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## An analysis of Norges Bank Investment Management's equity performance

En analyse av Norges Bank Investment Managements aksjeprestasjoner

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We take full responsibility for the content in this master thesis.

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## Abstract

The presented study examines the performance of Norges Bank Investment Management's (NBIM) equity investments and whether they generate alpha. The sample construction is based on two sample periods, the first consisting of NBIM's monthly equity returns from 2000-2017 and the second consisting of monthly equity returns from 2010-2017 which are compared to Kenneth R. French's global market factor and NBIM's reference index. In addition to looking at NBIM's equity investments as a whole, this thesis distinguishes between the active and passive equity investments by creating an alternative proxy-model 1 and an alternative model 2.

The analysis of this study produces no evidence that NBIM's management generates value. When comparing to the market, this study finds negative significant alpha values. This simply states that NBIM is underperforming compared to the market, and a higher value creation would be generated by truly passively diversify globally. When performing further analysis, this study does not find any evidence that NBIM outperforms the reference index.

In addition to our main sample periods we have evaluated the performance in the period 2013-2017 to compare our results with two opposing views of NBIM's active equity performance. This paper estimates insignificant positive alpha values in this period. Dahlquist and Ødegaard (2018) estimated positive, but insignificant alpha values for their proxy of the active equity investments. Insignificant alpha values are not an evidence of outperformance or underperformance and are therefore considered to be zero. Considering the regression estimates of these studies are based on returns measured before cost, adjusting for the management fees will bring the alphas correspondingly negative. In the findings of Hoddevik and Priestley (2018), they estimated significant negative alpha value for the same sample period, arguing that NBIM's equity investments do not generate excess returns.

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# Introduction

## Background

Norges Bank Investment Management (NBIM) and its performance is frequently mentioned in the news. Norwegian citizens are growing up hearing performance statements and return reports regarding NBIM's performance. The Norwegian "Oil fund" is constantly growing and the politicians debate about whether they should be spending more or less of the saved resources.

When Norway attracted more income than they planned on using in their budget they set aside the first surplus for the sovereign wealth fund in 1998. Norway kept on putting aside more and more surplus every year at the same time as they invested this money. The sovereign wealth fund's increase in value has been drastic, but how good is it performing compared to the relevant benchmarks? This was the first thing that caught our interest. After more research several other aspects caught our interest as well. How is NBIM's equity investments performing to relevant benchmarks? How are the active equity investments performing compared to the passive equity investments? And last, but not least, what is the reference index and how well does it fit as a benchmark? These are all aspects that need to be answered to be able to evaluate the performance of NBIM's equity investments.

The Norwegian citizens are indirectly the owners of the fund, and how NBIM is being managed should therefore reflect the interest of the people. The main object of NBIM is to maintain the welfare of the people and the future generations, as well as facilitate sustainable growth.

A discussion in "Dagens Næringsliv" in late 2017 gave further motivation regarding the subject. The varying performance reports and the contradicting findings of different economists increased the interest in evaluating the situation ourselves. It is important for the Norwegian people to gain knowledge of how the NBIM is performing and how the performance is measured. The subject is challenging as several economists argue what measures to use and end up finding different results. The underlying factors of these findings are discussed further in this master thesis.

## Problem statement

The problem can be formally stated as:

“Does the NBIM’s equity investments generate alpha?”

How is NBIM’s equity investment performing compared to the market and benchmark?

## Sovereign wealth fund

According to the Sovereign Wealth Funds institute<sup>1</sup>; a Sovereign Wealth Fund is a state-owned investment fund and typically created if a government has surplus and close to zero international debt. These funds are usually created through commodity exports, or through transfers of assets from foreign exchange reserves. It is typical for countries that have a sovereign wealth fund to be economies that rely heavily on one, or a few natural commodities. This investment mechanism is an effective tool to diversify and invest in equities, bonds, foreign currency, and/or real estate.

According to the World Economic Forum, Norway’s sovereign wealth fund, the Norwegian Government Pension Fund Global, exceeded 1 trillion USD in 2017 and is one of the largest sovereign wealth funds in the World.

## The Norwegian Government Pension Fund Global

The idea with a Norwegian oil fund arose in the 1960s when the government declared sovereignty over the Norwegian continental shelf. This laid the foundation for an oil policy based on strict governance, which the Norwegian Parliament (Stortinget) drew up the guidelines for long-term management for the oil and gas resources.

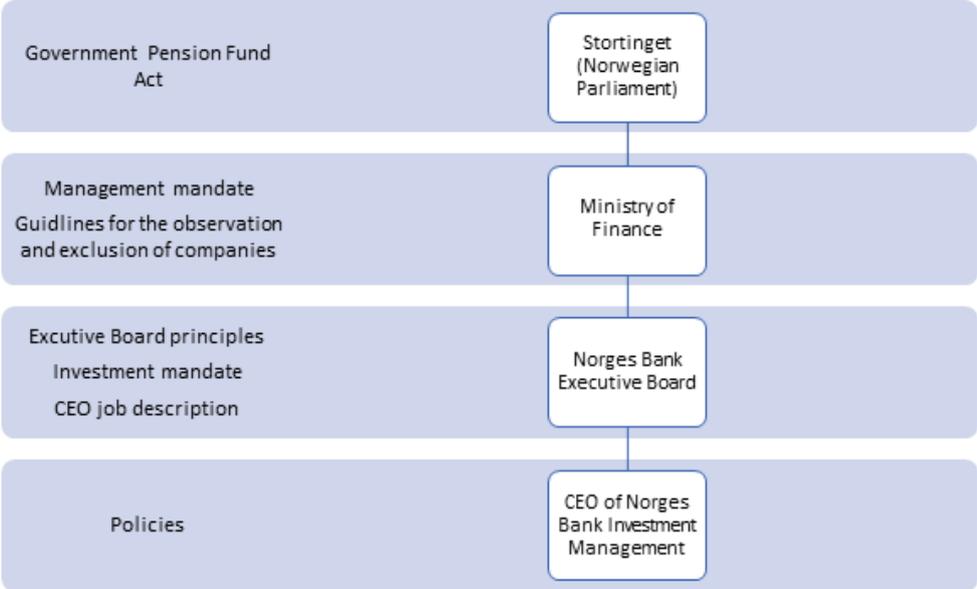
It was clear from the beginning that the petroleum activities would have a limited duration. To secure that the income could benefit the future generations, an oil fund was established in 1990 and the first deposit was injected in 1998. The Norwegian Petroleum Fund changed its name to the Government Pension Fund Global in 2006 as a reminder of the purpose. The fund is an integrated part of the government’s budget and is a buffer for government finances. Government budget surpluses were transferred to the fund, while deficits were covered by deducting from the fund. The Government Pension Fund Global is a tool for managing government-financed challenges related to increased elderly population and declining

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<sup>1</sup> <https://www.swfinstitute.org/sovereign-wealth-fund/>

petroleum revenues. The fiscal policy is based on non-oil budget expecting a real return on the fund to be estimated at 3 percent.

The responsibility of the fund can be visualised by the following Governance model.



The Norwegian parliament (the Storting) laid down the formal framework for the fund in the Government Pension Fund Act. The Ministry of Finance has the overall responsibility for the fund’s management and delegated the tasks of management to Norges Bank. Furthermore, the Executive Board has delegated the operational management of the fund to Norges Bank Investment Management. NBIM invests with a life-long horizon across the globe except for Norway. At the end of the first quarter 2018, the fund had a market value of approximately 8.124 billion Norwegian kroner<sup>2</sup>. 66.2 percent was invested in equity, 31.2 percent in fixed income, and 2.7 percent in unlisted real estate. This paper will focus on the equity investments.

<sup>2</sup> <https://www.nbim.no/en/transparency/reports/2018/1q-2018-quarterly-report/>

## A presentation of the main asset pricing models:

### Efficient Market Hypothesis (EMH)

The EMH was developed by Fama (1965) and states that securities reflect all available information and therefore are correctly priced. If this argument holds, securities cannot be over-priced or under-priced and it is not possible to outperform the market.

Malkiel and Fama (1970) divided the market efficiency in three different forms - weak, semi-strong and strong. The weak form of efficiency reflects all historical information in the stock price. The random walk theory by Samuelson (1965) states that prices in the past are not an indication of the future prices. For that reason, it is not possible to generate excessive returns by observing patterns in historical data. However, De Bondt and Thaler (1985) found that monthly return data on securities is consistent with an overreaction hypothesis. This means that the security's stock price can overreact to new information. In a situation like this, new negative information will cause the stock price to fall too much. In other words, the price of the security is not fully reflecting the security's true value. The research shows that in the long-run, the stocks that have done well in the past (winners) underperform compared to the stocks that have done poorly in the past (losers). On the other hand, Jagadeesh and Titman (1993) investigated whether buying winner-stocks and selling loser-stocks can generate significant positive returns over future holding periods. They found that winners outperform losers in the short-run. The most significant result is found over the first 6 months which is concurring with the traditional view of momentum and gives abnormal profit opportunities in the short-run. Novy-Marx (2012) states that the traditional view of momentum, where rising stocks tend to keep rising and falling stocks tend to keep falling, is not accurately describing the returns to buying winners and selling losers. *"On average recent winners that were intermediate horizon losers significantly under-perform recent losers that were intermediate horizon winners"* (Novy-Marx, 2012, p. 54-55). The findings of Novy-Marx are inconsistent with the traditional view of momentum.

The semi-strong form of efficiency reflects all historical data and all information available to the public in the stock price. So, neither fundamental nor technical analysis can be used to achieve superior gains. An investor in a market with semi-strong efficiency can only earn abnormal returns on investment by using inside information, which is illegal. Most, but not all, studies support the semi-strong form of efficiency. Keown and Pinkerton (1981) support

the semi-strong form of efficiency as the market's reaction to the new public information is complete by the day after the announcement. However, they do find contradicting evidence when investigating the market's reaction to intended mergers. The investigation shows that the market does react before the first public announcement. Even though this looks like inside trading, impending merger announcements are poorly held secrets and it often seems to be common knowledge. Reinganum (1981) states that it is not possible to earn abnormal returns on standardized unexpected earnings. This is contradicting to what Rendleman, Jones and Latané (1982) find as they show possible three months abnormal returns. Another notable exception to the support of the semi-strong form of efficiency is Bernard and Thomas (1989) as they investigate how earnings surprises affect the stock prices. In an efficient stock market any information surprise should be reflected rapidly in the stock price, but they found "drifts" in the returns after announcements. A "drift" is a continuous slow movement and is therefore inconsistent with an efficient market. Also, the so-called January effect is contradicting the market efficiency as the stock prices seems to increase in January, after a decrease in December. Chen and Singal (2004) suggests the reason for this change in stock price is a result of tax-loss harvesting to offset realized capital gains.

The strong form of efficiency fully reflects all information, historical, public and non public information in the stock price. This means that investors are not able to benefit from inside information and therefore outperforming the market is impossible. Kara and Denning (1998) states that their null hypothesis saying the US security markets are strong form can easily be rejected. Therefore, it can be interpreted as more evidence of profit potential for inside traders. Few would argue with the proposition that the corporate officers have access to information of great value. Strong form of efficiency of the market hypothesis is quite extreme. However, Eckbo and Smith (1997) documented zero or negative abnormal performance by insiders. They estimated the performance of insider trades on the closely held Oslo stock exchange (OSE) during a period of lax enforcement of insider trading regulations. Grossman and Stiglitz (1980) states that perfectly efficient markets can not exist, because if the market is truly efficient, there is no gain in gathering information and therefore no reason to trade. They argue that gaining information is costly, and since not everyone have the resources to gain all the information, prices cannot perfectly reflect the information that is available. If the prices did reflect all the information available, then those who spent resources gathering the information would have no compensation for it. Without getting compensated

for the information gathering, it would lead to less use of resources on gathering information. As a result of that, not all the information would be known, and the prices would not reflect all the information. To sum it all up briefly, efficient markets would make people buy index funds and choose passive investment strategies. This would lead to a less efficient market as no one would be willing to gather information.

### Capital Asset Pricing Model (CAPM)

The CAPM explains the relation between expected return and risk. The model is based on modern portfolio theory by Markowitz (1952) and was developed almost simultaneously by Treynor (1961) and Sharpe (1964), then further developed by Lintner (1965) and Mossin (1966). The CAPM can be expressed as<sup>3</sup>:

$$E(R_j) = R_f + \beta_j[E(R_m) - R_f]$$

To understand the intuition of CAPM<sup>4</sup>, a simplified version of the model may be expressed as expected return = risk free rate + risk premium. A risk-averse investor will receive a risk-free rate by investing in risk-free assets. To be willing to invest in a risky asset, the investor will require a risk premium. The risk premium is the compensation for systematic risk, or covariance risk with the market expressed as  $\beta$ . The main contribution of the CAPM is to show that an investor only cares about systematic risk. Unsystematic risk can be reduced by holding a well-diversified portfolio.

While empirical tests do not support the CAPM, it is nevertheless difficult to reject the model. The CAPM states that the market portfolio is the portfolio of all risky assets, including: stocks, bonds, real estate, art, etc. Empirical tests usually use one or a few market indexes, which is only a part of the true market portfolio. Roll criticises that: *“Asset pricing theory is testable in principle; but arguments are given that there is practically no possibility that such a test can be accomplished in the future”* (Roll, 1977, p.129) Furthermore, Roll argues that: *“The theory is not testable unless the exact composition of the true market portfolio is known and used in the tests. This implies that the theory is not testable unless all individual assets are included in the sample”* (Roll, 1977, p.130)

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<sup>3</sup> See appendix II for explanation of symbols.

<sup>4</sup> See appendix I for the complete list of assumptions

Fama & French (1992) summarize other key factors such as size effect by Banz (1981) and book-to-market equity by Stattman (1980), Rosenberg, Reid and Lanstein (1985), and Chan, Hamao and Lakonishok (1991). Their tests did not support the prediction that average stock returns are positively related to market  $\beta$ s.

### Arbitrage pricing theory (APT)

The arbitrage pricing theory was created by Stephen Ross in 1976. It is an asset pricing model based on the idea that an asset's return can be predicted using the relationship between that asset and several common risk factors. Ross (1976) states that the arbitrage model was proposed as an alternative to the mean variance capital asset pricing model, that has become the major analytic tool for explaining phenomena observed in capital markets for risky assets.

The APT model has been employed to calculate security prices based on several macroeconomic variables, such as interest rate, inflation rate, unemployment, and over-productivity. The outcome of the calculations is compared to the actual market prices, and the spread between them represent arbitrage opportunities. This gives a relatively over-priced asset and a relatively under-priced asset. A short position in the over-priced asset combined with a long position in the under-priced asset would theoretically result in a risk-free profit. If the market is efficient, then two assets with the same cash flow should have the same market price. If this is not the case, then arbitrage opportunities exists. Attentive investors can take advantage of the mispricing for a short period of time, until the market is corrected.

While the CAPM only uses beta as risk factor, the APT model thus uses several risk factors as this helps to define the systematic risk. However, it does not explain why and how many risk factors are empirically relevant (Ross, 1976). Prior to Ross (1976), Gehr (1975) claims two or three factors are enough to explain the major part of the variance in the underlying asset, while Roll and Ross (1980) claims you need at least three factors to explain it. Roll and Ross increased the number of portfolios in their research, but they could not distinguish between common factors for the whole analysis or unique factors for each portfolio. Dhrymes et. Al (1984) assumes there is a positive linear connection between the size of the portfolios and the explaining factors.

## Fama and French Three-factor model

Empirical data from Stattman (1980) and Banz (1988) indicates that  $\beta$  cannot solely explain return of a portfolio. In response to the criticism Fama and French (1992) developed the three-factor model as an expansion of CAPM. The point of Fama and French three-factor model is to show that their two additional factors can help explain cross-sectional stock returns. Fama and French (1992) identifies three stock-market factors: an overall market factor (CAPM), firm size (SMB), and book-to-market equity (HML).

First, small minus big (SMB) is calculated by comparing returns between firms with small market capitalization minus big market capitalization. Banz (1981) examines the relationship between the total market value of a common stock and its return. Banz tested the size effect on 25 different portfolios and his results show that the common stock of small firms had on average, higher risk-adjusted returns. Fama and French (1993) retested the assumption of the size-effect on 25 stock portfolios formed on market equity and book-to-market ratio. Their findings confirmed that on average, small stock portfolios outperform big stock portfolios. To summarize, the size effect exists, but it is not clear if it is size itself or if size is correlated with a true unknown factor.

Second, Rosenberg, Reid and Lanstein (1985) found a difference in returns between value and growth stocks. Book-to-market ratio is calculated as book value of the firm in the numerator and market value of the firm in the denominator<sup>5</sup>. High minus low (HML) compare firms with high book-to-market equity (value) minus firms with low book-to-market equity (growth). In the same population of 25 stock portfolios by Fama and French (1993), the top 30 % of BE/ME stocks were defined as value-stocks and bottom 30 % were defined as growth-stocks. Their findings indicate that on average, value-stock portfolios outperform growth-stock portfolios. Why value-stocks outperform growth-stocks may be explained by a common belief that the firm is not able to perform, or if the firm has experienced a recession and the market fear a bankruptcy. It can be argued that if one of these arguments are the case, an investor will require an additional risk premium. Using the two additional factors, Fama and French suggest the following return regression<sup>6</sup>:

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<sup>5</sup> See appendix II for formula

<sup>6</sup> See appendix II for calculation.

$$R_{j(t)} - R_{f(t)} = \alpha + \beta(R_m - R_f)_{(t)} + sSMB_{(t)} + hHML_{(t)} + \varepsilon_{(t)}$$

Like previous discussed theory, the three-factor model focus on well diversified portfolios.

#### Carhart Four-factor model

Carhart (1997) extends the three-factor model of Fama and French (1993) by accounting for momentum, which is based on the findings of Jagadeesh (1990). Jagadeesh documented a short-time momentum in the stock returns and found a positive serial correlation between a rising stock price at time t and continuing rising stock price a month later. Jagadeesh and Titman (1993) found the same results and says the effect of the momentum is relevant from three to twelve months.

#### Fama and French Five-factor model

The three-factor model is an incomplete model as Novy-Marx (2013) and Titman, Wei and Xie (2004) states in their papers. The three-factor model is not providing sufficient information about the variation in the average returns. As a response Fama and French (2015) added profitability (RMW) and investment (CMA) to the three-factor model to help explain the cross-sectional stock returns.

Novy-Marx (2013) shows that profitability, measured by gross profits-to-assets, has roughly the same power as book-to-market predicting the cross-section of average returns. Even though profitable firms have significantly higher valuation ratios than unprofitable firms, they also generate significantly higher returns.

Fama and French (2015) profitability factor is motivated by Novy-Marx (2013) but differs slightly in the underlying definition. Profitability is measured by accounting data for the fiscal year ending in year  $t_1$  and is calculated by taking the revenues minus the cost of goods sold, the selling, general and administrative costs and the interest expense. The result of this calculation will be divided by book equity. In this context, Fama and French found a difference between the returns on diversified portfolios of stocks with robust profitability minus weak profitability (RMW).

Lu Zhang (2009) found a weak but statistically reliable relation between investment and average return. Conservative minus aggressive investments (CMA) is the difference between the returns on diversified portfolios of stocks with low (conservative) and high (aggressive)

investment. The investment factor is calculated as the change in total asset from fiscal year  $t_2$  to the fiscal year  $t_1$ , divided by the total asset of fiscal year  $t_2$ . By adding these factors, Fama and French five-factor model capture the size, value, profitability, and investment patterns and can be defined as<sup>7</sup>:

$$R_{j(t)} - R_{f(t)} = \alpha_j + \beta_j(R_m - R_f)_{(t)} + s_j \text{SMB}_{(t)} + h_j \text{HML}_{(t)} + r_j \text{RMW}_{(t)} + c_j \text{CMA}_{(t)} + \varepsilon_{j(t)}$$

Fama and French (2017) states that the major challenge with the model is the misinterpretation for low average returns of small stocks, whose returns behave like those of low profitability firms that invest aggressively.

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<sup>7</sup> See appendix II for calculations.

# Performance measurement of mutual funds

## Summarizing the methodology

This paper now present different tools which are commonly used to measure the performance of mutual funds.

### Treynor ratio

The Treynor ratio by Treynor (1965) is a ratio derived from CAPM. The purpose of the ratio is to measure returns adjusted for systematic risk. By adjusting for systematic risk, an investor can compare portfolios with different volatility. The Treynor ratio can be expressed as<sup>8</sup>:

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

A high Treynor ratio indicates higher return compared to the systematic risk. The value of Treynor ratio is only meant as a comparison between different portfolios. Hübner (2005) criticise two key challenges with Treynor ratio. A challenge with the ratio is if a fund has positive abnormal returns and negative beta, however this is a rare occasion. For these funds the ratio is inapplicable as it attributes a negative performance. Furthermore, funds with negative abnormal return and negative beta attributes a positive performance. The second challenge Hübner states: *“Treynor measure is very sensitive to the denominator and provides unstable and imprecise performance measures for market neutral funds because of the risk of measurement error. For non-directional hedge funds, for instance, it is not likely to provide reliable performance values or stable portfolio rankings.”*

### Sharpe ratio

The Sharpe ratio by Sharpe (1966) is similar to the Treynor ratio, as a risk adjusted measure of return used to evaluate a portfolio's performance, relative to the risk. The ratio is used on historical data and was an attempt to extend Treynor's work by subjecting his measure to empirical testing. While Treynor ratio use market risk, Sharpe ratio focus on total risk.

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<sup>8</sup> See appendix II for explanation of symbols.

A high Sharpe ratio indicates that the portfolio has a good return relative to the risk. It is computed as follows

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

Due to the nature of the equations, Sharpe ratio and Treynor ratio have some common limitations. They will favour well diversified portfolios, since well diversified portfolios have lower variability according to portfolio theory. Due to the low variability, the return can decrease and still have a high ratio.

#### Jensen's alpha

Jensen's alpha by Jensen (1968) is a tool based on the intuition and assumptions<sup>9</sup> of CAPM and came as a reaction to EMH. The model compares a portfolio's average return to the predicted return of CAPM. The estimated over- or under-performance is expressed as alpha. If the portfolio performs better than predicted return, the alpha is positive. A significant positive alpha indicates that a portfolio manager's stock picking ability or luck performance is better than the market. Jensen's alpha can be expressed as:

$$E(R_j) = R_f + \beta_j[E(R_m) - R_f] + \alpha$$

Alpha ( $\alpha$ ) measure the absolute performance. The framework can easily be adjusted to allow for the estimation of alpha in the context of several factors.

#### Appraisal Ratio

A positive Jensen's alpha does not give an idea of how much residual risk or unsystematic risk was taken by a fund to obtain the alpha. Appraisal ratio represents the excess return per unit of residual risk taken [Treynor and Black (1973)]. In other words, appraisal ratio measures the skills of a fund manager's security picking ability and can be defined as<sup>10</sup>:

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<sup>9</sup> See appendix I for a complete list of the assumptions.

<sup>10</sup> See appendix II for explanation of symbols.

$$\text{Appraisal Ratio} = \frac{\alpha_p}{\sigma_{p,\varepsilon}}$$

Optimal selection in the active portfolio depends on appraisal risk and appraisal premiums, not on market risk or market premium. The use of appraisal ratio is only expedient when the alpha value is positive and significant.

### Empirical evidence

Comparing passive versus active management of funds requires to account for management fees. First, if returns are measured before costs then passive investments will have an alpha equal to zero. Active management may be superior if alpha is significantly higher than zero. Second, adjusting returns for costs allows to test whether (potential) superior performance benefits the investor in a mutual fund.

Jensen (1968) evaluated American mutual funds from 1945 to 1964. His results of active funds indicated a negative alpha on average returns compared to the market, both before and after accounting for management costs. In his sample, there were only insignificant alphas accounting for natural variation. Jensen concludes that most active funds cannot outperform the market.

Wermers (2000) decomposed mutual fund performance into stock-picking talent, style, transactions costs, and expenses. He used a new database to analyse components in the mutual fund industry versus the Vanguard Index 500 from 1975 to 1994. Wermers concluded that mutual funds outperform a broad market index by 1.3 percent before costs. After transaction costs and management fees, the average mutual fund underperformed by 1 percent.

Fama and French (2010) found that a value-weighted portfolio of active funds has a positive alpha before costs, while a value-weighted portfolio of active investments outside of mutual funds has a negative alpha. However, alpha is negative after cost in both cases mentioned above. The biggest challenge is to distinguish between skill or luck, when it comes to generating positive alpha. Fama and French (2010) looked at performance from 1984 to 2006 to test the persistence of the performance. They kept track of active funds that had generated high returns in the past and saw if they continued to generate high returns. Their results suggested that it might be some managers with enough skills to cover costs, but the data is

unclear and insignificant. Even for top performing active funds the alpha is close to zero, indicating that even the top performing funds might not be profitable for an investor.

Ferreira, Keswani, Miguel and Ramos (2012) examined how the performance of equity mutual funds relates to fund and country characteristic in 27 countries. The study was done in a large sample of open-end actively managed equity funds. The authors focus on domestic and cross-country mutual fund performance and found that in general funds underperform compared to the market. Ferreira et al. states that fund size is positively related to fund performance, if they can invest outside of their local market. Mutual funds supported by a large network of funds have superior performance, and scale can therefore be an advantage. The U.S. funds are the exception with negative relation between fund size and performance.

Cremers, Ferreira, Matos and Starks (2016) examine the relation between competition, active and passively managed equity mutual funds and ETF's in 32 countries (mainly in Europe, North-America and Asia Pacific). The authors found a correlation between high competition leading to an increase in activity and decrease in fund fees. Their findings are consistent with the intuition of Grossman and Stiglitz (1980) suggesting that active fund management can deliver positive alpha to an investor, if the passive investment is large.

Cremers, Ferreira, Matos and Starks are also consistent with the findings of Berk and Green (2004)<sup>11</sup>, that truly active managers are skilful and more beneficial for an investor, when managerial talent is a scarce resource as the scale of operations increases. Cremers et al. conclude that in regions with high competition active management is beneficial. In regions with few competitors, active funds are more passive and underperform compared to the market, and require a higher fee.

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<sup>11</sup> Berk and Green (2004) developed a model of active portfolio management and fund flows as a benchmark to evaluate observed returns, flows and performance outcomes. The model focuses on three elements: competitive provision of capital by investors to mutual funds, differential ability to generate high average returns, and learning about managerial ability from past returns. The simplest version of the model focuses on flows that are responsive to performance and performance that is not persistent. Their empirical evidence is consistent with a high level of skill among active management.

## Data

### Sample construction

The sample construction is based on two sample periods, the first consisting of NBIM's monthly equity returns from 2000-2017 and the second consisting of monthly equity returns from 2010-2017. The reason the main sample period is not set to start earlier is that the early years of the fund (1998,99) are very small in size, and therefore not representative. The monthly returns compared to the index fund rate over the full sample period equals 216 observations, while the recent period equals 96 observations. The recent period is chosen to represent a less unstable financial period. The Fama and French five-factor model will be the main model for the analysis, but other interesting observations in the other models will be mentioned. There are two additional data sets from the sample periods 1998-2017 and 2013-2017. These will be briefly mentioned to add further understanding of NBIM's performance. The monthly mean returns are measured arithmetic.

The data for the factors SMB, HML, WML, RMW, and CMA are based on monthly values from Kenneth R. French's data library from his website<sup>12</sup>. These factors are constructed the same way as Fama and French (1993) for SMB and HML, Carhart (1997) for the WML and Fama and French (2015) for RMW and CMA. The monthly factor values coherently dated to NBIM's return over the same 17 (7) years equals 216 (96) observations. The market factor will vary depending on the different versions of the models.

### Risk-free rate

Mukherji (2011) discusses the importance of using the correct risk-free rate in the models to achieve the most accurate results. The most common input for the risk-free rate is either short-term treasury bills or long-term treasury bonds. Kenneth R. French<sup>1</sup> uses the one-month U.S. treasury bill rate as the risk-free rate. The risk-free rate of return is the theoretical rate of return of an investment with zero risk over a specified period. The treasury bills are assumed to have zero default risk because they are backed by the good faith of the U.S. government.

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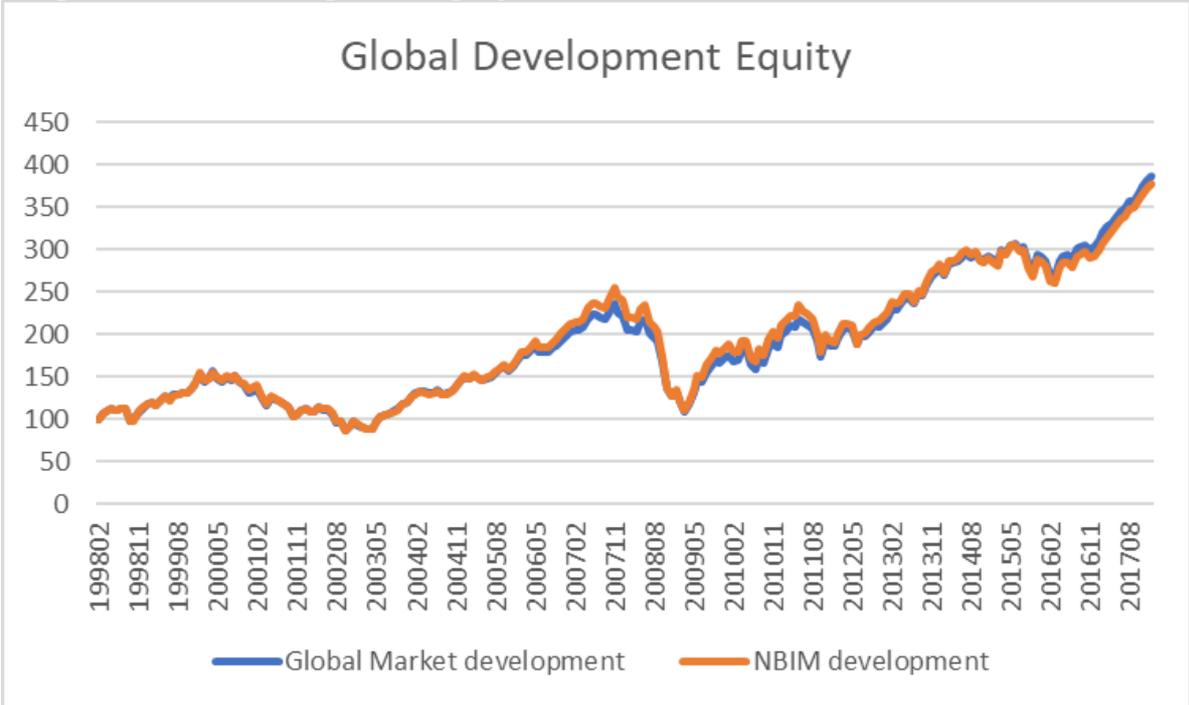
<sup>12</sup> [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

Currency

NBIM invests in global securities in foreign currencies. Returns are generally measured in international currency. This gives a weighted combination of the currencies in the fund's benchmark index for equities and bonds. At the end of 2017, the currency basket consisted of 34 currencies. To remove the currency effect, all returns are measured in USD.

Global Development

Graph I: Global Development Equity



The figure shows French’s global market return for the given period compared to NBIM’s return for the same period. The global market return consists of the return from developed markets. Both graphs start at 100 and ends up at almost 400, giving them a close to 400 percent increase in value. The downward trend in 2009 indicates that NBIM’s return tend to follow the market trends, as it shows downswing for the financial crisis. How NBIM’s equity investments are performing compared to French’s market return will be statistically tested later in the paper.

NBIM's report states the fund's equity investments have generated an annual return of 6.15 percent<sup>13</sup> in absolute terms, from the start-up in 1998 and the end of 2017. NBIM's total performance including equity, fixed income and real estate generated an annual return of 6.1 percent through its life period. Adjusted for management fees and inflation the reports show an average annual return of 4.2 percent. It is calculated an annual return of 7.43 percent from the market factor presented by Kenneth R. French<sup>1</sup>. This annual market return adjusted for the risk-free rate is 5.68 percent.

## Benchmark Indices

A benchmark is a tool to compare the performance of a fund and to reflect the preferences of the asset owner. An accurate benchmark is critical to produce reliable results. Grinblatt & Titman (1994) states that the choice of benchmark yield inferences can vary from the same measure when using different benchmarks. NBIM is a global fund, and a perfect benchmark may not exist, Roll (1978). A natural benchmark to start with will be the global market factor by French. Fama and French (2015) define the international market factor as a combination of four regions, North America, Japan, Asia Pacific and Europe. Combined the four regions are based on twenty-three developed markets<sup>14</sup> in total.

## The Reference Index (RI)

NBIM has several reference indices, and this paper will focus on the equity allocation and the benchmark for equities. The equity investments are measured against a benchmark index set by the Ministry of Finance. This benchmark is referred to as The Reference Index and is based on the FTSE Global Equity Index Series (GEIS), and Bloomberg Barclays Indices. When this paper refers to RI, it will be referring to this index. Because the Ministry of Finance sets the RI, there could be uncertainty whether the RI is easy to manipulate to benefit NBIM. Since the Ministry of Finance is a separate unit that delegates the responsibility to NBIM, it is considered natural that the Ministry of Finance wishes to set guidelines and to measure the performance. The RI is therefore considered unbiased. The RI does not consider transactional costs and may be unachievable high. The RI does not include the Norwegian

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<sup>13</sup> Copied from <https://www.nbim.no/en/the-fund/return-on-the-fund/> 20.03.18 17:52. The data is updated quarterly and may differ with some basis points from when they were downloaded.

<sup>14</sup> The complete list includes the United States, Canada, Japan, Australia, New Zealand, Hong Kong, Singapore, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

stock exchange (unlike the global market factor) and may be more accurate as a benchmark compared to the global market factor.

## Methodology

The regression models are based on the models in the Literature Review chapter. Please see this chapter for more information regarding the models. This paper will separate between two market factors; hence the market return  $R(M)$  will either be the global market factor, which we denote as  $R(MKT)$  or NBIM's benchmark, denoted as  $R(RI)$ . See Benchmark indices and the Reference Index section for further information.

The models are adjusted to the return of NBIM's equity minus the risk-free rate. By subtracting the risk-free rate, the left side of the model will represent NBIM's equity performance. The purpose of the various models will be to see if NBIM, in general, can outperform different benchmarks. Furthermore,  $\beta$ ,  $s$ ,  $h$ ,  $w$ ,  $r$  and  $c$  represent NBIM's exposure to the various factors. The modified regression models can be described as follows:

### Analysis of equity investments:

Jensen's alpha:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(M) - R_f) + \varepsilon$$

Fama and French three-factor model:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(M) - R_f) + sSMB + hHML + \varepsilon$$

Carhart four-factor model:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(M) - R_f) + sSMB + hHML + wWML + \varepsilon$$

Fama and French five-factor model:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(M) - R_f) + sSMB + hHML + rRMW + cCMA + \varepsilon$$

Because NBIM does not separate between active and passive returns, we need to find a reasonable proxy for the active part of the equity return. A proxy to measure the performance of active equity management can be , assuming the RI represent the passive returns. Below, we present two alternative proxy models capturing this intuition.

### Analysis of active equity investments (Model 1):

The proxy regression models will use French's market factor and can be written as:

Jensen's alpha:

$$[R_{\text{NBIM}} - R(\text{RI})] = \alpha + \beta(R(\text{MKT}) - R_f) + \varepsilon$$

Fama and French three-factor model:

$$[R_{\text{NBIM}} - R(\text{RI})] = \alpha + \beta(R(\text{MKT}) - R_f) + \text{sSMB} + \text{hHML} + \varepsilon$$

Carhart four-factor model:

$$[R_{\text{NBIM}} - R(\text{RI})] = \alpha + \beta(R(\text{MKT}) - R_f) + \text{sSMB} + \text{hHML} + \text{wWML} + \varepsilon$$

Fama and French five-factor model:

$$[R_{\text{NBIM}} - R(\text{RI})] = \alpha + \beta(R(\text{MKT}) - R_f) + \text{sSMB} + \text{hHML} + \text{rRMW} + \text{cCMA} + \varepsilon$$

Intuitively, a potential drawback of model 1 is that it implicitly assumes that the systematic risk exposure to the benchmark is one. However, this assumption might not reflect reality and a higher (or lower) exposure to the benchmark would not reflect active management. To address this issue, we present the following alternative model below.

### Analysis of active equity investments (Model 2):

Jensen's alpha:

$$(R_{\text{NBIM}} - R_f) = \alpha + \beta(R(\text{MKT}) - R_f) + \beta_2(R(\text{RI}) - R_f) + \varepsilon$$

Fama and French three-factor model:

$$(R_{\text{NBIM}} - R_f) = \alpha + \beta(R(\text{MKT}) - R_f) + \beta_2(R(\text{RI}) - R_f) + \text{sSMB} + \text{hHML} + \varepsilon$$

Carhart four-factor model:

$$(R_{\text{NBIM}} - R_f) = \alpha + \beta(R(\text{MKT}) - R_f) + \beta_2(R(\text{RI}) - R_f) + \text{sSMB} + \text{hHML} + \text{wWML} + \varepsilon$$

Fama and French five-factor model:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(MKT) - R_f) + \beta_2(R(RI) - R_f) + sSMB + hHML + rRMW + cCMA + \varepsilon$$

See the literature review or appendix V abbreviation factors for an explanation of the abbreviations.

# Empirical findings

## NBIM’s return compared to French’s market factor

The different models have been tested with NBIM's return minus the risk-free rate as the dependent variable. See the methodology section for the regression models. The empirical findings will mainly focus on the results in the global Fama and French five-factor model. All the regressions are done in IBM SPSS 25 and summarised in Microsoft Excel. When referring to NBIM’s return, this paper refers to NBIM’s return on equity.

**Table I: Descriptive statistics of equity investments with French’s market factor**

	Descriptive Statistics			
	2000-2017		2010-2017	
	Mean	Std. Deviation	Mean	Std. Deviation
Observations	216	216	96	96
NBIM-RF	0.399	4.781	0.808	4.193
Market-RF	0.399	4.429	0.888	3.777
SMB	0.274	1.891	0.087	1.311
HML	0.488	2.437	-0.642	1.652
RMW	0.339	1.587	0.225	1.156
CMA	0.407	1.931	0.084	0.992
WML	0.369	4.295	0.593	2.420

Table I presents the mean and standard deviation for the dependent variable NBIM-RF and the independent variables in the different sample periods. The Descriptive Statistics are summarised as one to create a clean overview. Observations refer to the number of observations from 2000 – 2017 and 2010 – 2017. The means, and the standard deviation of the means are monthly and presented in percent.

First, NBIMs performance is evaluated based on the monthly mean return to the global market monthly mean return. From table I, NBIM has a monthly mean return of 39.9 basis points for the full sample period and 80.8 basis points for the 2010 period. This is equal to the developed global markets for the full sample period but is 8 basis points lower for the recent sample period of 88.8 basis points. Furthermore, NBIM’s standard deviation of 4.78 percent and 4.14 percent, is higher than the 4.43 percent and 3.78 percent for the global developed market. This indicates that historically, NBIM has a slightly weaker performance compared to the global market. Consistent with this intuition, Table II compares the Sharpe ratios of NBIM to the Market.

**Table II: Sharpe Ratios of NBIM and French's market factor**

NBIM Sharpe Ratio	2000-2017		2010-2017	
	MKT Sharpe Ratio		NBIM Sharpe Ratio	MKT Sharpe Ratio
	0.109	0.115	0.194	0.236

NBIM has a Sharpe Ratio of 0.109 in the full sample period and 0.194 in the recent period. This indicates that NBIM has improved their terms of mean returns to total risk. The global market has a Sharpe Ratio of 0.115 and 0.236. Thus, NBIM has a lower Sharpe Ratio in both sample periods compared to French's global market factor. The different Sharpe Ratios confirm the finding in descriptive statistics, that the return per unit of total risk is higher for the global market than for NBIM.

**Table III: Summary equity investments regression models with French's market factor**

	French's market factor as market factor							
	Jensen's alpha		FF3		Carhart		FF5	
	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017
Observations	216	96	216	96	216	96	216	96
R square	0.986	0.987	0.987	0.987	0.997	0.988	0.988	0.987
Monthly alpha	-0.028	-0.172*	-0.062	-0.169*	-0.058	-0.139*	-0.111*	-0.170*
Market-RF	1.072*	1.103*	1.079*	1.103*	1.076*	1.099*	1.097*	1.103*
SMB			-0.034	-0.038	-0.030	-0.039	-0.004	-0.029
HML			0.074*	-0.003	0.072*	-0.029	0.066*	0.054
RMW							0.130*	0.056
CMA							0.857	-0.107
WML					-0.007	-0.047*		
Annualised alpha	-0.289	-0.896	-0.536	-0.892	-0.512	-0.834	-0.756	-0.893

Table III presents the factor regressions in two sample periods. The main regression by Fama and French is run by the following regression:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(MKT) - R_f) + sSMB + hHML + rRMW + cCMA + \varepsilon$$

The left-hand side variable represents the return of NBIM's equity minus the risk-free rate and the right-hand side variables are the factor returns. See methodology analysis of equity investments for the remaining models.

Each model presents their observations, coefficient of determination, alpha-value and beta-values.

The value of R-square and betas are represented as 1.00 = 100 percent.

The alphas are based on arithmetic returns and first presented monthly.

The monthly alphas are then annualised by the following calculations:

$((1 + \text{monthly alpha})^{12}) - 1$  and will be discussed later in this paper.

All the alphas are presented in percent.

\* denote significance level at 5 percent.

The table shows that none of the alphas are positive. All point estimates are negative and the Fama and French five-factor models produces negative and significant alphas in the full sample set and the recent sample set, respectively 11.1 basis points and 17 basis points. The significant negative alphas indicate that NBIMs equity investments under-performs compared to the global developed market. NBIM has a marginally stronger positive coefficient to the significant market factor that ranges from 1.07 to 1.1 in the full sample period and around 1.1 in the recent period. The factors HML and RMW has significant weak positive coefficients in the full sample period. The remaining factors are not significant in the full sample period.

In the recent sample period the momentum factor shows a significant weak negative coefficient. The remaining factors in the recent period are not significant.

The determination coefficients are extremely high, ranging from 98.6 to 99.7 percent. A coefficient of determination higher than 0,8 may indicate challenges with multicollinearity. This is tested for, and the regressions do not face any challenges with multicollinearity or autocorrelation. The recent sample period had some issues with heteroscedasticity and robust standard errors are used to prevent misinterpretation. Robust standard errors are used for all the summaries to support the validity of the results. The findings in 2000-2017 are similar the findings in the sample period of 1998-2017 and the findings from 2010-2017 are similar the findings in 2013-2017. See Appendix V.

Summing up, none of the regressions presented in this period suggest that NBIM outperforms the market. While this finding is of importance for Norwegian society, it does not necessarily mean that NBIM's management lacks skill as they are not allowed to invest unconditionally in the broad market but instead have to keep close track of the reference index. We turn to this issue next.

## NBIM's return compared to the Reference Index

The market factor includes Oslo stock exchange along with several other stock exchanges but does not include stock exchanges in South-America or Africa. The market factor contains some sectors that are excluded from NBIM's portfolio. Also, as just stated above, NBIM needs to closely track its reference index and we therefore repeat the above analysis using RI as the market factor.

**Table IV: Descriptive statistics of equity investments with the RI as market factor**

	Descriptive Statistics			
	2000-2017		2010-2017	
	Mean	Std. Deviation	Mean	Std. Deviation
Observations	216	216	96	96
NBIM-RF	0.399	4.781	0.808	4.193
RI-RF	0.365	4.693	0.780	4.133
SMB	0.274	1.891	0.087	1.311
HML	0.489	2.437	-0.064	1.652
RMW	0.339	1.587	0.225	1.156
CMA	0.407	1.931	0.084	0.992
WML	0.369	4.295	0.593	2.420

See table I for an explanation of the different values.

NBIM's performance is evaluated based on its monthly total mean return to the RI monthly total mean return. From table IV, NBIM has a monthly mean return of 39.9 basis points and 80.8 basis points in the different sample periods. This is higher compared to the 36.5 basis points and 78 basis points monthly mean return of the RI. Furthermore, NBIM has marginally higher volatility, the standard deviation of mean return is 4.78 percent and 4.19 percent. While the standard deviation of mean return of 4.69 percent and 4.13 percent for the RI.

**Table V: Sharpe Ratios of NBIM and the RI as market factor**

2000-2017		2010-2017	
NBIM Sharpe Ratio	RI Sharpe ratio	NBIM Sharpe Ratio	RI Sharpe ratio
0.109	0.102	0.194	0.190

NBIM has a Sharpe Ratio of 0.109 and 0.194. This is slightly higher than the Sharpe Ratio of the RI, that has a Sharpe Ratio of 0.102 and 0.190. Both NBIM and the RI have increasing Sharpe ratios, indicating that the recent period generally had a stronger performance compared to the full sample period. Risk-adjusted return of the NBIM marginally outperforms the RI's risk-adjusted return in both periods.

**Table VI: Summary equity investments regression models with the RI as market factor**

	The Reference Index as market factor							
	Jensen's alpha		FF3		Carhart		FF5	
	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017
Observations	216	96	216	96	216	96	216	96
R square	0.998	0.999	0.999	0.999	0.999	0.999	0.999	0.999
Monthly alpha	0.028	0.017	0.026*	0.015	0.022	0.016	0.027	0.025
RI-RF	1.018*	1.014*	1.017*	1.014*	1.019*	1.014*	1.015*	1.011*
SMB			0.049*	0.027*	0.045*	0.027*	0.050*	0.019*
HML			-0.011*	0.008	-0.010	0.007	-0.008	0.002
RMW							0.004	-0.026*
CMA							-0.023	-0.016
WML					0.007*	-0.001		
Annualised alpha	0.393	0.224	0.361	0.196	0.298	0.210	0.377	0.345

Table VI presents the factor regressions in two sample periods. The main regression by Fama and French is run by the following regression:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(RI) - R_f) + sSMB + hHML + rRMW + cCMA + \varepsilon$$

The left-hand side variable represents the return of NBIM's equity minus the risk-free rate and the right-hand side variables are the factor returns. See methodology analysis of equity investments for the remaining models and table III for explanation of the values.

Table VI displays results when regressing the excess return of NBIM on the excess return of the reference index and other risk factors. Contrary to previous results, none of the alphas are negative. The only significant alpha is in the Fama and French three-factor model in the 2000-2017 period, where the monthly alpha was 2.6 basis points. Untabulated results further show that the Fama and French five-factor model for the period 1998 – 2007 produces a significant monthly alpha of 3.5 basis points.

The significant beta value of the RI is slightly higher than 1 and ranges from 1.01 to 1.02. SMB is positive and significant, but close to zero in both sample periods. HML and CMA is not significant. RMW is slightly negative and significant in the recent period, while WML is slightly positive and significant in the full sample period.

The determination coefficients are similar to the French's market factor.

#### Proxy for NBIM's active equity performance alternative regression model 1

As explained above, the data provided by NBIM do not separate between the performance of active and passive equity investment. This paper assumes that the active management can be

measured by comparing NBIM's performance to the benchmark and create a proxy. The following factor regressions indicate how well NBIM's active equity investments are performing.

**Table VII: Summary of regressions models of active equity investments model 1**

	Active equity performance proxy							
	Jensen's alpha		FF3		Carhart		FF5	
	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017
Observations	216	96	216	96	216	96	216	96
R square	0.184	0.242	0.418	0.314	0.431	0.308	0.429	0.341
Monthly alpha	0.026	0.013	0.022	0.011	0.018	0.012	0.024	0.022
Market-RF	0.021*	0.016*	0.019*	0.016*	0.022*	0.016*	0.017*	0.013*
SMB			0.050*	0.027*	0.045*	0.027*	0.050*	0.019*
HML			-0.018*	0.005	-0.015*	0.004	-0.007	0.003
RMW							0.007	-0.024
CMA							-0.021	-0.017
WML					0.007*	-0.002		
Annualised alpha	0.361	0.168	0.298	0.140	0.239	0.154	0.329	0.298

Table VII presents the factor regressions in two sample periods. The main regression by Fama and French is run by the following regression:

$$[R_{NBIM} - R(RI)] = \alpha + \beta(R(MKT) - R_f) + sSMB + hHML + rRMW + cCMA + \varepsilon$$

The left-hand side variable represents the return of NBIM's equity minus the RI as benchmark and is meant as a proxy for active returns and the right-hand side variables are the factor returns. See methodology analysis of active equity investments (Model 1) for the remaining models and table III for explanation of the values.

Table VII now regresses the active return (NBIM – RI) on the excess return of the market and several risk factors. As seen in table VII, NBIM does not have a significant alpha for any of the models or the two sample sets. For completeness, in untabulated results we find a significant positive monthly alpha of 3.2 basis points in the Fama and French five-factor model from the sample period 1998 - 2017. See Appendix V for the results. The determination coefficients are lower for the proxy, ranging from 18.4 percent to 42.9 percent, reflecting the fact that the left-hand side variable reflects now the deviation of NBIMs return relative to the benchmark. As a consequence, the significant factor coefficients are smaller and closer to zero.

## Alternative regression model 2

Alternative model 2 is conceptually similar to model 1, but does not require the coefficient on the RI to be equal to one. As such, it addresses Hoddevik and Priestley's comment that NBIM can increase the return relative to the reference index by simply overweighting high beta stocks in the portfolio.

**Table VIII: Summary of regressions models of active equity investments model 2**

	Alternative regression model							
	Jensen's alpha		FF3		Carhart		FF5	
	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017	2000-2017	2010-2017
Observations	216	96	216	96	216	96	216	96
R square	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
Monthly alpha	0.021	0.004	0.019	0.005	0.018	0.007	0.018	0.015
MKT-Rf	0.121*	0.068*	0.054*	0.055*	0.048*	0.058*	0.062*	0.052*
RI-RF	0.905*	0.952*	0.967*	0.965*	0.975*	0.961*	0.959*	0.964*
SMB			0.047*	0.024*	0.042*	0.024*	0.047*	0.017
HML			-0.015*	0.005	-0.006	0.005	-0.004	0.005
RMW							0.012	-0.021
CMA							-0.021*	-0.020
WML					0.007	-0.004		
Annualised alpha	0.283	0.049	0.253	0.062	0.239	0.087	0.239	0.196

Table VIII presents the factor regressions in two sample periods. The main regression by Fama and French is run by the following regression:

$$(R_{NBIM} - R_f) = \alpha + \beta(R(MKT) - R_f) + \beta_2(R(RI) - R_f) + sSMB + hHML + rRMW + cCMA + \varepsilon$$

The left-hand side variable represents the return of NBIM's equity minus the risk-free rate and the right-hand side variables are the factor returns. See methodology analysis of active equity investments (Model 2) for the remaining models and table III for explanation of the values.

Table VIII regresses the excess return of NBIM, on the excess return of the reference index, the excess return on the market and several risk factors. It can be seen that there are no significant alphas. The French market factor and the RI have significant values in both sample sets. The beta of French's market factor is low and ranges from 0.05 to 0.12 in the full sample set and ranges from 0.05 to 0.06 in the recent period. NBIM compared to the RI has a beta slightly below 1, ranging from 0.91 to 0.98 and 0.95 to 0.97.

Taken together, the findings in this section produce no evidence that NBIM outperforms the reference index after adjusting for risk. Moreover, our analysis also shows that when

measured against the market, NBIM underperforms. Our findings therefore suggest that a simple source of value creation would entail dropping the (complicated) reference index and instead allowing NBIM to truly passively diversify globally.

## Management fees

The models used in the analysis are pre-cost regression models. It is important that the average Norwegian has the information needed to evaluate NBIM's performance. As the transparency is a challenging factor when it comes to collecting data for performance measuring and cost estimates, we have conservatively estimated equity management fees.

As NBIM's portfolio consists of equity, bonds and real estate, active and passive managed investments, there are different costs associated with the different forms of investment. An investment fee is the cost of having assets professionally managed. The fee compensations are incentives for active managers to pick securities which results in returns according to the fund's objective.

NBIM has since the beginning of 1998 had an average management fee of 9 basis points<sup>15</sup> of the total market value. Since NBIM does not provide information regarding management fees for equity, it was necessary to take a look at the annual reports<sup>16</sup> from 1998 until 2017. The annual reports separate between management fees associated with equities and fixed incomes from 1998 until 2008. From 2009 until 2017 the annual reports do not separate between management fees. Since this paper is focusing on equity, an estimate of the management fees associated with equity has been created by us. The calculation can be presented as:

### Formula 1: Estimated equity management fees

$$\text{Equity Management fees} = \frac{\frac{(TMF_t - TMF_{t-1}) - (PMF_t - PMF_{t-1}) * EPMFAE + (PMF_t - PMF_{t-1})}{2}}{\frac{MVE_t - MVE_{t-1}}{2}}$$

TMF = Total Management Fees

PFM = Performance-based Management Fee

<sup>15</sup> <https://www.nbim.no/en/the-fund/return-on-the-fund/>

<sup>16</sup> See <https://www.nbim.no/en/transparency/reports/> for the annual reports

EPMFAE = Estimated Percentage Management Fee Average Equity

MVE = Market Value Equity

See Appendix IV for calculations.

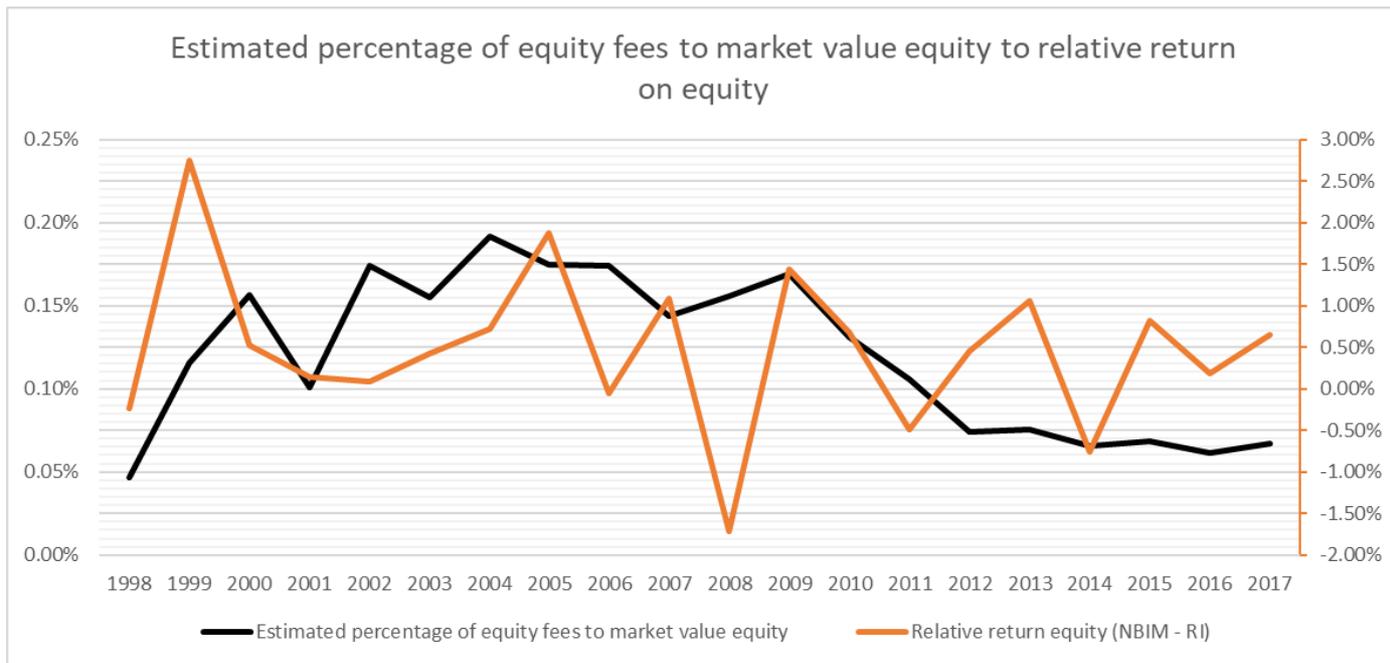
The performance-based management fees are associated with equity and subtracted from the total management fees, then it is multiplied with the estimated percentage equity management fees of total management fees. The reason is to calculate an estimate that is as correct as possible for the management fees that do not separate between management fees related to equity, bonds, and real estate. When the estimated equity management fees are calculated, the performance-based management fees are added to show the total management fees that are related to equity. When the total equity management fees are calculated, it is divided by the equity market value to estimate equity management fees as a percentage of equity market value. The estimated management fee percentage regarding average equity is estimated by calculating actual equity management fees divided by total management fees from 1999 until 2008. The estimate indicates that, on average, the equity related management fees represent 75.65 percent of total management fees. By using this estimate, the equity related management fees represent 12.02 basis points of the market value for equity.

Management fees and the equity market value are calculated in NOK. We assume that it will not be a problem to compare this with the return which is measured in USD, since the models are adjusted to percentages before they are compared.

From the previous annual reports, NBIM's percentage in equity was approximately 40-50 percent, while the management fees associated with equity represented 75.65 percent of the total management fees. In the annual reports where the management fees are not separated, the total equity percentage ranges from 59-67 of total market value. It is therefore a high probability that actual percentage of management fees associated with equities are higher than 75.65 percent. It can also be argued that in recent years a significant percentage of the increase in total management fees may be connected to real estate management fees. Based on this and the characteristics of the formula, average management fees adjusted for average equity cost and percentage fees are assumed to be in the range of 12.02 basis points.

Furthermore, an interesting aspect will be to compare the proxy and management fees that are related to equity.

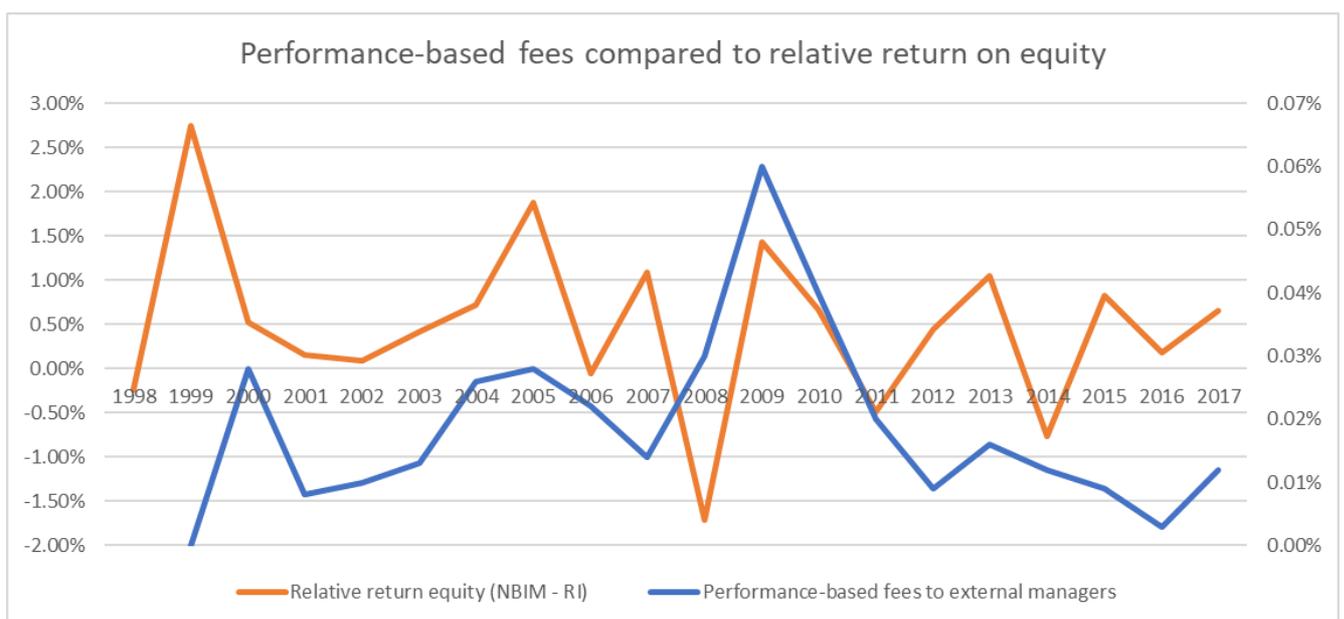
**Graph II: Estimated percentage of equity fees to equity market value compared to relative return on equity**



The left vertical axes show the estimated percentage of equity fees to NBIM’s equity market value. The right vertical axes show NBIM’s relative equity return minus the RI.

As seen from the graph, the relative return is more volatile compared to the annual estimated management fees. The correlation is calculated to 0.146. The estimate includes all the management fees related to equity such as regular management expenses. It will be interesting to use the proxy and compare it to the performance-based fees reported in the annual reports.

**Graph III: Performance-based fees compared to relative return on equity**



The left vertical axes show NBIM's relative equity return minus the RI and the right vertical axes show percentage of performance-based fees to external managers to the market value of NBIM's equity.

There is a close to zero correlation<sup>17</sup> of -0.0002 between performance-based fees and relative return on equity. This indicates that the cost associated with the equity management does not reflect the relative return on equity.

Taken together, the graphs shows that there are almost no connection between NBIM's relative equity performance and management fees related to equity.

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<sup>17</sup> See appendix IV calculations Management fees for calculations

## Discussion

### Different research results regarding $\alpha$

There have been several academical papers and articles debating if NBIM's active equity investments are profitable or not. This discussion will include two opposing views and why they have different alphas.

### Dahlquist and Ødegaard

In "A review of Norges Bank's Active Management of the Government Pension Fund Global" by Dahlquist and Ødegaard (2018), the authors argue that the active investments are profitable and generates a positive alpha after costs. Their data was based on 234 (54) observations from 1998-2017 (2013-2017).

Dahlquist and Ødegaard focuses on relative return with the same proxy as this paper. Their prime source of data and factors such as HML, RMW, and CMA were provided by NBIM. The authors uses the following factor model as their main model<sup>18</sup>:

$$R_t - R_t^b = \alpha + b_{MKT}MKT_t + b_{SMB}SMB_t + b_{HML}HML_t + b_{RMW}RMW_t + b_{CMA}CMA_t + b_{TERM}TERM_t + b_{DEF}DEF_t + \varepsilon_t$$

This model includes both equity and fixed income. By excluding the TERM and DEF factors, which are fixed-income factors, the model will present Dahlquist and Ødegaard's equity factor model.  $R_t - R_t^b$  represents the return of NBIM minus the return of their benchmark. See Appendix IV: Factors composed by Dahlquist and Ødegaard for further explanation of their factors. It will be natural that these are not equal to French's global factors and will affect the outcome of the model.

In addition to the data from the fund, Dahlquist and Ødegaard used international and US factors, such as the market factor that are measured in USD, and then the value was converted to NBIM's currency basket. The authors argue that the currency effect will be insignificant over time.

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<sup>18</sup> The model is copied from "a review of Norges Bank's Active Management of the Government Pension Fund Global" (2018) p.68 by Dahlquist and Ødegaard.

According to their paper, active equity management fees are 13 (7) basis points per annum and the active equity investments generates a mean of 36 (30) basis points after costs. First, they have a positive significant alpha value of 39 basis points (insignificant positive value of 26) before costs for the equity portfolio. When we estimate our alternative model (1) – which is very similar to their model – we find a significant positive annualised alpha of 45.9 basis points (insignificant positive alpha value of 29.8) before costs. For the purpose of the discussion and comparison, the focus will be on the recent data set.

Furthermore, they show that the external equity portfolio has a positive significant gross alpha of 3.28 percent in the recent sample period. However, we cannot verify this claim as we do not have access to the data set of external equity performance.

### Hoddevik and Priestley

Hoddevik and Priestley (2018) is a response to Dahlquist and Ødegaard (2018) where the latter reported positive alpha generated by NBIM's equity investments. Dahlquist and Ødegaard states in their report that NBIM's equity investments generate value over and above its cost, compared to the RI. The discussion is often linked to the sample period and Hoddevik and Priestley evaluates the performance from 2013-2017, as they want to measure the performance of recent years. Bernt Arne Ødegaard claims that to prove data statistically there is a need for more observations<sup>19</sup> and that the optimal estimation is based on the whole life-period of the fund. Hoddevik and Priestley's response to this is that due to the small size in the fund's initial years, it generated such a high relative return that it hides the negative alpha from the recent years.

The measure of the performance used by Hoddevik and Priestley (2018) is the following regression:

$$[R_{\text{NBIM}} - R(\text{RI})] = \alpha + \beta R(\text{MKT}) + s\text{SMB} + h\text{HML} + r\text{RMW} + c\text{CMA} + ch\text{CHIN} + e\text{EMG} + \varepsilon$$

The CHIN-factor represents the MSCI China index A, the EMG-factor represents MSCI Emerging Markets Index, while the remaining factors are based on Kenneth R. French's factors, the same as the models in this paper. Hoddevik and Priestley investigated the performance of NBIM's active equity investments by using an alternative proxy-model that

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<sup>19</sup> [http://rann.no/bibliotek/wp-content/uploads/2015/06/150716\\_Oedegaard\\_tilsvaer.pdf](http://rann.no/bibliotek/wp-content/uploads/2015/06/150716_Oedegaard_tilsvaer.pdf)

adjust NBIM's return for the reference index. This model evaluates the performance of NBIM's active equity performance and is similar to this paper's alternative proxy-model 1 with a few exceptions; the inclusion of CHIN and EMG factors. However, Hoddevik and Priestley did run their model without the inclusion of the two previously mentioned additional factors and estimated a significant alpha value of negative 39.7 basis points. This paper estimated an insignificant positive alpha of 29.8 basis points for the same model.

For further analysis, if the benchmark includes assets that are unpriced by the factors, such as lack of regional stock market integration, then Hoddevik and Priestley suggests adding the benchmark as a factor when assessing the performance measurement. This is similar to this paper's alternative model 2, and the regression results for the similar model in this paper are positive insignificant alpha values of 10 basis points for the equivalent period, but also positive insignificant for the 2000-2017 and 2010-2017 sample periods. Hoddevik and Priestley estimated negative alpha values when they took this approach in the Hoddevik and Priestley (2017) report.

An interesting supplement to the discussion is the two additional significant factors Hoddevik and Priestley (2018) implemented in their model. The RI includes Chinese H-shares and N-shares, but NBIM also invests in Chinese A-shares. The A-shares are traded on the Shenzhen and Shanghai Stock Exchange, while the H- and N-shares are listed in Hong Kong and New York. The A-shares are hardly part of the benchmark portfolio. The returns on Shenzhen and Shanghai Stock Exchange are quite extreme and Hoddevik and Priestley therefore states that it can have a big impact on the returns.

NBIM's active equity investments produces at best a zero additional return and at worst loses money according to Hoddevik and Priestley (2018). In their findings, NBIM generates negative significant alpha before cost. Hoddevik and Priestley find it difficult to understand why the Ministry of Finance, on behalf of the Norwegian public, would continue to ask NBIM to use resources to finance this activity. Hoddevik and Priestley (2018) believes that the best way to manage NBIM is to improve the RI so that it reflects NBIM in a better way. NBIM should go for a passive strategy with low costs and replicate the RI. They claim that the excess points achieved by the active equity investments could be generated more easily from replicating the RI and simply adjusting the weight of the equities.

The recommendation of Hoddevik and Priestley is consistent with our findings as we find a negative alpha relative to the market.

## Conclusion

Our analysis produces no evidence that NBIM's management generates value. Specifically, we find that when measured against the market, excess returns (alphas) are negative. This simply suggests that a source of value creation would entail dropping the (complicated) reference index and instead allowing NBIM to truly passively diversify globally.

Taking this issue aside – as the decision with regards to the reference index rests with the Ministry of Finance and not NBIM - we do not find any evidence that NBIM outperforms the reference index. In the sample period of 2013 to 2017, Dahlquist and Ødegaard had an insignificant positive alpha for the proxy of the active equity investments. On the other hand, Hoddevik and Priestley had a negative significant alpha, when they regressed a model similar to our alternative model 1. Our findings indicate a positive, but insignificant alpha for our alternative model 1 in the same sample period. The insignificant alphas provide no evidence of outperforming or underperforming and are therefore considered to be zero.

Finally, our regression estimates are based on returns measured before cost. Adjusting for costs will make the zero-alphas turn negative and will lead to even further negative alpha values for Hoddevik and Priestley. We consider both of the contradicting reports to be too extreme in each direction, but due to lack of significant results and the high management fees we find reason to agree with Hoddevik and Priestley's report.

The fact that the RI does not include the same type of investments in China as NBIM does, especially considering the Chinese stock market bubble in June, 2015, gives NBIM's results a boost, relatively speaking. The China A-shares' volatility is quite extreme and the annually returns differs from positive 82 percent<sup>20</sup> to negative 18 percent in the period from 2009 to 2017. By taking this into account, the positive alphas may turn negative with an accurate benchmark that includes the Chinese A-shares investments.

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<sup>20</sup> <https://www.msci.com/documents/10199/d84b06d0-b81c-48ce-89b8-c57f808065e4>

Data on a regional level would give a more precise analysis of NBIM's performance and give a better understanding of where they generate positive returns and how the benchmark is performing in these regions. Moreover, since NBIM focuses on transparency, it should be a clear line between return on active investments and return of passive investments. By making this clear line, the use of proxy-estimation would not be necessary. By actual measures on active equity investments, the use of regional factors would be considered more accurate, and do not depend on professional discretion.

With this in mind, NBIM should focus on their greatest strength, size. They should concentrate on their diversification and take advantage of systematic risk. NBIM should not try to exploit the market to achieve a short-term gain that contradicts with their long-term investment horizon.

## Limitations

- All the data is analysed in USD to achieve a more precise analysis of the equity performance. A weakness with the use of USD will be that NBIM is analysed from an American perspective and not a Norwegian one.
- As the data under management fees are collected manually from the annual reports, there is chance of mistyping, wrong calculations and/or miss categorization. The estimates are meant as an indication of an approximately value.
- A single global model does not take regional factors into account.
- There are some weaknesses with the benchmarks of choice. The benchmark is not adjusted for transactional costs and the performance can be considered unachievable high. The international market factor includes the Norwegian stock exchange, while the purpose of NBIM is to invest outside of Norway. The market factor does not include stock exchanges in South-America or Africa, which NBIM invest a small portion in. Another weakness with the benchmark is NBIM's guidelines for observation and exclusion from the fund<sup>21</sup>. There are some industries that NBIM does not invest in, including tobacco, and weapon production. However, the findings of Bauer, Koedjik and Otten (2005) states with international evidence on ethical mutual

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<sup>21</sup> <https://www.nbim.no/en/the-fund/governance-model/guidelines-for-observation-and-exclusion-from-the-fund/>

fund performance that this has no effect. The market factor is nonetheless considered a good benchmark, despite the imperfections.

## Suggested future research

Interesting aspects that might add further depth to the discussion of NBIM, would be a regional analysis of North America, Europe, and Asia, if NBIM provide the necessary regional returns. A regional analysis could provide an understanding regarding that NBIM might have excess returns in certain regions.

Another interesting question would be; is the RI truly passive? If the RI is not passive, the alternative proxy model will not be a proxy for active return, but rather a way to remove some of the weak performances of NBIM. This is a consequence of NBIM outperforming the current complicated RI.

This paper has focused on the equity performance in NBIM, another interesting question would be regarding the unlisted real estates that NBIM invests in. Are they a further diversification, or an unprofitable active investment strategy? This question is rather challenging to answer, since the true value of the unlisted real estate will not be revealed until NBIM starts to sell the recent acquired assets.

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## Appendix I: Assumptions of the CAPM

- Investors are risk-averse individuals who maximize the expected utility of their wealth.
- Investors are price takers and have homogeneous expectations about asset returns that have a joint normal distribution.
- There exists a risk-free asset such that investors may borrow or lend unlimited amounts at a risk-free rate.
- The quantiles of assets are fixed. Also, all assets are marketable and perfectly divisible.
- Asset markets are frictionless, and information is costless and simultaneously available to all investors.
- There are no market imperfections such as taxes, regulations, or restrictions on short selling.

These assumptions are copied from “Financial Theory and Corporate Policy” fourth edition, page 145-146 by Copeland, Weston and Shastri.

## Appendix II: Explanation of symbols

### CAPM

$E(R_j)$  = Expected return portfolio j

$R_f$  = Risk free rate.

$\beta_j$  = Sensitivity of the portfolio compared to the market.

$E(R_m)$  = Expected return market

$[E(R_m) - R_f]$  = Market risk premium.

### Fama and French

$R_{(t)} - R_{f(t)}$  = Return of portfolio minus Return of risk free rate

$SMB_{(t)}$  = The difference of return between a portfolio of small stocks and a portfolio of big stocks.

$$SMB_{(t)} = \frac{\phi_i - \phi_m}{\phi_m}$$

$\phi_i$  = market value of security i

$\phi_m$  = average market value

$HML_{(t)}$  = The difference of return between a portfolio of value stocks and a portfolio of growth stocks.

$$\text{Book-to-Market ratio} = \frac{\text{book value of firm}}{\text{market value of firm}}$$

RMW calculation:  $(\text{Revenues} - \text{COGS} - \text{SG\&A} - \text{IE}) / \text{book equity}$

CMA calculation:  $(TA_{t_2} - TA_{t_1}) / TA_{t_1}$

$\beta$ ,  $s$ ,  $h$ ,  $r$  and  $c$  are the factor sensitivities or slopes in a time-series regression.

If the exposure to the five factors  $\beta$ ,  $s$ ,  $h$ ,  $r$  and  $c$  capture all the variation in expected returns the interception  $\alpha$  is zero for all securities and portfolios j.

### Performance measurement

$R_p$  = Average return of portfolio

$\beta_p$  = Sensitivity of the portfolio

$\sigma_p$  = Standard deviation portfolio

$\alpha_p$  = abnormal return of portfolio

$\sigma_{p,\varepsilon}$  = residual risk

$R_b$  = average return of benchmark

$\sigma(R_p - R_b)$  = volatility of the difference = tracking error

# Appendix III: Calculations Management Fees

Classification	1998	1999	2000	2001	2002	2003	2004	2005
* indicates that the number is taken from the annual report								
Total management fees in %*	0.00121	0.00087	0.0011	0.00075	0.0009	0.00104	0.00105	0.00106
Total management fees (bNOK)	0.066795	0.160668	0.316812	0.354765	0.559835	0.7609	0.984137	1.238681
The funds equity change/Total management fees	1047.98263	149.376354	186.23032	262.145364	-26.7936088	170.850309	55.886528	134.013519
Total market value of the fund (bNOK) *	172	222	386	614	609	845	1016	1399
Total equity of the fund (bNOK) *	70	94	153	246	231	361	416	582
Percentage invested in equity	0.40697674	0.42342342	0.39637306	0.40065147	0.37931034	0.42721893	0.40944882	0.41601144
Percentage of management fees to average total assets		0.0816%	0.1042%	0.0710%	0.0916%	0.1047%	0.1058%	0.1026%
Average total management fees		0.0850%						
Amount in millions kroner*								
Salary, social security and other personal-related costs	38.355	82.952	118.156	149.438	281.868	331.134	291.537	334.681
Custody cost	14.069	21.418	38.323	63.147	69.829	104.666	81.364	112.358
IT services, systems, data and informataion	0	0	0	0	0	0	0	0
Research, consulting and legal fees	0	0	0	0	0	0	0	0
Other costs	0	0	0	0	0	0	0	0
Allocated costs Norges Bank	0	0	0	0	0	0	0	0
Base fees to external managers	14.371	56.298	79.449	103.982	141.491	235.648	364.575	471.46
Performance-based fees to external managers		0	80.884	38.198	66.647	89.452	246.661	320.182
<b>Total management fees</b>	<b>66.795</b>	<b>160.668</b>	<b>316.812</b>	<b>354.765</b>	<b>559.835</b>	<b>760.9</b>	<b>984.137</b>	<b>1238.681</b>
Sum equity management fees*	32.637	108.362	239.045	247.639	401.221	560.227	796.027	1.015.708
Percentage of equity fees to total management fees	48.86%	67.44%	75.45%	69.80%	71.67%	73.63%	80.89%	82.00%
<b>Average percentage equity fees except for starting year</b>		<b>75.6471%</b>						
Estimated sum equity management fees based on average								
Estimated percentage of equity fees to market value equity	0.0466%	0.1153%	0.1562%	0.1007%	0.1737%	0.1552%	0.1914%	0.1745%
Estimated percentage of equity fees to market value equity								
Estimated percentage of equity fees to market value equity	<b>0.05%</b>	<b>0.12%</b>	<b>0.16%</b>	<b>0.10%</b>	<b>0.17%</b>	<b>0.16%</b>	<b>0.19%</b>	<b>0.17%</b>
Average management fee to equity - 1998	0.1202%							
Average management fee to equity 2009-2017	0.0909%							
Performance-based fees to external managers		0.00%	0.03%	0.01%	0.01%	0.01%	0.03%	0.03%
Total management fees	0.00121	0.00087	0.0011	0.00075	0.0009	0.00104	0.00105	0.00106
Relative return equity (NBIM - RI)	-0.24%	2.74%	0.52%	0.15%	0.09%	0.42%	0.72%	1.88%
Relative return combined (NBIM - RI)	0.1733%	1.1244%	0.2352%	0.1695%	0.3012%	0.5020%	0.5033%	0.9862%
Total management fees	0.00121	0.00087	0.00110	0.00075	0.00090	0.00104	0.00105	0.00106
Estimated % average management fees adjusted to average equity		0.0814%	0.1438%	0.0824%	0.1086%	0.1217%	0.1429%	0.1401%
Average management fee to equity - 1998		0.0981%						
Average management fee to equity 2009-2017		0.0860%						
Estimated %management fees adjusted to equity one year	0.0388%	0.0724%	0.1140%	0.0671%	0.1098%	0.1042%	0.1319%	0.1207%

**NOTE! The calculations are not adjusted for equity percentage of the fund, since historical**



## Appendix IV: Factors composed by Dahlquist and Ødegaard

This Appendix is copied from “A Review of Norges Bank’s Active Management of the Government Pension Fund Global” (2018) p. 138-139.

We construct several factors on our own. First, we follow Ang et al. (2014) and consider one additional term (duration) factor and three additional default (credit risk) factors. The term factor is the difference in returns between the total-return BarCap US Treasury 20+ yr index and the total-return BarCap US Treasury Bill 1–3-mth index (referred to simply as “term”). The three default factors are: i. the difference in returns between the total-return BarCap US Corporate Aa Long-Maturity index and the total-return BarCap US Treasury 20+ yr index (referred to as Credit Aa); ii. the difference in returns between the total-return US Corporate Baa Long-Maturity index and the total-return BarCap US Corporate Aa Long-Maturity index (Credit Baa); and iii. the difference in returns between the total-return BarCap US Corporate High-Yield Caa index and the total-return BarCap US Corporate Baa Long-Maturity Baa index (Credit HY). The returns for these factors are all obtained from Morningstar. Second, we consider returns in developed markets (MSCI World) and emerging markets (MSCI EM). We construct them either in excess of the risk-free rate (see above) or as an emerging market factor constituting the return on the emerging markets minus the return on the developed markets. These returns are obtained from Morningstar. Third, we consider the return on a variance swap between implied and realized volatility on the S&P500, as computed by Daniel and Moskowitz (2016). We refer to this as the selling-volatility factor. Fourth, we construct foreign exchange factors. We consider carry and dollar-carry factors in accordance with Lustig et al. (2011, 2014) as constructed by Dahlquist and Hasseltoft (2017) for G10 currencies. Fifth, we consider several liquidity and funding factors. We consider the change in the VIX (referred to as  $\Delta VIX$ ) and the change in the TED spread (i.e., the three-month USD Libor minus the three-month US T-bill rate, referred to as  $\Delta TED$ ). VIX data are retrieved from the Chicago Board Options Exchange. The TED spread is constructed from data from the FRED database at the Federal Reserve Bank of St. Louis. We also consider three liquidity measures, constructed like those of Nagel (2016). The first and second liquidity measures are the change in the spread between the three-month general collateral repurchase agreement rate and the three-month T-bill rate (referred to as  $\Delta Repo$ ) and

the spread between the three-month certificate of deposit rate and the three-month T-bill rate (referred to as  $\Delta CD$ ). These series are retrieved from Bloomberg. The third liquidity measure is the spread between the on-the-run two-year Treasury note rate and the off-the-run two-year rate (referred to as  $\Delta On/off$ ), as constructed by Gürkaynak et al. (2007). The on-the-run rate is retrieved from Bloomberg and the off-the-run rate from the Federal Reserve Board webpage:

<https://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html>.

## Appendix V: Fama and French five-factor model different data sets

	French's market factor		The RI as market factor		Alternative model 1		Alternative model 2	
	FF5		FF5		FF5		FF5	
	1998-2017	2013-2017	1998-2017	2013-2017	1998-2017	2013-2017	1998-2017	2013-2017
Observations	239	60	239	60	239	60	239	60
R square	0.986	0.986	0.999	0.999	0.374	0.286	0.999	0.999
Monthly alpha	-0.093*	-0.214*	0.035*	0.026	0.032*	0.022	0.030	0.008
Market-RF	1.097*	1.072*			0.015*	0.015*	0.037	0.076
RI-RF			1.014*	1.013*			0.980*	0.942*
SMB	-0.017	0.067	0.045*	0.014	0.044*	0.015	0.043*	0.018
HML	0.070*	0.154*	-0.014	0.013	-0.014	0.014	-0.012	0.022
RMW	0.119*	0.253*	0.007	-0.027	0.009	-0.023	0.011	-0.007
CMA	-0.013	-0.179*	-0.025	-0.026	-0.023*	-0.026	-0.023	-0.035
Annualised alpha	-0.690	-0.944	0.511	0.361	0.459	0.298	0.426	0.100