portfolio theory and explain how the return of a portfolio, active return, and excess return are calculated. Furthermore, we introduce a measure of individual equities' contribution to the active return of a fund. Lastly, we discuss how an attribution analysis can decompose active return into different attributes.

2.3.1 Portfolio Theory

The *return of a portfolio* (R_P) is the weighted average of the return of every individual equity in the portfolio (P). Let (R_i) denote the return of equity (i) and let ($W_{P,i}$) denote the portfolio weight of equity (i). The return of a portfolio can then be expressed as:

$$R_P = \sum_{i=1}^{N} R_i * W_{P,i} \tag{1}$$

The *active return* (R_A) of a portfolio (P) is the difference between the return of the portfolio (R_P) and the return of the benchmark (R_B). Active return will be positive if the portfolio return exceeds the benchmark return. Active return can be expressed as:

$$R_A = R_P - R_B \tag{2}$$

The *excess return* (ER_i) of equity (i) is the difference between the individual return of the equity (R_i) and the total return of the benchmark (R_B). Excess return will be positive if the return of the equity exceeds the total return of the benchmark. Excess return can be expressed as:

$$ER_i = R_i - R_B \tag{3}$$

2.3.2 Contribution to the Active Return

The Contribution to the active return (CAR) measures an individual equity's contribution to the active return of a portfolio. This measure depends on two factors; the excess return (ER_i) of equity (i) and the difference between the equity's weight in the portfolio (W_{Pi}) and the benchmark (W_{Bi}). The Contribution to the active return (CAR) for equity (i) can be expressed as:

$$CAR_i = (R_i - R_B) * (W_{P,i} - W_{B,i}) \tag{4}$$

$(W_{P,i} - W_{B,i})$ represent the fund's overweight or underweight in equity (i). Table 2.3.1 displays how CAR depends on different scenarios of excess return and the directions of the bet.

Table 2.3.1: Contribution to active return

Scenario	Excess return	Direction of the bet	CAR
1	$ER_i > 0$	$W_{F,i} > W_{B,i}$	$CAR_i > 0$
2	$ER_i > 0$	$W_{F,i} < W_{B,i}$	$CAR_i < 0$
3	$ER_i < 0$	$W_{F,i} > W_{B,i}$	$CAR_i < 0$
4	$ER_i < 0$	$W_{F,i} < W_{B,i}$	$CAR_i > 0$

Scenario 1 shows that CAR is positive if the excess return is positive and the equity is overweighted. Scenario 2 shows that the CAR is negative if the excess return is positive and the equity is underweighted. Scenario 3 shows that the CAR is negative if the excess return is negative and the equity is overweighted. Scenario 4 shows that the CAR is positive if the excess return is positive and the equity is underweighted.

We can calculate the contribution to the active return from a group(G) of equities. E.g., equities from a specific region. The group's CAR will be equal to the sum of the CAR of every individual equity in the group. This can be expressed as:

$$CAR_G = \sum_{i=1}^{N} CAR_{G,i} \tag{5}$$

The active return of a portfolio will equal the sum of every individual equities' CAR. This is expressed in equation 6. The implication of this is that a fund can create a positive active return by overweighting stocks that generate positive excess returns, and underweighting stocks that generate negative excess returns.

$$R_A = R_P - R_B = \sum_{i=1}^{N} (R_i - R_B) * (W_{P,i} - W_{B,i}) \tag{6}$$

The Contribution to the active return captures effects from both stock selection and allocation and is therefore not a useful measure to capture these separate effects. In the analysis, contribution to the active return is used to determine how different groups have contributed to the Fund's active return.

2.3.3 Attribution Analysis

We want to decompose the active return into different sources or attributes. An analysis of these sources is called an attribution analysis.

In our analysis, the Brinson-Fachler(BF) model is used to decompose active return into three attributes, which are selection, allocation, and interaction (Baker and Wright, 2012). The BF model was initially created to analyze the attributes of different sectors, but the model can be used for other groups as well. A group is simply a way of classifying different equities. E.g., a security class, sector, or region. We use the BF model mainly because of how the model defines the allocation attribute. The BF model distributes the excess return of the group to the allocation attribute, whereas other models distributes the group's absolute return.

The selection attribute shows how security selection has contributed to the active return (Baker and Wright, 2012). The attribute is determined by how a group(G)'s portfolio return ($R_{P,G}$) has performed relative to the benchmark return of the group ($R_{B,G}$). If the portfolio return of the group has been higher than the benchmark return of the group, the selection attribute will be positive. See equation 7 for the calculation of the selection attribute.

$$Selection_G = (R_{P,G} - R_{B,G}) * W_{B,G} \tag{7}$$

The allocation attribute shows how allocation has contributed to the active return (Baker and Wright, 2012). The attribute is determined by two factors. First, the deviation between the portfolio weight ($W_{P,G}$) and the benchmark weight ($W_{B,G}$) of the group. Second, whether or not this deviation has been successful. If a group is overweighted ($W_{P,G} - W_{B,G}) > 0$, the allocation effect is positive if the group's benchmark return ($R_{B,G}$) outperforms the total benchmark return (R_B).The objective for a fund is to overweight

groups that outperform the benchmark and underweight groups that underperform the benchmark. The allocation effect is displayed in equation 8.

$$Allocation_G = (W_{P,G} - W_{B,G}) * (R_{B,G} - R_B) \tag{8}$$

The interaction attribute is a combination of the allocation effect and the selection effect (Baker and Wright, 2012). Therefore, it depends on two factors. First, the group's weight in the portfolio ($W_{P,G}$) compared to the benchmark ($W_{B,G}$). Second, the portfolio return of the group ($R_{P,G}$) compared to the benchmark return of the group ($R_{B,G}$). The first part is related to the allocation effect, while the latter is related to the selection effect. The objective is to overweight groups with a good performance in security selection and underweight groups with poor performance. The interaction effect can be expressed as:

$$Interaction_G = (W_{P,G} - W_{B,G}) * (R_{P,G} - R_{B,G}) \tag{9}$$

The most relevant attributes to evaluate are the selection and allocation attribute. In most investment decisions, the allocation decision comes first, and the selection decision follows after the capital has been allocated. Interaction is typically not a part of any investment decision (Baker and Wright, 2012). This is mainly because it is hard to predict which groups will have a positive or negative effect from security selection.

2.4 Measurement of Active Management

Bjerksund and Døskeland (2015) considered four different measures for how actively a fund is managed. These measures are active return, tracking error, active share, and R-squared. They concluded that active return is not well suited to measure how actively a fund is managed. Furthermore, Bjerksund and Døskeland (2015) claim R-squared adds a low amount of new information, in addition to the tracking error and active share. This section presents tracking error and active share as measures of active management.

2.4.1 Tracking Error

Tracking error (TE), or relative volatility, is a measure of the fluctuations of active return and is defined as the standard deviation of the active return (Bjerksund and Døskeland, 2015). The formula of tracking error is presented in equation 10 and a simple example of the calculation of tracking error is presented in table 2.4.1.

$$TE = \sigma(R_A) = \sigma(R_F - R_B) \tag{10}$$

Table 2.4.1: Tracking Error Example

	$\boldsymbol{R_P}$	$\boldsymbol{R_B}$	$\boldsymbol{R_A}$
Year 1	0.25	0.15	0.10
Year 2	0.45	0.25	0.20
$TE_P = \sigma(0.10, 0.20) = 5\%$			

The table displays yearly returns for a fund portfolio and a benchmark portfolio, and the calculation of the tracking error.

A fund's risk budget can be determined with a tracking error limit. If a fund has a tracking error limit of 10%, the standard deviation of the fund's active return cannot exceed 10%. Therefore, a tracking error limit will set boundaries of how much active return can deviate. This implies that a high tracking error increases the possibility of a larger active return in absolute values. I.e., a portfolio with a high tracking error may achieve a larger positive active return and a larger negative active return. (Cremers and Petajisto, 2009; Petajisto, 2013). If a fund wants to generate an active return, it is necessary to allow for some amount of tracking error. An actively managed fund will have a higher tracking error than a passively managed fund.

2.4.2 Active Share

Active Share (AS) is a measure of active management introduced by Cremers and Petajisto (2009). Since mutual funds rarely take short positions, their active share will mostly be between 0 and 100%. The Active share can then be interpreted as the share of a fund portfolio which deviates from the benchmark portfolio. The formula of active share is presented in equation 11, where $(W_{P,i})$ and $(W_{B,i})$ are the portfolio weight and benchmark weight for equity (i).

$$AS = \frac{1}{2} \sum_{i=1}^{N} |W_{Fi} - W_{Bi}| \tag{11}$$

Table 2.4.2 provides a simple example of the calculation of Fund A's active Share. Active share for a fund is calculated by dividing total bets on two. If a fund overweights a company (e.g., Apple), it compensates by underweighting another company (e.g., Volvo). Therefore, it is necessary to divide by two, to not count these bets twice.

Table 2.4.2: Active Share Example: Fund A

	$\boldsymbol{W_{P,i}}$	$\boldsymbol{W_{B,i}}$	$\boldsymbol{AS_i}$
Apple	60%	50%	$\lvert 60\% - 50\% \rvert = 10\%$
Volvo	40%	50%	$\lvert 40\% - 50\% \rvert = 10\%$
Total	100%	100%	$\frac{10\%+10\%}{2} = 10\%$

The table displays the calculation of the active share for a fund portfolio with two equities.

Having an active share is a condition for generating an active return. It is only possible to obtain an active return on shares that deviates from the benchmark (Bjerksund and Døskeland, 2015). Therefore, active share is a useful measure since it says something about the potential of outperforming the benchmark (Cremers and Petajisto, 2009). It is possible to classify funds after their active share. Funds with an active share below 20% should be considered index funds, funds with an active share between 20 - 60% should be regarded as "closet indexers". In cotrast, funds with an active share above 60% should be considered active funds (Bjerksund and Døskeland, 2015).

2.4.3 Tracking Error and Active Share

Tracking error and active share can be used as measures of active management alone, but they work best in a combination. This is because different types of active management affect the measures differently. A fund with large exposure to security selection could have low exposure to risk factors or fund allocation. Therefore, the portfolio return can be similar to the benchmark return, which would give a low tracking error. However, if the degree of security selection is large, the active share will be high. Contrary, if the fund is betting on systematic risk factors (fund allocation), it could imply a low active share but a high tracking error. As we see, different types of active management affect the measures differently. It is, therefore, necessary to use both measures to get a complete picture of the active management in a fund. We can say that tracking error is a proxy for fund allocation, and active share is a proxy for security selection.

Tracking error and active share are affected differently by the correlation between the fund portfolio and the benchmark portfolio. Suppose there are two similar companies, company X and company Y, with an equal return of $R_X = R_Y$. Company X is included in both the fund and the benchmark, while company Y is not included in either portfolios. If a fund sells company X and buys company Y, it will affect tracking error and active share differently. The total return of the fund will not change because $R_X = R_Y$ and the tracking error will therefore not change. However, the active share will increase since company Y is not included in the benchmark.

3 Data Treatment and Methodology

This chapter will explain our approach for answering the research questions. To conduct a holdings-based analysis, we need data of the Fund's holdings, the benchmark's holdings, and return data. In section 3.1, 3.2, and 3.3, we explain how we retrieved, merged, and adjusted the data to obtain a workable dataset. In section 3.4 and 3.5, we present the dataset and discuss the problem of missing data. In section 3.6 we explain how our research questions will be answered and tested in the analysis.

The amount of data treatment in this thesis has been severe, and there have been several considerations, decisions, and assumptions. In this chapter, we discuss the most important considerations. For further explanations and discussions, we refer to section 7.3 in the appendix.

3.1 Data Retrieval

3.1.1 Fund holdings and fixed holdings assumption

Data of the Fund's holdings in equities was downloaded from NBIM's website. The data contained information about the Fund's holdings in equities per 31/12 each year and included important information such as company name, industry, country, and weight in the fund portfolio. Additionally, we received data from NBIM containing ISIN codes per company for every year in the time period. ISIN is a unique identifier of securities and facilitates the process of merging the holdings of the Fund and the benchmark. The ISIN data was merged with the holdings data by company name. See appendix 7.3.1 for further information about the Fund's holdings and ISIN data.

We have only available data of the Fund's holdings per 31/12 each year. As a result of this, we assume the Fund does not buy or sell equities during the year. This is a simplification and nowhere near the reality since the Fund continuously trades during the year. Therefore, our estimated return will deviate from the Fund's reported return. The precision of our estimated returns will be assessed in section **??**.

3.1.2 Benchmark holdings

The Fund's equity benchmark is based on the FTSE Global All Cap index. We received the benchmark from FTSE Russell's customer service after submitting a formal request through their website. The benchmark we received contains information about the equities' weight and a SEDOL code to identify them. Since we use ISIN codes to identify the Fund's equities, we needed ISIN codes for the benchmark data to match the two datasets.

Corresponding ISIN codes were retrieved for the benchmark data, using NHH's access to Eikon. For more information about the benchmark see section 2.1.4 and appendix 7.3.3.

3.1.3 Return data

We obtained monthly prices of the equities adjusted for dividends and stock splits. This data was downloaded through Datastream, using RIC codes of the Fund's holdings. RIC codes were obtained through Eikon. Monthly returns were calculated from the price data and merged with the holdings data using ISIN codes.

3.2 Data merging

The data of the Fund's holdings and the benchmark's holdings were merged by ISIN codes. This implies equities in the Fund's holdings were matched with the corresponding equity in the benchmark's holdings and stored in a merged dataset. For every year, there are missing observations in the merged dataset. A missing observation is an observation that is included in the holdings of both the Fund and the benchmark but is missing in the merged dataset. Since we matched the data by ISIN codes, a missing ISIN or a wrong ISIN will lead to a missing observation.

We looked over unmatched observations from the benchmark holdings for every year in the time period. Then, we tried to find a matching equity in the Fund's holdings, primarily by investigating company names. We manually added the correct ISIN code to the benchmark if we found the equity in the Fund's holdings. This was done to ensure the equity was included in the merged dataset. Hundreds of equities were manually added to the dataset every year, and even more, were investigated. The purpose of the manual matching was to ensure the amount of missing data was as low as possible and that the coverage of the Fund's total market value was as high as possible. In section 3.5, we discuss the problem of missing data.

3.3 Data adjustment

The benchmark is only based on the FTSE Global All cap index and is adjusted to account for excluded companies and geographical affiliation. This section explains how these adjustments are performed and how the benchmark must be adjusted to account for different share classes.

3.3.1 Scaling of weights

There are companies in the benchmark that the Fund excludes. Their weights must be distributed equally amongst the remaining companies. Additionally, because of missing observations, the sum of the benchmark weights and the fund weights in the merged dataset is not equal to 100%. These problems are solved by scaling the weights. This implies distributing the missing weights equally amongst all equities in the merged dataset. We only merge companies present in both the Fund's holdings and the benchmark's holdings. Therefore, we do not have to manually remove excluded companies from the merged dataset. The benchmark weight of these companies will be missing in the merged dataset. These weights will be distributed to the remaining companies, together with the weights of the missing companies.

The weights are scaled by dividing all weights by the sum of all weights in the merged dataset. E.g., if the fund weights of all missing observations equal 10%, all remaining fund weights are scaled by dividing by 90%. If the benchmark weights of all missing observations equal 10%, and the benchmark weights of all excluded companies equal 10%, all remaining benchmark weights are scaled by dividing by 80%. See appendix, section 7.3.4, for the formula for scaling the weights and the effect of missing observations on scaling the weights.

3.3.2 Geographical adjustment

The geographical adjustment is performed to assign a different benchmark weight to the equities, according to which region they belong. All equities belong to a country, classified in four different regions. See table 2.1.1 for the adjustment factors, and section 7.2.1 in the appendix for countries' regional classification.

1. Developed Markets in Europe
2. Developed Markets in North America
3. New Countries in the FTSE Index from 2019
4. Other Markets

We use NBIM's publicly available data of the actual benchmark per country to adjust for geographical affiliation. This data contains the actual benchmark weight for each country after they are adjusted for geographical affiliation. See appendix 7.2.2 for the actual benchmark for 2021. We adjust the benchmark weights in our merged dataset to ensure the weights are equal to the actual benchmark on an aggregated regional level. E.g., suppose the actual benchmark weight of all equities in developed countries in Europe equals 40%, but the weight in our dataset only equals 30%. Then, all equities in this region will be multiplied by 40% and divided by 30%. This ensures that the sum of the benchmark weights in developed markets in Europe will equal 40% in our dataset. See section 7.3.5 in the appendix for the formula of the geographical adjustment.

3.3.3 Adjusting for different share classes

In the benchmark, there are companies with several share classes. E.g., Berkshire Hathaway has one holding for A-shares and one for B-shares. The Fund data does not divide between different share classes for a company. This means Berkshire Hathaway will be included only once in the fund data, even though it consists of several share classes. It is not possible to identify which share class the Fund holds. To simplify the problem, we assume NBIM holds the same security classes as the benchmark. Therefore, the benchmark weights of a company with several share classes are summed into one holding. We use the return data from the share class with the largest benchmark weight. If the benchmark weight of Berkshire Hathaway is larger for A-shares than B-shares, we use the return data of the A-shares.

The assumptions of share classes have implications for our analysis. First, the return of a company may not be precise since we only use the return data of the share class with the largest weight. Second, it will be impossible to identify how the Fund has distributed their assets amongst different share classes in the same company. E.g., the Fund may overweight A-shares and underweight B-shares. We are not able to identify these bets. See section 7.3.6 in the appendix for further discussion of the treatment of equities with different share classes.

3.4 Presentation of the dataset

This section presents the scope of the data, the time frame we are analyzing, and summary statistics of the dataset. The purpose of this section is to understand the data we work with.

3.4.1 Scope of data

We only consider the Fund's investment in equities and cannot evaluate other asset classes such as bonds and real estate. Additionally, we only study listed equities and not investments in derivatives, unlisted equities, short selling, and security lending. We are not able to separate between active indexation and active management. Since we cannot identify the purpose of a deviation from the benchmark, every deviation will be categorized as active bets. Our analysis will therefore include effects from both active indexation and active management. See section 2.2.3 for the definition of active indexation.

3.4.2 Time period

We are analyzing the time period from 1/1/2014 to 30/09/2021. Since the Fund's active management changes over time, it is most relevant to analyze the latest years. We have only access to precise benchmark data from 2014 to 2021. If we were to analyze further back in time, we would have to use a proxy for the benchmark. This is not an optimal alternative since the data further back in time would be less precise. The time period consists of 93 months or 7.75 years. This is a short time period and should ideally be longer. Therefore, it would complicate the process of finding inference. Even if our findings have small standard deviations, the short time frame can lead to large standard errors and statistically insignificant results.

3.4.3 Summary Statistics

Table 3.4.1 presents summary statistics of the holdings in the merged dataset. Table 3.4.2 presents summary statistics of the return data.

Table 3.4.1: Summary Statistics of Holdings

Annual means	
Number of holdings	6309
Number of overweights	3041
Number of underweights	3268
Coverage of market cap	96.97%
Coverage of total number of equities	74.11%

Coverage of market cap is the market value in the merged dataset divided by the market value of the Fund's holdings. Coverage of total number of equities is the number of equities in the merged dataset divided by the number of equities in the Fund's holdings.

Table 3.4.2: Summary Statistics of Returns

	Fund return	**Benchmark return**	**Active return**
Mean monthly return	0.880%	0.882%	-0.002%
Mean annualized return	10.57%	10.59%	-0.022%
Monthly standard deviation	3.66%	3.58%	0.145%
Annualized standard deviation	12.67%	12.42%	0.503%
Number of time periods	93	93	93

3.5 Missing data

In this section, we discuss the problem of missing data. Before we assess the amount of missing observations, it is necessary to clarify of what this term implies. In section 3.2, we explained that a missing observation is an observation that is included in both the fund and benchmark portfolio but is missing from the merged dataset. This term implies that every active bet taken by the Fund that is not included in the merged dataset is a missing observation. First, we discuss if the amount of missing data is substantial by assessing the coverage of the market capitalization. In the next section, we discuss divestments, which are a special case of missing observations. Lastly, we discuss problems with the return data.

3.5.1 Missing Data Statistics

Table 3.5.1 displays the coverage of the Fund's market capitalization (hereafter market cap) and the coverage of the total number of equities in our merged dataset. The coverage of the market cap has been in the range of 96.38-98.44%. The coverage of total equities has been in the range of 68.15-78.90%. This implies that a large share of total equities of the Fund's holdings is missing in our dataset. However, considering the high coverage of the market cap, the missing equities consist of equities with small fund weights. We do not believe that missing observations will invalidate our results, assuming they have normally distributed returns and bets. Based on this, we believe conclusions from the analysis are representative of the Fund.

Table 3.5.1: Missing data

	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Percentage coverage of market cap	96.82	95.58	96.38	96.49	96.58	97.10	98.38	98.44
Percentage coverage of companies	76.81	68.15	70.67	71.93	72.55	75.04	78.90	78.82

3.5.2 Risk-based divestments

The Fund chooses to divest in several companies. This can be categorized into two types of divestments (NBIM, 2019*a*):

1. Ethical exclusions
2. Risk-based divestments

Ethical exclusions are companies excluded by the executive board of Norges Bank. They are not in the Fund's adjusted benchmark, and the Fund is prohibited from investing in them. Therefore, excluded companies are not considered active bets and are not missing observations.

Risk-based Divestments (hereafter divestments) are companies the Fund has chosen not to invest in for reasons other than being excluded by the executive board of Norges Bank. These are companies that do business in a way that the Fund does not consider as sustainable or could have a negative financial implication (NBIM, 2019*a*). Divestments are active bets and should ideally be included with a 0% fund weight and a 100% underweight. The data of the Fund's holdings do not include companies with a 0% weight. Therefore, divestments will not be included in the merged dataset. Divestments become missing observations since they are active bets.

To include divestments, we would have to add them manually to our dataset. This would introduce a risk of wrongfully classifying a missing observation as a divestment. Different company names in the benchmark and the fund holdings make it hard to determine for sure if an equity in the benchmark is a divestment or a regular missing company. Therefore, we have decided not to include divestments as they could potentially introduce more errors in our data, and including them is a time-demanding process. Including divestment is a trade-off between a potentially higher precision and a longer time period. Because of the risk of introducing errors and the already short time period, we chose not to include divestments. Since it is hard to identify divestments, we do not know their proportion of the benchmark.

3.5.3 Return data

As mentioned in section 3.1.3, we had to obtain the RIC codes of the equities to download the price data. Not all RIC codes were possible to obtain by the ISIN codes. This was particularly problematic for companies that have been delisted, merged, or acquired during the time period. We attempted to find the missing RIC codes manually. A large fraction of these codes were obtained, but it was not possible to find all. We chose only to add RIC codes when we were confident the code was correct. This was done to minimize the possibility of obtaining incorrect return data.

Without a RIC code, the return of an equity was not possible to obtain through Datastream. Therefore, these holdings were removed from our dataset. This might have implications for our findings, but we believe this is not of major concern since the missing observations made up a small proportion of the data.

3.6 Testing methodology

This section explains how we answer the research questions. Therefore, it is necessary with a reminder of them:

1. How actively has the Fund been managed?
2. How have the Fund distributed their bets?
3. Where is the Fund's active return created?

The first research question will be answered by estimating the tracking error and the active share of the Fund. The second research question will be answered by studying how the Fund has distributed their bets between overweights and underweights, regions, and industries. The third research question will be answered by testing the contribution to the active return from different groups. Furthermore, we explain how these groups are tested.

We define a set of groups and test whether their contribution to the active return is significantly different from zero. This enables us to tell how a group has contributed to the Fund's active return. First, we test different groups of overweights and underweights. Second, we test different groups of regions. Third, we test different groups of industries. See table 3.6.1 for the test groups. For the regions and industries, we first test their total contribution before we perform an attribution analysis.

Table 3.6.1: Test groups

Overweights & underweights	**Regions**	**Industries**
All overweights	Europe	Financials
All underweights	North America	Industrials
Top 20 overweights	Asia	Consumer Goods
Top 20 underweights	Oceania	Consumer Services
Top 20 overweights and top 20 underweights	Latin America	Basic Materials
	Africa	Technology
	Middle East	Health Care
		Oil & Gas
		Utilities
		Telecommunications

We use a two-sided t-test to test if our findings are significantly different from zero (Keller and Gaciu, 2012). See equation 12 and 13 for the null hypothesis and alternative hypothesis. The test statistic is given in equation 14, where $(\bar{X}_G)$ is the mean contribution to the active return from group (G). (μ) is the value we test if the contribution to the active return differs from. Since we test if the contribution is significantly different from zero, (μ) equals zero.

$$H_0 : \mu = 0 \tag{12}$$

$$H_1 : \mu \neq 0 \tag{13}$$

$$t = \frac{\bar{X}_G - \mu}{SE_{Newey-West}} \tag{14}$$

The t-test assumes normally distributed means, with independent observations (Keller and Gaciu, 2012). In times series, observations are rarely mutually independent. This can cause biased standard errors, which can lead to an invalid inference. To account for the problem of dependent observations, we use Newey-West standard errors, which account for autocorrelation and heteroscedasticity (Newey and West, 1987).

As long as the data we are testing are normally distributed, the t-statistic is t-distributed with T-1 degrees of freedom. According to Keller (2012), the results from a t-test are robust as long as the distribution does not deviate severely from the normal distribution. In the appendix, section 7.1, we discuss whether the data is normally distributed. We use a significance level of 5% when we test our hypothesis. The significance level is the probability of rejecting the null hypothesis, given that the null hypothesis is true. This is known as a type I error. If a false null hypothesis is not rejected, it is known as a type II error.

4 Analysis

In this chapter, we conduct our analysis and present the findings of our thesis. We answer the main research question: How does the Fund distribute their bets, and where is the Fund's active return created? This chapter is organized into three different sections, one for each sub-question.

1. How actively has the Fund been managed?
2. How have the Fund distributed their bets?
3. Where is the Fund's active return created?

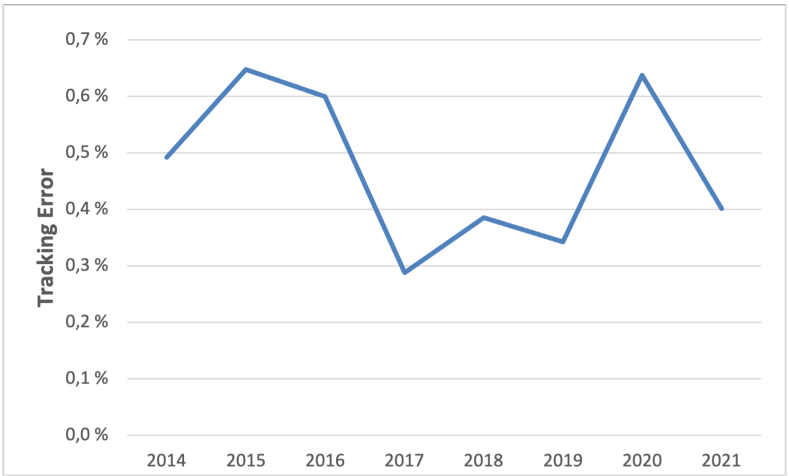
4.1 Measurement of active management

In this section, we answer the first sub-question: How actively has the Fund been managed? The purpose of the section is to understand how actively the Fund is managed. We have used tracking Error and active share, as these are recommended measures for measuring the active management (Bjerksund and Døskeland, 2015).

4.1.1 Tracking Error

Tracking error measures the standard deviation of the active return. Figure 4.1.1 displays the range of the tracking error and how it has developed for the time period. The annualized tracking error for the time period was 0.50%. The tracking error has been below the risk budget limit of 1.25% during the entire time period. A low tracking error indicates that deviations from the benchmark returns have been limited.

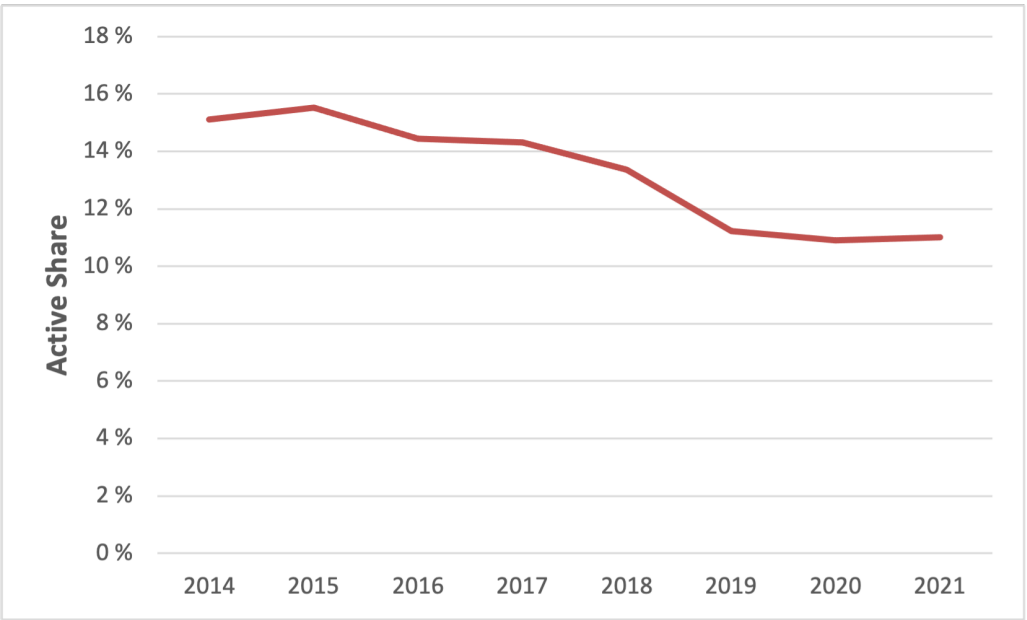
Figure 4.1.1: The Fund's tracking error



4.1.2 Active Share

Active share measures the proportion of the fund portfolio that deviates from the benchmark portfolio. Our data suggest the Fund's active share has been in the range of 11-16%, with an average active share of 13.2%. Dahlquist and Ødegaard (2018) found an active share in the range of 15-20% for the time period of 2013-2017. In the same period, our range was 13-16%. The deviation may be explained by our assumptions and missing data. According to Cremers and Petajisto (2009), a fund with an active share below 20% can be considered an index fund. The Fund's active share has been lower than 20% and can therefore be characterized as an index fund. We found a decreasing active share from 2014, suggesting that the Fund has become less active in the latest years. This is consistent with the findings of Dahlquist and Ødegaard (2018).

Figure 4.1.2: The Fund's active share

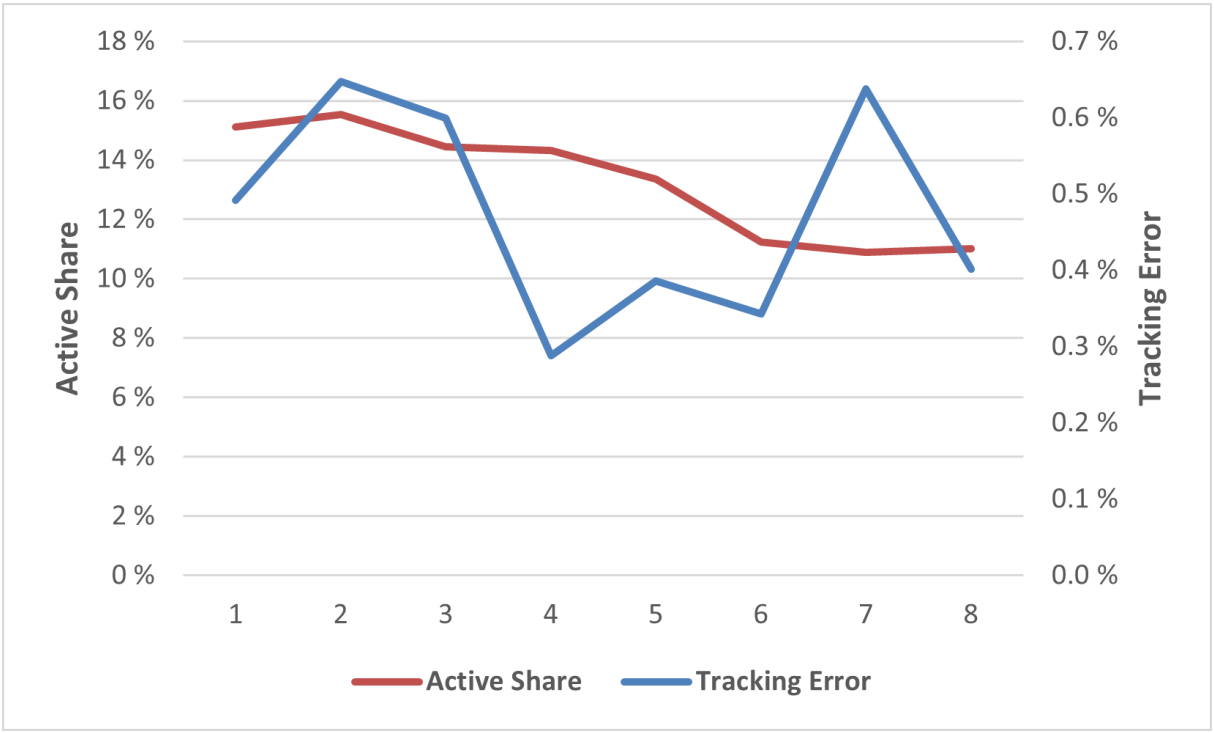


4.1.3 Overall assessment of how actively the Fund is managed

The annualized tracking error of 0.50% for the entire time period shows the Fund is well within its risk budget of 1.25%. Figure 4.1.3 indicates that the tracking error has been volatile in the time period. Based on the development of the tracking error, it is impossible to determine any trends of how actively the Fund has been managed. The active share of the Fund has been in the range of 11-16%, which resembles an active share of an index fund (Cremers and Petajisto, 2009).

Our data suggest a decreasing trend in the active share, which indicates the Fund has become less active during the time period. Since active share can be viewed as a proxy of security selection, this indicates that the degree of security selection has decreased during the time period. Overall, the tracking error and active share imply a small degree of active management in the Fund. Although we cannot conclude that the Fund has become less active over the time period, a lower active share indicates this.

Figure 4.1.3: Tracking Error & Active Share



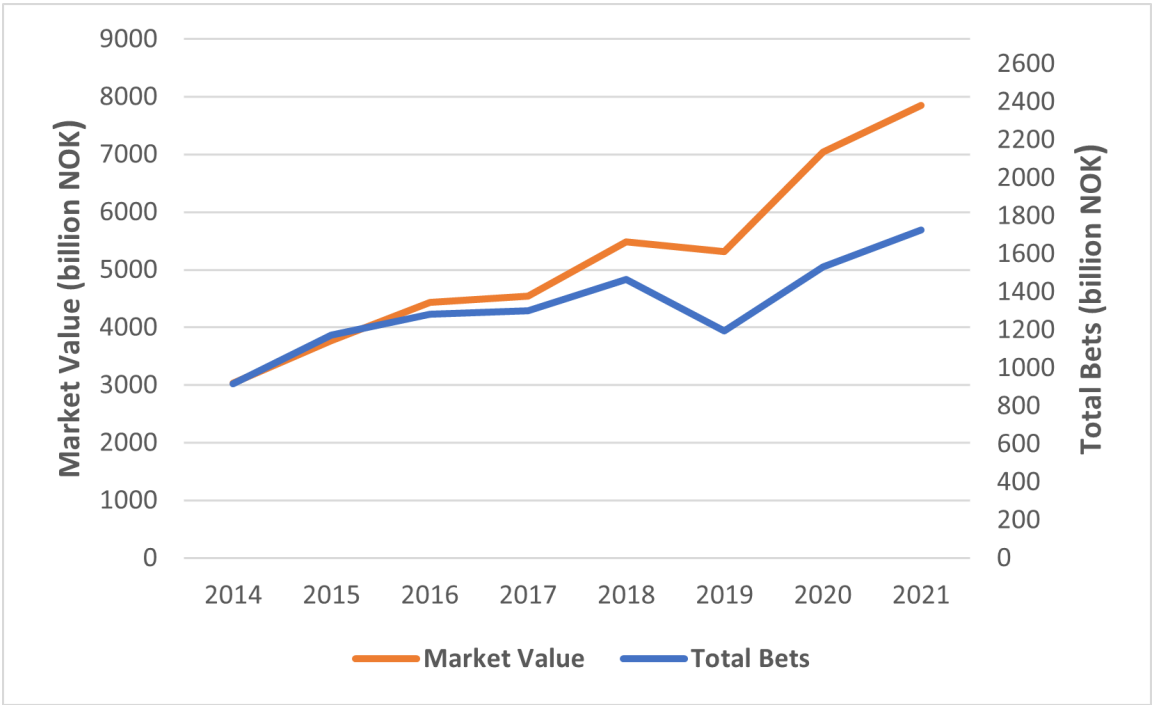
4.2 Distribution of the Fund's bets

In this section, we answer the second research question: How have the Fund distributed their bets? The purpose is to understand how the Fund's bets are distributed between overweights and underweights, regions, industries, and companies. First, we present the total amount of bets placed by the Fund. Second, we present which equities the Fund places their largest bets in and how they are distributed between overweights and underweights. Third, we present how their bets are distributed between regions and industries.

4.2.1 Total bets

According to our data, the Fund has placed an amount of 1727 billion NOK in total bets at the start of 2021. Total bets have gradually increased from about 900 billion NOK in 2013, which indicates that the Fund has taken more bets in monetary terms. This amount must be viewed in comparison to the market value of the Fund and the active share. The increasing market value and the decreasing active share indicate that the increase in total bets is caused by a larger market value. As we can see in figure 4.2.1, the Fund's market value has increased at a faster pace than total bets.

Figure 4.2.1: The Fund's market value and total bets



4.2.2 Largest active bets

We assume the Fund places their largest bull (bear) bets in the equities they believe will outperform (underperform) the benchmark the most. The Fund's largest bets are identified to understand which equities the Fund believes in the most and how much they believe in these equities. The 20 largest overweights and the 20 largest underweights, as of 31/12/2020, are presented in table 4.2.1 and 4.2.2. It should be noted that it is a possibility that some of the missing divestments would have been included in the group of the 20 largest underweights.

Table 4.2.1: Top 20 overweights

Company name	**Region**	**Country**	**Industry**	**Overweight (billion NOK)**
Vonovia SE	Europe	Germany	Financials	24.4
T-Mobile US Inc	North America	USA	Telecommunications	19.0
Alexandria Real Estate Equities Inc	North America	USA	Financials	15.6
BHP Group PLC	Europe	United Kingdom	Basic Materials	14.3
AXA SA	Europe	France	Financials	13.2
Equity Residental	North America	USA	Financials	12.6
Deutsche Wohnen SE	Europe	Germany	Financials	10.9
Linde PLC SE	North America	USA	Basic Materials	10.6
UBS Group AG	Europe	Switzerland	Financials	10.0
Boston Properties Inc	North America	USA	Financials	9.2
Facebook Inc	North America	USA	Technology	8.9
Gecina SA	Europe	France	Utilities	7.7
Iberdrola SA	Europe	Spain	Utilities	7.5
Infineon Technologies AG	Europe	Germany	Technology	6.7
Nextera Energy Inc	North America	USA	Utilities	6.3
Shaftesbury PLC	Europe	United Kingdom	Financials	6.2
Regency Centers Corp	North America	USA	Financials	5.6
Naspers LTD	Africa	South Africa	Technology	5.5
Equitable holdings Inc	North America	USA	Financials	5.2
Vornado Realty Trust	North America	USA	Financials	5.2

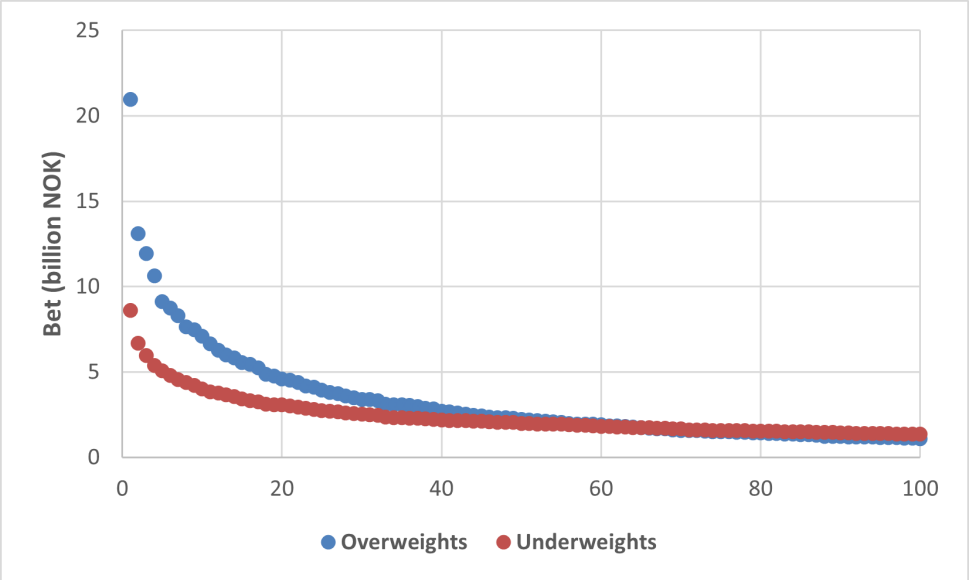
Table 4.2.2: Top 20 underweights

Company name	**Region**	**Country**	**Industry**	**Underweight (billion NOK)**
BHP Group LTD	Oceania	Australia	Basic Materials	11.6
BASF SE	Europe	Germany	Basic Materials	10.6
Tencent Holdings Ltd	Asia	China	Technology	8.8
Givaudan SA	Europe	Switzerland	Basic Materials	6.5
SAP SE	Europe	Germany	Technology	5.8
Apple Inc	North America	USA	Technology	5.8
Zurich Insurance Group AG	Europe	Switzerland	Financials	5.6
Visa Inc	North America	USA	Financials	5.5
JPMorgan Chase & CO	North America	USA	Financials	5.3
Daimler AG	Europe	Germany	Consumer Goods	5.0
3M CO	North America	USA	Industrials	4.8
Commonwealth Bank of Australia	Oceania	Austrlia	Financials	4.7
Air Liquide SA	Europe	France	Basic Materials	4.6
Deutsche Bank AG	Europe	Germany	Financials	4.6
Rio Tinto LTD	Oceania	Australia	Basic Materials	4.3
Goldman Sachs Group INC/THE	North America	USA	Financials	4.1
KBC Group NV	Europe	Belgium	Financials	4.1
Itau Unibanco Holding SA	Latin America	Brazil	Financials	4.1
HSBC Holdings PLC	Europe	United Kingdom	Financials	4.1
Air Products and Chemicals Inc	North America	USA	Basic Materials	4.0

The German real estate company Vonovia SE is by far the most overweighted company, with a total overweight of 24.4 billion NOK. Without the exception of the South African holding company Naspers LTD, the remaining companies are listed in the USA and Europe. The resource company BHP Group LTD, listed in Australia, is the most underweighted company with a total underweight of 11.6 billion NOK. However, the Fund has a 14.3 billion NOK overweight in the same company, listed in the United Kingdom. This could indicate a strategy to overweight a company listed in one market and underweight the same company in another market. The remaining companies of the 20 largest underweights are represented in Europe, Asia, North America, Oceania, and Latin America.

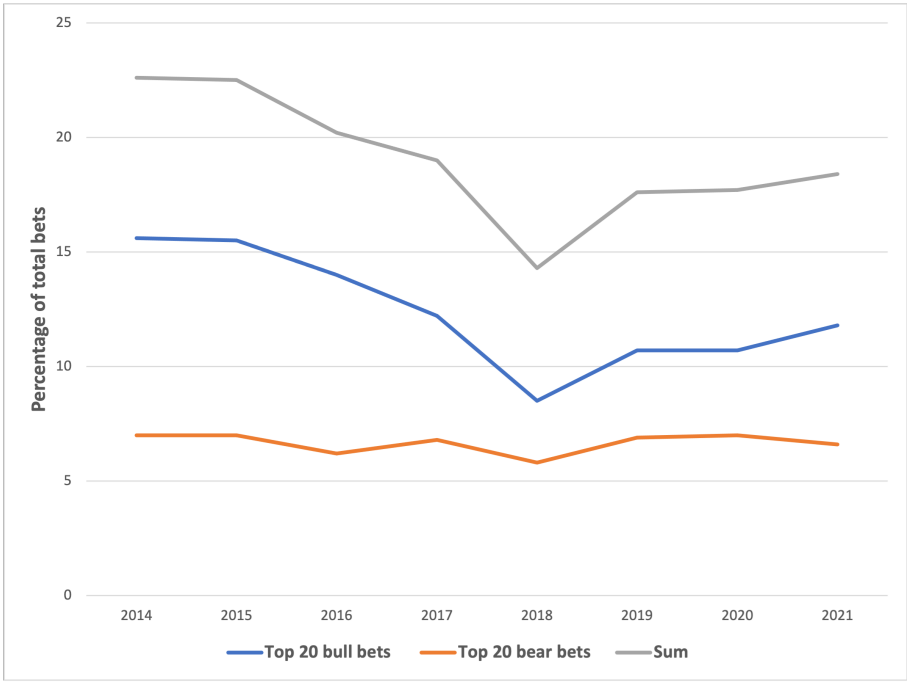
The size of the 20 largest overweights and underweights indicates that the Fund believes more in their largest bull bets than their largest bear bets. We have plotted the average bet of the 100 largest bull and bear bets, to investigate this further. In figure 4.2.2, we see that the largest bull bets are larger than the largest bear bets, but the difference diminishes when we approach the 60th largest bet.

Figure 4.2.2: Variation of the 100 largest positions



The 20 largest bull bets have on average accounted for 12.4% of the Fund's total bets, and the 20 largest bear bets have on average accounted for 6.7%. In figure 4.2.3, we see that the 20 largest overweights have decreased in size compared to total bets, while the size of the 20 largest underweights have been stable. It is noteworthy that 40 equities (0.63% of the mean number of holdings) account for as much as 19.1% of total bets.

Figure 4.2.3: Percentage of total bets



4.2.3 Distribution of bets in regions and industries

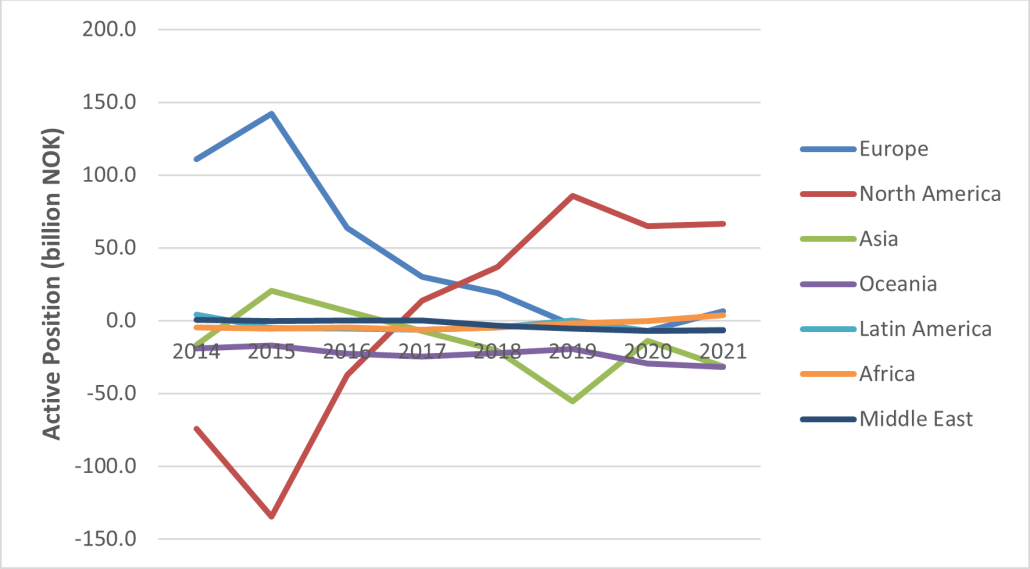
We want to examine how the Fund's bets are distributed between regions and industries. Table 4.2.3 and 4.2.4 display the average total bets, active position, active share, and market value for regions and industries. The average active position shows how a region or industry has been overweighted or underweighted during the time period. Active share shows how a group's active share would have been as an independent portfolio and indicates how active the Fund has been in different regions and industries.

Table 4.2.3: Regional distribution of bets

Region	**Total bets**	**Active position**	**Active share**	**Market cap**
Europe	517.4	45.2	14%	1887.0
North America	429.8	2.7	11%	2081.1
Asia	279.3	-14.9	15%	989.9
Oceania	42.1	-23.3	15%	113.5
Latin America	33.9	-3.9	24%	65.0
Africa	17.4	-3.0	25%	32.8
Middle East	8.9	-2.8	21%	14.7

Total bets, active position, and market cap are expressed billion NOK.

Figure 4.2.4: Active position of regions



See table 7.4.1 in the appendix for the active position for each year.

Table 4.2.3 shows that most of the Fund's bets are taken in Europe, North America, and Asia. This is not surprising since these regions make up the largest proportion of the Fund's equities. The distribution of bets between regions is largely explained by market cap, but some of the variations can be explained by how actively different regions are managed. E.g., total bets in Europe is larger than in North America even though the market cap of the portfolio in North America is the largest. The active share shows that the smaller regions in market size are managed most actively. This means the Fund takes more bets relative to their market size in the smaller regions.

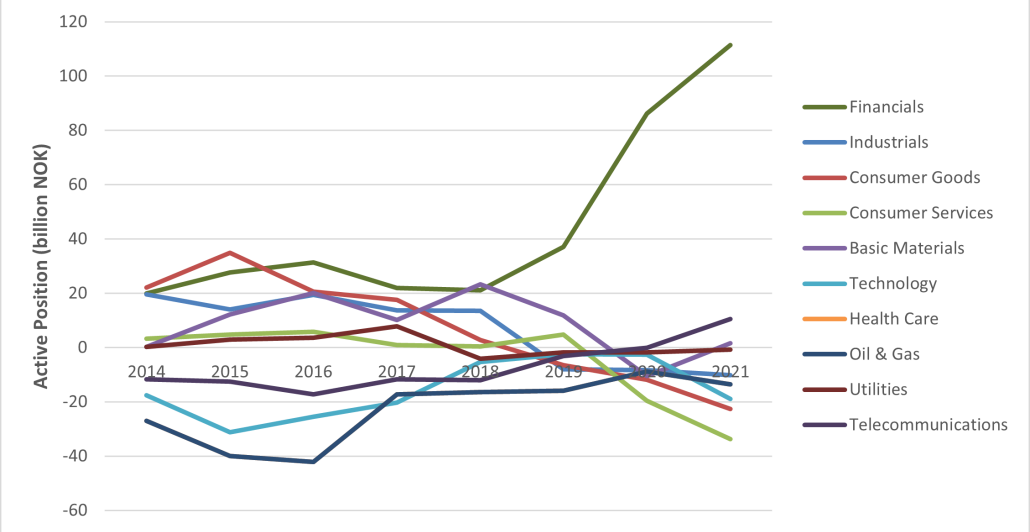
Europe has on average been the most overweighted region, while Oceania has been the most underweighted region. Except overweights in Europe and North America, all of the other regions have on average been underweighted. Figure 4.2.4a shows the development of the active positions. North America was largely underweighted at the start of the time period but has been overweighted in the latest years. Europe was largely overweighted at the beginning of the period, but the overweight has diminished in the latest years. The development of the active positions in Europe and North America can indicate that the Fund positions itself for the proposed change of weights in Europe and North America.

Table 4.2.4: Industrial distribution of bets

Industry	Total bets	Active position	Active share	Market cap
Financials	419.2	44.6	18%	1212.5
Industrials	190.0	6.7	14%	701.7
Consumer Goods	150.6	7.1	12%	664.0
Consumer Services	128.5	-4.2	13%	546.7
Basic Materials	117.3	8.6	22%	266.5
Technology	91.9	-15.5	8%	645.5
Health Care	83.7	-22.7	8%	555.4
Oil & Gas	56.2	-18.2	10%	282.4
Utilities	50.1	0.8	16%	154.0
Telecommunications	41.2	-7.2	13%	155.0

Total bets, active position, and market cap are expressed in billion NOK.

Figure 4.2.5: Active position of industries



See table 7.4.1 in the appendix for the active position for each year.

Financials is the largest industry by total bets, while telecommunications is the smallest. The distribution of the bets is correlated with the market size of the industries. Still, some of the variations can be explained by the degree of active management in each industry. The active share of the industry portfolios varies substantially. Basic materials has the largest active share, while Technology and Health Care have the smallest. Technology has lower total bets compared to Basic Materials, even though Technology has a substantially larger market cap.

Financials has, on average, been the most overweighted industry, while Health Care has been the most underweighted. Figure 4.2.5a shows the development of the active positions of the industries over the time period. The active position of Financials has increased considerably in the latest years, while Industrials and Consumer Goods have decreased steadily during the time period.

We consider three possible reasons for regions and industries having a positive or negative active position. First, it could be an active choice (fund allocation) because they believe the region or industry will perform well or poorly compared to the benchmark. Secondly, stock selection of individual companies can randomly make the active position different from zero. Lastly, returns may effect the development of the active positions for regions and industries. E.g., if an overweighted industry outperforms the benchmark, the active position will increase in size, all else equal.

4.3 Contribution to the active return

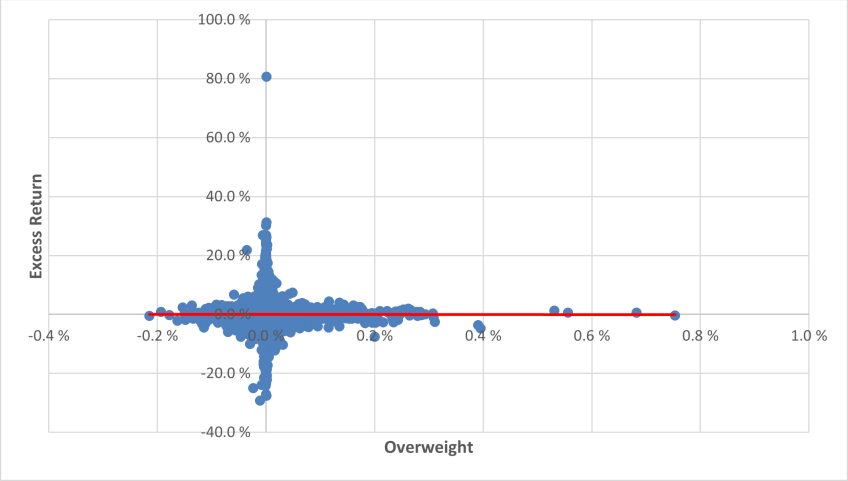
In this section, we answer the third research question: Where is the Fund's active return created? This question will be answered by testing if the contribution to the active return (CAR) from a set of groups is significantly different from zero. First, we study the return of the entire Fund. This is to get an overview of the active return the groups are contributing to. Second, we test groups of overweights and underweights. Third, we test different regions, and last, we test different industries. This tells us how a group has contributed towards the active return and if the contribution has been significantly different from zero. We calculate our results as monthly arithmetic means, and all computations are value-weighted.

4.3.1 The Fund's return

We want to examine if there is any relationship between the size of the overweight and the size of the excess return. Therefore, we have plotted the percentage overweight and the percentage excess return for every observations for every year. Ideally, observations would lie on a straight line in the first and third quadrant with a slope equal to one. This would imply the Fund perfectly overweighted equities that outperform the benchmark, and perfectly underweighted equities that underperfom the benchmark.

There is a marginal negative relationship between overweight and excess return. The correlation between percentage overweight and percentage excess return is equal to -0.0004. However, the correlation is practically equal to zero and it is impossible to detect any systematic trend in the regression line in figure 4.3.1a.

Figure 4.3.1: Overweight and excess return



The red line shows a linear trend line of the observations

The active return of a portfolio is the difference between the fund return and the benchmark return. There have been years with positive and negative active return during the time period. To identify how well the Fund has performed over the time period, the mean monthly active return (hereafter MMR) is calculated. Table 4.3.1 shows that the MMR of the Fund has been -0.0018% for the time period. A negative active return implies that the fund return has been lower than the benchmark return. However, the MMR is not significantly different from zero. Therefore, we cannot conclude that the negative active return is caused by the Fund's poor performance, and it could easily be a coincidence.

Table 4.3.1: The active return of the Fund

	The Fund
Mean monthly return (%)	-0.0018
Mean monthly standard deviation (%)	0.1451
Standard Error[1] (%)	0.0170
T-statistic	-0.1084
P-value	0.9139
Number of observations	93

4.3.2 Overweights and underweights

We want to analyze if there are any systematic differences in the contribution to the active return (CAR) from overweights and underweights. We start by analyzing all overweights and underweights before we analyze the 20 largest overweights and underweights.

4.3.2.1 All overweights and underweights

The CAR from all overweights was a MMR of -0.0073%. The negative contribution means that the fund return of all overweights has been lower than the return of the benchmark. The t-statistic in table 4.3.2 shows that the MMR is not significantly different from zero. All underweights contributed with a MMR of 0.0055%. The positive contribution means that the return of all underweights was lower than the return of the benchmark. The t-statistic in table 4.3.2 shows that the MMR is not significantly different from zero.

[1]Newey-West standard error

Table 4.3.2: All overweights and underweights

	All overweights	**All underweights**
Mean monthly return (%)	-0.0073	0.0055
Mean monthly standard deviation (%)	0.1149	0.0734
Standard error[2] (%)	0.0138	0.0064
T-statistic	-0.5324	0.8661
P-Value	0.5957	0.3887
Number of observations	93	93

The results show that the Fund's underweights have contributed positively to the active return, and the overweights have contributed negatively. This could indicate that the Fund is more skilled in finding stocks that will underperform than overperform. However, since the results from the t-tests are not statistically significant, we cannot conclude that this is due to skill and not a coincidence. It can also be noted that the standard deviation of the overweights is larger compared to the underweights. This is most likely a result of how the Fund distributes their bets, where they take larger bets in the largest overweights compared to the largest underweights. The larger standard deviation in the overweights makes it harder to obtain inference.

4.3.2.2 The 20 largest overweights and underweights

The Fund holds thousands of stocks, and it would require a lot of resources to analyze every company carefully. Therefore, we expect the Fund to use the most effort on their largest bets and that these bets contribute positively to the active return. To examine this, we have analyzed the contribution to the active return (CAR) of the 20 largest overweights and the 20 largest underweights.

The CAR from the 20 largest overweights was a MMR of -0.0071%. The group's contribution is negative, implying that the 20 bets the Fund believes will outperform the benchmark the most had a lower return than the benchmark. The result implies that the largest share of the negative contribution from the group of all overweights originates from the 20 largest overweights. The t-statistic in table 4.3.3 tells us that the result is not significantly different from zero.

The CAR from the 20 largest underweights was a MMR of 0.0046%. This means the fund return of the group was lower than the benchmark return. The t-statistic in 4.3.3

[2]Newey-West standard error

tells us the result is significantly different from zero on a 5% significance level. Therefore, we conclude the CAR was significantly positive from the 20 largest underweights. This result also shows that the largest share of the positive contribution from the group of all underweights is generated in the 20 largest underweights.

The CAR from the 20 largest overweights and the 20 largest underweights as one group was a MMR of -0.0025%. This result is surprising since we expect the Fund to perform well in their largest bets. However, the result is not statistically significant, and we cannot conclude that this is caused by the Fund's poor performance. Table 4.3.3 shows the statistics of the group. The group's contribution to the active return is lower than the entire Fund's active return. This means the remaining bets, on average, contribute positively to the active return.

Table 4.3.3: Top 20 overweights and top 20 underweights

	Top 20 overweights	**Top 20 underweights**	**Both groups**
Mean monthly return (%)	-0.0071	0.0046	-0.0025
Mean monthly standard deviation (%)	0.0612	0.0244	0.0684
Standard error[3] (%)	0.0064	0.0022	0.0075
T-statistic	-1.1012	2.0758	-0.3365
P-Value	0.2737	0.0407	0.7372
Number of observations	93	93	93

This section shows that the Fund's 20 largest overweights have contributed negatively to the active return, while the 20 largest underweights have contributed positively. The results indicate the Fund is more skilled in finding equities that will underperform than overperform. This is a similar result as the findings from the analysis of all overweights and underweights. It can also be noted that the standard deviation of the largest overweights is larger compared to the largest underweights. This is most likely a result of how the Fund distributes their bets. They take larger bets in the largest overweights than the largest underweights. The larger standard deviation in the top 20 overweights makes it harder to obtain inference.

[3]Newey-West standard error

4.3.3 Regions and Industries

We want to analyze if there are any systematic differences in the contribution to the active return (CAR) from regions and industries. We start by analyzing the total contribution from each region and industry. Then, we conduct an attribution analysis to divide the CAR into different attributes. This section aims to study the source of the CAR from regions and industries.

4.3.3.1 Regions

Table 4.3.4 shows that Asia (AS) had the highest CAR, with a MMR of 0.0022%. North America (NA) had the lowest CAR, with a negative MMR of 0.0061%. None of the regions had a significant CAR. As a result of this, we cannot conclude that the performance of the Fund in any regions is significantly different from zero. The Fund's managers are largely given mandates of different sectors and not for different regions. Therefore, it is not surprising that we did not find any significant result of the management from different regions.

Table 4.3.4: All regions

	EU	**NA**	**AS**	**OC**	**LA**	**AF**	**ME**
Mean Monthly return (%)	0.0022	-0.0061	0.0024	0.0007	-0.0004	-0.0003	-0.0003
Monthly Standard Deviation (%)	0.0812	0.0645	0.0423	0.0155	0.0094	0.0082	0.0034
Standard Error[4] (%)	0.0078	0.0078	0.0050	0.0011	0.0007	0.0007	0.0003
T-statistics	0.2762	-0.7748	0.4751	0.6411	-0.5604	-0.3791	-1.1184
P-value	0.7830	0.4405	0.6358	0.5231	0.5765	0.7055	0.2663
Number of observations	93	93	93	93	93	93	93

*S*ee appendix 7.4.2 for the abbreviations of the regions.

Table 4.3.5 shows how the CAR from regions can be decomposed in selection, allocation, and interaction. The result shows that the CAR from security selection has been largest in Europe (EU) and lowest in North America (NA). The allocation effect has been the largest in North America and the lowest in Latin America (LA). The interaction effect is close to zero for every region and is of little interest. All attributes are statistically insignificant. This means we cannot conclude if the Fund has performed well or poorly in any attribute in any region. See appendix 7.4.3 for the test-statistics of the attribution analysis.

[4]Newey-West standard error

Table 4.3.5: Attribution analysis of regions

	EU	**NA**	**AS**	**OC**	**LA**	**AF**	**ME**
Selection (%)	0.0021	-0.0090	0.0019	0.0002	0.0000	-0.0003	-0.0006
Allocation (%)	-0.0002	0.0025	0.0006	0.0006	-0.0004	-0.0001	0.0002
Interaction (%)	0.0002	0.0004	-0.0002	-0.0001	0.0000	0.0001	0.0001
Total (%)	0.0022	-0.0061	0.0024	0.0007	-0.0004	-0.0003	-0.0003

*S*ee appendix 7.4.2 for the abbreviations of the regions.

4.3.3.2 Industries

Table 4.3.6 shows that Basic Materials (BM) had the highest CAR, with a MMR of 0.0022%. Consumer Services (CS) had the lowest CAR, with a negative MMR of 0.0047%. The MMR of 0.0019% in Utilities (UTI) is significantly different from zero. This indicates that Utilities has contributed significantly positively to the active return. We were not able to find inference in any other industries. Therefore, we cannot reject their null hypothesis of a zero contribution to the active return.

Table 4.3.6: All industries

	FIN	**IND**	**CG**	**CS**	**BM**
Mean Monthly return (%)	0.0015	0.0014	-0.0020	-0.0047	0.0022
Monthly Standard Deviation (%)	0.0617	0.0259	0.0340	0.0290	0.0234
Standard Error[5] (%)	0.0057	0.0032	0.0039	0.0039	0.0024
T-statistics	0.2592	0.4441	-0.5082	-1.2039	0.8842
P-value	0.7960	0.6580	0.6125	0.2317	0.3786
Number of observations	93	93	93	93	93
	TEC	**HC**	**OG**	**UTI**	**TEL**
Mean Monthly return (%)	-0.0016	0.0001	-0.0010	0.0019	0.0004
Monthly Standard Deviation (%)	0.0200	0.0219	0.0230	0.0089	0.0173
Standard Error[6] (%)	0.0019	0.0022	0.0022	0.0009	0.0021
T-statistics	-0.8289	0.0378	-0.4526	2.0382	0.1989
P-value	0.4093	0.9699	0.6519	0.0444	0.8428
Number of observations	93	93	93	93	93

*S*ee appendix 7.4.2 for the abbreviations of the industries.

[5]Newey-West standard error

[6]Newey-West standard error

Table 4.3.7 shows how the CAR from industries can be decomposed in selection, allocation, and interaction. The results show that the CAR from security selection has been largest in Financials (FIN) and Basic Materials (BM) and worst in Consumer Services (CS). The allocation effect has been the largest in Telecommunications (TEL) and the lowest in Health Care (HC). The interaction effect is close to zero in every industry. As earlier mentioned, the total contribution to the active return from Utilities (UTI) has been statistically significant. This is caused by a positive selection attribute, which is also statistically significant. The positive selection attribute indicates that the Fund has skills in selecting stocks in the Utility industry. See appendix 7.4.3 for the test-statistics of the attribution analysis.

Table 4.3.7: Attribution analysis of industries

	FIN	**IND**	**CG**	**CS**	**BM**
Selection (%)	0.0025	0.0013	-0.0027	-0.0049	0.0025
Allocation (%)	-0.0011	0.0000	0.0006	0.0000	-0.0003
Interaction (%)	0.0001	0.0001	0.0001	0.0000	0.0000
Total (%)	0.0015	0.0014	-0.0020	-0.0047	0.0022
	TEC	**HC**	**OG**	**UTI**	**TEL**
Selection (%)	-0.0002	0.0019	-0.0015	0.0020*	-0.0004
Allocation (%)	-0.0013	-0.0018	0.0005	-0.0001	0.0007
Interaction (%)	-0.0001	0.0000	0.0000	0.0000	0.0001
Total (%)	-0.0016	0.0001	-0.0010	0.0019*	0.0004

*S*ee appendix 7.4.2 for the abbreviations of the industries.

4.4 Implications of the Findings

In this section, we discuss the implications of our findings and connect the results of our second and third research questions. We do not discuss the first research question since this question adds less value to the subject of our thesis. In the analysis, we discussed how the Fund's bets can be divided into groups and how these groups have contributed to the active return. First, we discuss the implications of the fund returns and market efficiency. Second, we discuss the findings from overweights and underweights. Third, we discuss the findings from regions, and last, we discuss the findings from industries.

Without a few exceptions, the results in our analysis are not statistically significant. Therefore, the implications we present are mostly indications of what our data suggests and not conclusions of the Fund's performance.

4.4.1 Fund returns and market efficiency

In section 4.3.1, we found that the Fund had a negative active return during the time period. The result was not statistically significant, and we cannot reject the null hypothesis of a zero active return. This is consistent with the Efficient Market Hypothesis, which argues that outperforming the mean is not possible in the long haul. However, we found statistically significant results from the top 20 underweights and Utilities. This suggests that markets are not perfectly efficient. Still, we should not place too much weight on these conclusions, as lack of precision in the active return and type I errors might invalidate our results.

4.4.2 Overweights and underweights

In section 4.2.2, we identified how bets are distributed between overweights and underweights. In section 4.3.2, we analyzed the contribution to the active return from the group of overweights and underweights.

We found that the largest overweights were larger than the largest underweights. This indicates the Fund believes more in their largest bull bets than their largest bear bets. As a result, we expect the Fund's overweights to perform better than the Fund's underweights. However, our findings indicate the opposite. The 20 largest overweights contributed negatively to the active return, while the 20 largest underweights contributed positively. This indicates that the Fund's strategy of placing larger bets in the overweights than underweights has contributed negatively to the active return. It can be mentioned that the Fund has reduced the difference in size between the largest overweights and the largest underweights. This may be a result of the poor results from the largest overweights.

We found that the Fund's best ideas, the group of the 20 largest overweights and the 20 largest underweights, had a negative CAR. This is inconsistent with the findings of Cohen et al. (2009). They found that active managers' best ideas, the largest bets, outperform the market and the remaining bets.

4.4.3 Regions

In section 4.2.3, we identified how bets are distributed between regions. In section 4.3.3.1, we analyzed the contribution to the active return from different regions.

Europe was the most overweighted region on average, while Oceania was the most underweighted region. The attribution analysis shows that the allocation attribute was negative for Europe and positive for Oceania. This means that overweighting Europe has not been successful, while underweighting Oceania has contributed positively. In the analysis, we found that the development in the active position in North America went from being underweighted to being overweighted. The shift in the active position was successful, as allocation in North America had a positive CAR.

Measured in active share, the Fund was most active in Latin America, Africa, and the Middle East. These are the three smallest regions, measured in market value. The high active share could be caused by the Fund being less linked to the benchmark in less transparent markets and the usage of external managers. The security selection in these regions all had a zero or negative contribution. Therefore, it is worth questioning if the Fund should be less active in these regions, given the poor performance in security selection.

4.4.4 Industries

In section 4.2.3, we identified how bets are distributed between industries. In section 4.3.3.2, we analyzed the contribution to the active return from different industries.

Our findings suggest Financials has been the most overweighted region during the entire time period and has increased substantially in the latest years. Based on the allocation attribute, we see that this overweight has not contributed positively. Health care was the most underweighted industry. This underweight has not been successful, as the allocation attribute was negative. In fact, the Fund had the worst result from allocation in Health Care.

The two most actively managed industries were Financials and Basic Materials. The security selection was the largest in these two industries, which means taking more bets in these industries has been successful. The two least actively managed industries were

Health Care and Technology. Health Care had a positive selection attribute, which means that the Fund might have been better off being more active in this industry. The technology industry had a marginal negative selection attribute.

The Fund had a significant positive CAR from Utilities, mainly due to a significant positive selection attribute. This indicates the Fund performs well in stock selection in Utilities. The Utility industry had an active share above the average, which means it was more actively managed. This was a smart choice of the Fund, as the selection attribute has been significantly positive.

5 Precision of the Findings

In this chapter, we discuss the precision of our findings. This chapter aims to assess if our data is representative for the Fund and if our results can be trusted.

Replicating the benchmark, adjusting weights, and obtaining correct returns is a challenging task with many considerations. Therefore, we must assess the precision of our data. This is achieved by comparing our estimated fund returns, benchmark returns, and active returns with the numbers reported by NBIM. In table 5.0.1, we present the mean difference, the standard deviation of the differences, and the correlation, between our estimates and NBIM's reports. A more thorough analysis of the deviations is presented in appendix 7.5.

Table 5.0.1: Difference between of our estimations and NBIM's reports

	Fund return	**Benchmark return**	**Active return**
Mean difference (%)	0.005	0.022	-0.017
Standard deviation of the differences (%)	0.099	0.104	0.104
Correlation (%)	99.96	99.96	74.59

The fund return has a mean difference of 0.005% and a correlation of 99.96%, while the benchmark return has a mean difference of 0.022% and a correlation of 99.96%. This suggests our findings are quite precise compared to NBIM's reported numbers. The active return has a small mean difference of -0.017% but has a correlation of only 74.59%.

We have plotted our estimated returns and NBIM's reported returns in figure 5.0.1, 5.0.2, and 5.0.3. This is to identify how our estimations coincide with NBIM's reported numbers. From figure 5.0.1 and 5.0.2, we see that the estimated fund and benchmark return coincide closely with NBIM's reports. Figure 5.0.3 shows that the estimated active returns coincide less with NBIM's reported numbers than the fund returns and benchmark returns.

The precision of the active return shows it is hard to replicate the Fund's positions and returns. This was largely caused by the challenges of matching fund holdings with benchmark holdings. We were fortunate enough to obtain ISIN codes of the Fund's holdings, but it was still challenging to match companies. NBIM does not publish the ISIN codes, so relying on publicly available data only would make it even more challenging. It should also be mentioned that the Fund does not publish data on which share classes they own of a stock, which makes the task of replicating the returns harder. For an outsider, it is a time-demanding task to replicate the Fund's positions and returns, and a 100% match is unrealistic.

Figure 5.0.1: The Precision of Fund Return

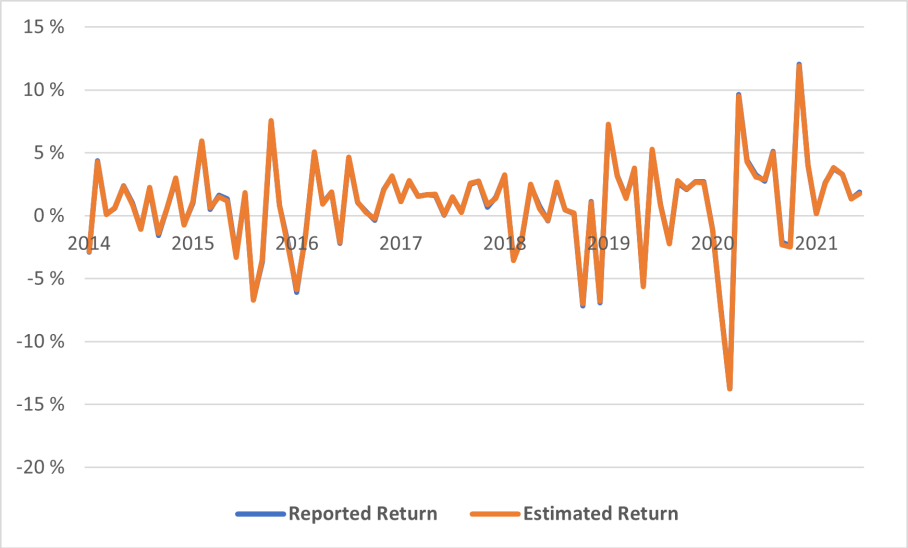


Figure 5.0.2: The Precision of Benchmark Return

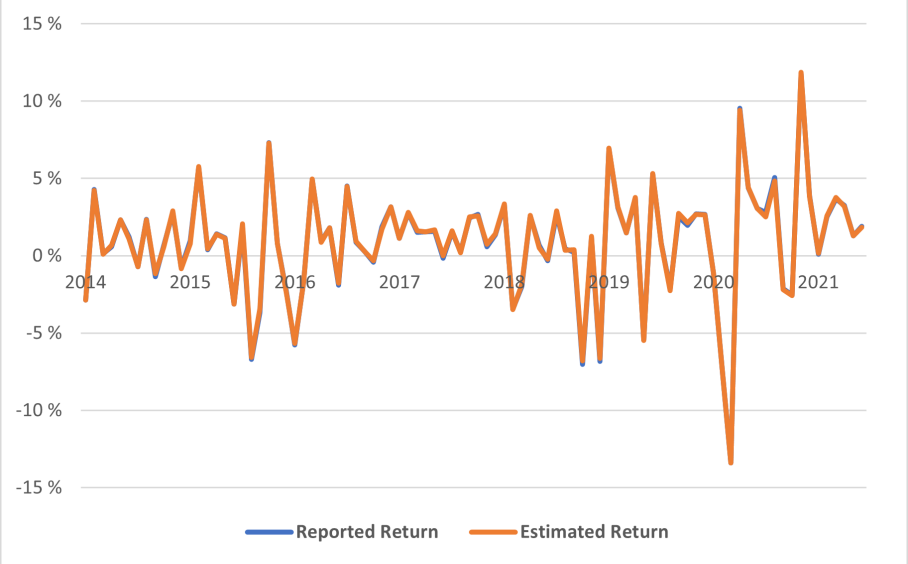
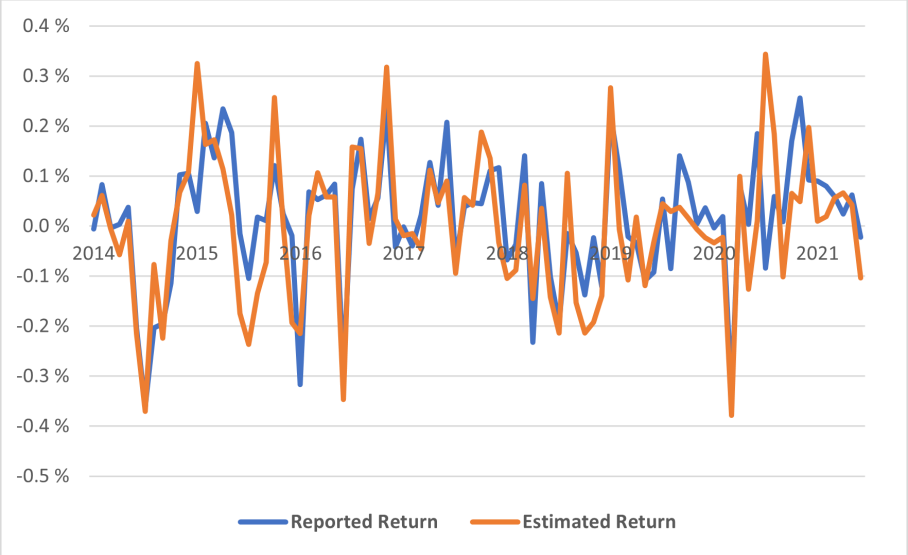


Figure 5.0.3: The Precision of Active Return



The percentage coverage of the market cap was in the range of 96.38-98.44%. Based on the high coverage, we believe our results are representative of the Fund. This is supported by the high correlation between our eatimated fund and benchmark returns with NBIM's reported numbers. However, there is a larger degree of uncertainty in the active return. Therefore, we must be careful with statistically significant results since our data is not 100% precise.

6 Concluding Remarks

In this thesis, we study the active management of the Fund by conducting a holdings-based analysis. We compare the Fund's holdings with the holdings of the adjusted benchmark index FTSE Global All Cap. We analyze the performance of the portfolio of equities for the time period from 2014 to 2021. The Fund has been evaluated several times, and the main motivation of our thesis is to extend the research of previous evaluations by answering the following three research questions:

1. How actively has the Fund been managed?
2. How have the Fund distributed their bets?
3. Where is the Fund's active return created?

In this chapter, we answer the research questions and provide suggestions of further research.

6.1 Conclusion

The *first research question* is answered by measuring tracking error and active share. The tracking error was well within the limit of the active risk budget, and the active share was low and decreasing. Therefore, we conclude that the degree of active management of the Fund was low during the time period.

The *second question* is answered by mapping the Fund's active bets. Our findings show that the Fund distributes its overweights differently from its underweights. The largest overweights were larger in size than the largest underweights, and the group of all overweights had a larger standard deviation than the group of all underweights. Further, our findings show that the regional distribution of the bets is largely explained by the market size of the regions. However, some variations are caused by different degrees of active management in the regions. The industrial distribution of the bets is largely explained by the market size as well but is even more affected by the degree of active management than the regions.

The *third research question* is answered by analyzing different groups' contribution to the active return (CAR). Our findings show that all overweights contributed negatively to the active return, while all underweights contributed positively. The same pattern was found in the largest bets. Of these findings, the only statistically significant result was from the 20 largest underweights. Therefore, we can reject the null hypothesis of a zero

CAR from the 20 largest underweights and conclude that the positive CAR was caused by good performance. We fail to reject the null hypothesis for the remaining groups of overweights and underweights. Therefore, it is a large possibility that coincidences caused our positive and negative CAR.

In the analysis of the CAR from different regions, we found no statistically significant results. This means we fail to reject the null hypothesis of a zero CAR from different regions. Therefore, it is a large possibility that coincidences caused our positive and negative CAR from regions. This result indicates there are no systematical differences in the performance of the Fund in different regions.

In the analysis of the industries, we found that the CAR from Utilities was positive and statistically significant. Therefore, we reject the null hypothesis of a zero CAR from Utilities and conclude that the Fund has performed well in the Utilities industry. For the remaining industries, we fail to reject the null hypothesis. Therefore, it is a large possibility that coincidences caused our positive and negative CAR from the industries. The result from Utilities indicates there are systematical differences in the performance of the Fund in different industries. However, because of estimation uncertainty and only one significant result, our findings do not indicate clear systematical differences.

6.2 Suggestions of further research

Analyzing a longer time period would introduce several interesting possibilities and provide more insight into the Fund's active management. First, it would be possible to analyze the degree of active management over time. Second, changes in the Fund's strategies could be identified and analyzed. In particular, it would be interesting to study the distribution of the Fund's bets between overweights and underweights over a longer time period. Additionally, analyzing a longer time period would increase the possibilities of obtaining statistically significant results. We also recommend to increase the precision of our research by including divestments and manually matching more observations. However, this could be a very time-demanding task.

In section 4.2.2, we mentioned the Fund probably uses a carry trade, where they underweight a company in one market and overweight the same company in another market. It would be interesting to study the scope of this strategy and its contribution to the active return. The same could be said about different share classes, but there is currently not enough publicly available data for this task.

In our thesis, we have not adjusted the return for risk. For further research, it could be interesting to look at the risk-adjusted contribution to the active return from different groups. The Fama-French factors are an example of risk exposures that can be adjusted for. This could give a better picture of the performance of the groups, as well as explore the risk factors.

Bibliography

Baker, C, R. and Wright, M, A. (2012), *Return Attribution*, CFA Institute.

Bjerksund, P. and Døskeland, T, M. (2015), 'Mål på ativ forvaltning av aksjefond', https://fil.forbrukerradet.no/wp-content/uploads/2017/10/fra-forbrukerradet-mal-pa-aktiv-forvaltning-01jun2015.pdf.

Carhart, M. M. (1997), 'On persistence in mutual fund performance', *The Journal of finance* **52**(1), 57–82.

Cohen, R. B., Polk, C. and Silli, B. (2009), Best ideas, *in* 'AFA 2011 Denver Meetings Paper'.

Cremers, K. M. and Petajisto, A. (2009), 'How active is your fund manager? a new measure that predicts performance', *The review of financial studies* **22**(9), 3329–3365.

Dahlquist, M. and Ødegaard, B, A. (2018), 'A review of norges bank's active management of the government pension fund global'.

Døskeland, T, M. and Strömberg, P. (2018), 'Evaluating investments in unlisted equity for the norwegian government pension fund global (gpfg)', https://www.regjeringen.no/contentassets/7fb88d969ba34ea6a0cd9225b28711a9/evaluating_doskelandstromberg_10012018.pdf.

Eidem, M. (2021), 'Studie viser at aktive norske fond lønner seg. finanswatch.', https://finanswatch.no/nyheter/kapitalforvaltning/article13303227.ece.

Ferson, W. E. and Qian, M. (2004), *Conditional performance evaluation, revisited*, Citeseer.

Finansdepartementet (2010), 'Meld. 24: Statens pensjonsfond 2021', https://lovdata.no/dokument/INS/forskrift/2010-11-08-1414.

Finansdepartementet (2019), 'Bruk av oljepenger', https://www.regjeringen.no/no/tema/okonomi-og-budsjett/norsk_okonomi/bruk-av-oljepenger-/id449281/.

Finansdepartementet (2020), 'Statsbudsjettet 2021: Statens inntekter og utgifter', https://www.regjeringen.no/no/statsbudsjett/2021/statsbudsjettet-2021-statens-inntekter-og-utgifter/id2768898/.

Finansdepartementet (2021*a*), 'Investeringsstrategi: Statens pensjonsfond', https://www.regjeringen.no/en/topics/the-economy/the-government-pension-fund/investment-strategy-of-the-government-pe/id699600/.

Finansdepartementet (2021*b*), 'Investeringsstrategi: Statens pensjonsfond utland (spu)', https://www.regjeringen.no/no/tema/okonomi-og-budsjett/statens-pensjonsfond/statens-pensjonsfond-utland-spu1/investeringsstrategi/id696849/.

Finansdepartementet (2021*c*), 'Meld. 24: Statens pensjonsfond 2021', https://www.regjeringen.no/no/dokumenter/meld.-st.-24-20202021/id2843255/.

Finansdepartementet (2021*d*), 'Strategic benchmark index: Government pension fund global (gpfg)', https://www.regjeringen.no/en/topics/the-economy/the-government-pension-fund/government-pension-fund-global-gpfg/strategic-benchmark-index-for-the-govern/id696850/.

Grossman, S. J. and Stiglitz, J. E. (1980), 'On the impossibility of informationally efficient markets', *The American economic review* **70**(3), 393–408.

Høegh-Krohn, N, J. (2004), *Viktige Problemstilling og Utviklingstrekk i moderne kapitalforvaltning*, Universitetsforlaget.

Ito, M., Noda, A. and Wada, T. (2014), 'International stock market efficiency: a non-bayesian time-varying model approach', *Applied Economics* **46**(23), 2744–2754.

Jensen, M. C. (1968), 'The performance of mutual funds in the period 1945-1964', *The Journal of finance* **23**(2), 389–416.

Kaplan, P. D. (2003), 'Holdings-based and returns-based style models', *Morningstar, INC* .

Keller, G. and Gaciu, N. (2012), *Managerial statistics*, South-Western Cengage Learning.

Lettau, M. and Madhavan, A. (2018), 'Exchange-traded funds 101 for economists', *Journal of Economic Perspectives* **32**(1), 135–54.

Malkiel, B. G. (2003), 'The efficient market hypothesis and its critics', *Journal of economic perspectives* **17**(1), 59–82.

Melgård, M. (2021), 'Støre med valgløfte: Vil innføre nullutslippskrav for for oljefondets investeringer. dagens næringsliv.', https://www.dn.no/politikk/store-med-valglofte-vil-innfore-nullutslippskrav-for-oljefondets-investeringer/2-1-1056745.

NBIM (2019*a*), 'Divestments', https://www.nbim.no/en/the-fund/responsible-investment/divestments/.

NBIM (2019*b*), 'Governance model', https://www.nbim.no/en/organisation/governance-model/.

NBIM (2021*a*), 'External mandates', https://www.nbim.no/en/the-fund/how-we-invest/external-mandates/.

NBIM (2021*b*), 'Historiske referanseindekser', https://www.nbim.no/no/oljefondet/slik-er-fondet-investert/referanseindeksene/benchmarks-historic/.

NBIM (2021*c*), 'The history', https://www.nbim.no/en/the-fund/the-history/.

NBIM (2021*d*), 'Investeringsstrategien', https://www.nbim.no/en/organisation/governance-model/management-mandate/.

NBIM (2021*e*), 'Market value', ttps://www.nbim.no/en/the-fund/market-value/.

NBIM (2021*f*), 'Observasjon og utelukkelser av selskaper', https://www.nbim.no/no/oljefondet/ansvarlig-forvaltning/utelukkelse-av-selskaper/.

Newey, W. K. and West, K. D. (1987), 'A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix', *Econometrica* **55**(3), 703–708.

Petajisto, A. (2013), 'Active share and mutual fund performance', *Financial Analysts Journal* **69**(4), 73–93.

Russel, F. (2021), 'Equity country classification', https://www.ftserussell.com/equity-country-classification.

Sharpe, W. F. (1970), 'Efficient capital markets: a review of theory and empirical work: discussion', *The Journal of Finance* **25**(2), 418–420.

Sharpe, W. F. (1991), 'The arithmetic of active management', *Financial Analysts Journal* **47**(1), 7–9.

Statista (2021), 'Largest sovereign wealth funds worldwide as of september 2021, by asset under management. statista.', https://www.statista.com/statistics/276617/sovereign-wealth-funds-worldwide-based-on-assets-under-management/.

7 Appendix

7.1 Statistical inference: normality condition

According to Keller (2012), statisticians have shown that results from the t-test are robust, as long as the distribution of the sample is not extremely non-normal. Furthermore, the results from the t-test may be valid in the case of extreme non-normality if the sample size is large enough.

We have analyzed the contribution to the active return from different groups of bets and used T-tests to test for statistically significant results. In this section, we assess the normality condition for our test groups. We found three statistically significant results. The 20 largest underweights, utilities, and selection in Utilities. Therefore, we evaluate if these groups are normally distributed. Additionally, we assess the remaining groups of overweights and underweights. We will not evaluate the normality condition for the rest of the regions and industries (66 t-tests). However, if statistically significant results were found, the normality in these groups could be assessed in a similar manner as in Utilities.

To assess if a variable is normally distributed, we use the Shapiro-Wilk test, histogram, and Q-Q-plot of the variables. The Shapiro-Wilk test is a known test for evaluating if observations are normally distributed (Emons and Sijtsma, 2010). With a significance level of 5%, the null hypothesis of a normally distributed population is rejected if the p-value is under 0.05. The Shapiro-Wilk test is presented in table 7.1.1. The results show that the null hypothesis is rejected for group 2, All Overweights. We must therefore assess how non-normal this group is distributed.

Table 7.1.1: Shapiro-Wilks test

Group nr.	Group	Statistic	P-value	Df
1	Total active return	0.983	0.249	92
2	All overweights	0.961	0.008*	92
3	All underweights	0.978	0.120	92
4	The 20 largest overweights	0.981	0.189	92
5	The 20 largest underweights	0.985	0.388	92
6	The 20 largest overweights and underweights	0.983	0.248	92
7	Utilities	0.98896	0.6328	92
8	Selection in Utilities	0.983	0.248	92

Figure 7.1.1 to 7.1.8 displays the histogram and QQ-plot for the groups tested. The histogram of the group of all overweights shows that the distribution of the observations is not symmetrical. However, there is an outlier in the group, and we suspect this outlier has a great impact on the Shapiro-Wilk test. Therefore, we believe that the distribution of all overweights is not too non-normal. Consequently, we conclude that the normality condition is fulfilled for the group of all overweights. The Shapiro-Wilk tests of the other groups are not statistically significant. However, we should still assess if the groups are extremely non-normally distributed based on the histograms and QQ-plots. The histograms and QQ-plots of the remaining seven groups show that they are not perfectly normally distributed. However, none of the groups have deviations from the normality, which we would classify as extreme non-normality. Therefore, we conclude that the normality assumption for all eight groups we assessed is fulfilled, and the results from the t-tests are robust.

Figure 7.1.1: Total active return

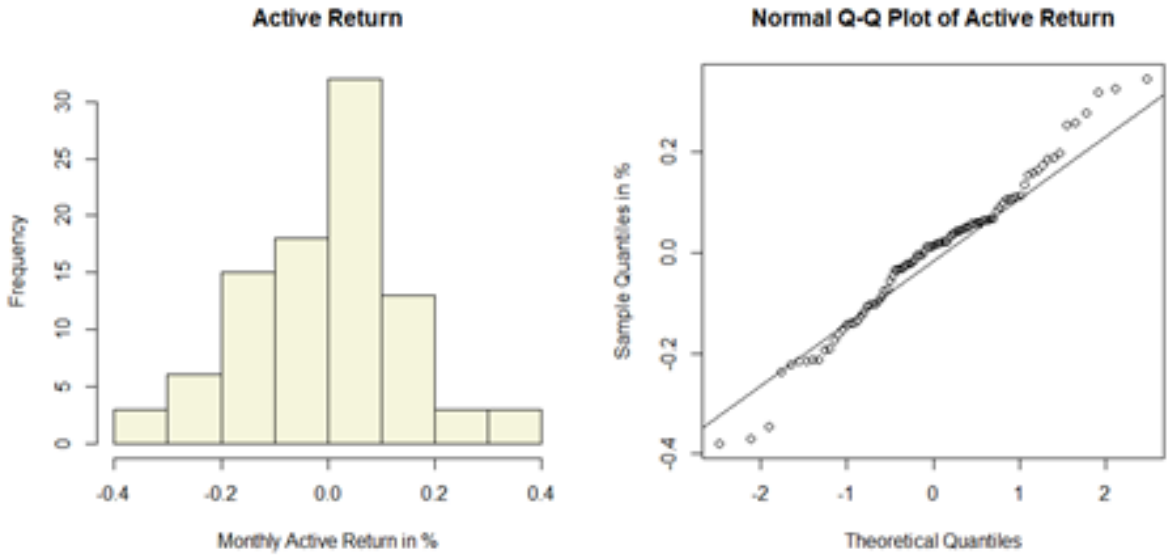


Figure 7.1.2: All overweights

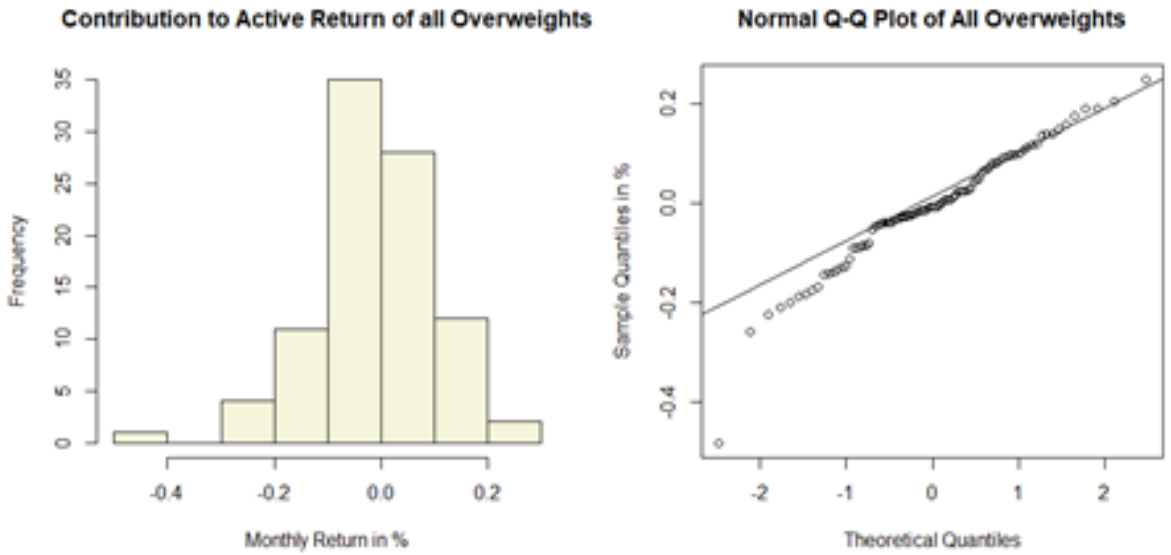


Figure 7.1.3: Allunderweights

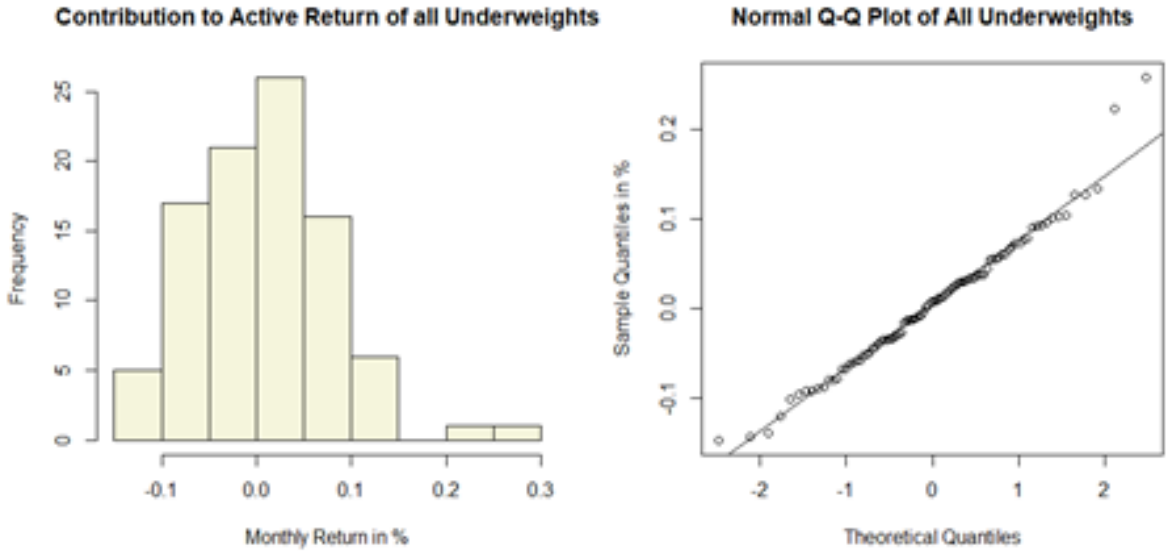


Figure 7.1.4: 20 largest overweights

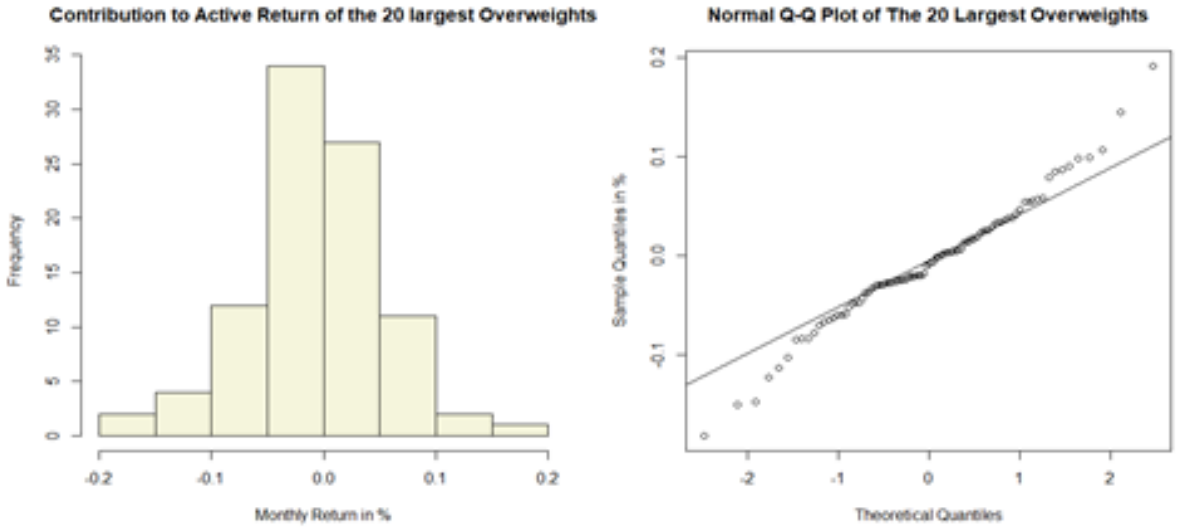


Figure 7.1.5: 20 largest underweights

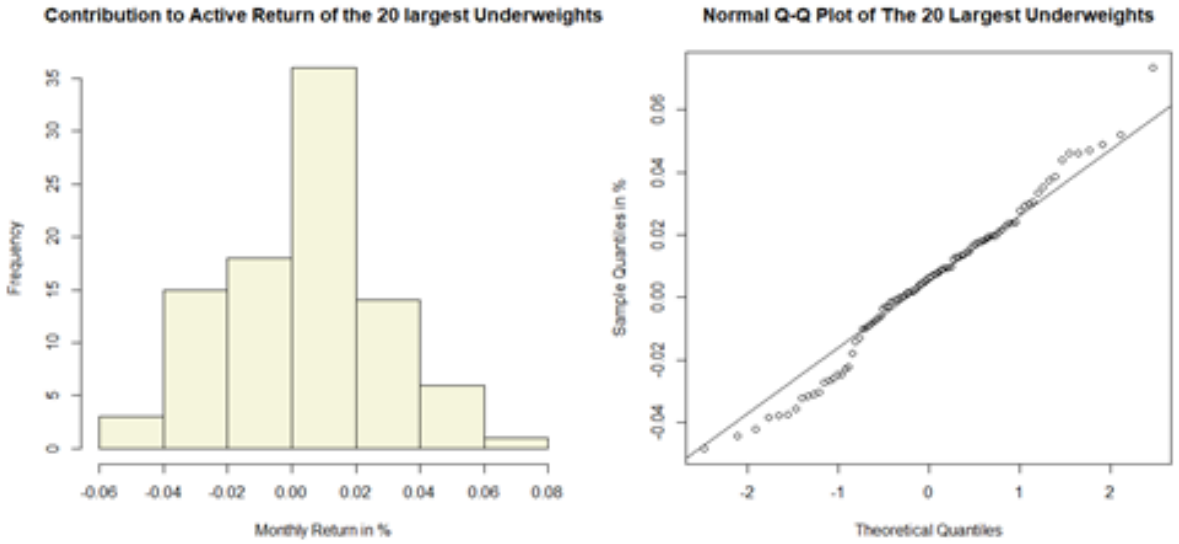


Figure 7.1.6: 20 largest overweights and 20 largest underweights

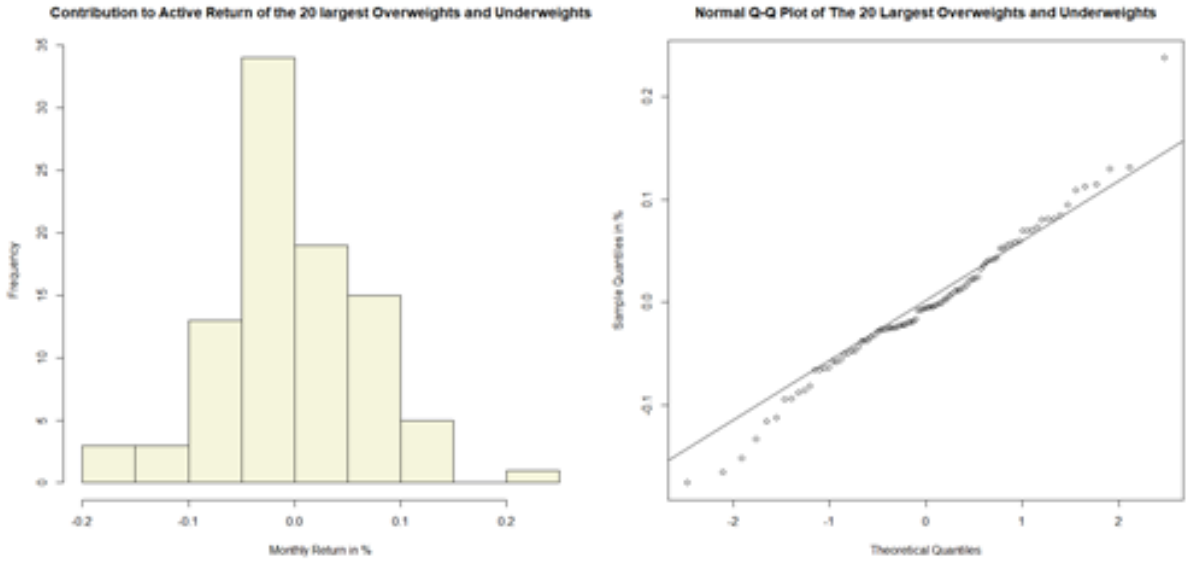


Figure 7.1.7: Utilities

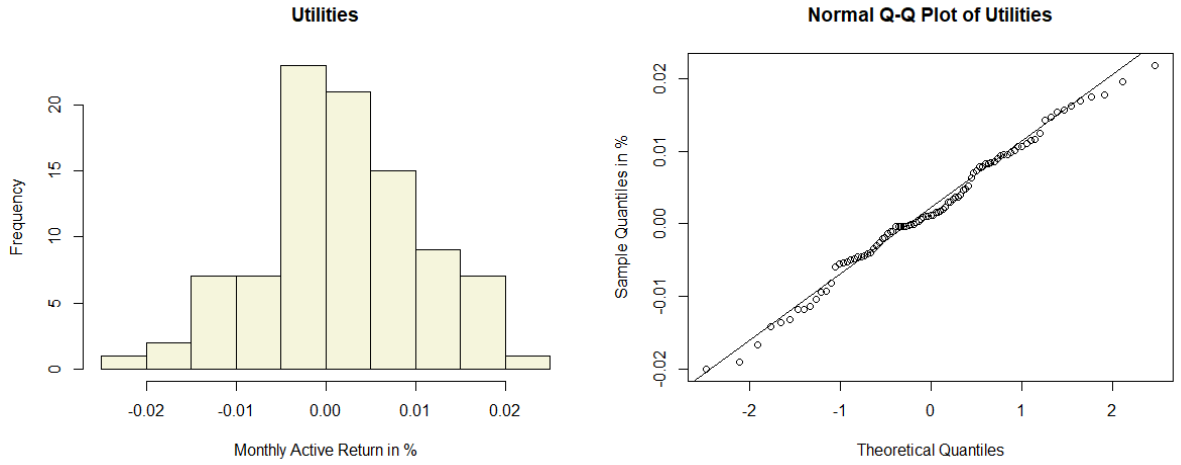
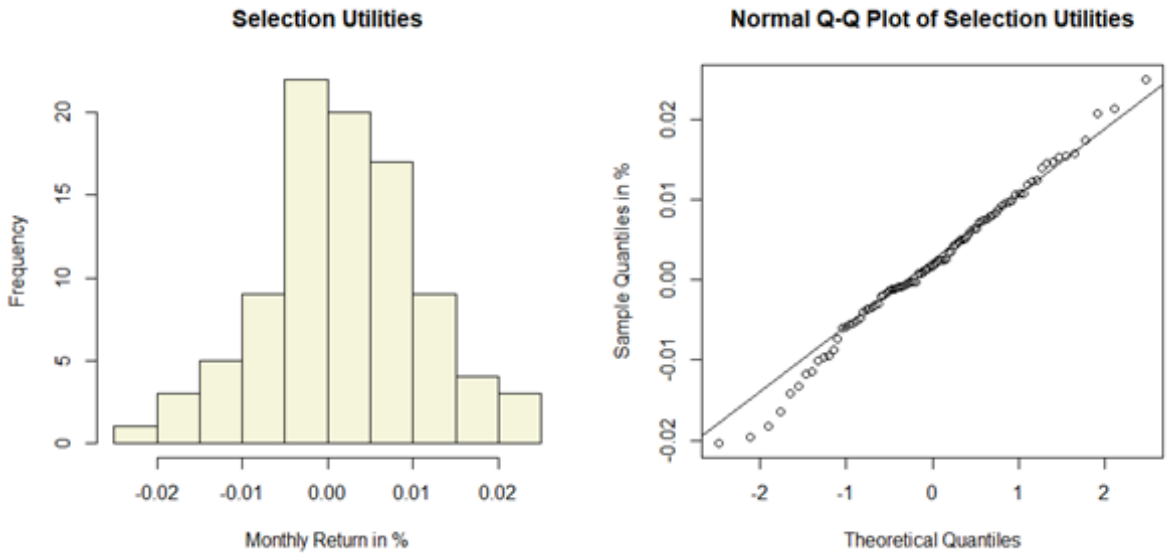


Figure 7.1.8: Selection in Utilities



7.2 Context

7.2.1 Regional classification of countries

Table 7.2.1 displays an overview the regional classification of countries. The country classification is based on the classification made by FTSE Russel (2021).

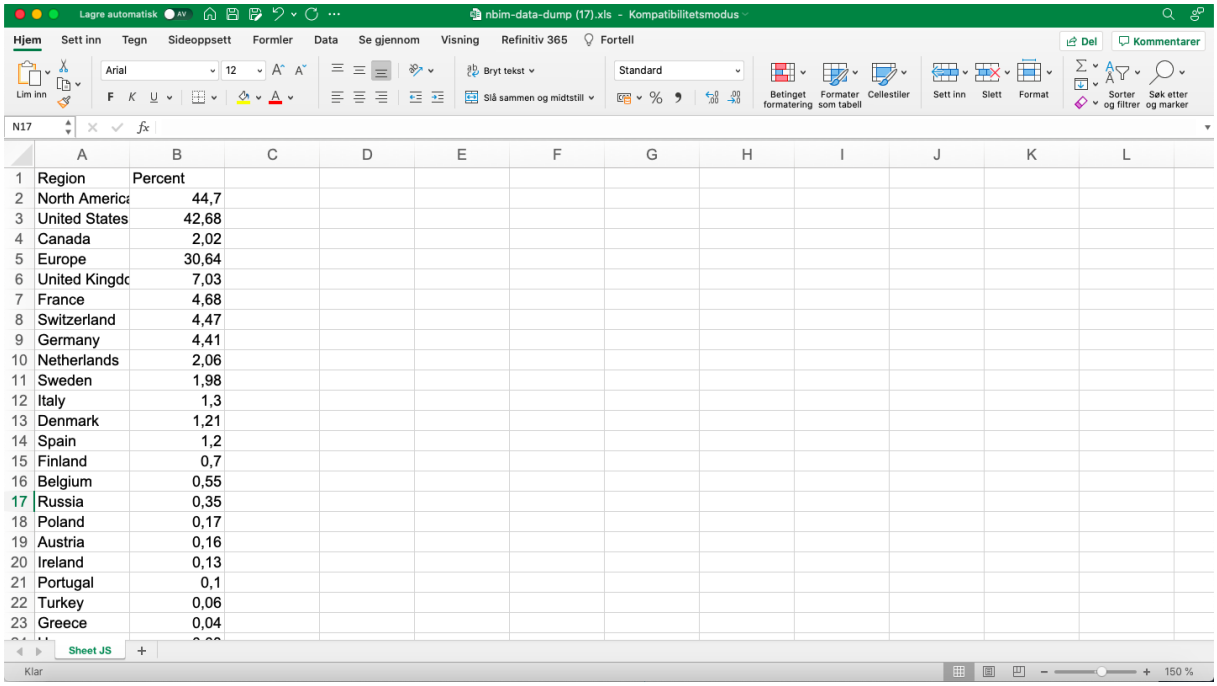
Table 7.2.1: Regional classification of countries

Developed Markets in Europe	**Developed markets in North America**	**New countries in FTSE index from 2019**	**Other countries in FTSE index**
Austria	Canada	Romania	Brazil
Belgium	United States	Saudi Arabia	Chile
Belgium			China
Denmark			Colombia
Finland			Czech Republic
France			Egypt
Germany			Hungary
Ireland			India
Italy			Indonesia
Netherlands			Kuwait
Poland			Malaysia
Portugal			Mexico
Spain			Pakistan
Sweden			Philippines
Switzerland			Qatar
United Kingdom			Russia
Luxembourg			Taiwan
			Thailand
			Turkey
			UAE

7.2.2 Actual benchmark

We downloaded data of the actual benchmark for each year for 2014-2021 from NBIM's website (NBIM, 2021*b*). This data contains information about how large the actual benchmark was for each country and region, per year. See figure 7.2.1 for a look at the actual benchmark for 2021.

Figure 7.2.1: Actual benchmark for 2021



	A	B
1	Region	Percent
2	North America	44,7
3	United States	42,68
4	Canada	2,02
5	Europe	30,64
6	United Kingdo	7,03
7	France	4,68
8	Switzerland	4,47
9	Germany	4,41
10	Netherlands	2,06
11	Sweden	1,98
12	Italy	1,3
13	Denmark	1,21
14	Spain	1,2
15	Finland	0,7
16	Belgium	0,55
17	Russia	0,35
18	Poland	0,17
19	Austria	0,16
20	Ireland	0,13
21	Portugal	0,1
22	Turkey	0,06
23	Greece	0,04

7.2.3 Excluded companies

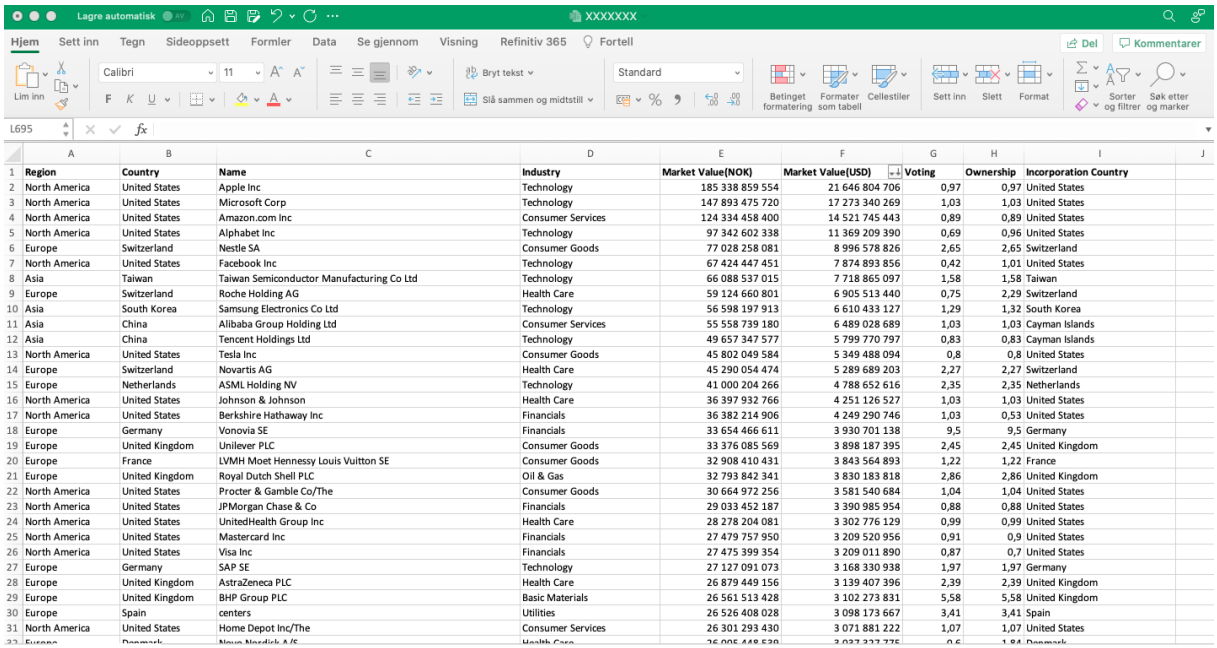
Observation and exclusion of companies are determined by the Executive Board of Norges Bank (NBIM, 2021*f*). A list of companies which are excluded or observed can be viewed at: www.nbim.no/no/oljefondet/ansvarlig-forvaltning/utelukkelse-av-selskaper.

7.3 Data treatment

7.3.1 Fund holdings

Data of the Fund's holdings in equities are downloaded from www.nbim.no/the-fund/investments/. We have downloaded data for each year from 2014 to 2021. Figure 7.3.1 shows a view of the dataset for 2021.

Figure 7.3.1: Fund holdings 2021

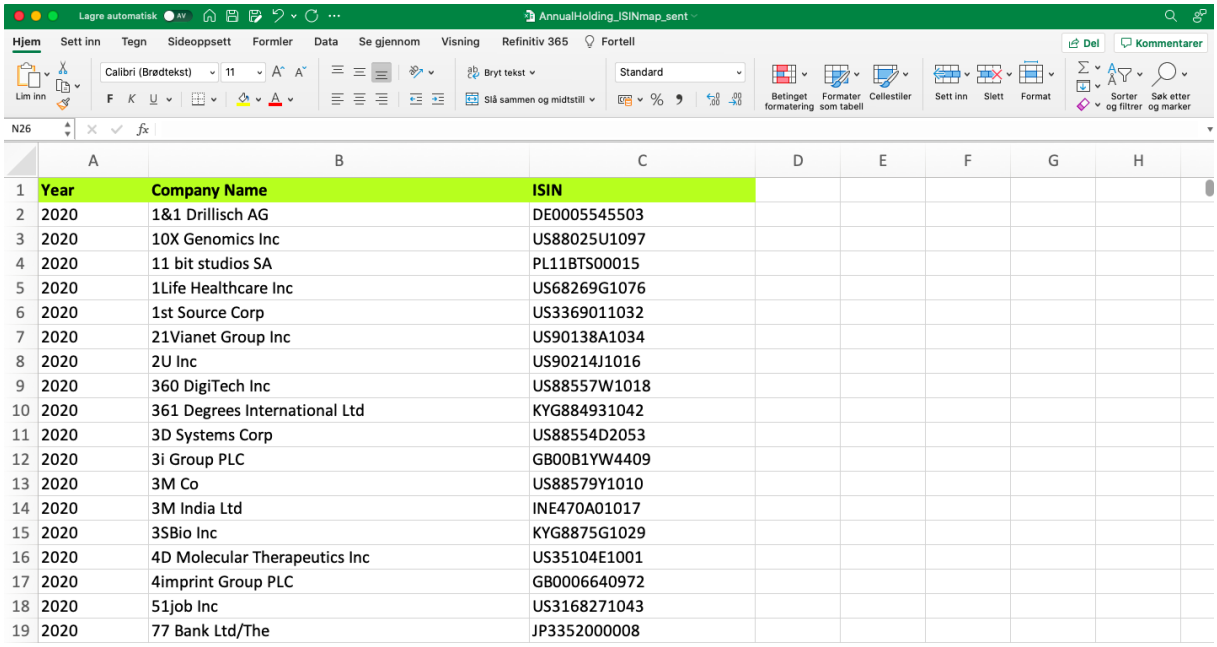


	A	B	C	D	E	F	G	H	I
1	Region	Country	Name	Industry	Market Value(NOK)	Market Value(USD)	Voting	Ownership	Incorporation Country
2	North America	United States	Apple Inc	Technology	185 338 859 554	21 646 804 706	0,97	0,97	United States
3	North America	United States	Microsoft Corp	Technology	147 893 475 720	17 273 340 269	1,03	1,03	United States
4	North America	United States	Amazon.com Inc	Consumer Services	124 334 458 400	14 521 745 443	0,89	0,89	United States
5	North America	United States	Alphabet Inc	Technology	97 342 602 338	11 369 209 390	0,69	0,96	United States
6	Europe	Switzerland	Nestle SA	Consumer Goods	77 028 258 081	8 996 578 826	2,65	2,65	Switzerland
7	North America	United States	Facebook Inc	Technology	67 424 447 451	7 874 893 856	0,42	1,01	United States
8	Asia	Taiwan	Taiwan Semiconductor Manufacturing Co Ltd	Technology	66 088 537 015	7 718 865 097	1,58	1,58	Taiwan
9	Europe	Switzerland	Roche Holding AG	Health Care	59 124 660 801	6 905 513 440	0,75	2,29	Switzerland
10	Asia	South Korea	Samsung Electronics Co Ltd	Technology	56 598 197 913	6 610 433 127	1,29	1,32	South Korea
11	Asia	China	Alibaba Group Holding Ltd	Consumer Services	55 558 739 180	6 489 028 689	1,03	1,03	Cayman Islands
12	Asia	China	Tencent Holdings Ltd	Technology	49 657 347 577	5 799 770 797	0,83	0,83	Cayman Islands
13	North America	United States	Tesla Inc	Consumer Goods	45 802 049 584	5 349 488 094	0,8	0,8	United States
14	Europe	Switzerland	Novartis AG	Health Care	45 290 054 474	5 289 689 203	2,27	2,27	Switzerland
15	Europe	Netherlands	ASML Holding NV	Technology	41 000 204 266	4 788 652 616	2,35	2,35	Netherlands
16	North America	United States	Johnson & Johnson	Health Care	36 397 932 766	4 251 126 527	1,03	1,03	United States
17	North America	United States	Berkshire Hathaway Inc	Financials	36 382 214 906	4 249 290 746	1,03	0,53	United States
18	Europe	Germany	Vonovia SE	Financials	33 654 466 611	3 930 701 138	9,5	9,5	Germany
19	Europe	United Kingdom	Unilever PLC	Consumer Goods	33 376 085 569	3 898 187 395	2,45	2,45	United Kingdom
20	Europe	France	LVMH Moet Hennessy Louis Vuitton SE	Consumer Goods	32 908 410 431	3 843 564 893	1,22	1,22	France
21	Europe	United Kingdom	Royal Dutch Shell PLC	Oil & Gas	32 793 842 341	3 830 183 818	2,86	2,86	United Kingdom
22	North America	United States	Procter & Gamble Co/The	Consumer Goods	30 664 972 256	3 581 540 684	1,04	1,04	United States
23	North America	United States	JPMorgan Chase & Co	Financials	29 033 452 187	3 390 985 954	0,88	0,88	United States
24	North America	United States	UnitedHealth Group Inc	Health Care	28 278 204 081	3 302 776 129	0,99	0,99	United States
25	North America	United States	Mastercard Inc	Financials	27 479 757 950	3 209 520 956	0,91	0,9	United States
26	North America	United States	Visa Inc	Financials	27 475 399 354	3 209 011 890	0,87	0,7	United States
27	Europe	Germany	SAP SE	Technology	27 127 091 073	3 168 330 938	1,97	1,97	Germany
28	Europe	United Kingdom	AstraZeneca PLC	Health Care	26 879 449 156	3 139 407 396	2,39	2,39	United Kingdom
29	Europe	United Kingdom	BHP Group PLC	Basic Materials	26 561 513 428	3 102 273 831	5,58	5,58	United Kingdom
30	Europe	Spain	centers	Utilities	26 526 408 028	3 098 173 667	3,41	3,41	Spain
31	North America	United States	Home Depot Inc/The	Consumer Services	26 301 293 430	3 071 881 222	1,07	1,07	United States

7.3.2 ISIN codes for the Fund's equities

We received a list of company names and corresponding ISIN codes, for each year. Figure 7.3.2 displays a part of this list. Using the programming language R, ISIN codes were added as a column to the dataset containing holdings.

Figure 7.3.2: ISIN codes

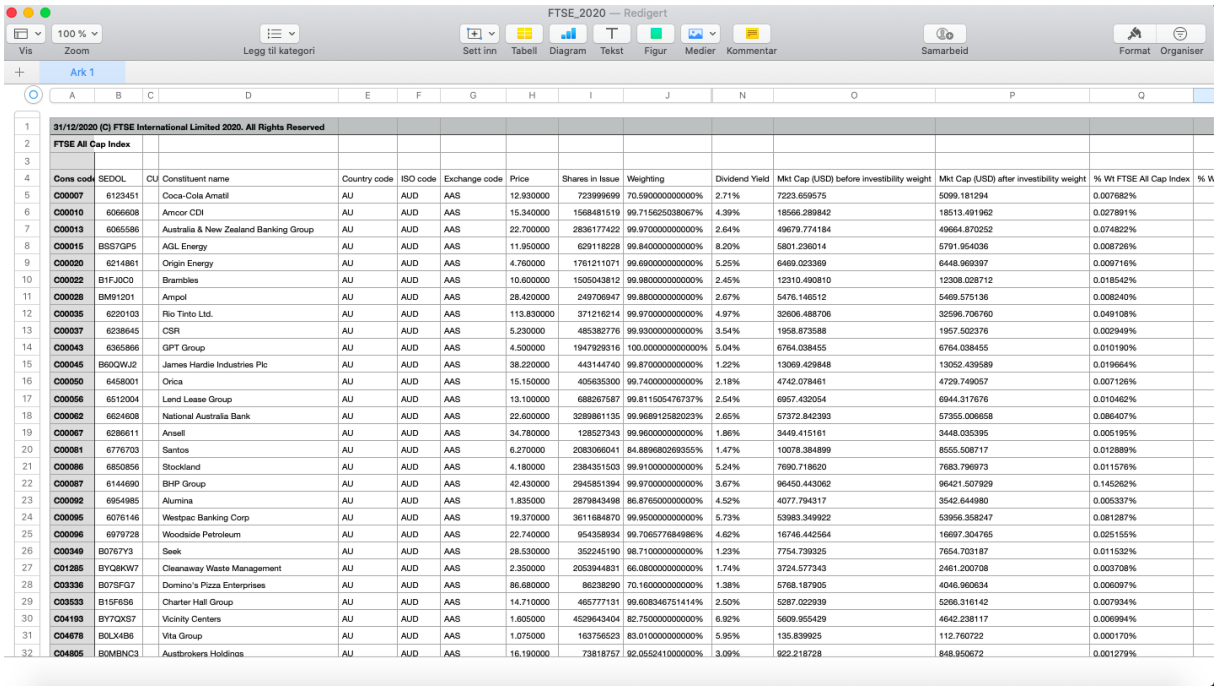


	A	B	C
1	**Year**	**Company Name**	**ISIN**
2	2020	1&1 Drillisch AG	DE0005545503
3	2020	10X Genomics Inc	US88025U1097
4	2020	11 bit studios SA	PL11BTS00015
5	2020	1Life Healthcare Inc	US68269G1076
6	2020	1st Source Corp	US3369011032
7	2020	21Vianet Group Inc	US90138A1034
8	2020	2U Inc	US90214J1016
9	2020	360 DigiTech Inc	US88557W1018
10	2020	361 Degrees International Ltd	KYG884931042
11	2020	3D Systems Corp	US88554D2053
12	2020	3i Group PLC	GB00B1YW4409
13	2020	3M Co	US88579Y1010
14	2020	3M India Ltd	INE470A01017
15	2020	3SBio Inc	KYG8875G1029
16	2020	4D Molecular Therapeutics Inc	US35104E1001
17	2020	4imprint Group PLC	GB0006640972
18	2020	51job Inc	US3168271043
19	2020	77 Bank Ltd/The	JP3352000008

7.3.3 Benchmark holdings

We received the actual holdings of the FTSE Global All Cap index from FTSE Russel by mail, after we sent a formal request. Figure 7.3.3 shows a view of the benchmark for 2021.

Figure 7.3.3: Benchmark holdings



FTSE_2020 — Redigert

	A	B	C	D	E	F	G	H	I	J	N	O	P	Q
1	31/12/2020 (C) FTSE International Limited 2020. All Rights Reserved													
2	FTSE All Cap Index													
3														
4	Cons code	SEDOL	CU	Constituent name	Country code	ISO code	Exchange code	Price	Shares in Issue	Weighting	Dividend Yield	Mkt Cap (USD) before investibility weight	Mkt Cap (USD) after investibility weight	% Wt FTSE All Cap Index
5	C00007	6123451		Coca-Cola Amatil	AU	AUD	AAS	12.930000	723999699	70.590000000000%	2.71%	7223.659575	5099.181294	0.007682%
6	C00010	6066608		Amcor CDI	AU	AUD	AAS	15.340000	1568481519	99.715625038067%	4.39%	18566.289842	18513.491962	0.027891%
7	C00013	6065586		Australia & New Zealand Banking Group	AU	AUD	AAS	22.700000	2836177422	99.970000000000%	2.64%	49679.774184	49664.870252	0.074822%
8	C00015	BSS7GP5		AGL Energy	AU	AUD	AAS	11.950000	629118228	99.840000000000%	8.20%	5801.236014	5791.954036	0.008726%
9	C00020	6214861		Origin Energy	AU	AUD	AAS	4.760000	1761211071	99.690000000000%	5.25%	6469.023369	6448.969397	0.009716%
10	C00022	B1FJ0C0		Brambles	AU	AUD	AAS	10.600000	1505043812	99.980000000000%	2.45%	12310.490810	12308.028712	0.018542%
11	C00028	BM91201		Ampol	AU	AUD	AAS	28.420000	249706947	99.880000000000%	2.67%	5476.146512	5469.575136	0.008240%
12	C00035	6220103		Rio Tinto Ltd.	AU	AUD	AAS	113.830000	371216214	99.970000000000%	4.97%	32606.488706	32596.706760	0.049108%
13	C00037	6238645		CSR	AU	AUD	AAS	5.230000	485382776	99.930000000000%	3.54%	1958.873588	1957.502376	0.002949%
14	C00043	6365866		GPT Group	AU	AUD	AAS	4.500000	1947929316	100.000000000000%	5.04%	6764.038455	6764.038455	0.010190%
15	C00045	B60QWJ2		James Hardie Industries Plc	AU	AUD	AAS	38.220000	443144740	99.870000000000%	1.22%	13069.429848	13052.439589	0.019664%
16	C00050	6458001		Orica	AU	AUD	AAS	15.150000	405635300	99.740000000000%	2.18%	4742.078461	4729.749057	0.007126%
17	C00056	6512004		Lend Lease Group	AU	AUD	AAS	13.100000	688267587	99.811505476737%	2.54%	6957.432054	6944.317676	0.010462%
18	C00062	6624608		National Australia Bank	AU	AUD	AAS	22.600000	3289861135	99.968912582023%	2.65%	57372.842393	57355.006658	0.086407%
19	C00067	6286611		Ansell	AU	AUD	AAS	34.780000	128527343	99.960000000000%	1.86%	3449.415161	3448.035395	0.005195%
20	C00081	6776703		Santos	AU	AUD	AAS	6.270000	2083066041	84.889680269355%	1.47%	10078.384899	8555.508717	0.012889%
21	C00086	6850856		Stockland	AU	AUD	AAS	4.180000	2384351503	99.910000000000%	5.24%	7690.718620	7683.796973	0.011576%
22	C00087	6144690		BHP Group	AU	AUD	AAS	42.430000	2945851394	99.970000000000%	3.67%	96450.443062	96421.507929	0.145262%
23	C00092	6954985		Alumina	AU	AUD	AAS	1.835000	2879843498	86.876500000000%	4.52%	4077.794317	3542.644980	0.005337%
24	C00095	6076146		Westpac Banking Corp	AU	AUD	AAS	19.370000	3611684870	99.950000000000%	5.73%	53983.349922	53956.358247	0.081287%
25	C00096	6979728		Woodside Petroleum	AU	AUD	AAS	22.740000	954358934	99.706577684986%	4.62%	16746.442564	16697.304765	0.025155%
26	C00349	B0767Y3		Seek	AU	AUD	AAS	28.530000	352245190	98.710000000000%	1.23%	7754.739325	7654.703187	0.011532%
27	C01285	BYQ8KW7		Cleanaway Waste Management	AU	AUD	AAS	2.350000	2053944831	66.080000000000%	1.74%	3724.577343	2461.200708	0.003708%
28	C03336	B07SFG7		Domino's Pizza Enterprises	AU	AUD	AAS	86.680000	86238290	70.160000000000%	1.38%	5768.187905	4046.960634	0.006097%
29	C03533	B15F6S6		Charter Hall Group	AU	AUD	AAS	14.710000	465777131	99.608346751414%	2.50%	5287.022939	5266.316142	0.007934%
30	C04193	BY7QXS7		Vicinity Centers	AU	AUD	AAS	1.605000	4529643404	82.750000000000%	6.92%	5609.955429	4642.238117	0.006994%
31	C04678	B0LX4B6		Vita Group	AU	AUD	AAS	1.075000	163756523	83.010000000000%	5.95%	135.839925	112.760722	0.000170%
32	C04805	B0MBNC3		Austbrokers Holdings	AU	AUD	AAS	16.190000	73818757	92.055241000000%	3.09%	922.218728	848.950672	0.001279%

7.3.4 Scaling of weights

The benchmark weights in the merged dataset are adjusted by dividing the weight ($W_{B,i}$) by the sum of the weights of all companies. The formula of this adjustment is displayed in equation 15, where ($W_{B,i,NEW}$) is the new benchmark weight for company (i), and ($W_{B,i,OLD}$) is the old benchmark weight for the company (i).

$$W_{B,i,NEW} = \frac{W_{B,i,OLD}}{\sum_{i=1}^{N} W_{B,i,OLD}} \tag{15}$$

The fund weights are adjusted similarly to the benchmark weights. The formula for the adjustment of the fund weights is displayed in equation 16, where ($W_{F,i,NEW}$) is the new fund weight for company (i), and ($W_{F,i,OLD}$) is the old weight for company (i).

$$W_{F,i,NEW} = \frac{W_{F,i,OLD}}{\sum_{i=1}^{N} W_{F,i,OLD}} \tag{16}$$

We assume the overweights and underweights of the missing data are normally distributed with an expected overweight of zero. Since the missing data is by definition unmatched data, there is no way of knowing for sure how this data is distributed. However, there are no logical reasons for missing data not to be normally distributed after our opinion. We believe in the law of big numbers and find it reasonable that the missing observations have a zero expected overweight.

If this assumption is true, missing observations will affect the scaling of weights in a particular way. Scaling of weights caused by missing observations makes both the fund weights and the benchmark weights proportionally larger. E.g., if 5 % of both the fund weight and the benchmark weight is missing, both the fund weight and the benchmark weight of every company will become $\frac{1}{1-5\%}$ larger. Every overweight and every underweight will then also become $\frac{1}{1-5\%}$ larger in absolute value.

7.3.5 Geographical adjustment

The geographical adjustment we perform ensures that the weights of our benchmark are equal to the Fund's Actual Benchmark. This is expressed in equation 17.

$$W_{B,k,i,NEW} = \frac{W_{AB,k}}{\sum_{i=1}^{N} W_{B,k,i,OLD}} \tag{17}$$

Where $(W_{B,k,i,NEW})$ is the new benchmark weight for company (i) in region (k), $(W_{AB,k})$ is the actual benchmark in region (k), and $(\sum_{i=1}^{N} W_{B,k,i,OLD})$ is the sum of the old benchmark weights, for all companies (i) in region (k).

We believe missing data is normally distributed amongst the regions we use for geographical adjustments. This assumption implies that these regions have a proportional share of missing observations. This assumption still allows for certain countries to be overly represented amongst missing data, as long as the aggregated level of the region is neither over-represented nor under-represented. We believe this is reasonable for the following reason. One could argue that companies in certain countries are harder to match (for instance, China). However, as the regions are large, we believe the problem of particular countries being over-represented to be offset by other countries with fewer problems. If the assumption of normally distributed missing data across regions does not hold and missing data are substantial in a particular region, the remaining companies in that region would be awarded an unproportionally large weight in the geographical adjustment. This is because the sum of the weights in a region in our dataset is set to equal the actual benchmark weight of that region, no matter how many companies are included in that region in our dataset.

We also assume missing data is normally distributed amongst industries. We believe in this assumption since we do not believe the industry of a company is correlated with any of the data errors causing missing data (wrong ISIN, missing ISIN, divestments).

7.3.6 Different Share classes

FTSE Global All Cap includes companies with different types of shares, while the holdings data of the fund does not include or specify any different types of shares. Therefore, we assume that NBIM holds every type of share in the benchmark. There are several reasons for making this assumption. First of all, when looking at the overweights and underweights in the companies with different types of shares, treating them collectively gives the least abnormal overweight/underweight. For companies with different types of shares, the ISIN provided by NBIM for the company has changed during the years. This change has often been between the ISIN of the different share types. E.g., one year, the ISIN corresponds to the A-share, while the next year, the ISIN corresponds to the B-share. We do not know the reason for these changes in the list provided by NBIM, but we do not believe the fund switch between share types frequently. We believe these changes indicate they own both types of shares.

An alternative to treating them collectively is to pick one of the share types to match the Fund's holdings with the benchmark, e.g., an ordinary share or preferred share. This would result in more extreme deviations from the benchmark. Another alternative would be to not include companies with different share types. We do not fancy this solution as the coverage of our dataset would be smaller, and it would lead to more missing data.

7.4 Analysis

7.4.1 Development of active position in regions and industries

Table 7.4.1: Active position every year for Regions and industries

Regions									
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Mean**
Europe	111	142	64	30	19	-3	-7	7	45
North America	-74	-134	-37	14	37	86	65	67	3
Asia	-17	20	6	-7	-21	-56	-14	-32	-15
Oceania	-19	-17	-23	-25	-22	-19	-30	-32	-23
Latin America	4	-5	-5	-6	-5	0	-7	-7	-4
Africa	-5	-6	-5	-6	-5	-2	0	4	-3
Middle East	0	0	0	0	-4	-6	-7	-7	-4
Industries									
Financials	20	28	31	22	21	37	86	11	45
Industrials	20	14	19	14	14	-8	-8	-10	7
Consumer Goods	22	35	21	18	3	-7	-12	-23	7
Consumer Services	3	5	6	1	0	5	-20	-34	-4
Basic Materials	0	12	20	10	23	12	-11	2	9
Health Care	-27	-40	-42	-17	-16	-16	-9	-14	-23
Oil & Gas	-9	-13	-16	-23	-23	-16	-22	-23	-18
Telecommunications	-12	-13	-17	-12	-12	-3	0	10	-7
Utilities	0	3	4	8	-4	-2	-2	-1	1
Technology	-18	-31	-25	-20	-5	-2	-3	-19	-16

7.4.2 Abbreviations

Table 7.4.2: Abbreviations Regions

Abbreviation	Region
EU	Europe
NA	North America
AS	Asia
OC	Oceania
LA	Latin America
AF	Africa
ME	Middle East

Table 7.4.3: Abbreviations Industries

Abbreviation	Industry
FIN	Financials
IND	Industrials
CG	Consumer Goods
CS	Consumer Services
BM	Basic Materials
TEC	Technology
HC	Health Care
OG	Oil gas
UTI	Utilities
TEL	Telecommunications

7.4.3 T-tests for attribution analysis

Table 7.4.4: T-tests for Regions

	Selection	Allocation	Interaction	Total
Europe				
Mean Monthly return (%)	0.0021	-0.0002	0.0002	0.0022
Monthly Standard Deviation (%)	0.0710	0.0262	0.0042	0.0812
Standard Error (%)	0.0079	0.0021	0.0006	0.0078
T-statistics	0.2621	-0.0707	0.3968	0.2762
P-value	0.7938	0.9438	0.6924	0.7830
North America				
Mean Monthly return (%)	-0.0090	0.0025	0.0004	-0.0061
Monthly Standard Deviation (%)	0.0634	0.0229	0.0033	0.0645
Standard Error (%)	0.0074	0.0021	0.0004	0.0078
T-statistics	-1.2092	1.1603	1.0804	-0.7748
P-value	0.2297	0.2489	0.2828	0.4405
Asia				
Mean Monthly return (%)	0.0019	0.0006	-0.0002	0.0024
Monthly Standard Deviation (%)	0.0378	0.0126	0.0015	0.0423
Standard Error (%)	0.0043	0.0012	0.0002	0.0050
T-statistics	0.4443	0.5172	-1.0319	0.4751
P-value	0.6579	0.6062	0.3048	0.6359
Oceania				
Mean Monthly return (%)	0.0002	0.0006	-0.0001	0.0007
Monthly Standard Deviation (%)	0.0107	0.0124	0.0018	0.0155
Standard Error (%)	0.0009	0.0008	0.0002	0.0011
T-statistics	0.2412	0.7639	-0.4223	0.6411
P-value	0.8099	0.4469	0.6738	0.5231
Latin America				
Mean Monthly return (%)	0.0000	-0.0004	0.0000	-0.0004
Monthly Standard Deviation (%)	0.0069	0.0060	0.0007	0.0094
Standard Error (%)	0.0005	0.0005	0.0000	0.0007
T-statistics	0.0070	-0.7523	-0.2711	-0.5604
P-value	0.9944	0.4538	0.7869	0.5765
Africa				
Mean Monthly return (%)	-0.0003	-0.0001	0.0001	-0.0003
Monthly Standard Deviation (%)	0.0071	0.0060	0.0007	0.0082
Standard Error (%)	0.0007	0.0005	0.0000	0.0007
T-statistics	-0.3856	-0.7523	-0.2711	-0.3791
P-value	0.7007	0.4538	0.7869	0.7055
Middle East				
Mean Monthly return (%)	-0.0006	0.0002	0.0001	-0.0003
Monthly Standard Deviation (%)	0.0034	0.0016	0.0008	0.0034
Standard Error (%)	0.0003	0.0002	0.0001	0.0003
T-statistics	-1.8203	1.0667	0.7475	-1.1184
P-value	0.07197	0.2889	0.4567	0.2663

All standard errors are Newey-West standard errors.

Table 7.4.5: T-tests for Industries

	Selection	Allocation	Interaction	Total
Financials				
Mean monthly return (%)	0.0025	-0.0011	0.0001	0.0015
Monthly standard deviation (%)	0.0572	0.0173	0.0020	0.0617
Standard Error (%)	0.0047	0.0020	0.0002	0.0057
T-statistics	0.5368	-0.5585	0.4295	0.2592
P-value	0.5927	0.5779	0.6686	0.7960
Industrials				
Mean Monthly return (%)	0.0013	0.0000	0.0001	0.0014
Monthly Standard Deviation (%)	0.0241	0.0036	0.0008	0.0259
Standard Error (%)	0.0029	0.0004	0.0001	0.0032
T-statistics	0.4585	0.0687	0.6561	0.4441
P-value	0.6477	0.9454	0.5134	0.6580
Consumer Goods				
Mean Monthly return (%)	-0.0027	0.0006	0.0001	-0.0020
Monthly Standard Deviation (%)	0.0317	0.0061	0.0015	0.0340
Standard Error (%)	0.0035	0.0007	0.0002	0.0039
T-statistics	-0.7728	0.9484	0.3102	-0.5082
P-value	0.4416	0.3454	0.7571	0.6125
Consumer Services				
Mean Monthly return (%)	-0.0049	0.0001	0.0000	-0.0047
Monthly Standard Deviation (%)	0.0284	0.0034	0.0006	0.0290
Standard Error (%)	0.0038	0.0005	0.0001	0.0039
T-statistics	-1.2903	0.3211	0.4107	-1.2039
P-value	0.2002	0.7489	0.6822	0.2317
Basic Materials				
Mean Monthly return (%)	0.0025	-0.0003	0.0000	0.0022
Monthly Standard Deviation (%)	0.0222	0.0067	0.0014	0.0234
Standard Error (%)	0.0021	0.0007	0.0001	0.0024
T-statistics	1.1744	-0.4959	0.4043	0.8842
P-value	24.33	62.12	68.69	0.3786
Technology				
Mean Monthly return (%)	-0.0002	-0.0013	-0.0001	-0.0016
Monthly Standard Deviation (%)	0.0165	0.0099	0.0008	0.0200
Standard Error (%)	0.0016	0.0009	0.0001	0.0019
T-statistics	-0.1020	-1.4138	-0.7659	-0.8289
P-value	0.9189	0.1608	0.4457	0.4093
Health Care				
Mean Monthly return (%)	0.0019	-0.0018	0.0000	0.0001
Monthly Standard Deviation (%)	0.0154	0.0130	0.0007	0.0219
Standard Error (%)	0.0015	0.0013	0.0001	0.0022
T-statistics	1.2613	-1.4252	-0.1982	0.0378
P-value	0.2104	0.1575	0.8433	0.9699
Oil & Gas				
Mean Monthly return (%)	-0.0015	0.0005	0.0000	-0.0010
Monthly Standard Deviation (%)	0.0186	0.0143	0.0010	0.0230
Standard Error (%)	0.0016	0.0014	0.0001	0.0022
T-statistics	-0.9239	0.3339	0.5060	-0.4526
P-value	0.3579	0.7392	0.6141	0.6519
Utilities				
Mean Monthly return (%)	0.0020	-0.0001	0.0000	0.0019
Monthly Standard Deviation (%)	0.0090	0.0030	0.0003	0.0089
Standard Error (%)	0.0009	0.0002	0.0000	0.0009
T-statistics	2.1190	-0.5392	0.6037	2.0382
P-value	0.0368	0.5910	0.5476	0.0444
Telecommunications				
Mean Monthly return (%)	-0.0004	0.0007	0.0001	0.0004
Monthly Standard Deviation (%)	0.0169	0.0063	0.0016	0.0173
Standard Error (%)	0.0020	0.0006	0.0002	0.0021
T-statistics	-0.2232	1.3185	0.5384	0.1989
P-value	0.8239	0.1906	0.5916	0.8428

All standard errors are Newey-West standard errors.

7.5 Precision of findings

Table 7.5.1: Deviation of fund returns, benchmark returns, and active returns

Deviations of fund returns (in %)								
	2014	2015	2016	2017	2018	2019	2020	2021
January	0.05	0.11	0.18	-0.01	0.03	0.11	-0.03	-0.03
February	-0.09	0.01	-0.09	0.04	-0.07	-0.05	-0.04	-0.01
March	-0.03	0.12	0.07	0.00	0.05	-0.07	-0.02	0.10
April	0.05	-0.14	-0.07	0.00	0.13	0.10	-0.10	-0.03
May	-0.03	-0.18	-0.02	0.10	-0.20	-0.05	-0.09	0.01
June	-0.12	-0.16	0.07	0.04	0.07	0.11	-0.15	-0.14
July	0.01	0.12	0.06	0.04	0.19	-0.04	0.13	
August	0.09	-0.02	0.05	-0.02	0.02	-0.02	-0.12	
September	0.16	0.17	-0.05	0.07	0.04	0.14	-0.20	
October	-0.02	0.11	0.11	0.03	0.17	0.07	-0.12	
November	0.12	-0.02	-0.07	0.19	-0.07	-0.05	-0.12	
December	-0.06	-0.26	0.07	-0.08	0.16	-0.07	0.06	
Deviations of benchmark returns (in %)								
	2014	2015	2016	2017	2018	2019	2020	2021
January	0.02	-0.19	0.08	0.01	0.07	0.06	0.00	0.05
February	-0.06	0.06	-0.04	0.02	-0.02	0.06	0.00	0.05
March	-0.03	0.09	0.02	0.07	0.11	0.02	0.02	0.10
April	0.11	-0.02	-0.06	0.01	0.04	0.05	-0.12	-0.07
May	-0.01	-0.02	0.01	0.10	-0.15	-0.04	0.04	0.02
June	-0.11	0.00	0.13	0.16	0.11	0.05	0.02	-0.06
July	0.00	0.26	-0.03	0.06	0.21	-0.03	-0.30	
August	-0.03	0.13	0.07	-0.04	-0.10	-0.13	-0.24	
September	0.19	0.25	0.00	0.08	0.14	0.25	-0.09	
October	-0.10	-0.03	0.10	-0.11	0.24	0.14	-0.01	
November	0.15	0.01	-0.15	0.17	0.10	-0.04	0.09	
December	-0.06	-0.08	0.02	0.07	0.18	-0.01	-0.05	
Deviations of active returns(in %)								
	2014	2015	2016	2017	2018	2019	2020	2021
January	0.03	0.30	0.10	-0.02	-0.04	0.05	-0.03	-0.08
February	-0.02	-0.04	-0.05	0.02	-0.05	-0.12	-0.04	-0.06
March	0.00	0.04	0.05	-0.07	-0.06	-0.09	-0.04	0.00
April	-0.06	-0.12	0.00	-0.02	0.09	0.05	0.02	0.04
May	-0.03	-0.17	-0.03	0.01	-0.05	-0.01	-0.13	-0.02
June	-0.01	-0.16	-0.06	-0.12	-0.04	0.06	-0.17	-0.08
July	-0.01	-0.13	0.08	-0.02	-0.02	-0.01	0.43	
August	0.13	-0.15	-0.02	0.02	0.12	0.11	0.12	
September	-0.03	-0.08	-0.05	0.00	-0.10	-0.10	-0.11	
October	0.09	0.14	0.01	0.14	-0.08	-0.07	-0.10	
November	-0.03	-0.02	0.08	0.02	-0.17	-0.01	-0.21	
December	0.00	-0.17	0.06	-0.15	-0.02	-0.06	0.11	