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# Do Norwegian Bond Funds Create Value?

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# Acknowledgements

The background for selection of research question was to gain a deeper understanding of the Norwegian bond fund market. Despite the importance of the asset class, limited research has been conducted on bond funds, especially in relation to the Norwegian bond fund market. The writing process has been a challenging, yet rewarding experience, and has provided us with knowledge which we will bring into our further careers.

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While writing the dissertation, we contacted a number of people in the bond market business. The industry in general deserves recognition for their contribution. Also, a special thanks to Joackim Kvamvold and Jørn Nilsen in Folketrygdfondet and Torgeir Stensaker in Nordea.

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# Abstract

Performance evaluations of Norwegian bond mutual funds have until this date received limited attention. The introduction of updated credit-indices by Nordic Bond Pricing, has allowed for new opportunities to analyse funds of this major asset class. The main objective of this thesis is to evaluate whether Norwegian bond mutual funds are capable of creating value. In the study, we examine investment grade funds over two separate sample-periods from 2010-2019 and 2015-2019. The thesis employ three separate approaches for evaluating whether funds are able to create value, namely active return, value added and factor models.

Our findings indicate that the average Norwegian bond fund is capable of creating value compared to proper benchmarks. However, none of the generated value benefits investors. Further, we find that the apparent value creation relates to exposure toward common risk factors and not from fund managers possessing skill. When employing factor models, not a single fund exhibit a positive significant performance neither gross nor net of expenses. The sign and significance are robust across all factor models applied. The results of this thesis are important as funds for a long period of time have been compared to inappropriate indices, misleading investors.

As an extension of the performance analysis, we consider whether it is possible to identify funds by examining their characteristics. Fund age, assets under management (AUM) and expense ratio are evaluated. Our findings suggest that funds with a high AUM are able to outperform others both gross and net of expenses. In addition, we find evidence that funds with high expense ratios generate higher returns gross of expenses.

***Keywords*** *– Bonds, Bond funds, Nordic Bond Pricing, Active management, Factor exposure, CAPM*

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# 1 Introduction

According to figures produced by Statistisk Sentralbyrå (2020), the outstanding amount in Norwegian mutual fund shares totaled 337 billion NOK by the end of 2019. This equates to approximately 25 percent of the total outstanding amount in mutual fund shares. Even so, almost all empirical analysis performed on actively managed mutual funds in the international financial literature, has been in relation to equity funds (Cremers, Fulkerson & Riley, 2019). For the Norwegian market, only a handful of studies regarding bond funds have been conducted.

When considering the magnitude of this asset class, it is necessary to understand how well these funds are performing and the underlying factors that drive their performance. The majority of existing literature within the bond mutual fund field, both domestically and internationally, measure performance employing factor models. The general understanding of active bond fund management, is that funds are able to outperform pre expenses, but unable after expenses (Cremers et al., 2019).

In 2017, Nordic Bond Pricing (NBP) introduced new bond indices for the Norwegian market, providing a long awaited index-standard. Prior to the introduction, the bond mutual fund industry were using government bond indices that did not truly represent the underlying risks of the funds (Alfred Berg, 2019). The introduction of representative indices has made it possible to perform a thorough analysis of Norwegian investment grade funds. The main objective of this thesis is to examine how well these funds are performing. On that basis the main research question is defined accordingly:

- Are Norwegian bond funds creating value?

In the study, we examine investment grade funds over two separate sample-periods from 2010-2019 and 2015-2019. Three separate approaches are considered for evaluating whether funds are capable of creating value, namely active return, value added and factor models. The overall findings of this thesis indicate that funds are capable of creating value. However, none of this benefits investors. When controlling for factor exposure, the alphas are significantly negative across all factor models applied. Accordingly, we find that the apparent value creation relates to exposure toward common risk factors and not from fund managers possessing skill.

As an extension of the performance analysis, we are interested in examining the relationship between fund characteristics and their performance. Funds in the bond mutual fund market differ in terms of investment mandate, size, minimum investment, risk, age and expenses amongst others. For an investor it is difficult to navigate and know which funds to invest in. Accordingly, we form a second research question as follows:

- Is it possible to identify well-performing funds by examining their characteristics?

In order to address the research question, three separate characteristics, namely age, AUM and expense ratio are evaluated. Our findings indicate that funds with a high AUM outperform others both gross and net of expenses. Furthermore, funds with high expense ratios appear to generate greater returns compared to other funds gross of expenses.

This thesis makes three distinct contributions to the existing Norwegian bond fund literature. First, we improve the current evaluation of Norwegian bond mutual funds by measuring them in relation to representative indices as delivered by NBP. Secondly, we are the first to employ a broad spectre of performance measurements, including active return and value added. Finally, to our knowledge, this is the first study examining the relationship between performance and fund characteristics in the Norwegian bond mutual fund market.

The next parts of this thesis is structured as follows. Section 2 describes the relevant theoretical framework. Further, section 3 provides a brief overview within the existing bond fund literature. Then, section 4 will describe the data and the processing of these. Section 5 presents the methodology applied, while section 6 and 7 presents and discusses the results. Finally, section 8 draws the overall conclusions of this thesis.

# 2 Theoretical Framework

## 2.1 Introduction

This part of this thesis discusses and elaborates on the theoretical framework relevant for the analysis. First, we will define bonds and their characteristics. Secondly, bond mutual funds and bond indices will be presented, while the last part of this section contains methods and measurements for evaluating bond mutual fund performance.

## 2.2 Bonds

### 2.2.1 What is a Bond?

First, a clear understanding of the fixed-income security of bonds is required. A bond is a borrowing agreement between an issuer and a bondholder. The issuer, typically a government or a company, issues the bond in order to raise capital. The bondholder, which can be either a private investor or a company, lends money to the issuer by buying the bond. The agreement obligates the issuer to make specified payments, known as coupon payments, to the bondholder. The frequency and size will depend on the form of the contract. At maturity, the principal amount of the bond is repaid (Bodie, Kane & Marcus, 2014).

### 2.2.2 Pricing

The bond contract, called indenture, holds details of the bond´s terms and characteristics (Fabozzi and Mann, 2012). Bonds are heterogeneous securities with multiple attributes that separate them from one another, making pricing of bonds a complicated matter. According to Merton (1974) the bond price is dependent on three factors. The first factor is the rate of return on a risk-free asset. The second, is specific restrictions and provisions in the indenture, while the last factor is the probability that the firm will be unable to meet their obligations. Accordingly, the investor is compensated for holding a risk- free asset, the characteristics of the indenture as well as the probability of default of the bond. The pricing formula for a simple bond is defined below:

$$P = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} + \frac{FV}{(1+r)^T} \tag{2.1}$$

The price ($P$) is calculated as the sum of the present value of all future cash flow payments until the time to maturity ($T$). The cash flow consists of coupon payments ($C_t$) and the face value of the bond ($FV$), that is discounted with the expected rate of return ($r$) (Bodie et al., 2014). This is also known as the yield-to-maturity (YTM) and measures the return for the investor in the event the bond is held to maturity.

Although bonds are considered a safer investment vehicle than stocks, they are not without risk. Thus, the future cash flow holds uncertainty. Occasionally, the issuer will fail to meet their obligations and default on the bond, hence raising the discount rate $r$ (Merton, 1974). The issuer‘s ability to meet their obligations as stated in the indenture, is known as credit risk (Fabozzi and Mann, 2012).

The compensation obtained for the credit risk depends on the issuer´s creditworthiness. Credit rating firms such as Moody's, Standard and Poor's (S&P) and Fitch measure the creditworthiness of bond issuers, by applying a variety of credit measurements (Bodie et al., 2014). The credit rating firms apply a letter-based grading scale displayed in Figure 2.1 in order to classify bonds by their ability to meet their obligations.

**Figure 2.1:** Credit Ratings

| | Moody's | S&P | Fitch | Meaning |
|---|---|---|---|---|
| Investment Grade | Aaa | AAA | AAA | Prime |
| | Aa1 | AA+ | AA+ | High Grade |
| | Aa2 | AA | AA | |
| | Aa3 | AA- | AA- | |
| | A1 | A+ | A+ | Upper Medium Grade |
| | A2 | A | A | |
| | A3 | A- | A- | |
| | Baa1 | BBB+ | BBB+ | Lower Medium Grade |
| | Baa2 | BBB | BBB | |
| | Baa3 | BBB- | BBB- | |
| Junk | Ba1 | BB+ | BB+ | Non Investment Grade Speculative |
| | Ba2 | BB | BB | |
| | Ba3 | BB- | BB- | |
| | B1 | B+ | B+ | Highly Speculative |
| | B2 | B | B | |
| | B3 | B- | B- | |
| | Caa1 | CCC+ | CCC+ | Substantial Risks |
| | Caa2 | CCC | CCC | Extremely Speculative |
| | Caa3 | CCC- | CCC- | In Default w/ Little Prospect for Recovery |
| | Ca | CC | CC+ | |
| | | C | CC | In Default |
| | | | CC- | |
| | D | D | DDD | |

Figure 2.1: The figure displays the credit rating schemes of the different credit rating firms. Source: (WEF, 2020).

AAA (Aaa) is the highest rating, solely obtained by firms with a negligible probability of default. Oppositely, firms with a credit rating of D are either in default or in the process of filing for default (S&P, 2019). Based on their credit rating, bonds with a rating of BBB- (Baa3) or better are defined as Investment Grade (IG). On the other hand, all bonds with a rating lower than BBB- (Baa3) are considered more speculative and are defined as High Yield (HY) (reported as "Junk" in Figure 2.1).

In addition to being exposed to credit risk, bond prices are sensitive to changes in interest rates. This is also known as term risk, and is measured by the duration of the bond (Bodie et al., 2014). Duration is calculated as the weighted average of future cash flows with weights proportional to the present value of payments. Accordingly, bonds with a high duration will be more affected by changes in interest rates than bonds with a low duration, hence increasing the discount rate $r$ in equation 2.1. Figure 2.2 illustrates a yield curve under normal economic conditions depicting yields of bonds with varying maturities. As displayed in the figure, bonds with a longer time to maturity will have a higher expected yield (discount rate).

**Figure 2.2:** The Yield Curve

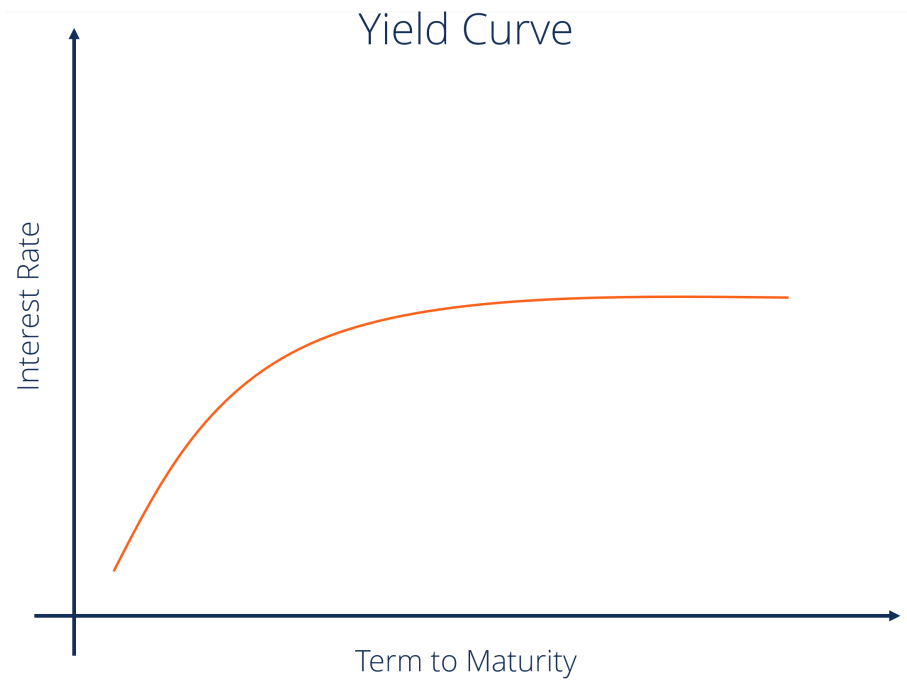



Figure 2.2: The figure displays a yield curve under normal economic conditions. Source: (CFI, 2020).

### 2.2.3 Bond Mutual Funds

Unlike stocks, investing directly in bonds is uncommon for private investors. High minimum investment requirements, transaction costs and lack of liquidity makes it difficult to build a diversified portfolio (BlackRock, 2020). Accordingly, most private investors access this asset class by investing in bond mutual funds.

All Norwegian funds are required to provide an investment mandate for their investors (Verdipapirfondloven, 2012, § 8-3(2)). The investment mandate shall give guiding principles on how the fund invests its capital (VFF, 2020). The typical mandate includes information regarding the areas of investment, degree of active management, risk profile, management costs, benchmark, industry segments etc. Particularly, bond mutual funds tend to have constraints for short-sale, leverage and which credit rating groups they primary invest in (Choi and Kronlund, 2018).

Bond mutual funds are managed according to different guidelines (VFF, 2020). Two of the main categories are active and passive funds. Active managers try to earn active return by taking positions that deviate from their benchmark. In contrast, passive funds seek to replicate the returns of a predetermined benchmark (Ang, 2014).

#### 2.2.3.1 Bond Indices

In order to measure the performance of a fund, it is compared in relation to a benchmark consisting of similar principles and restrictions as the investment mandate (van Binsbergen and Koijen, 2018). Brown (2002) distinguishes between two main purposes of corporate bond indices. Indices established to track the market performance and indices for investment performance benchmarks. Moreover, Ang (2014) expresses that ideal benchmarks should be:

1. Well-defined
2. Tradable
3. Replicable
4. Adjusted for risk

First, the benchmark should be well defined, in other words it should be produced by an independent index provider. Secondly, it needs to be tradable and replicable in order to be considered as an investable investment strategy. Finally, a benchmark should reflect the relevant risk exposure of the fund.

## 2.3 Evaluation and Performance Measurements

From this part on, the theoretical framework comprising performance measurements, is presented. Prior to the introduction of evaluation methods a discussion of why evaluate funds is made.

### 2.3.1 Why Evaluate?

The bond mutual fund market can be difficult to navigate for investors. Here, we argue why it is important to measure the performance of mutual funds, both from the investors´ and the asset managers´ perspective.

First and foremost, the objective of the investor is to evaluate the return of their portfolio. This is necessary in order to consider whether their manager performed a good job or not (Døskeland, 2019). In the case the investor is dissatisfied, an evaluation process can help them change strategy or the manager of their portfolio.

For the asset manager, on the other hand, performance evaluation enables them to demonstrate their skill. This is necessary in order to attract new customers to the fund (Døskeland, 2019). Investors chase performance, accordingly inflow and outflow of funds is driven by their track record (Ellison and Chevalier, 1996).

The subsequent paragraphs will elaborate on how to evaluate the performance of funds.

### 2.3.2 Active Return and Information Ratio

The fund manager is first and foremost asked to beat the benchmark and will generate returns relative to that benchmark (Ang, 2014). This is known as the active return of the fund. For fund $i$ at time period $t$, the active return ($R_{A,it}$) is calculated as the difference between the return of the fund ($R_{i,t}$) and the return of the benchmark ($R_{B,t}$). The computed active return is displayed in equation 2.2 below:

$$R_{A,it} = R_{i,t} - R_{B,t} \tag{2.2}$$

Equation 2.3 below display how the mean active return for $T$ time periods is calculated:

$$\overline{R}_{A,i} = \frac{1}{T}\sum_{t=1}^{T} R_{A,it} \tag{2.3}$$

where $\sum_{t=1}^{T} R_{A,it}$ is the sum of all active returns for fund $i$, and $T$ is number of time periods.

To further assess the active return, another measurement is employed. As good performance often generates new flow of capital to a fund, with the manager having incentives to take higher risk in order to generate higher active return. Thus, it is necessary to evaluate the active return in relation to the active risk. This is measured through the information ratio (IR). The IR is the average active return the fund generates for each extra unit of risk (Ang, 2014) and is displayed in equation 2.4 below:

$$IR = \frac{\overline{R}_{A,i}}{\sigma(\overline{R}_{A,i})} \tag{2.4}$$

where $\sigma(\overline{R}_{A,i})$ is the standard deviation of mean active return, also known as the tracking error (TE). TE measures the volatility of the active return, or the active risk of the fund. The TE describe how closely linked the returns of the fund and the benchmark are (Morningstar, 2020). A high TE indicate that the fund is taking positions that deviate from the market weights.

### 2.3.3 Value Added

A drawback of the active return as a performance measurement is that it does not explicitly consider differences in size between funds. To account for the size of the fund, Berk and van Binsbergen (2015) multiply the active return with the AUM to obtain the value added. Put differently, we now take into account that a fund earning a small return on a large asset base might be more valuable than large returns on small asset bases (Dahlqvist and Ødegaard, 2018).

Formally, the valued added ($V_{it}$) for fund $i$ at time $t$, can be calculated by multiplying the active return at time $t$ ($R_{A,it}$) with the inflation-adjusted AUM at time $t-1$ ($AUM_{i,t-1}$).[1] The model is presented in equation 2.5:

$$V_{it} = AUM_{i,t-1} \times R_{A,it} \tag{2.5}$$

Further, the estimated value added for fund $i$ for a total of $T$ time periods, denoted as $\overline{V}_i$ is displayed in equation 2.6:

$$\overline{V}_i = \frac{1}{T}\sum_{t=1}^{T} V_{it} \tag{2.6}$$

Where $\sum_{t=1}^{T} V_{it}$ is the sum of value added for fund $i$ and $T$ is the number of time periods.

### 2.3.4 Factor Models

Assets earn risk premiums as they are exposed to underlying risk-factors (Ang, 2014). The first model using factor risk was the Capital Asset Pricing Model (CAPM) developed by Treynor (1961, 1962), Sharpe (1964), Lintner (1965) and Mossin (1966). The CAPM states that there is only one factor that drives the return of an asset, namely the market premium. The relationship is calculated as follows:

$$R_i = \beta_i(R_m) \tag{2.7}$$

where the excess return of asset $i$ over the risk-free rate ($R_i$) is expressed by the asset exposure ($\beta_i$) toward the market return in excess of the risk-free rate ($R_m$).

Although the CAPM is derived using strong assumptions and the empirical evidence is limited, the basic intuition of the model still holds true. It is the factors underlying the assets that determine the assets risk premiums, and that these risk-premiums are compensation for the investor bearing losses during bad times (Ang, 2014).

An extension of the CAPM was the inclusion of $\alpha$ as introduced by Jensen (1967). He highlighted that the exposure toward the market premium could not explain all the excess return over the risk- free rate and denoted the difference as Jensen's alpha. The extended model is described below:

$$R_i = \alpha_i + \beta_i(R_m) \tag{2.8}$$

[1] Inflation-adjusted values are calculated in order to obtain the real size of the fund.

The intercept $\alpha_i$ (Jensen's alpha) can be interpreted as the risk-adjusted performance. This is the return of asset $i$ in excess of the risk-free rate ($R_i$) that is not explained by the exposure ($\beta_i$) toward the market premium ($R_m$) (Bodie et al., 2014). When the return of the market is proxied by the returns of an index, equation 2.8 can be denoted as a single-index model. These are specified versions of CAPM, where historical index returns are applied to proxy the risk of the market (Bodie et al., 2014).

The initial single-index model solely controlled for funds exposure to the market premium. However, Fama and French (1993) criticized the CAPM, showing that market risk was not the only systematic determinant for the returns of stocks. They introduced a multi factor model arguing that the size of the fund and the book-to-market value could explain variation in returns. For the bond market, Fama and French (1993) identified two risk factors that are driving the return of bonds and that investors demand compensation for being exposed to. This was the term risk premium and the credit risk premium.

Ilmanen (2018) defines the term premium as returns arising from interest rate exposure. According to the expectations hypothesis, as developed by Fisher (1930), investments in different maturities will generate the same expected return for a given investment horizon. As a result, default-free bonds of all maturities are perfect substitutes. However, the expectations hypothesis does not take into account that future interest rates are uncertain and investors will thus demand compensation for taking on interest rate risk (NBIM, 2011). On the other hand, the credit premium is defined as exposure to default risk (Ilmanen, 2018). In order to offset expected default losses, investors will demand a premium for bearing credit risk.

Sharpe (1992) applied the multiple risk factors in order to separate between the management style and skill of the fund. Each factor beta represents how the assets excess return over a risk-free rate ($R_i$) is explained by their exposure toward each risk factor. The model is defined in equation 2.9 below:

$$R_i = \alpha_i + \beta_{i1}F_1 + \beta_{i2}F_2 + ... + \beta_{iN}F_N + \epsilon_i \tag{2.9}$$

As equation 2.8, the $\alpha_i$ is the risk adjusted performance measurement for the portfolio that is not explained by the exposure toward risk factors, denoted as $F_i$. $\beta_{ij}$ measures the assets sensitivity toward the included risk factors.

To summarize, the alpha term can be considered as the value the managers generate after adjusting for fund exposure toward risk factors, and is a standard performance measurement (Dahlqvist and Ødegaard, 2018).

#### 2.3.4.1 Appraisal Ratio

Although the $\alpha$ of the factor model is considered the return of the portfolio after adjusting for exposure to risk factors, it does not consider the amount of risk undertaken. The appraisal ratio (AR) describe the alpha in relation to unsystematic risk shown in equation 2.10:

$$AR = \frac{\alpha_i}{\sigma(\epsilon_i)} \tag{2.10}$$

where $\alpha_i$ denotes the return of the fund after adjusting for factor exposure using the factor model, and $\sigma(\epsilon_i)$ is the unsystematic risk of the fund (NBIM, 2019). Thus, AR is a direct measurement of the value obtained through security selection relative to its risk (Døskeland, 2019).

# 3 Literature Review

This part of this thesis will make a brief overview of the existing literature within the field of performance and bond mutual funds. Despite the importance bonds have for the economy, a limited amount of research has been conducted in relation to bond mutual funds than the more prominent equity funds (Cremers et al., 2019). The literature review will first present relevant studies that measure the performance of bond funds, then the current literature regarding fund attributes and performance is reviewed. Each subsection is summed up by presenting this thesis´ approach to the research questions.

## 3.1 Performance Measurements

The first comprehensive study that examines the performance of bond mutual funds is by Blake, Elton & Gruber (1993). They compare the performance of actively managed bond funds in the U.S. market by employing a variety of factor models. First, the study employs a single-index model using a broad market index. This is further extended by dividing the market into sub-indices, first reflecting the exposure to the credit premium, then to the term premium. Finally, the two models are combined. According to the findings of the article, funds underperform relevant indices post fees. For most of the funds, this underperformance is approximately equal to the average management fee. According to the authors, the lack of available index funds coupled with high transactions costs appear to describe the appeal for actively managed funds, despite their apparent underperformance.

Dietze, Entrop & Wilkens (2009) examine the performance of investment grade corporate funds with evidence from the European market. Based on the approach of Blake et al. (1993), Dietze et al. (2009) separate between the credit and term risk. For credit risk, a number of letter-based sub-indices are applied. Moreover, the term risk is measured using maturity-based baskets, where bonds within the same interval of maturity are placed together. The findings of Dietze et al. (2009) indicate that most funds underperform relative to relevant benchmark portfolios consisting of multiple indices. Across all tested models, there is not a single fund exhibiting significant positive performance.

On the other hand, Moneta (2015) finds evidence that active bond fund managers possess skill in the U.S bond market. The bond funds are able to outperform the benchmark portfolio by an annual average of 1 percent pre expenses, adjusting for style and timing ability. However, controlling for fees, most funds underperform. Ferson, Henry & Kisgen (2006) and Cici and Gibson (2012) find similar underperformance after fees in U.S government and U.S corporate bond mutual funds.

Choi and Kronlund (2018) analyse the active return of U.S. corporate bond funds and their degree of loading toward risk-factors. They name the active return of the funds as "reaching for yield", and the paper concludes that funds applying this strategy on average produce a higher raw return. However, by controlling for common risk factors, there appear to be no evidence of significant outperformance.

The lack of bond mutual fund studies is also prominent for the Norwegian market. As far as the authors are aware of, there only exists three studies that test the performance of Norwegian investment grade mutual funds.

Although all studies apply factor models in order to analyse the performance of funds, their selection of benchmark diverge. While Gjerde and Sættem (1996) test the performance in relation to the BRIX-index,[2] Berge and Kamalanathan (2016) apply a self-constructed index. Finally, Røe and Kochhar (2017) compare the performance of the funds with S&P Norwegian Investment Grade Corporate Bond Index. However, a drawback using the S&P indices is the number of bonds that constitute their indices. For instance, the AAA index only constitute of two bonds (Standard & Poor's, 2020).

Røe and Kochhar (2017) find evidence that 70 percent of funds are able to generate excess returns gross of expenses and 30 percent after adjusting for expenses. On the other hand, neither Gjerde and Sættem (1996) nor Berge and Kamalanathan (2016) can conclude that investment grade bond funds are able to outperform a passive benchmark portfolio net of expenses.

An issue regarding the apparent underperformance of actively managed bond funds is the lack of a generally accepted model controlling for bond-portfolio risk as pointed out by Cremers et al. (2019). Illustrated in the literature review, a variety of models and approaches have been utilized. With this in mind, there currently exists a lack of consensus

[2] The BRIX-index was suspended in the turmoil of the financial crisis of 2008, and is no longer listed on the Oslo Stock Exchange (Oslo Børs, 2020).

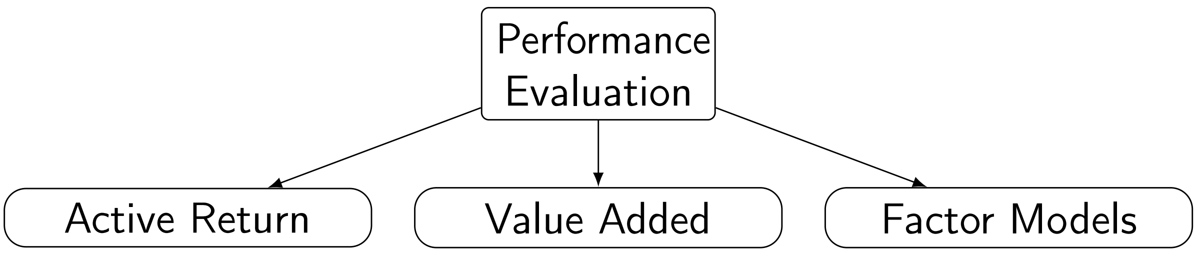
for understanding the performance of bond mutual funds.

Almost all studies identified, focus their research at risk-adjusting the performance using some sort of factor models. Whether funds should be credited for their excess return generated by risk factors is an open question (Dahlqvist and Ødegaard, 2018). Berk and van Binsbergen (2015) do not measure performance based on factor models. The authors point out that these factors are only valid for interpretation if they are tradable portfolios. In other words, the factor benchmark is often a better investment opportunity than what is available for the investor.

Berk and van Binsbergen (2015) calculate the performance of U.S. equity funds as the excess return of a tradable benchmark (i.e net active return). In addition, to measure the skill of the fund managers, the gross value added is calculated. They find no evidence of outperformance for the net active return. Thus, making the investor indifferent between an active and passive investment strategy. This follows the findings of Berk and Green (2004), who argue that the competitiveness of the market is driving the net return down to, or close to zero. However, Berk and van Binsbergen (2015) find evidence that managers are consistently able to extract value from the capital markets. With this in mind, this thesis will in addition to factor models, employ the active return and value added as performance measurements.

Based on the theoretical framework and the existing literature regarding bond mutual fund performance, this thesis employs three performance approaches to test whether Norwegian bond funds are capable of creating value. These are displayed in Figure 3.1 below:

**Figure 3.1:** Performance Evaluation Approaches




Although the presented literature on the performance of active bond mutual funds is limited, the existing evidence states that bond funds on average underperform net of expenses compared to relevant market indices. Applying the approaches shown in Figure

3.1, this thesis will examine whether the same conclusions can be drawn for investment grade funds in the Norwegian market.

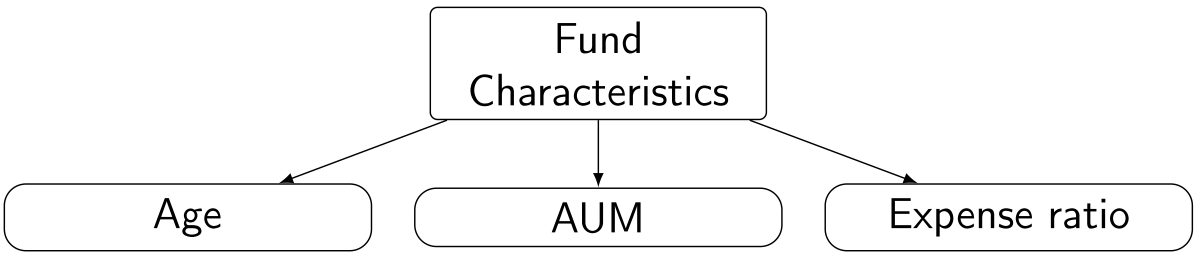
## 3.2 Fund Characteristics

Moving on to fund characteristics, only a handful of papers examine the relationship between performance and specific attributes. According to Philpot, Hearth & James (1998) there exists a negative relationship between returns and expenses. In addition, the article states that there appears to be some evidence of economies of scale in the bond mutual fund business. Dietze et al. (2009) reaches some of the same conclusions and advises investors to hold older funds with low management fees. Moreover, Blake et al. (1993) test the relationship between the expense ratio and the alphas of the funds. Their findings indicate that a percentage-point increase in expenses leads to a percentage-point decrease in returns.

For the Norwegian market, Røe and Kochhar (2017) examine whether fund characteristics are able to predict bond fund performance. Their findings suggest that only the abnormal performance in the previous period seems to have the ability to predict performance.

This thesis will in assessing whether it is possible to identify well-performing funds by examining characteristics, consider three separate attributes. In line with the presented literature, the fund age, AUM and expense ratio will be considered in relation to the performance of the funds. The characteristics are illustrated in Figure 3.2 below.

**Figure 3.2:** Fund Characteristics




In the following section the relevant data for this thesis will be presented and discussed.

# 4 Data

This section will present the source data of the analysis. First, a short introduction to the Norwegian bond market will be made. Secondly, the Norwegian bond mutual fund market and the sample funds will be presented. Further, the bond indices of Nordic Bond Pricing (NBP) is introduced. Finally, the choice of risk-free rate is discussed.

## 4.1 The Norwegian Bond Market

In the Norwegian bond market, there are two separate marketplaces for listing and trading of bonds, namely Oslo Børs and Nordic ABM (Oslo Børs, 2015). The choice of market place is decided by the policy of the issuers and the investment mandates of the investors. As of January 1st 2020 there were almost 3000 issued securities in the Norwegian bond market which had approximately 2000 billion NOK outstanding. Figure 4.1 displays the outstanding amount in billion NOK and the number of issues from 2010-2020 for the IG and HY market respectively.

**Figure 4.1:** The Norwegian Investment Grade and High Yield Market

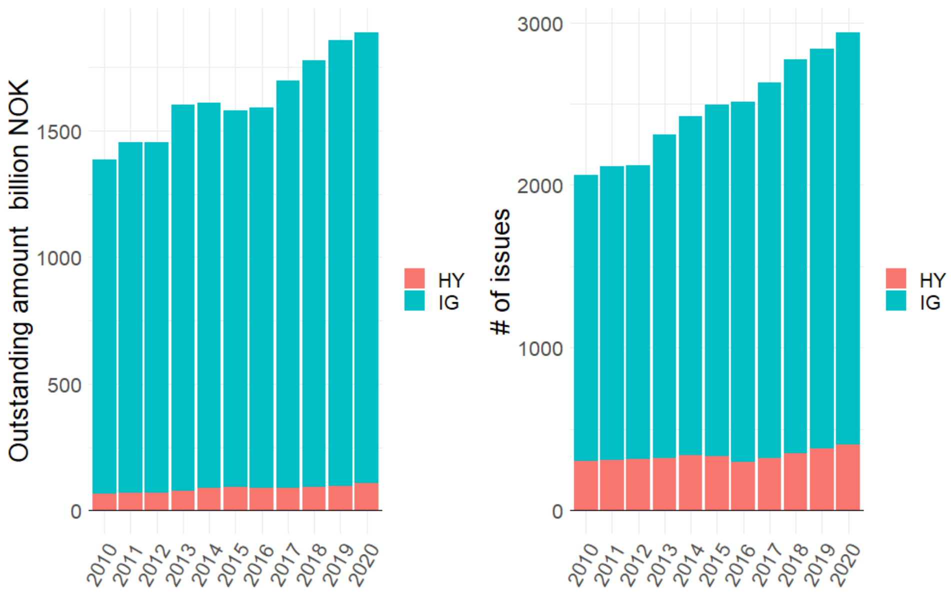



Figure 4.1: The figure illustrates the outstanding amount in billion NOK and number of issues for the Norwegian IG and HY market. The numbers are as of January 1st in the reported years. Source: Stamdata.

The figure reports a steady increase in the number of issues for the time period of interest.

Apparent in the figure, the Norwegian market mainly consists of IG bonds, with HY posing a share of approximately 5% of the market value and 13% of the issues.[3]

## 4.2 The Norwegian Bond Mutual Fund Market

At the end 2019, more than 1 360 billion NOK were invested in Norwegian mutual funds (Statistisk Sentralbyrå, 2020). Figure 4.2 display the distribution across the different fund classes.

**Figure 4.2:** Fund Class Market Share

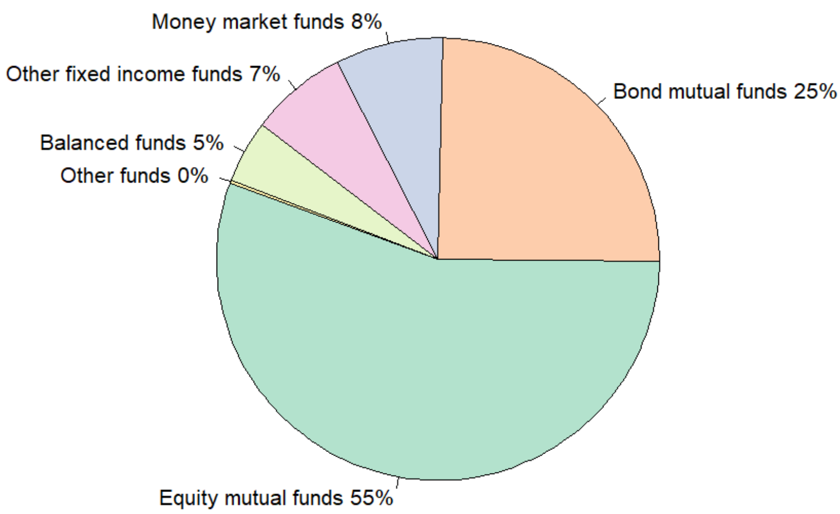



Figure 4.1: The figure displays the distribution of share capital across Norwegian registered mutual funds, managed by Norwegian fund and management companies. The data is based on Q4 2019 figures. Source: SSB

Illustrated in the figure, bond funds is the second largest share class with approximately one quarter of the total capital invested in mutual funds. Together with equity mutual funds, the two classes comprise more than 80 % of capital invested.

In this thesis we are interested in evaluating bond mutual funds. Figure 4.3 displays the evolution of share capital in billion NOK for Norwegian bond mutual funds from 2010 until 2019.

[3] As of January 1st 2020.

**Figure 4.3:** Share Capital Bond Mutual Funds

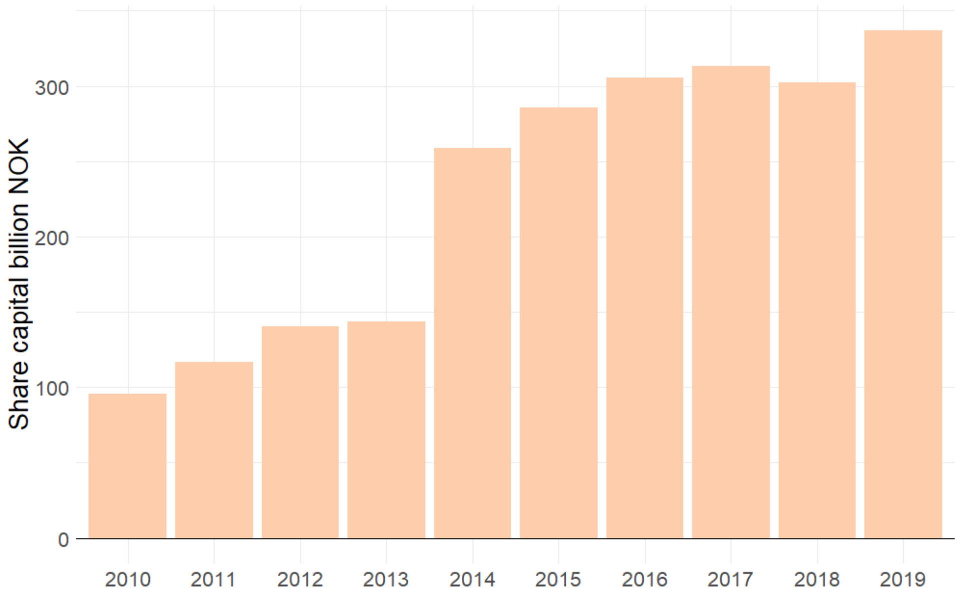



Figure 4.3: The figure reports the share capital for bond mutual funds in the period of 2010-2019. Reported figures are as of Q4. Source: SSB.

As illustrated in the figure, there has been a major increase since the beginning of the decade, with capital invested in bond funds reaching an amount of approximately 340 billion NOK at the end of 2019. Compared to the beginning of the decade, the share capital has more than tripled.

The organization dividing mutual funds into separate categories or classifications in the Norwegian market, is the Norwegian Fund and Asset Management Association (VFF). All large Norwegian asset management institutions are members of the association that works to achieve a healthy development of the fund and asset management industry (VFF, 2020). One of the key activities of VFF is to develop industry wide standards for market practice that its member organisations are obligated to adhere to.

In this thesis, VFFs industry standard for classification of bond mutual funds (VFF, 2017) will be discussed.[4] The objective of the standard is primarily to separate money-market funds, bond mutual funds and other types of bond funds. In addition, the standard seeks to highlight the main elements creating dispersion in the risk and return of the funds (VFF, 2020). The following requirements apply to funds classified as Norwegian bond mutual funds:

[4]The standard was passed on December 18th 2017.

- The fund must invest in Norwegian fixed income securities denominated in Norwegian Krone (NOK) and the issuer is subject to Norwegian jurisdiction.
- The fund must only invest in fixed income securities with a minimum rating of BBB- (IG). If the security is not graded the issuers rating may be used.
- Downgraded securities with a lower rating of BBB- can be no more than 10% of the fund´s assets, and must be sold within a month after they have been downgraded.

The listed requirements put strict restrictions for which bonds the funds can invest in, in order to be defined as a bond mutual fund. In addition, VFF categorize two risk factors for the bond mutual funds and divide them into separate classifications based on these. The first is the interest rate sensitivity of the fund expressed by the modified duration.[5] Second, is the credit risk exposure expressed in different types of investment grade categories. Based on these two risk factors the bond funds are categorized as shown in Table 4.1 below.

**Table 4.1:** VFF Bond Mutual Fund Risk Categories

| **Interest rate sensitivity category** | **Credit risk category** |
|---|---|
| *Bond mutual fund 0.125*: Funds with an expected modified duration equal to 0.125 with a maturity between 0 and 1 years. | *Category 1*: Funds that invest in securities issued or guaranteed by the Norwegian government or covered bonds with a rating of AA or better. |
| *Bond mutual fund 1*: Funds with an expected modified duration equal to 1 with maturity between 0 and 2 years. | *Category 2*: Funds that invest in securities issued with a rating minimum of AA- or other bonds issued by senior financial institution with a rating of BBB- or better. |
| *Bond mutual fund 3*: Funds with an expected modified duration equal to 3 with maturity between 1 and 5 years. | *Category 3*: Funds that invest in other senior securities issued and covered bonds with a minimum rating of BBB-. |
| *Bond mutual fund 5*: Funds with an expected modified duration equal to 5 with maturity between 3 and 7 years. | *Category 4*: Funds that invest in securities that complies with the demands to be classified as a Bond mutual fund, but does not meet the requirements of the other credit risk categories. |
| *Other bond mutual fund*: Funds with an expected interest rate sensitivity other than the categories mentioned above. | |

[5]Bonds with a different expected interest rate sensitivity than the one listed in Table 4.1 are classified as other Norwegian bond funds until the number of funds are large enough to form a separate class (VFF, 2017).

For instance, if a bond mutual fund is classified by VFF as an *Interest rate sensitivity category 1* and *Credit risk category 3*, the fund can only invest in bonds with maturity between 0 and 2 years and with a credit rating of BBB- or better. The displayed classifications are relevant for the selection of fund sample as discussed below.

### 4.2.1 Bond Mutual Fund Sample

The central component for the analysis is data of bond mutual funds. Information regarding the relevant Norwegian bond funds is retrieved from VFF.

If funds are to be eligible for inclusion in the sample, they are required to comply with the following requirements:

- Classified in the interest rate sensitivity categories 1, 2 or 3 with credit risk category of 1, 2 or 3 by VFF (as defined in Table 4.1).
- Required to have a complete time series throughout the five-year period from January 2015 to December 2019.[6]

As previously introduced, the first requirement restricts the sample to only include funds investing in the IG-segment and fixed-income securities denominated in NOK. On the other hand, the disclosed requirements exclude funds operating within the HY-segment and funds classified as bond mutual fund 0.125. The background for exclusion of HY-funds relates to the availability of clearly defined indices. Following the approach of Blake et al. (1993), who exclude money market funds from their analysis, bond mutual funds 0.125 are not included in our sample. These funds are similar to money market funds with low or no interest rate sensitivity.[7]

In total, 32 funds are included in the period of analysis (27 for the 2010-2019 sample period). As of December 2019 the selected funds manage a total of 116 billion NOK. Figure 4.4 display how this capital is distributed across the sample.

[6]This follows the approach by Dietze et al. (2009).

[7]As classified by VFF, bond mutual funds 0.125 have an expected modified duration of 0.125, while money market funds have a modified duration of less than 1.

**Figure 4.4:** Fund Sample - AUM

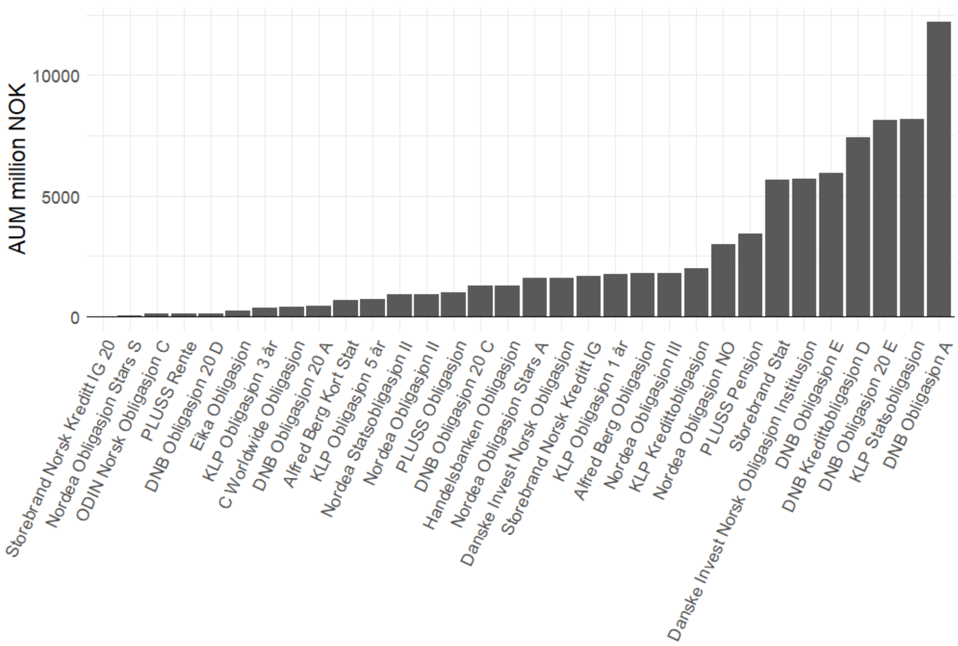



Figure 4.4: The figure reports AUM in million NOK as of December 31st 2019.

As demonstrated by the figure, most funds manage less than 5 billion NOK, however there are large variations between funds. DNB Obligasjon A has the highest AUM in the sample with almost 30 billion NOK, while Storebrand Norsk Kreditt IG 20 only manages roughly 40 million.

A total of 122 end-of-month price observations for each fund from the period of December 2009 through January 2020 were included. The time-series were obtained from Morningstar Direct and were thoroughly cross-checked using Thomas Reuters Eikon. Calculations of gross and net returns is thoroughly described in Appendix A1.

In addition, Morningstar Direct was applied in order to retrieve the inception date and AUM of the funds. The inception date is obtained in order to calculate the age of the fund, while AUM is utilized both in fund characteristics and in the calculation of value added.[8]

[8]Although a minor issue, a total of 2.6% of AUM observations were missing. In order to calculate the value added, a complete set of AUM observations are necessary. Hence, missing observations were estimated by calculating the mean of the previous and following observation. In the case of a series of missing observations, a moving average was applied.

#### 4.2.1.1 Descriptive Statistics

Table 4.2 display descriptive statistics for all 32 funds included in the analysis. The traits of gross returns, net returns, volatility and expense ratio are calculated based upon observations from 2015 through 2019. The table displays that the monthly mean gross return of the fund is 0.166%, that is reduced to 0.143% considering net returns.[9] Furthermore, the average fund has a monthly expense ratio of 0.023%, is 18 years and has approximately 3 500 million NOK in AUM.

#### 4.2.1.2 Survivorship Bias

The requirement of complete time series may introduce biased results, known as survivorship bias. It is a well-known phenomenon that mutual funds unable to deliver excess returns to their customers are dissolved or merged. When only the surviving funds are included in the analysis, it may lead to overstating fund performance (Vanguard, 2015). In addition, survivorship bias can cause biased results concerning the relationship between performance and fund characteristics (Carhart, Carpenter, Lynch & Musto, 2002).[10]

Consequently, not considering the effect of dissolved and merged funds may lead to an overestimation of fund performance. However, Blake et al. (1993) state that survivorship bias is a less important matter for bond funds than for equity funds. Bond funds fluctuate less and hence fewer funds will merge or dissolve.

The question to consider is whether the survivors differ from non-survivors in ways that are relevant to the topic of study. We investigate whether survivorship bias will affect the results of our sample funds by calculating the mean of the sample for all time periods and comparing it to the mean for all funds (including liquidated and merged). The annual difference of 0.011% for the 2010-2019 sample period and 0.002% for the 2015-2019 sample period, lead us to believe that the effect of survivorship is suppressed to a level where it will not alter the results. The method is further described in Appendix A2, including an overview of the liquidated and merged funds.

[9] For the purpose of evaluating the performance of funds we use arithmetic mean returns throughout this thesis.

[10] The evidence from Carhart et al. (2002) is based on studies of U.S. equity funds from 1962-1995.

**Table 4.2:** Descriptive Statistics

| | Return | | | Fund Characteristics | | |
|---|---|---|---|---|---|---|
| Fund | Gross | Net | Volatility | Expense ratio | Age | AUM |
| Alfred Berg Kort Stat | 0.106 | 0.060 | 0.070 | 0.046 | 25.72 | 848 |
| KLP Obligasjon 1 år | 0.144 | 0.136 | 0.120 | 0.008 | 25.44 | 1675 |
| PLUSS Obligasjon | 0.184 | 0.163 | 0.258 | 0.021 | 14.16 | 1605 |
| PLUSS Rente | 0.185 | 0.143 | 0.256 | 0.042 | 27.80 | 97 |
| ODIN Norsk Obligasjon C | 0.171 | 0.130 | 0.210 | 0.041 | 25.13 | 102 |
| Nordea Statsobligasjon II | 0.078 | 0.065 | 0.290 | 0.013 | 15.84 | 873 |
| C Worldwide Obligasjon | 0.149 | 0.120 | 0.363 | 0.029 | 31.13 | 533 |
| Danske Invest Norsk Obligasjon | 0.190 | 0.156 | 0.410 | 0.034 | 25.95 | 425 |
| DNB Obligasjon 20 E | 0.185 | 0.172 | 0.378 | 0.013 | 15.26 | 4139 |
| DNB Obligasjon 20 A | 0.183 | 0.142 | 0.376 | 0.041 | 15.26 | 221 |
| DNB Obligasjon 20 C | 0.183 | 0.154 | 0.376 | 0.029 | 15.26 | 97 |
| DNB Obligasjon 20 D | 0.184 | 0.167 | 0.375 | 0.017 | 15.26 | 183 |
| Eika Obligasjon | 0.145 | 0.128 | 0.324 | 0.017 | 13.11 | 1047 |
| KLP Obligasjon 3 år | 0.152 | 0.143 | 0.303 | 0.009 | 25.41 | 945 |
| Nordea Obligasjon II | 0.151 | 0.134 | 0.335 | 0.017 | 27.16 | 1593 |
| PLUSS Pensjon | 0.172 | 0.130 | 0.261 | 0.042 | 26.15 | 42 |
| Storebrand Norsk Kreditt IG 20 | 0.164 | 0.152 | 0.358 | 0.012 | 8.08 | 2661 |
| Alfred Berg Obligasjon | 0.188 | 0.140 | 0.304 | 0.048 | 29.12 | 7392 |
| Danske Invest Norsk Obligasjon Institusjon | 0.190 | 0.156 | 0.396 | 0.034 | 14.82 | 11606 |
| DNB Kredittobligasjon D | 0.202 | 0.185 | 0.364 | 0.017 | 15.26 | 8399 |
| DNB Obligasjon E | 0.216 | 0.200 | 0.375 | 0.016 | 22.05 | 26836 |
| DNB Obligasjon A | 0.215 | 0.174 | 0.373 | 0.041 | 22.05 | 1816 |
| KLP Kredittobligasjon | 0.171 | 0.162 | 0.324 | 0.009 | 10.62 | 2467 |
| Nordea Obligasjon Stars A | 0.179 | 0.141 | 0.369 | 0.038 | 6.12 | 42 |
| Nordea Obligasjon Stars S | 0.178 | 0.165 | 0.371 | 0.013 | 6.12 | 1796 |
| Nordea Obligasjon III | 0.167 | 0.153 | 0.357 | 0.014 | 14.50 | 5059 |
| Nordea Obligasjon NO | 0.151 | 0.146 | 0.515 | 0.005 | 5.09 | 1672 |
| Storebrand Norsk Kreditt IG | 0.188 | 0.171 | 0.332 | 0.017 | 8.08 | 18144 |
| KLP Statsobligasjon | 0.122 | 0.113 | 0.624 | 0.009 | 10.64 | 6744 |
| Storebrand Stat | 0.107 | 0.095 | 0.580 | 0.012 | 19.06 | 1935 |
| KLP Obligasjon 5 år | 0.166 | 0.158 | 0.570 | 0.008 | 25.07 | 1235 |
| Handelsbanken Obligasjon | 0.143 | 0.116 | 0.651 | 0.027 | 17.89 | 634 |
| **Average** | 0.166 | 0.143 | 0.361 | 0.023 | 18.08 | 3527 |
| **Median** | 0.172 | 0.144 | 0.363 | 0.017 | 15.55 | 1599 |
| **Maximum** | 0.216 | 0.199 | 0.651 | 0.047 | 31.13 | 26836 |
| **Minimum** | 0.078 | 0.060 | 0.070 | 0.005 | 5.09 | 42 |

Table 4.2: Table 4.2 displays descriptive statistics for all funds. Reported values for returns are monthly figures in %. Values are based on observations from 2015 throughout 2019. Gross and net returns are reported as arithmetic averages, age is the last observation date (31.12.2019) minus the date of inception, expense ratio is the monthly average reported in % while AUM are displayed in million NOK.

## 4.3 Bond Indices

In this part, the institution delivering bond indices for the Norwegian market, Nordic Bond Pricing, is presented. First a short introduction of the company is made, before a more thorough presentation of the investment universe and indices is displayed. Finally, some of the criticism of the indices is discussed.

### 4.3.1 Nordic Bond Pricing

#### 4.3.1.1 Background

Nordic Bond Pricing (NBP) was established in 2013 by Nordic Trustee and VFF as an infrastructure company to support the various participants in the Norwegian bond market (Nordic Bond Pricing, 2020). The company delivers daily pricing information of bonds as well as a series of credit indices that measure the breadth of the Norwegian bond market. Prior to the introduction of the credit indices by NBP in 2017, the standard benchmark for bond mutual funds was government indices (Alfred Berg, 2019).

In line with the classifications of VFF, displayed in Table 4.1, NBP have developed indices for the corresponding classifications. At the time of the thesis, daily data of 26 different indices for the IG-segment denoted as the regular market (RM), are delivered (Annweiler, 2019). Before a more thorough examination of the indices is made, the requirements for bond inclusion in the RM universe is discussed.

#### 4.3.1.2 NBP Investment Universe

If bonds are to be included in the NBP Norwegian index universe, a number of criteria need to be met. Firstly, the bonds are required to have a NO-ISIN number.[11] Secondly, the issue size of the bond is required to be at least 300 million NOK. Furthermore, the issuer needs to be listed[12] and finally, no convertibles or structured notes are included in the universe (Annweiler, 2019).

[11] This is the licence number of the bonds.
[12] This requirement does not apply to municipalities.

#### 4.3.1.3 Indices

In line with the classifications of VFF, NBP separates their indices based on interest rate sensitivity categories and credit risk categories. The matrix in Figure 4.2 depicts the full set of specific target indices provided by NBP (NBP, 2019).

**Figure 4.5:** Nordic Bond Pricing Indices

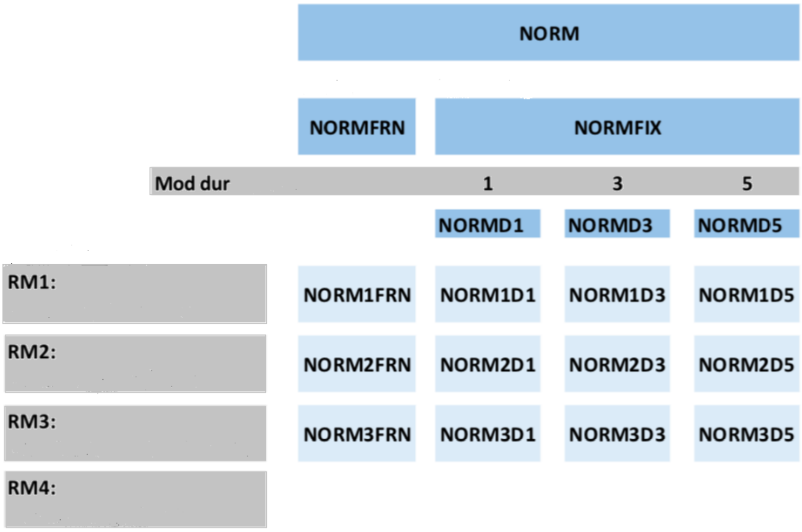



Figure 4.2: The figure displays the indices of NBP. Note that FRN relates to Bond Mutual Fund 0.125. Source: (Annweiler, 2019)

NORM is the aggregate index that represent all the bonds included in the RM universe. This is further split into a floating-rate (NORMFRN) and a fixed-rate index (NORMFIX). The fixed-rate index is then divided into three separate indices with a fixed modified duration of respectively 1, 3 and 5.[13] Moreover, the indices are separated into four different credit risk categories, referred to as regular market groups (RM1-RM4).

Based on the classifications of VFF, a proper benchmark can be selected applying the NBP index universe. For instance, if a fund is classified as bond mutual fund 1 credit risk 1, the proper benchmark would be NORM1D1. In addition the indices allow for a combination of the regular market groups (RM1-RM3). Accordingly, a fund classified as bond mutual fund 1 credit risk 3, would be assigned the NORM123D1 index.[14]

Table 4.3 report the number of constituents and market value for several of the indices.

[13] In line with the interest rate sensitivity categories of VFF described in Table 4.1.

[14] Although not displayed in Figure 4.2, this would involve a combination of either the RM1/RM2 classes or the RM1/RM2/RM3 classes with equal duration.

Apparent from the table, the modest index NORM3D1 has a market value of 30 billion NOK and is made up of 53 issues. Accordingly, the indices should not suffer from being poorly estimated as some of the S&P indices applied in Røe and Kochhar (2017).

**Table 4.3:** NBP Indices Statistics

| Index | MV (NOK bn.) | # of issues |
|---|---|---|
| NORM | 1374 | 1152 |
| NORMD1 | 165 | 218 |
| NORMD3 | 295 | 329 |
| NORMD5 | 325 | 363 |
| NORMFRN | 993 | 679 |
| NORM1D1 | 87 | 101 |
| NORM1D3 | 133 | 113 |
| NORM1D5 | 149 | 131 |
| NORM2D1 | 47 | 64 |
| NORM2D3 | 93 | 116 |
| NORM2D5 | 94 | 118 |
| NORM3D1 | 30 | 53 |
| NORM3D3 | 68 | 99 |
| NORM3D5 | 81 | 113 |

Table 4.3: The table shows the market value in billion NOK and the number of issues for several of the NBP in the universe.

Figure 4.6 display the cumulative return index for the credit risk based sub-indices compared to a government index (ST4X), all with a fixed duration of 3.

**Figure 4.6:** RM1, RM2, RM3 and Government Bond Index - 3 Year Duration

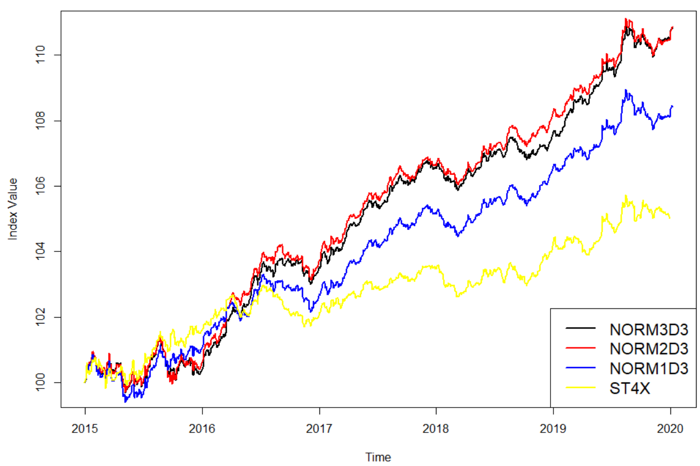



Figure 4.6: The figure plots the cumulative return for the different credit classes including the Norwegian government bond 3 year index (ST4X) from 2015 through 2019.

In line with expectations, investors holding bonds with higher credit risk should be rewarded with a higher return. However, within the indices there are return patterns that stand in contrast to the expectations. As apparent in Figure 4.6, the return of the RM2 and RM3 index follow each other closely and are identical at the end of 2019. The same pattern can also be seen for the fixed duration of 1 and 5 included in Appendix A3.

#### 4.3.1.4 Critics of the Indices

Outlined in section 2, Ang (2014) lists a number of traits that ideal benchmarks should possess. Amongst others, this relates to tradeability and replicability. A critique of the indices provided by NBP is that many of the bonds are untraded (Andresen, 2019). An analysis of the NORM123D3 index, reveals that solely 18 percent of the bonds were traded more than five times. In addition, 40 percent were hold-to-maturity bonds bought by large institutional firms and were never returned to the market (Andresen, 2019). Consequently, critics argue that the indices of NBP are not replicable and do not possess the necessary amount of liquidity.

Although replicating the indices "bond for bond" is not possible, buying bonds within similar categories allows the investor to "replicate" the index (Stensaker, 2019). Brandtun and Hornseth (2017) test whether it is possible to replicate the NORM index of NBP in the pursuit of a passive investing strategy. Their findings indicate that a passive strategy in the Norwegian bond market is possible.

### 4.3.2 Sample Indices

In order to measure the performance of funds, we obtain data of the relevant indices directly from NBP. For all indices, price data is available from December 30th 2015, hence restricting the period of analysis. Accordingly, the sample period from 2015-2019 reflects the availability of index observations.

All 26 indices by NBP for the IG-market is included in the obtained data set. The initial sample contains daily index observations, hence transformation of the data to an end-of-month basis is required. The final sample encompasses a number of 1560 monthly observations. For the analysis, the returns of the indices are necessary. Equation 4.1 displays the calculation of monthly index returns:

$$R_{bt} = \frac{Index_{bt} - Index_{b,t-1}}{Index_{b,t-1}} \tag{4.1}$$

where $R_{bt}$ describes the return of benchmark $b$ at time $t$, and $Index_{bt}$ is the monthly price of the index.

## 4.4 Risk-Free Rate

Following Gjerde and Sættem (1996), the nominal 1-month Norwegian Interbank Offered Rate (NIBOR) is utilized as a proxy for the risk-free rate.[15][16] The dataset is obtained from Norges Bank. All values were reported at an annualized 1-month nominal rate. Hence, calculation of the monthly risk-free rate is computed by dividing the values by 12.

In the following section the methodology of the thesis will be outlined and discussed.

[15] NIBOR is now defined as the Norwegian Overnight Weighted Average (NOWA).
[16] A similar methodology can be seen in Dietze et al. (2009) who utilize 1-month Euribor.

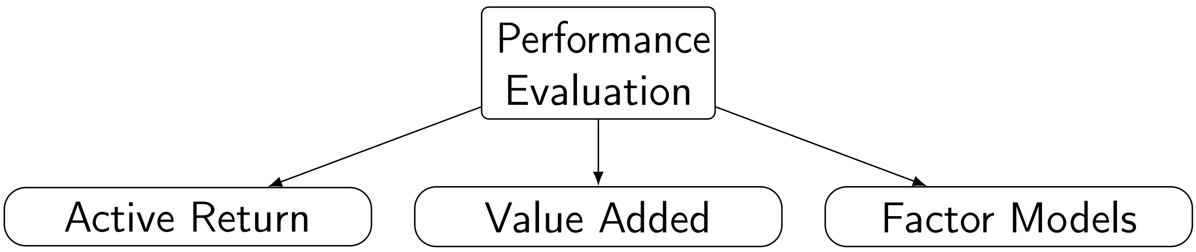
# 5 Methodology

This section of the thesis presents the models applied in the empirical analysis in order to address the research questions. Initially we start by addressing whether funds are able to create value for their investor, and the three separate approaches that are applied for evaluating this performance. Then, the method for whether it is possible to identify well-performing funds by examining their characteristics is presented. Finally, we discuss robustness of the models employed as well as diagnostic tests and potential violations of OLS assumptions.

## 5.1 Performance Evaluation

As discussed in the theoretical framework and literature review, this thesis utilizes three separate approaches for evaluating whether funds are capable of creating value. The first approach measures the active return of the funds. Secondly, value added is calculated by employing the estimated active returns. Finally, factor models are applied in order to estimate the performance of funds controlling for factor exposure. The included approaches are illustrated in Figure 5.1 below.

**Figure 5.1:** Performance Evaluation Approaches




In addition to consider the results for all single funds, they are evaluated based on an equally weighted portfolio in order to assess the sample on an overall basis. Furthermore, all measurements are reported both gross and net of expenses.

### 5.1.1 Active Return

First of all, the funds are evaluated based on their active returns. As outlined in section 2, this describes the difference in return between the fund and the benchmark. The assumption made is that the benchmark captures the risk of the fund on a one-to-one basis (Dahlqvist and Ødegaard, 2018). The measure of active return will depend on the benchmark against which the funds are evaluated. In relation to the properties of ideal benchmarks as introduced by Ang (2014), three separate benchmarks are considered.

First, we measure the active return in relation to the reported benchmark of the fund. This reflects the performance that is and has been observable to investors. The analysis account for changes in reported benchmarks for the period of interest. Eventual prior benchmarks and effective date of change are displayed in Table A4.1 in the appendix.[17]

Second, the mutual funds are split into their respective classification by VFF and matched with the corresponding index as provided by NBP. In relation to the discussion and criticism regarding the tradeability and replicability of NBP indices, evaluating the performance employing these may pose inaccurate results. Accordingly, following the method of Berk and van Binsbergen (2015), an alternative benchmark approach is presented.

Although passive bond mutual funds are common for both the U.S. and the European market, there is currently no such option for investors in the Norwegian bond market (Brandtun and Hornseth, 2017). However, the funds of KLP are widely considered as a cost-efficient method of holding a well-diversified portfolio in the Norwegian market. In addition, their funds have a low minimum investment and long historic time series. Accordingly, the KLP funds can be considered as being closest to an index fund/ETF. KLP Obligasjon 1 år, 3 år and 5 år are chosen as the alternative investment opportunity set and all sample funds are matched with the KLP fund of corresponding duration.

Table 5.1 displays the sample of bond funds included in the analysis paired with their reported, NBP and alternative benchmark. The table show that most funds have changed to NBP indices. However, approximately 30% of the funds still report government indices as benchmark.

[17]For some of the reported benchmarks, it was not possible to retrieve the return data. This was evident for the OBI Statsobligasjonsindeks 2 år, the SWAP3Y index and the OB Govt All Index (before January 2nd 2014). The problem was resolved by assigning government indices with equal duration to the fund as classified by VFF as a proxy for the period of unavailable reported benchmark observations.

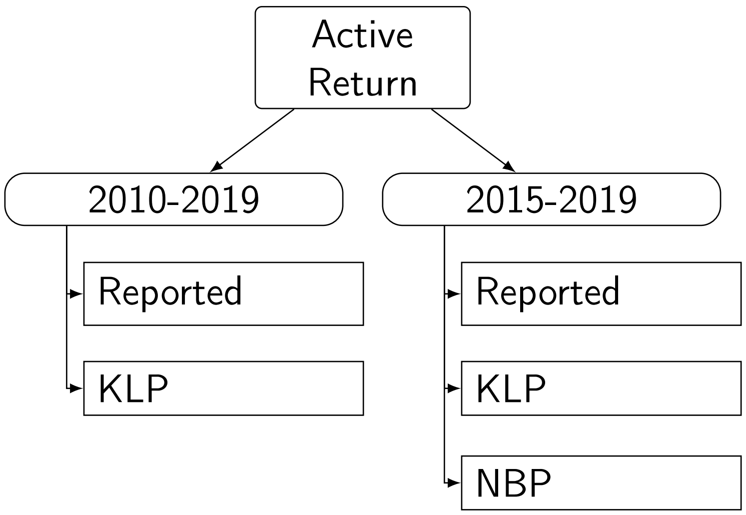
**Table 5.1:** Benchmark Overview

| | Benchmark | | |
|---|---|---|---|
| Fund | Reported benchmark | NBP | KLP |
| Alfred Berg Kort Stat | ST3X | NORM1D1 | KLP 1 år |
| KLP Obligasjon 1 år | NORM12D1 | NORM12D1 | KLP 1 år |
| PLUSS Obligasjon | ST3X/ST4X | NORM12D1 | KLP 1 år |
| PLUSS Rente | ST3X/ST4X | NORM12D1 | KLP 1 år |
| Odin Norsk Obligasjon C | NORM123D1 | NORM123D1 | KLP 1 år |
| Nordea Statsobligasjon II | ST4X | NORM1D3 | KLP 3 år |
| C Worldwide Obligasjon | ST4X | NORM12D3 | KLP 3 år |
| Danske Invest Norsk Obligasjon | NORM12D3 | NORM12D3 | KLP 3 år |
| DNB Obligasjon 20 E | NORM12D3 | NORM12D3 | KLP 3 år |
| DNB Obligasjon 20 A | NORM12D3 | NORM12D3 | KLP 3 år |
| DNB Obligasjon 20 C | NORM12D3 | NORM12D3 | KLP 3 år |
| DNB Obligasjon 20 D | NORM12D3 | NORM12D3 | KLP 3 år |
| Eika Obligasjon | ST4X | NORM12D3 | KLP 3 år |
| KLP Obligasjon 3 år | NORM12D3 | NORM12D3 | KLP 3 år |
| Nordea Obligasjon II | NORM12D3 | NORM12D3 | KLP 3 år |
| PLUSS Pensjon | ST4X | NORM12D3 | KLP 3 år |
| Storebrand Kreditt IG 20 | NORM12D3 | NORM12D3 | KLP 3 år |
| Alfred Berg Obligasjon | NORM12D3 | NORM123D3 | KLP 3 år |
| Danske Bank Institusjon | NORM12D3 | NORM123D3 | KLP 3 år |
| DNB Kreditt D | NORM12D3 | NORM123D3 | KLP 3 år |
| DNB Obligasjon E | NORM12D3 | NORM123D3 | KLP 3 år |
| DNB Obligasjon A | NORM12D3 | NORM123D3 | KLP 3 år |
| KLP Kredittobligasjon | NORM12D3 | NORM123D3 | KLP 3 år |
| Nordea Norsk Kreditt | NORM12D3 | NORM123D3 | KLP 3 år |
| Nordea Norsk Kreditt I | NORM12D3 | NORM123D3 | KLP 3 år |
| Nordea Obligasjon III | NORM12D3 | NORM123D3 | KLP 3 år |
| Nordea Obligasjon NO | NORM12D3 | NORM123D3 | KLP 3 år |
| Storebrand Norsk Kreditt IG | NORM12D3 | NORM123D3 | KLP 3 år |
| KLP Statsobligasjon | OB Govt Bonds All Index | NORM1D5 | KLP 5 år |
| Storebrand Statsobligasjon | ST5X | NORM1D5 | KLP 5 år |
| KLP Obligasjon 5 år | NORM12D5 | NORM12D5 | KLP 5 år |
| Handelsbanken Obligasjon A | ST5X | NORM12D5 | KLP 5 år |

Table 5.1: The table displays the reported benchmark of each fund as of December 31st 2019, NBP benchmark and the KLP benchmark.

As previously discussed, price data of the NBP indices is only available from the end of 2014. We note that this sample period is short and might make it difficult to estimate results with statistical precision (Merton, 1980). Accordingly, two separate time periods are analysed for the active return. A sample period from 2015-2019 that include all three listed benchmarks, while an extended time period from 2010-2019 is applied for the reported and alternative (KLP) benchmark. Figure 5.2 shows an overview of the included sample periods and benchmarks.

**Figure 5.2:** Active Return




### 5.1.2 Value Added

An extension of the active return measurement is to consider the value added of funds. As discussed in section 2, a drawback of active return is its failure to adjust for differences in size between funds. This is accounted for by multiplying the active return with the inflation adjusted AUM to obtain the value added. All AUM values are inflation-adjusted[18] by applying the Norwegian consumer price index.

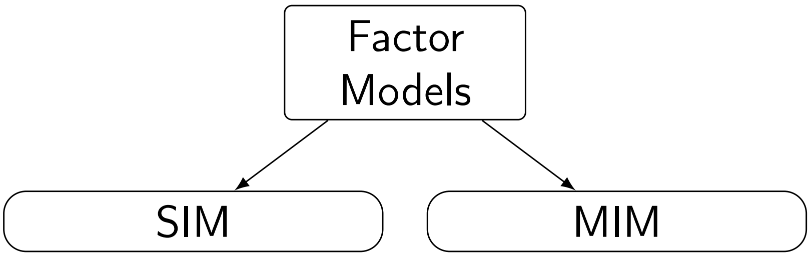
The value added is in line with the active return considered for the two sample periods and the separate benchmarks as displayed in Figure 5.2. In addition, it is considered both net and gross of expenses. In relation to the arguments of Berk and van Binsbergen (2015), the gross value added express the value that is extracted from the capital markets, while net value added measure the value provided to investors.

[18]To December 2009 NOK for the 2010-2019 sample period and to December 2014 NOK for the 2015-2019 sample period.

### 5.1.3 Factor Models

This part employs factor models in order to obtain the risk-adjusted performance of funds. Time-series models are estimated by applying OLS regressions. Robustness and potential violations of OLS assumptions is discussed in subsection 5.3. Figure 5.3 displays an overview of the included factor models which will be outlined more thoroughly below.

**Figure 5.3:** Factor Models




#### 5.1.3.1 Single-Index Model

The first model employed in order to obtain the risk-adjusted performance of funds, is a single-index model using the aggregate NORM index as benchmark. As outlined in section 2, the single-index model captures the alpha ($\alpha_i$) solely controlling for exposure toward the return above the risk-free rate of the market (Jensen, 1967). Later applied by Blake et al. (1993) for the bond market, the model is presented as follows:

$$R_{it} = \alpha_i + \beta_i NORM_t + \epsilon_{it} \tag{5.1}$$

where $R_{it}$ describe the return of the fund in excess of the risk-free rate at time $t$. $\beta_i$ is the fund sensitivity towards the NORM index in excess of the risk- free rate. Moreover, $\alpha_i$ is the average performance of fund $i$ adjusted for market risk, while $\epsilon_{it}$ is the residual return unexplained by the model.

#### 5.1.3.2 Multi-Index Model

Extending the single-index model, we are interested in examining the performance of the funds adjusting for multiple risk factors. As identified by Fama and French (1993) there are two main factors driving the returns of bonds, namely credit risk and term risk.

In order to control for the sensitivity toward the credit and term risk premium, the aggregated NORM index is replaced with specific sub-indices. Dietze et al. (2009), separate credit groups by their letter-based rating as provided by international rating agencies. However, the majority of issuers in the Norwegian market lack an official credit rating (Granlund, 2018). Accordingly, the regular market groups of NBP (RM1-RM3) are applied in order to control for the credit premium.

Each fund is coupled with the index of equal duration. For instance, a fund with a fixed duration of 3 will be measured in relation to the RM1-RM3 of equal duration. In other words, we simultaneously separate the funds based on credit and term risk by applying the indices of NBP. In line with Dietze et al. (2009), government indices (STX) are included in order to control for exposure toward government bonds. Table 5.2 comprises the included factors:

**Table 5.2:** Risk Factors

| Risk Factor | Calculation |
|---|---|
| STX | Excess return of the STX index with equal duration |
| RM1 | Excess return of the RM1 index with equal duration |
| RM2 | Excess return of the RM2 index with equal duration |
| RM3 | Excess return of the RM3 index with equal duration |

Table 5.2: The table summarises the duration based credit sub-indices employed in the MIM model. The return of the factors is in excess of the risk- free rate.

Applying the summarized risk factors in Table 5.2 the multi- index model is specified in equation 5.2 below:

$$R_{it} = \alpha_i + \beta_{i,STX} STX_t + \beta_{i,RM1} RM1_t + \beta_{i,RM2} RM2_t + \beta_{i,RM3} RM3_t + \epsilon_{it} \qquad (5.2)$$

The intercept, $\alpha_i$ is the risk-adjusted performance of fund $i$. $\beta_{STX}$ measure the sensitivity of fund $i$ toward the return of the government index, while $\beta_{RM1-RM3}$ are the sensitivities toward the NBP sub-indices.[19]

In line with the discussion in section 4 of NBP index availability, all factor models are solely considered for the 2015-2019 sample-period.

[19] Following the methodology of Blake et al. (1993) and Dietze et al. (2009), we also estimated a factor model with restrictions for short-sale and leverage. The results of this model, denoted as ACFM, are reported in Appendix A10.

## 5.2 Fund Characteristics

Up until this point, the focus of the analysis has been to uncover mutual funds capable of creating value. From this part on, the focus will be on examining whether it is possible to identify well-performing funds by observing some of their key attributes. The methodology closely relates to the approach of Dietze et al. (2009) that amongst others regress the performance of the fund with age, AUM and expense ratio. The characteristics of each fund are summarized in Table 4.2. The method is employed for all the estimated alphas and active return performance models presented in the methodology, and regressed on each fund characteristic separately. Equation 5.3 display the model:

$$Performance\,measurement_i = intercept + \beta_i Characteristic_i + \epsilon_i \tag{5.3}$$

where $\beta_i$ describe fund $i$´s relationship with the performance and characteristic. Thus, the sign of the $\beta_i$ and its significance indicate whether there exists a negative or positive relationship between fund performance and characteristics.

## 5.3 Robustness of Models

First of all, there are some issues for the time series observations of the monthly active return and value added. It is likely that the active return and value added might be correlated over time. With this in mind, we apply the method of Newey and West (1987) (with an optimal lag length using a Bartlett Kernel) to obtain t-statistics that are robust to serial correlation. These corrections did not alter our conclusions in terms of significance.

Furthermore, the calculation of standard errors for IR and AR assumes independent and identically distributed (IID) return data.[20] If the data deviate from the assumptions, the calculated t-statistics might be over- or understated.

For the factor models and fund characteristics model, a variety of diagnostic tests were conducted in order to uncover potential violations of the OLS properties. The properties and tests are reported and thoroughly described in Appendix A5 and A6.

[20] The standard error of the monthly IR and AR is calculated as $\sqrt{(1 + \frac{1}{2}IR^2)/T}$ where $IR$ is either IR or AR, and $T$ is the number of time periods in the sample. The formula assumes that the monthly active returns and alphas are independent and normally distributed (IID) (NBIM, 2019).

The potential problem of heteroskedasticity is addressed by applying the Breusch-Pagan test. Across both the factor models and the fund characteristics model we observe indications of heteroskedasticity. This is simply resolved by running robust regressions. For fund characteristics, we account for heteroskedasticity employing the method of Huber (1967).

For the factor models, we also need to be aware of the potential problem of serial correlation. This is addressed by applying the Durbin-Watson test. Across both factor models we observe indications of serial correlation. The problem of both heteroskedasticity and serial correlation in the factor models is resolved by running robust regressions as in Newey and West (1987). The corrections mentioned did not alter the conclusions of our analysis.

Moreover, the problem of normality was addressed by running a Shapiro-Wilk test. Our results give indications that the residuals in some cases are not normally distributed. However, although our models assume normality, Fitzmaurice, Laird & Ware (2004) show that linear regression models are relatively robust to violations.

Finally, an issue regarding our multi-index model is in relation to multicollinearity. Displayed in Table A7.1-3 in the appendix, several of the included risk factors are highly correlated. Although it does not affect the goodness of fit, the high correlation between the factors can cause a large variance for the $\beta$- coefficients. As a result, one needs to be cautious when interpreting the estimated coefficients (Woolridge, 2018). However, the objective of this thesis is to examine whether the mutual funds create value, in this context measured by alpha. In general, the measurement of alpha will not be affected by high correlation between the explanatory factors (Dietze et al., 2009).

# 6 Analysis

This section presents empirical results for all applied models. First, the models regarding fund performance is examined. Then, the results for the relationship between performance and fund characteristics is presented.

## 6.1 Performance Evaluation

### 6.1.1 Active Return

Table 6.1 reports the mean active return gross and net of expenses for an equally weighted portfolio of funds.[21] Results are reported for both the 2010-2019 and 2015-2019 sample periods and include the information ratio and appraisal ratio for all models.

Panel A reports the results for the 2010-2019 sample period. The estimated monthly active return of the funds in excess of the reported benchmark is 0.1%. On the other hand, the active return compared to the KLP benchmark only returns a monthly value of 0.027%. Both values are significantly different from zero at a 5% level. Evaluating the active return net of expenses, the reported benchmark approach continues to deliver a high monthly return with 0.076%, significant at a 5% level. For the KLP benchmark approach, the estimated monthly net active return is 0.003% and insignificantly different from zero.

Evaluating the positive IR and AR of the active return in excess of the reported benchmark, returns seem to be generated both from factor exposure and security selection. Furthermore, both of the measurements are statistically significant at a 1% level. On the other hand, considering the significantly positive IR and negative AR for the KLP benchmark approach, the mean active return appear to be generated through factor exposure and not security selection.

[21] Results for each separate fund is reported in Appendix A8.

**Table 6.1:** Active Return - Equally Weighted Portfolio

| | Reported | KLP | NBP |
|---|---|---|---|
| Panel A: 2010-2019 | | | |
| Gross | | | |
| Mean | 0.101*** | 0.027** | |
| | (3.039) | (2.609) | |
| IR | 0.342*** | 0.359*** | |
| | (2.873) | (2.951) | |
| AR | 0.268*** | -0.625*** | |
| | (2.889) | (-6.265) | |
| Net | | | |
| Mean | 0.077** | 0.003 | |
| | (2.304) | (0.278) | |
| IR | 0.259** | 0.033 | |
| | (2.394) | (0.363) | |
| AR | 0.155* | -0.822*** | |
| | (1.684) | (-7.789) | |
| Panel B: 2015-2019 | | | |
| Gross | | | |
| Mean | 0.072 | 0.022* | 0.023 |
| | (1.622) | (1.657) | (1.382) |
| IR | 0.305* | 0.271* | 0.231 |
| | (1.893) | (1.749) | (1.558) |
| AR | 0.061 | -1.007*** | -0.541*** |
| | (0.474) | (-6.353) | (3.915) |
| Net | | | |
| Mean | 0.049 | -0.000 | 0.000 |
| | (1.118) | (-0.001) | (0.016) |
| IR | 0.209 | -0.000 | 0.003 |
| | (1.443) | (-0.001) | (0.021) |
| AR | -0.038 | -1.345*** | -0.826*** |
| | (-0.290) | (-7.317) | (-5.646) |

*Note:* *p<0.10; **p<0.05; ***p<0.01

Table 6.1: The table displays the arithmetic mean active returns gross and net of expenses. Panel A reports the results for the 2010-2019 sample period, while Panel B reports for the 2015-2019 sample period. Means are expressed in % per month. Newey and West (1987) corrected t-statistics robust to serial correlation (with an optimal lag length using a Bartlett Kernel) are shown in parenthesis for the mean active return. T-statistics for IR and AR is estimated by calculating the standard errors applying the following formula: $\sqrt{(1+\frac{1}{2}IR^2)/T}$ where $IR$ is either IR or AR, and $T$ is the number of time periods in the sample.

For the more recent sample period of 2015-2019, reported in panel B, the active returns are lower for the fund sample across all estimated benchmarks both gross and net of expenses. The funds generate a monthly active return of 0.070% in excess of the reported benchmark, while the active return for the KLP and NBP approach is estimated to approximately 0.022%. In relation to significance, solely the KLP benchmark approach is statistically significant at a 10% level. Net of expenses, the funds delivers a monthly active return of 0.047% in excess of the reported benchmark, while both the NBP and KLP benchmark approaches are close to zero. None of the net models are statistically significantly different from zero.

Evaluating the IR and AR, the outperformance of the benchmark seem to be due to factor exposure. This is evident both gross and net of expenses. Considering the negative statistically significant AR, security selection does not seem to generate value for the funds.

Figure 6.1 and 6.2 report the estimated gross active return for the 2010-2019 and 2015-2019 sample periods respectively. For both figures, the reported benchmark approach becomes more alike the KLP and NBP approaches toward the end of the sample periods. This relates to a large number of funds changing their index in the years of 2018/2019. In addition, as evident from Table 6.2, the KLP and NBP approaches follow each other closely.

**Figure 6.1:** Active Return - 2010-2019 Sample Period

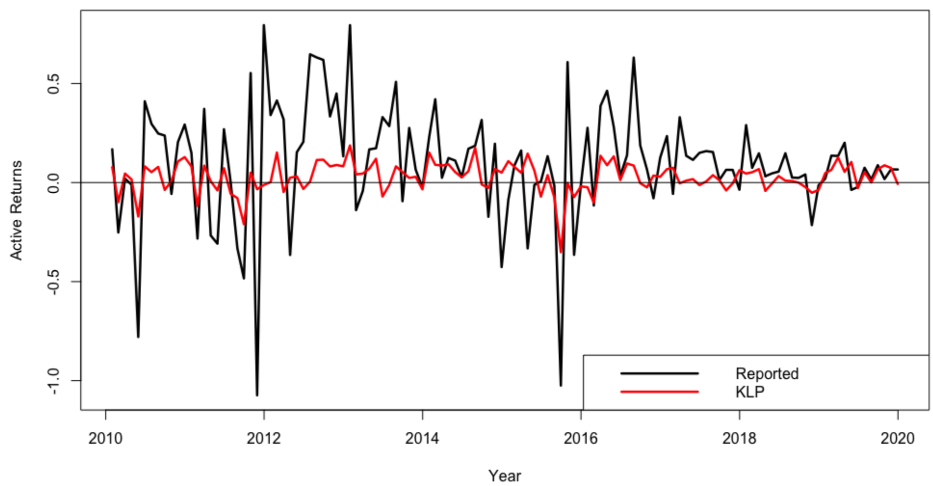



Figure 6.1: The figure displays the monthly equally weighted active gross return for the fund sample between 2010 to 2019 denoted in percent. The active return is calculated in excess of the reported benchmark and KLP benchmark.

**Figure 6.2:** Active Return - 2015-2019 Sample Period

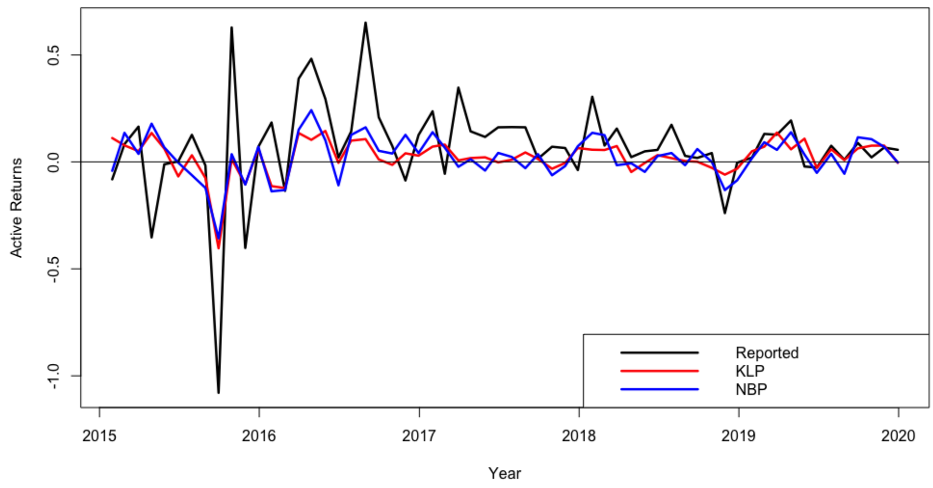



Figure 6.2: The figure displays the monthly equally weighted active gross return for the fund sample between 2015 to 2019 denoted in percent. The active return is calculated in excess of the reported benchmark, KLP benchmark and NBP benchmark.

### 6.1.2 Value Added

Table 6.2 present the value added measures before and after expenses for the equally weighted portfolio of funds.[22] Results are reported for both the 2010-2019 and the 2015-2019 sample periods. All figures are reported in million NOK.

Panel A displays the results for the 2010-2019 period. For both the reported and KLP benchmark approaches it appears that the funds are able to generate value added with respectively 2.346 and 0.647 million NOK. Both are significant at a 5% level. When considering net of expenses, the reported benchmark approach continues to deliver a significant value added with a monthly value of 1.904 million NOK. On the other hand, the value added applying the KLP benchmark only returns a statistically insignificant amount of 0.229 million.

For the more recent sample period of 2015-2019, the results for the reported benchmark are similar to those estimated for the 2010-2019 sample period. However, the statistical significance drops, with the gross value added solely being significant at a 10% level and the net returns exhibiting insignificant results. On the other hand, for the KLP benchmark approach, the results are reportedly higher. When employing the KLP and

[22] Results for each separate fund is presented in Appendix A9.

NBP benchmarks, the funds deliver a monthly value added of roughly 1 million NOK, that is approximately cut in half considering net of expenses. The gross results are significant at a 5% and 10% level respectively, and insignificant net of expenses.

**Table 6.2:** Value Added - Equally Weighted Portfolio

| | Reported | KLP | NBP |
|---|---|---|---|
| Panel A: 2010-2019 | | | |
| Gross | | | |
| Mean | 2.431*** | 0.671** | |
| | (3.001) | (2.048) | |
| Net | | | |
| Mean | 1.989*** | 0.229 | |
| | (2.649) | (0.718) | |
| Panel B: 2015-2019 | | | |
| Gross | | | |
| Mean | 2.383* | 1.101** | 0.993* |
| | (1.811) | (2.127) | (1.764) |
| Net | | | |
| Mean | 1.851 | 0.552 | 0.462 |
| | (1.417) | (1.104) | (0.823) |

*Note:* *p<0.10; **p<0.05; ***p<0.01

Table 6.2: The table reports the monthly value added gross and net of expenses. Panel A report the results for the 2010-2019 sample period, while Panel B report for the 2015-2019 sample period. The means are reported in million NOK. Newey and West (1987) corrected t-statistics robust to serial correlation (with an optimal lag length using a Bartlett Kernel) are shown in parenthesis.

Figure 6.3 and 6.4 report the estimated value added for both sample periods. As evident from the active return, the reported benchmark approach consistently reports higher values than the other benchmark approaches. However, as seen in the figure, the volatility is also greater. For both figures, the value added in excess of the reported benchmark becomes more like the others toward the end of the sample periods.

**Figure 6.3:** Value Added - 2010-2019 Sample Period

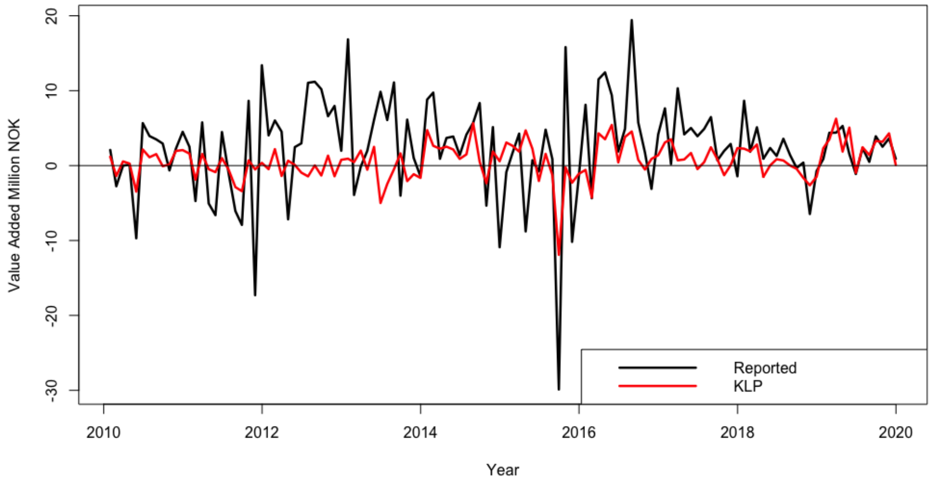



Figure 6.3: The figure shows the monthly value added gross of fees for an equally weighted portfolio of funds. The sample period is from 2010 through 2019.

**Figure 6.4:** Value Added - 2015-2019 Sample Period

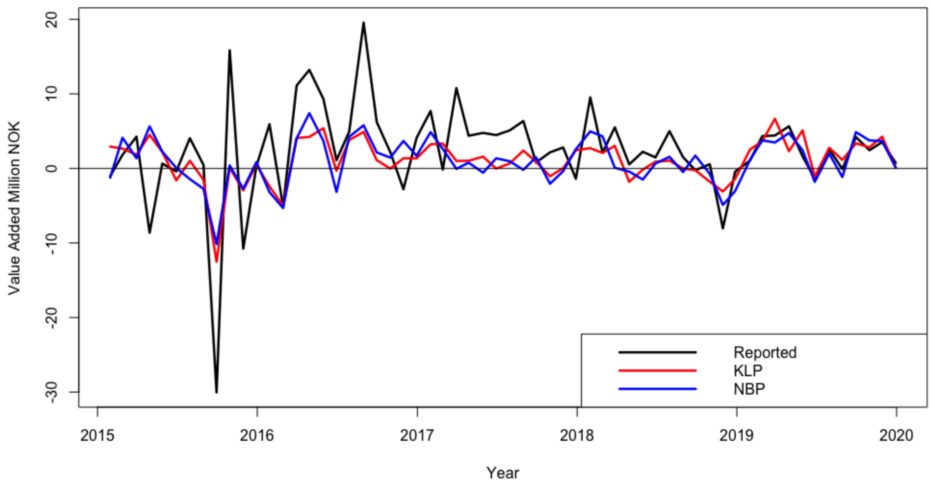



Figure 6.4: The figure displays the monthly value added gross of fees for an equally weighted portfolio of funds. The sample period is from 2015 through 2019.

### 6.1.3 Factor Models

In this part, a number of factor models are applied in order to calculate the gross and net alpha of the sample funds. Detailed in the methodology a number of four regressions are run (equally distributed across net and gross models). Table 6.3 below presents the alpha and average adjusted $R^2$ for all risk-adjusted models applied for all the funds. The $\beta$ coefficients and adjusted $R^2$ for each sample funds are reported in Appendix A10.

The employed single-index model displays that not a single fund is able to produce a positive risk-adjusted return, neither gross nor net of expenses. The average estimated monthly gross alpha is -0.139%, with 23 out of 32 funds being statistically significant at a 1% level.

Extending the single-index model to include multiple risk factors, the average monthly gross alpha increases to -0.054%. Accordingly, when controlling for multiple risk factors the funds appear to be generating less negative returns. Moreover, only one fund exhibits a positive alpha, however this is not statistically significant. Comparing the single-index and multi-index model, substituting the NORM index with sub-indices and including government indices, increases the explanatory power of the model. In other words, the ability of the multi-index model to capture differences in exposure to the credit classes yielded a superior fit. Considering net returns, the average monthly alpha decreases by approximately 0.02% for all models applied. This is in line with the average expense ratio displayed in Table 4.2. Further, no fund exhibits a positive significant alpha net of expenses.

Overall, the risk-adjusted performance of funds is negative, with the majority displaying statistical significance. Concerning sign and significance, the results appear to be robust both across models and gross and net of expenses. For all employed models, there is not a single fund exhibiting a statistically significant alpha.

**Table 6.3:** Factor Alpha Table

| | Gross alpha ($\alpha_i$%) | | Net alpha ($\alpha_i$%) | |
|---|---|---|---|---|
| Fund | SIM | MIM | SIM | MIM |
| Alfred Berg Kort Stat | -0.007 | -0.045**** | -0.054*** | -0.091*** |
| KLP Obligasjon 1 år | -0.013 | -0.057*** | -0.021 | -0.065*** |
| PLUSS Obligasjon | -0.035 | -0.066* | -0.056 | -0.087** |
| PLUSS Rente | -0.034 | 0.014 | -0.076 | -0.028 |
| ODIN Norsk Obligasjon C | -0.013 | -0.024 | -0.055 | -0.065*** |
| Nordea Statsobligasjon II | -0.127** | -0.087*** | -0.140** | -0.101*** |
| C Worldwide Obligasjon | -0.182*** | -0.080*** | -0.211*** | -0.101*** |
| Danske Invest Norsk Obligasjon | -0.174*** | -0.057*** | -0.208*** | -0.092*** |
| DNB Obligasjon 20 E | -0.164*** | -0.057*** | -0.176*** | -0.069*** |
| DNB Obligasjon 20 A | -0.164*** | -0.057*** | -0.205*** | -0.099*** |
| DNB Obligasjon 20 C | -0.164*** | -0.057*** | -0.193*** | -0.087*** |
| DNB Obligasjon 20 D | -0.163*** | -0.057*** | -0.180*** | -0.074*** |
| Eika Obligasjon | -0.151*** | -0.072*** | -0.169*** | -0.089*** |
| KLP Obligasjon 3 år | -0.129*** | -0.058*** | -0.137*** | -0.067*** |
| Nordea Obligasjon II | -0.155*** | -0.072*** | -0.172*** | -0.089*** |
| PLUSS Pensjon | -0.088*** | -0.018* | -0.130*** | -0.060*** |
| Storebrand Norsk Kreditt IG 20 | -0.162*** | -0.059*** | -0.175*** | -0.072*** |
| Alfred Berg Obligasjon | -0.106*** | -0.030** | -0.153*** | -0.077*** |
| Danske Invest Norsk Obligasjon Institusjon | -0.154*** | -0.039** | -0.166*** | -0.0517** |
| DNB Kredittobligasjon D | -0.138*** | -0.049*** | -0.154*** | -0.065*** |
| DNB Obligasjon E | -0.129*** | -0.036*** | -0.146*** | -0.052*** |
| DNB Obligasjon A | -0.129*** | -0.036*** | -0.170*** | -0.077*** |
| KLP Kredittobligasjon | -0.133*** | -0.059*** | -0.142*** | -0.068*** |
| Nordea Obligasjon Stars A | -0.164*** | -0.072*** | -0.201*** | -0.110*** |
| Nordea Obligasjon Stars S | -0.166*** | -0.074*** | -0.178*** | -0.086*** |
| Nordea Obligasjon III | -0.165*** | -0.073*** | -0.179*** | -0.088*** |
| Nordea Obligasjon NO | -0.079 | -0.013 | -0.085 | -0.018 |
| Storebrand Norsk Kreditt IG | -0.118*** | -0.032* | -0.135*** | -0.049** |
| KLP Statsobligasjon | -0.244* | -0.080*** | -0.252** | -0.089*** |
| Storebrand Stat | -0.229** | -0.079*** | -0.242** | -0.091*** |
| KLP Obligasjon 5 år | -0.264*** | -0.058*** | -0.272*** | -0.067*** |
| Handelsbanken Obligasjon | -0.318*** | -0.097*** | -0.346*** | -0.125*** |
| **Average** | -0.139 | -0.054 | -0.162 | -0.077 |
| **Median** | -0.153 | -0.057 | -0.169 | -0.077 |
| **Positive()*** | 0(0) | 1(0) | 0(0) | 0(0) |
| **Negative()*** | 32(26) | 31(29) | 32(27) | 32(30) |
| **Average adjusted $R^2$** | 0.762 | 0.915 | 0.762 | 0.915 |

*Note:* *p<0.10; **p<0.05; ***p<0.01

Table 6.3: The table reports the monthly $\alpha$ for fund $i$ in % for the factor models specified in section 5. In addition the average adjusted $R^2$ is displayed. The model parameters are estimated through OLS. Regressions are robust to heteroskedasticity and serial correlation with an optimal lag length using Bartlett Kernel as in Newey and West (1987). Mean and median are reported in %. Positive(*) and Negative (*) indicate the number of positive and negative funds, while (*) is the number who are statistically significant at a 10%. The sample period is from 2015 through 2019.

Table 6.4 reports the results for an equally weighted portfolio of funds, which are analogous to the ones obtained through the analysis of the single funds. The obtained alphas are significantly negative at a 1% level across all applied models. In addition, the adjusted

$R^2$ is higher than in the single fund case. This might be explained by diversification of idiosyncratic risk in the portfolios of funds (Dietze et al., 2009).

Considering the appraisal ratio of the models, describing the alpha in relation to the unsystematic risk, all models both net and gross display a negative ratio that is statistically significant at a 1% level. Accordingly the average fund appear to have lost value through security selection.

**Table 6.4:** Factor Models - Equally Weighted Portfolio

| | | SIM | MIM |
|---|---|---|---|
| Gross | | | |
| | Constant | -0.139*** | -0.052*** |
| | | (-6.452) | (-5.262) |
| | AR | -1.790*** | -1.102*** |
| | | (-8.595) | (-6.733) |
| Net | | | |
| | Constant | -0.161*** | -0.073*** |
| | | (-7.503) | (-7.453) |
| | AR | -2.057*** | -1.611*** |
| | | (-9.027) | (-8.233) |
| $R^2$ | | 0.941 | 0.977 |

*Note:* *p<0.1; **p<0.05; ***p<0.01

Table 6.4: The table reports the monthly alpha (constant) in % and AR for the included factor models. The model parameters are estimated through OLS. Newey and West (1987) corrected t-statistics robust to serial correlation and heteroskedasticity (with an optimal lag length using a Bartlett Kernel) are shown in parenthesis for the constants. T-statistics for AR is estimated by calculating the standard errors applying the following formula: $\sqrt{(1+\frac{1}{2}AR^2)/T}$ . The sample period is from 2015 through 2019. Reported $R^2$ is the adjusted $R^2$.

## 6.2 Fund Characteristics

In this part, we evaluate whether it is possible to identify well performing funds by examining their characteristics. Table 6.5 summarizes the results of the regressions. Panel A displays the results when regressing gross performance measurements of each fund on the different fund characteristics. Panel B shows the corresponding net results. The slope exhibits the relationship between the fund performance and each characteristic. In addition, the table reports t-statistics and adjusted $R^2$ for all models.

For age, the majority of models have positive coefficients both gross and net of expenses, indicating that older funds generate greater returns than their younger counterparts. However, none of the t-statistics are statistically significant. A large number of the models have a negative adjusted $R^2$, indicating that the fit of the model is imperfect (Woolridge, 2018).

On the other hand, AUM has a positive coefficient across all except one of the applied models. Hence, the slope suggests that funds are able to utilize economies of scale. With regards to significance, the majority of models are significant at a 5% level both gross and net of expenses.

Evaluating the last characteristics, expense ratio, there are large differences between the gross and net models. For gross returns there appears to exist a positive relationship between the alpha and the expense ratio of the fund, indicating that a greater expense ratio increases the gross performance. Whilst, two of the models are statistically significant at a 5% level, five of them are significant at a 10% level. Considering net of expenses, the models are distributed across positive and negative values. None of the estimated models are statistically significant.

In the following section, the presented empirical results will be discussed thoroughly.

**Table 6.5:** Fund Characteristics

Panel A. *Gross Alpha and Active Return Regressed on Fund Characteristics*

| | Age | | | AUM | | | Expense ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Slope | t- statistic | $R^2$ | Slope | t- statistic | $R^2$ | Slope | t- statistic | $R^2$ |
| Reported 10y | 3.30e-03 | (1.293) | 0.050 | 4.70e-06 | (1.194) | 0.013 | 1.873* | (1.875) | 0.136 |
| KLP 10y | 1.52e-03 | (0.883) | -0.010 | 4.69e-06 | (1.462) | 0.030 | 1.259 | (1.559) | 0.064 |
| Reported 5y | 4.94e-04 | (0.819) | -0.02 | 1.65e-06*** | (3.198) | 0.055 | 0.996*** | (2.759) | 0.150 |
| KLP 5y | 7.23e-05 | (0.126) | -0.033 | 1.80e-06** | (2.382) | 0.070 | 0.671 | (1.589) | 0.049 |
| NBP 5y | 4.23e-04 | (0.695) | -0.024 | 1.53e-06** | (2.224) | 0.039 | 0.877** | (2.407) | 0.103 |
| SIM | 1.99e-03 | (1.216) | 0.013 | -1.42e-07 | (-0.106) | -0.033 | 1.468 | (1.564) | 0.053 |
| MIM | 2.96e-05 | (-0.043) | -0.033 | 8.90e-07** | (1.978) | 0.014 | 0.684* | (1.785) | 0.320 |

Panel B. *Net Alpha and Active Return Regressed on Fund Characteristics*

| | Age | | | AUM | | | Expense ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Slope | t- statistic | $R^2$ | Slope | t- statistic | $R^2$ | Slope | t- statistic | $R^2$ |
| Reported 10y | 1.93e-03 | (0.866) | 0.002 | 6.10e-06* | (1.751) | 0.063 | 0.912 | (0.915) | 0.008 |
| KLP 10y | 4.12e-04 | (0.250) | -0.038 | 6.10e-03** | (2.150) | 0.089 | 0.298 | (0.368) | -0.034 |
| Reported 5y | -3.14e-04 | (-0.655) | -0.027 | 2.19e-06*** | (4.458) | 0.155 | 0.034 | (0.095) | -0.033 |
| KLP 5y | -7.36e-04 | (-1.414) | -0.002 | 2.34e-06*** | (3.793) | 0.150 | -0.290 | (-0.679) | -0.017 |
| NBP 5y | -3.84e-04 | (-0.723) | -0.025 | 2.07e-06*** | (4.126) | 0.117 | -0.084 | (-0.230) | -0.032 |
| SIM | 1.18e-03 | (0.745) | -0.015 | 3.91e-07 | (0.345) | -0.032 | 0.509 | (0.548) | -0.022 |
| MIM | 4.82e-06 | (0.0071) | -0.033 | 1.39e-06*** | (2.586) | 0.097 | -0.344 | (-1.010) | 0.010 |

*Note:* *p<0.1; **p<0.05; ***p<0.01

Table 6.5: The table reports the results from the regression employing equation 5.4 ($Performance\,measurement_i = intercept + \beta_i Characteristic_i + \epsilon_i$). The regression is run for each performance measurement and each fund characteristic separately. The model parameters are estimated through OLS. Fund characteristics are given by the age of the fund in years as of December 2019, the asset under management in million NOK (as of December 2019), and the expense ratio as the monthly average difference between gross and net returns. The slope is the $\beta$ coefficient for each model. Reported t-statistics are robust to heteroskedasticity (Huber, 1967).

# 7 Discussion

As previously discussed, performance is a demanding topic to approach and there is limited degree of consistency in the bond mutual fund literature both internationally and domestically. Specified in the literature review, there is a lack of a generally accepted model controlling for bond-portfolio risk (Cremers et al., 2019). Accordingly, in examining whether Norwegian bond mutual funds create value, three separate performance approaches have been applied.

When considering the active return gross of expenses, Norwegian bond mutual fund managers are able to outperform their benchmark for both of the examined sample-periods. The results are significantly positive for all benchmarks applied in the 2010-2019 sample period. For the latter sample period, only the KLP benchmark has a significant result. This is in line with existing literature, showing that funds are able to outperform their benchmark before costs (Cremers et al., 2019).

However, evaluating net of expenses, the active return turns negative or close to zero for both the KLP and NBP benchmark. The results are consistent for both time periods. In other words, the cost of active management is approximately the same as the outperformance of the fund. This is in line with the findings of Berk and van Binsbergen (2015) and Berk and Green (2004). Berk and Green (2004) argues that skill is in short demand, and that the competitiveness of the market drives the net active return down to zero. Moreover, although managers are able to generate positive active return gross of expenses, the positive IR and negative AR indicate that this active return is a result of factor exposure and not security selection.

Furthermore, the self-reported benchmark approach consistently reports greater results both gross and net of expenses. However, caution is in order. We do not choose to assert this as a good performance measurement due to funds reporting government indices as benchmark, thus appearing to be delivering superior returns.

In line with the results of active return, funds are able to generate a statistically significant value added gross of expenses. These findings are consistent with Berk and van Binsbergen (2015), who find that fund managers are able to generate value through active management. However, when evaluating the results net, most of the mean value added extracted by the manager disappears due to expenses. As with the active return, the results for the relevant benchmark approaches of KLP and NBP are not statistically significant when evaluating net of expenses.

Controlling for factor exposure by applying factor models, the average Norwegian bond mutual fund underperform. This is in line with the findings of Blake et al. (1993), Cici and Gibson (2012), Ferson et al. (2006) and Dietze et al. (2009). Although, the average fund generate a statistically significant active return pre expenses, there is no evidence that this is due to managers exhibiting skill ($\alpha$). In line with the findings of Choi and Kronlund (2018) for the U.S bond mutual fund market, the active return does not yield from managerial skill, but rather from exposure toward common risk factors. Sign and significance of the alphas are to a large extent robust across the different factor models. In addition, the results are consistent both net and gross of fees. When risk-adjusting the alpha by calculating the AR, the results are negative both gross and net of expenses across all models. In other words, the manager is unable to create value in excess of the benchmark, when controlling for factor exposure.

Prior discussions have questioned whether the factor models reflect an investable investment opportunity that is available for the investor. With this in mind, Berk and van Binsbergen (2015) do not calculate the net alpha based on a factor model, but instead calculates the excess return of a tradable benchmark (i.e net active return). Moreover, the authors point out that the risk factors are only valid for interpretation if they are tradable portfolios. In relation to prior discussions, the replicability and investability of the NBP indices are uncertain. Accordingly, the factor models may pose an inaccurate measurement for the performance of the funds.

As an extension of the performance analysis, we are interested in the relationship between fund characteristics and performance. Based on the results reported in Table 6.5, some of the included characteristics give indications of a relationship.

For age, the findings are in line to those of Dietze et al. (2009), as most models display a positive insignificant relationship with performance. This outperformance might be due to older funds having more experience and better cost structures than their younger counterparts. However, the models does not display statistical significance and we are not able to draw any conclusions.

Evaluating AUM, all except one of the included models report a positive relationship, with the majority being statistically significant. In line with the studies by Philpot et al. (1998) and Dietze et al. (2009), our findings indicate that there appears to be some evidence of economies of scale apparent in the bond market. As discussed in section 2, investing in bonds requires a high minimum investment. Accordingly, it is difficult to build a diversified portfolio of bonds. These factors might explain why larger funds appear to exhibit superior performance.

Considering expense ratio, it is difficult to reach any clear conclusions. When evaluating gross performance and expenses, there is a positive relationship across all models, with the majority exhibiting a statistical significance at 10% level. In other words, it appears that funds with higher expense ratios generate higher performance. Accordingly, the well-performing fund managers appear to be demanding higher compensation for their services. Moreover, for the net returns, the results are inconclusive. None of the models exhibits statistical significance.

### 7.0.1 Limitations and Further Research

Prior to the conclusion of this thesis, a couple of remarks regarding the limitations of the study as well as suggestions for future research is discussed.

One part of this thesis evaluates funds performance in relation to their classification by VFF. However, these classifications may be inaccurate in reflecting the investment universe of the funds. In addition, the industry wide standards that the fund managers are obligated to adhere to are formed by the fund managers themselves. Consequently, there might have been a conflict of interest when the indices and classifications were established.

Secondly, at the time of study, the time-series data available for the NBP indices is limited to December 30th 2014. An extended time-period might give more concluding evidence of skill among managers and their ability to consistently add value. Accordingly, future research might analyse a broader time-perspective to reach even more robust conclusions.

Finally, an interesting further extension of the thesis would be to examine whether there is any consistency in the performance of funds. This is necessary in order to separate between luck and skill of the fund managers.

# 8 Conclusion

Share capital in Norwegian bond mutual funds totalled more than 340 billion NOK at the end of 2019. Still, almost all empirical analysis in the financial literature, both domestically and internationally, have been in relation to equity funds. The objective of this thesis has been to evaluate whether bond mutual funds are capable of creating value by employing three separate performance approaches. Extending this performance analysis, we consider whether it it possible to identify well-performing funds by examining their characteristics.

Our main conclusion suggest that the average Norwegian bond fund is capable of creating value compared to proper benchmarks. However, none of the generated value benefits investors. Accordingly, the average value creation is approximately equal to the expenses the fund charges. Further, we find that the apparent value creation relates to exposure toward common risk factors and not from fund managers possessing skill. These results are further confirmed running factor models. Not a single fund exhibit a positive significant performance neither gross nor net of expenses. The sign and significance are robust across all models applied. These findings are in line with the general perception of performance and bond mutual funds.

Furthermore, we conclude that it is possible to identify well-performing funds by examining their characteristics. Our findings suggest that funds with high AUM outperform other funds both net and gross of expenses. Furthermore, funds with high expense ratios generate greater returns compared to other funds gross of expenses.

The results of this thesis are important as funds for a long period of time have been compared to inappropriate indices, misleading investors. By applying a large spectre of performance measurements, this thesis has thoroughly analysed Norwegian bond mutual funds and their capability of creating value.

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# Appendix

## A1 Return Calculations

The NAV, represent the share price for fund $i$ at time $t$. It is calculated by dividing the total value net of fees and expenses on the number of shares outstanding (Morningstar, 2020):

$$NAV_{it} = \frac{Net\ asset\ share\ class_{it}}{Number\ of\ shares\ outstanding_{it}} \tag{.1}$$

Next, the NAV observations are applied in order to calculate the net return of the funds. The net return for fund $i$ at time $t$ is calculated by computing the difference between the end of month NAV and the NAV of the previous month divided by the NAV of the previous month. If the fund paid dividend($Div_{it}$), we assumed that this dividend was reinvested at the end of the ex-dividend month[23](Morningstar, 2020). Calculations of net returns are displayed in the equation below:

$$Net\ Return_{it} = \frac{NAV_{it} - NAV_{i,t-1}}{NAV_{i,t-1}} + \frac{Div_{it}}{NAV_{i-1}} \tag{.2}$$

In addition to net returns, gross returns are calculated. Gross returns are the returns of the fund before expenses and fees are charged. The expense ratio($e_{it}$) is the annual percentage fee of all assets the bond mutual fund charge their shareholders. In order to calculate gross returns, the monthly expense ratio is subtracted from the net return displayed in the eqaution below:

$$Gross\ Return_{it} = \frac{1 + Net\ Return_{it}}{(1 - \frac{e_{it}}{12})} - 1 \tag{.3}$$

The expense ratio does not include portfolio transaction costs, brokerage costs or sales charges (Morningstar, 2020). However, we cannot identify any funds in the sample who are imposing such redemption fees or sales charges.[24] For this reason, these type of transaction costs are disregarded as having negligible or no impact for the analysis.

[23]The date at which new investors no longer are entitled to the upcoming dividend.

[24]That being said, we are not able to leave out the possibility that some if the funds have been imposing such during the sample period.

# A2 Survivorship Bias

In relation to the method of Horst et al. (1998), an analysis calculating the mean of the sample of surviving funds for each time period is compared to the mean of the sample of all funds (surviving and non-surviving) for each time period. The results indicate an annual difference of 0.011% basis points for the 10-year sample period and 0.002% basis points for the 5-year sample period. This is by the authors considered as an negligible difference that will not alter the results of the thesis. Note that as past classifications of VFF are not available, we made an evaluation of which funds should have been a part of the bond mutual funds 1,2,3 credit risk 1,2,3 by evaluating their investment mandate. The liquidated and merged funds are illustrated in table A2.1 below:

**Table A2.1:** Merged and Liquidated Funds

| Name | Merged Into Security | Merged into Security ID | Obsolete Date | Obsolete Type |
|---|---|---|---|---|
| Alfred Berg Lang Obligasjon | Alfred Berg Obligasjon | NO0010089410 | 10.02.2017 | Merged |
| Alfred Berg Obligasjon 1-3 | Alfred Berg Nordic Inv Grade Mid Dur I | NO0010811938 | 30.08.2019 | Merged |
| Alfred Berg Obligasjon 3-5 | | | 06.10.2016 | Liquidated |
| Alfred Berg Kort Obligasjon | | | 09.08.2012 | Liquidated |
| DNB AM Lang Statsobligasjon 2 | | | 25.08.2013 | Liquidated |
| DNB AM Obligasjon 2 | | | 25.08.2013 | Liquidated |
| DNB AM Obligasjon 4 | | | 25.08.2013 | Liquidated |
| DNB Lang Obligasjon 20 | | | 25.04.2018 | Liquidated |
| DNB Obligasjon (II) | DNB Obligasjon | NO0005143800 | 07.03.2014 | Merged |
| DNB Statsobligasjon (I) | | | 09.09.2013 | Liquidated |
| DNB Statsobligasjon (III) | | | 09.09.2013 | Liquidated |
| Handelsbanken Obligasjon | Handelsbanken Obligasjon A1 NOK | SE0009696875 | 25.08.2017 | Merged |
| Storebrand Obligasjon | | | 19.08.2013 | Liquidated |
| Storebrand Stat | | | 12.05.2013 | Liquidated |

Table A2.1: The table displays all Norwegian Bond mutual funds that were merged and or liquidated in the period from 2010 through 2019. Data material is provided by Morningstar Direct.

# A3 NBP - Duration Indices

**Figure A3.1:** RM1, RM2, RM3 and Government Bond Index - 1 Year Duration

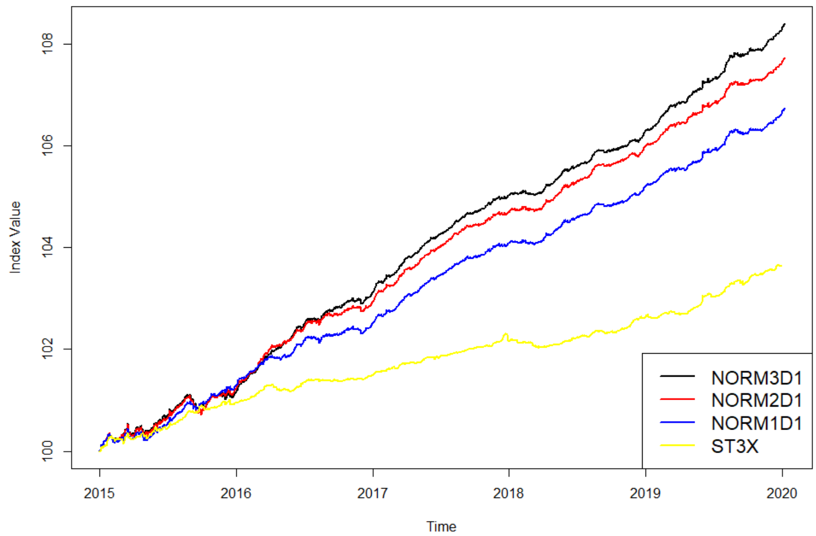


Figure A3.1: The figure plots the cumulative return for the different credit classes including the Norwegian government bond 1 year index (ST3X) from 2015 through 2019. All of the included factors have a fixed duration of 1 years.

**Figure A3.2:** RM1, RM2, RM3 and Government Bond Index - 5 year duration

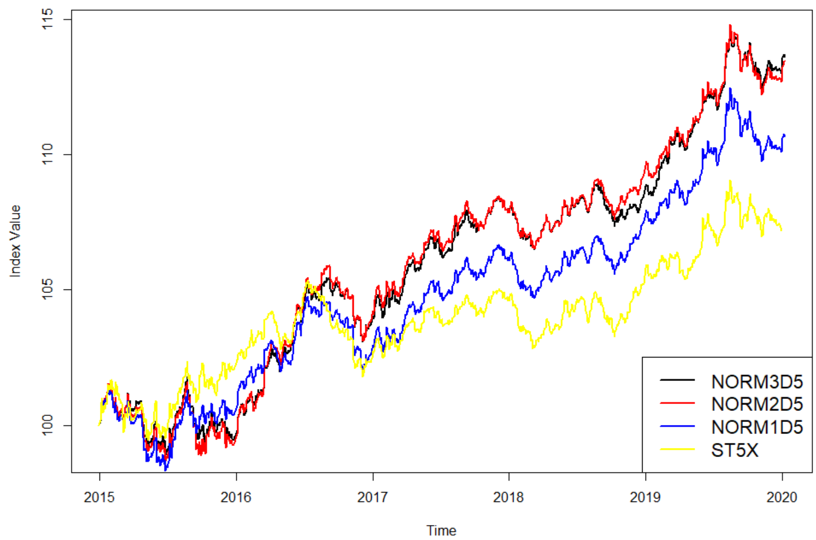


Figure A3.2: The figure plots the cumulative return for the different credit classes including the Norwegian government bond 5 year index (ST5X) from 2015 through 2019. All of the included factors have a fixed duration of 5 years.

# A4 Changes in Reported Benchmarks

**Table A4.1:** Changes in Reported Benchmark

| Name | Prior benchmark | Date change |
|---|---|---|
| Alfred Berg Kort Stat | | |
| KLP Obligasjon 1 år | ST3X | 01.07.2018 |
| PLUSS Obligasjon | OBI Statsobligasjonsindeks 2 år | 01.12.2014 |
| PLUSS Rente | | |
| Odin Norsk Obligasjon | ST3X | 11.06.2018 |
| Nordea Statsobligasjon II | | |
| C Worldwide Obligasjon | | |
| Danske Invest Norsk Obligasjon | ST4X | 01.01.2019 |
| DNB Obligasjon 20 E | ST4X | 01.06.2018 |
| DNB Obligasjon 20 A | ST4X | 01.06.2018 |
| DNB Obligasjon 20 C | ST4X | 01.06.2018 |
| DNB Obligasjon 20 D | ST4X | 01.06.2018 |
| Eika Obligasjon | | |
| KLP Obligasjon 3 år | ST4X | 01.06.2018 |
| Nordea Obligasjon II | ST4X | 12.12.2018 |
| PLUSS Pensjon | | |
| Storebrand Kreditt IG 20 | ST4X | 01.01.2019 |
| Alfred Berg Obligasjon | ST1X | 01.01.2019 |
| Danske Bank Institusjon | ST4X | 01.01.2019 |
| DNB Kreditt D | ST4X | 01.06.2018 |
| DNB Obligasjon E | ST4X | 01.06.2018 |
| DNB Obligasjon A | ST4X | 01.06.2018 |
| KLP Kredittobligasjon | SWAP3Y | 01.07.2018 |
| Nordea Obligasjon Stars A | ST4X | 02.01.2019 |
| Nordea Obligasjon Stars S | ST4X | 02.01.2019 |
| Nordea Obligasjon III | ST4X | 12.12.2018 |
| Nordea Obligasjon NO | ST4X | 12.12.2018 |
| Storebrand Norsk Kreditt IG | ST4X | 01.01.2019 |
| KLP Statsobligasjon | | |
| Storebrand Statsobligasjon | | |
| KLP Obligasjon 5 år | ST5X | 01.07.2018 |
| Handelsbanken Obligasjon A | | |

Table A4.1: The table shows eventual changes in reported benchmark for the sample period. The prior benchmark is listed including the effective date of change. If a fund did not change their benchmark in the period the rows are empty.

# A5 Time Series Regression Analysis

## A5.1 Properties of Ordinary Least Squares - Time-Series Regression Model

Below the sample properties of OLS under classical assumptions is listed for the time series regression analysis. The properties were obtained from Woolridge (2018).

**Assumption 1**: *Linear Parameters*: The time series follows a stochastic process $(X_{t1}, X_{t2}, ..., X_{tk}) : t = 1, 2..., n$ thus the model

$$Y_t = \beta_0 + \beta_1 X_{1,t} + \beta_2 X_{2,t} + ... + \beta_n X_{n,t} + e_t \tag{.4}$$

where $(X_{t1}, X_{t2}, ..., X_{tk}) : t = 1, 2..., n$ is the errors of the time series, and $n$ is the number of time periods.

**Assumption 2**: *No Perfect Collinearity*: Non of the independent variables in the time series are constant or have a perfect linear relationships with each other.

**Assumption 3**: *Zero Conditional Mean*: The error term $(e_t)$ for each time period of the independent variables has an expected value of zero. The average value of expressed mathematically as:

$$E(e_t|X) = 0,\ t = 1, 2..., n. \tag{.5}$$

**Assumption 4**: *Homoskedasticity*: The variance of $u_t$ is not dependant on X, and is the same for all $t$: $Var\ (e_t|X) = VAR(e_t) = \sigma^2$, $t = 1, 2, ..., n$.

**Assumption 5**: *No Serial Correlation*: Conditional on X, the errors in two different time periods are ucorrelated: $Corr\ (e_t, e_s|X) = 0$, for all $t \neq s$

**Assumption 6**: *Normality*: The errors $(e_t)$ are independent of the explanatory variables and normally distributed as Normal $(0,\ \sigma^2)$

## A5.2 Diagnostic Tests of OLS Properties

### A5.2.1 Breusch-Pagan Test for Heteroskedasticity

The assumption of homoskedasticity is adressed by appyling the Breusch-Pagan test. The assumption, states that the variance of of the unobserved error, $u$, conditional on the explanatory variables, is constant (Woolridge, 2018). If the model is suffering from heteroskedascity, the variance of the error term is not constant and will typically follow a clear pattern. Formally we hypothesize:

H0: Constant variance. H1: Non-constant variance.

If the null hypothesis is rejected, this is an indication of heteroskedascity. Apparent from Table A5.1-2 there seem to be some of indications of heteroskedascitiy in our data. This problem is addressed by running robust regressions using an optimal Bartlett Kernel as in Newey and West (1987). The corrections did not alter our conclusions.

### A5.2.2 Durbin- Watson Test for Serial Correlation

The issue of serial correlation (autocorrelation) is examined by applying the Durbin-Watson test for serial correlation. If there is presence of serial correlation in our data, the error terms in the different time periods will be correlated (Woolridge, 2018). Formally we hypothesize:

H0: No serial correlation. H1: Serial correlation

If the null hypothesis is rejected, there are indications of serial correlation in our data. Apparent from Table A5.3-4 some of our models seem to be serially correlated. As in the case of homoskedascity this is resolved by running robust regressions using an optimal Bartlett Kernel as in Newey and West (1987). The corrections did not alter our conclusions.

### A5.2.3 Shapiro-Wilk Test for Normality

Finally, the assumption of normality is assessed by applying the Shapiro-Wilk test. The normality assumption assumes that the error (or dependent variable) has a normal distribution (Woolridge, 2018). We formally hypothesize:

H0: Normally distributed residuals. H1: Non-normally distributed residuals.

The results of the Shapiro-Wilk test is reported in Table A5.5-6. However, although our models assume normality, Fitzmaurice et al. (2011) show that linear regression models are relatively robust to violations.

**Table A5.1:** Breusch-Pagan Test for Heteroskedasticity (SIM)

| Fund | $\chi^2$ | p- value | Rejected/Not rejected |
|---|---|---|---|
| Alfred Berg Kort Stat | 5.114 | 0.024 | Rejected |
| KLP Obligasjon 1 år | 1.770 | 0.183 | Not rejected |
| PLUSS Obligasjon | 11.618 | 0.001 | Rejected |
| PLUSS Rente | 10.196 | 0.001 | Rejected |
| Odin Norsk Obligasjon | 13.575 | 0.000 | Rejected |
| Nordea Statsobligasjon II | 5.124 | 0.024 | Rejected |
| C Worldwide Obligasjon | 0.095 | 0.758 | Not rejected |
| Danske Invest Norsk Obligasjon | 0.146 | 0.702 | Not rejected |
| DNB Obligasjon 20 E | 0.168 | 0.682 | Not rejected |
| DNB Obligasjon 20 A | 0.134 | 0.715 | Not rejected |
| DNB Obligasjon 20 C | 0.121 | 0.728 | Not rejected |
| DNB Obligasjon 20 D | 0.148 | 0.700 | Not rejected |
| Eika Obligasjon | 1.219 | 0.270 | Not rejected |
| KLP Obligasjon 3 år | 13.03 | 0.000 | Rejected |
| Nordea Obligasjon II | 8.927 | 0.003 | Rejected |
| PLUSS Pensjon | 1.159 | 0.282 | Rejected |
| Storebrand Kreditt IG 20 | 4.119 | 0.042 | Rejected |
| Alfred Berg Obligasjon | 1.340 | 0.247 | Not rejected |
| Danske Bank Institusjon | 0.287 | 0.592 | Not rejected |
| DNB Kreditt D | 0.025 | 0.873 | Not rejected |
| DNB Obligasjon E | 0.283 | 0.595 | Not rejected |
| DNB Obligasjon A | 0.247 | 0.619 | Not rejected |
| KLP Kredittobligasjon | 13.826 | 0.000 | Rejected |
| Nordea Obligasjon Stars A | 0.716 | 0.397 | Not rejected |
| Nordea Obligasjon Stars S | 1.099 | 0.294 | Not rejected |
| Nordea Obligasjon III | 0.372 | 0.542 | Not rejected |
| Nordea Obligasjon NO | 0.202 | 0.653 | Not rejected |
| Storebrand Norsk Kreditt IG | 0.908 | 0.341 | Not rejected |
| KLP Statsobligasjon | 7.602 | 0.006 | Rejected |
| Storebrand Statsobligasjon | 6.263 | 0.012 | Rejected |
| KLP Obligasjon 5 år | 13.771 | 0.000 | Rejected |
| Handelsbanken Obligasjon A | 12.294 | 0.000 | Rejected |
| Equally weighted portfolio | 0.334 | 0.563 | Not rejected |

Breusch-Pagan test for heteroskedasticity. H0: Constant variance H1: Non-constant variance.

**Table A5.2:** Breusch-Pagan Test for Heteroskedasticity (MIM)

| Fund | $\chi^2$ | p- value | Rejected/Not rejected |
|---|---|---|---|
| Alfred Berg Kort Stat | 3.0964 | 0.542 | Not rejected |
| KLP Obligasjon 1 år | 6.4843 | 0.166 | Not rejected |
| PLUSS Obligasjon | 4.117 | 0.391 | Not rejected |
| PLUSS Rente | 2.527 | 0.640 | Not rejected |
| Odin Norsk Obligasjon | 14.168 | 0.001 | Rejected |
| Nordea Statsobligasjon II | 1.557 | 0.817 | Not rejected |
| C Worldwide Obligasjon | 3.512 | 0.476 | Not rejected |
| Danske Invest Norsk Obligasjon | 4.488 | 0.344 | Not rejected |
| DNB Obligasjon 20 E | 2.760 | 0.560 | Not rejected |
| DNB Obligasjon 20 A | 2.757 | 0.601 | Not rejected |
| DNB Obligasjon 20 C | 2.604 | 0.626 | Not rejected |
| DNB Obligasjon 20 D | 2.902 | 0.574 | Not rejected |
| Eika Obligasjon | 2.116 | 0.714 | Not rejected |
| KLP Obligasjon 3 år | 6.484 | 0.166 | Not rejected |
| Nordea Obligasjon II | 18.77 | 0.000 | Rejected |
| PLUSS Pensjon | 6.581 | 0.160 | Not rejected |
| Storebrand Kreditt IG 20 | 10.692 | 0.030 | Rejected |
| Alfred Berg Obligasjon | 2.475 | 0.649 | Not rejected |
| Danske Bank Institusjon | 4.494 | 0.343 | Not rejected |
| DNB Kreditt D | 2.303 | 0.680 | Not rejected |
| DNB Obligasjon E | 0.714 | 0.947 | Not rejected |
| DNB Obligasjon A | 0.708 | 0.950 | Not rejected |
| KLP Kredittobligasjon | 0.923 | 0.921 | Not rejected |
| Nordea Obligasjon Stars A | 3.057 | 0.548 | Not rejected |
| Nordea Obligasjon Stars S | 3.398 | 0.494 | Not rejected |
| Nordea Obligasjon III | 8.526 | 0.074 | Rejected |
| Nordea Obligasjon NO | 2.464 | 0.651 | Not rejected |
| Storebrand Norsk Kreditt IG | 0.221 | 0.994 | Not rejected |
| KLP Statsobligasjon | 1.224 | 0.874 | Not rejected |
| Storebrand Statsobligasjon | 9.465 | 0.051 | Rejected |
| KLP Obligasjon 5 år | 0.904 | 0.924 | Not rejected |
| Handelsbanken Obligasjon A | 1.784 | 0.775 | Not rejected |
| Equally weighted portfolio | 10.279 | 0.0360 | Rejected |

Breusch-Pagan test for heteroskedasticity. H0: Constant variance H1: Non-constant variance.

**Table A5.3:** Durbin-Watson Test for Serial Correlation (SIM)

| Fund | $D-W$ *statistic* | p- value | Rejected/Not rejected |
|---|---|---|---|
| Alfred Berg Kort Stat | 1.795 | 0.432 | Not rejected |
| KLP Obligasjon 1 år | 2.180 | 0.462 | Not rejected |
| PLUSS Obligasjon | 1.681 | 0.214 | Not rejected |
| PLUSS Rente | 1.631 | 0.146 | Not rejected |
| Odin Norsk Obligasjon | 2.080 | 0.726 | Not rejected |
| Nordea Statsobligasjon II | 1.978 | 0.868 | Not rejected |
| C Worldwide Obligasjon | 1.347 | 0.008 | Rejected |
| Danske Invest Norsk Obligasjon | 2.045 | 0.844 | Not rejected |
| DNB Obligasjon 20 E | 1.924 | 0.792 | Not rejected |
| DNB Obligasjon 20 A | 1.925 | 0.712 | Not rejected |
| DNB Obligasjon 20 C | 1.929 | 0.748 | Not rejected |
| DNB Obligasjon 20 D | 1.914 | 0.756 | Not rejected |
| Eika Obligasjon | 1.570 | 0.116 | Not rejected |
| KLP Obligasjon 3 år | 1.407 | 0.018 | Rejected |
| Nordea Obligasjon II | 1.656 | 0.158 | Not rejected |
| PLUSS Pensjon | 1.944 | 0.828 | Not rejected |
| Storebrand Kreditt IG 20 | 2.178 | 0.502 | Not rejected |
| Alfred Berg Obligasjon | 1.539 | 0.080 | Rejected |
| Danske Bank Institusjon | 2.171 | 0.472 | Not rejected |
| DNB Kreditt D | 1.874 | 0.664 | Not rejected |
| DNB Obligasjon E | 1.564 | 0.070 | Rejected |
| DNB Obligasjon A | 1.566 | 0.062 | Rejected |
| KLP Kredittobligasjon | 1.573 | 0.090 | Rejected |
| Nordea Obligasjon Stars A | 1.842 | 0.506 | Not rejected |
| Nordea Obligasjon Stars S | 1.839 | 0.556 | Not rejected |
| Nordea Obligasjon III | 1.835 | 0.520 | Not rejected |
| Nordea Obligasjon NO | 2.919 | 0.010 | Rejected |
| Storebrand Norsk Kreditt IG | 1.607 | 0.134 | Not rejected |
| KLP Statsobligasjon | 2.175 | 0.450 | Not rejected |
| Storebrand Statsobligasjon | 2.103 | 0.704 | Not rejected |
| KLP Obligasjon 5 år | 1.699 | 0.264 | Not rejected |
| Handelsbanken Obligasjon A | 1.813 | 0.450 | Not rejected |
| Equally weighted portfolio | 1.642 | 0.130 | Not rejected |

Durbin-Watson test for serial correlation. H0: No serial correlation H1: serial correlation.

**Table A5.4:** Durbin-Watson Test for Serial Correlation (MIM)

| Fund | $D-W$ *statistic* | p- value | Rejected/Not rejected |
|---|---|---|---|
| Alfred Berg Kort Stat | 1.795 | 0.486 | Not rejected |
| KLP Obligasjon 1 år | 2.180 | 0.478 | Not rejected |
| PLUSS Obligasjon | 1.682 | 0.222 | Not rejected |
| PLUSS Rente | 1.632 | 0.136 | Not rejected |
| Odin Norsk Obligasjon | 2.080 | 0.822 | Not rejected |
| Nordea Statsobligasjon II | 1.979 | 0.992 | Not rejected |
| C Worldwide Obligasjon | 1.348 | 0.006 | Rejected |
| Danske Invest Norsk Obligasjon | 2.046 | 0.848 | Not rejected |
| DNB Obligasjon 20 E | 1.924 | 0.840 | Not rejected |
| DNB Obligasjon 20 A | 1.529 | 0.066 | Rejected |
| DNB Obligasjon 20 C | 1.528 | 0.068 | Rejected |
| DNB Obligasjon 20 D | 1.507 | 0.040 | Rejected |
| Eika Obligasjon | 1.570 | 0.088 | Rejected |
| KLP Obligasjon 3 år | 1.408 | 0.012 | Rejected |
| Nordea Obligasjon II | 1.656 | 0.144 | Not rejected |
| PLUSS Pensjon | 1.943 | 0.866 | Not rejected |
| Storebrand Kreditt IG 20 | 2.178 | 0.484 | Not rejected |
| Alfred Berg Obligasjon | 1.539 | 0.078 | Not rejected |
| Danske Bank Institusjon | 2.170 | 0.504 | Not rejected |
| DNB Kreditt D | 1.874 | 0.688 | Not rejected |
| DNB Obligasjon E | 1.564 | 0.092 | Not rejected |
| DNB Obligasjon A | 1.537 | 0.066 | Rejected |
| KLP Kredittobligasjon | 1.573 | 0.106 | Not rejected |
| Nordea Obligasjon Stars A | 1.842 | 0.588 | Not rejected |
| Nordea Obligasjon Stars S | 1.839 | 0.504 | Not rejected |
| Nordea Obligasjon III | 1.835 | 0.496 | Not rejected |
| Nordea Obligasjon NO | 2.919 | 0.002 | Rejected |
| Storebrand Norsk Kreditt IG | 1.607 | 0.122 | Not rejected |
| KLP Statsobligasjon | 2.175 | 0.450 | Not rejected |
| Storebrand Statsobligasjon | 2.103 | 0.666 | Not rejected |
| KLP Obligasjon 5 år | 1.700 | 0.234 | Not rejected |
| Handelsbanken Obligasjon A | 1.813 | 0.486 | Not rejected |
| Equally weighted portfolio | 1.174 | 0.000 | Rejected |

Durbin-Watson test for serial correlation. H0: No serial correlation H1: serial correlation.

**Table A5.5:** Shapiro-Wilk Test (SIM)

| Fund | $W$ | p- value | Rejected/Not rejected |
|---|---|---|---|
| Alfred Berg Kort Stat | 0.985 | 0.690 | Not rejected |
| KLP Obligasjon 1 år | 0.989 | 0.865 | Not rejected |
| PLUSS Obligasjon | 0.949 | 0.014 | Rejected |
| PLUSS Rente | 0.942 | 0.007 | Rejected |
| Odin Norsk Obligasjon | 0.894 | 0.000 | Rejected |
| Nordea Statsobligasjon II | 0.976 | 0.296 | Not rejected |
| C Worldwide Obligasjon | 0.981 | 0.463 | Not rejected |
| Danske Invest Norsk Obligasjon | 0.962 | 0.057 | Rejected |
| DNB Obligasjon 20 E | 0.971 | 0.169 | Not rejected |
| DNB Obligasjon 20 A | 0.970 | 0.152 | Not rejected |
| DNB Obligasjon 20 C | 0.970 | 0.138 | Not rejected |
| DNB Obligasjon 20 D | 0.971 | 0.162 | Not rejected |
| Eika Obligasjon | 0.967 | 0.100 | Rejected |
| KLP Obligasjon 3 år | 0.978 | 0.367 | Not rejected |
| Nordea Obligasjon II | 0.985 | 0.677 | Not rejected |
| PLUSS Pensjon | 0.983 | 0.615 | Not rejected |
| Storebrand Kreditt IG 20 | 0.986 | 0.714 | Not rejected |
| Alfred Berg Obligasjon | 0.981 | 0.485 | Not rejected |
| Danske Bank Institusjon | 0.968 | 0.118 | Not rejected |
| DNB Kreditt D | 0.985 | 0.693 | Not rejected |
| DNB Obligasjon E | 0.957 | 0.034 | Rejected |
| DNB Obligasjon A | 0.955 | 0.028 | Rejected |
| KLP Kredittobligasjon | 0.951 | 0.017 | Rejected |
| Nordea Obligasjon Stars A | 0.977 | 0.349 | Not rejected |
| Nordea Obligasjon Stars S | 0.977 | 0.301 | Not rejected |
| Nordea Obligasjon III | 0.979 | 0.400 | Not rejected |
| Nordea Obligasjon NO | 0.538 | 0.000 | Rejected |
| Storebrand Norsk Kreditt IG | 0.937 | 0.004 | Rejected |
| KLP Statsobligasjon | 0.967 | 0.116 | Not rejected |
| Storebrand Statsobligasjon | 0.978 | 0.351 | Not rejected |
| KLP Obligasjon 5 år | 0.945 | 0.009 | Rejected |
| Handelsbanken Obligasjon A | 0.928 | 0.002 | Rejected |
| Equally weighted portfolio | 0.983 | 0.577 | Not rejected |

Shapiro-Wilk test for normality. H0: Normally distributed residuals. H1: Non-normally distributed residuals.

**Table A5.6:** Shapiro-Wilk Test (MIM)

| Fund | $W$ | p- value | Rejected/Not rejected |
|---|---|---|---|
| Alfred Berg Kort Stat | 0.971 | 0.159 | Not rejected |
| KLP Obligasjon 1 år | 0.989 | 0.900 | Not rejected |
| PLUSS Obligasjon | 0.984 | 0.620 | Not rejected |
| PLUSS Rente | 0.961 | 0.054 | Not rejected |
| Odin Norsk Obligasjon | 0.986 | 0.742 | Not rejected |
| Nordea Statsobligasjon II | 0.979 | 0.379 | Not rejected |
| C Worldwide Obligasjon | 0.965 | 0.085 | Rejected |
| Danske Invest Norsk Obligasjon | 0.943 | 0.007 | Rejected |
| DNB Obligasjon 20 E | 0.931 | 0.002 | Rejected |
| DNB Obligasjon 20 A | 0.934 | 0.003 | Rejected |
| DNB Obligasjon 20 C | 0.944 | 0.007 | Rejected |
| DNB Obligasjon 20 D | 0.929 | 0.002 | Rejected |
| Eika Obligasjon | 0.972 | 0.180 | Not rejected |
| KLP Obligasjon 3 år | 0.978 | 0.367 | Not rejected |
| Nordea Obligasjon II | 0.970 | 0.145 | Not rejected |
| PLUSS Pensjon | 0.939 | 0.005 | Rejected |
| Storebrand Kreditt IG 20 | 0.980 | 0.432 | Not rejected |
| Alfred Berg Obligasjon | 0.905 | 0.000 | Rejected |
| Danske Bank Institusjon | 0.968 | 0.118 | Not rejected |
| DNB Kreditt D | 0.953 | 0.021 | Rejected |
| DNB Obligasjon E | 0.874 | 0.000 | Rejected |
| DNB Obligasjon A | 0.874 | 0.000 | Rejected |
| KLP Kredittobligasjon | 0.951 | 0.017 | Not rejected |
| Nordea Obligasjon Stars A | 0.977 | 0.304 | Not rejected |
| Nordea Obligasjon Stars S | 0.985 | 0.666 | Not rejected |
| Nordea Obligasjon III | 0.980 | 0.432 | Not rejected |
| Nordea Obligasjon NO | 0.506 | 0.000 | Rejected |
| Storebrand Norsk Kreditt IG | 0.847 | 0.000 | Rejected |
| KLP Statsobligasjon | 0.988 | 0.819 | Not rejected |
| Storebrand Statsobligasjon | 0.957 | 0.035 | Rejected |
| KLP Obligasjon 5 år | 0.979 | 0.402 | Not rejected |
| Handelsbanken Obligasjon A | 0.984 | 0.645 | Not rejected |
| Equally weighted portfolio | 0.945 | 0.009 | Rejected |

Shapiro-Wilk test for normality. H0: Normally distributed residuals. H1: Non-normally distributed residuals.

# A6 Cross-Sectional Regression Analysis

In order to examine the relationship between performance and fund characteristics, we employ a cross-sectional regression the performance measurements on the different characteristics using equation 5.3 in the methodology. Below the sample properties of OLS under classical assumptions is listed for the cross- sectional regression analysis. The properties were obtained from (Woolridge, 2018).

## A6.1 Properties of Ordinary Least Squares - Cross-Sectional Regression Model

Below the sample properties of OLS under classical assumptions is listed for the cross-sectional regression analysis. The properties were obtained from Woolridge (2018).

**Assumption 1**: *Linear Parameters*: The dependent variables is related to the independent variables and error terms ($e$) as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + e \tag{.6}$$

**Assumption 2**: *Random Sampling*: We assume that the data obtained are the result of random sampling. This can be written in the term as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + e \;\; i = 1, 2...n \tag{.7}$$

**Assumption 3**: *Zero Conditional Mean*: The error term ($e$) for each time period of the independent variables has an expected value of zero. The average value of expressed mathematically as:

$$E\left(e|X\right) = 0 \tag{.8}$$

**Assumption 4**: *Homoskedasticity*: The variance of $e$ is not dependant on X: $Var\left(e|X\right) = VAR\left(e\right) = \sigma^2$

### A6.1.1 Diagnostic Tests of OLS Properties

In order to test for homoskedasticity and normality we apply the Breusch-Pagan and Shapiro-Wilk test respectively. The tests are described in detail in A5.2. As evident from Table A7.2 one of the model give indications of heteroskedascity. This is resolved by running robust regressions using Huber (1967) standard errors.

**Table A6.1:** Breusch-Pagan Test for Heteroskedasticity (Fund Charateristics)

| Fund | $\chi^2$ | p- value | Rejected/Not rejected |
|---|---|---|---|
| Age - Reported 10y | 1.923 | 0.166 | Not rejected |
| Age - KLP 10y | 2.017 | 0.156 | Not rejected |
| Age - Reported 5y | 0.430 | 0.512 | Not rejected |
| Age - KLP 5y | 0.015 | 0.902 | Not rejected |
| Age - NBP 5y | 0.006 | 0.938 | Not rejected |
| Age - SIM | 0.304 | 0.582 | Not rejected |
| Age - MIM | 0.037 | 0.847 | Not rejected |
| AUM - Reported 10y | 1.802 | 0.180 | Not rejected |
| AUM - KLP 10y | 0.002 | 0.967 | Not rejected |
| AUM- Reported 5y | 1.043 | 0.307 | Not rejected |
| AUM - KLP 5y | 0.413 | 0.521 | Not rejected |
| AUM - NBP 5y | 0.757 | 0.384 | Not rejected |
| AUM - SIM | 1.679 | 0.195 | Not rejected |
| AUM - MIM | 1.390 | 0.239 | Not rejected |
| Expense Ratio - Reported 10y | 0.195 | 0.659 | Not rejected |
| Expense Ratio - KLP 10y | 1.923 | 0.166 | Not rejected |
| Expense Ratio- Reported 5y | 0.458 | 0.498 | Not rejected |
| Expense Ratio - KLP 5y | 0.239 | 0.625 | Not rejected |
| Expense Ratio - NBP 5y | 0.923 | 0.337 | Not rejected |
| Expense Ratio - SIM | 3.935 | 0.047 | Rejected |
| Expense Ratio - MIM | 3.474 | 0.062 | Not rejected |

Breusch-Pagan test for heteroskedasticity. H0: Constant variance H1: Non-constant variance.

**Table A6.2:** Shapiro-Wilk Test for Normality (Fund Characteristics)

| Fund | $W$ | p- value | Rejected/Not rejected |
|---|---|---|---|
| Age - Reported 10y | 0.966 | 0.857 | Not rejected |
| Age - KLP 10y | 0.895 | 0.010 | Rejected |
| Age - Reported 5y | 0.936 | 0.059 | Rejected |
| Age - KLP 5y | 0.927 | 0.033 | Rejected |
| Age - NBP 5y | 0.936 | 0.057 | Rejected |
| Age - SIM | 0.955 | 0.200 | Not rejected |
| Age - MIM | 0.962 | 0.306 | Not rejected |
| AUM - Reported 10y | 0.964 | 0.837 | Not rejected |
| AUM - KLP 10y | 0.872 | 0.003 | Rejected |
| AUM- Reported 5y | 0.954 | 0.193 | Not rejected |
| AUM - KLP 5y | 0.908 | 0.010 | Rejected |
| AUM - NBP 5y | 0.935 | 0.057 | Rejected |
| AUM - SIM | 0.936 | 0.058 | Not rejected |
| AUM - MIM | 0.927 | 0.033 | Not rejected |
| Expense Ratio - Reported 10y | 0.921 | 0.403 | Not rejected |
| Expense Ratio - KLP 10y | 0.908 | 0.021 | Rejected |
| Expense Ratio- Reported 5y | 0.938 | 0.064 | Rejected |
| Expense Ratio - KLP 5y | 0.923 | 0.026 | Rejected |
| Expense Ratio - NBP 5y | 0.946 | 0.115 | Not rejected |
| Expense Ratio - SIM | 0.943 | 0.094 | Not rejected |
| Expense Ratio - MIM | 0.962 | 0.306 | Not rejected |

Shapiro-Wilk test for normality. H0: Normally distributed residuals. H1: Non-normally distributed residuals.

# A7 Correlation Tables

**Table A7.1:** Correlation Table - Credit Risk Factors (Duration 1)

| | ST3X | NORM1D1 | NORM2D1 | NORM3D1 |
|---|---|---|---|---|
| ST3X | 1 | | | |
| NORM1D1 | 0.658 | 1 | | |
| NORM2D1 | 0.390 | 0.851 | 1 | |
| NORM3D1 | 0.471 | 0.887 | 0.932 | 1 |

**Table A7.2:** Correlation Table - Credit Risk Factors (Duration 3)

| | ST4X | NORM1D3 | NORM2D3 | NORM3D3 |
|---|---|---|---|---|
| ST4X | 1 | | | |
| NORM1D3 | 0.838 | 1 | | |
| NORM2D3 | 0.618 | 0.871 | 1 | |
| NORM3D3 | 0.683 | 0.920 | 0.958 | 1 |

**Table A7.3:** Correlation Table - Credit Risk Factors (Duration 5)

| | ST5X | NORM1D5 | NORM2D5 | NORM3D5 |
|---|---|---|---|---|
| ST5X | 1 | | | |
| NORM1D5 | 0.900 | 1 | | |
| NORM2D5 | 0.739 | 0.907 | 1 | |
| NORM3D5 | 0.801 | 0.946 | 0.969 | 1 |

# A8 Active Return

**Table A8.1:** Active Return - 2010-2019 Sample Period

| | Gross active return($\overline{R}^G_{i,A}$) | | Net active return($\overline{R}^N_{i,A}$) | |
|---|---|---|---|---|
| Fund | Reported | KLP | Reported | KLP |
| Alfred Berg Kort Stat | 4.14 | -3.88 | -0.46 | -8.48 |
| KLP Obligasjon 1 år | 8.74 | 1.25 | 7.49 | 0.00 |
| PLUSS Obligasjon | 13.97 | 7.91 | 11.87 | 5.81 |
| PLUSS Rente | 14.49 | 8.43 | 10.05 | 3.99 |
| Odin Norsk Obligasjon C | 9.54 | 2.13 | 5.38 | -2.04 |
| Nordea Statsobligasjon II | -0.51 | -8.24 | -1.81 | -9.53 |
| C Worldwide Obligasjon | 12.06 | 4.34 | 9.14 | 1.41 |
| Danske Invest Norsk Obligasjon | 13.22 | 6.18 | 9.44 | 2.40 |
| DNB Obligasjon 20 E | 11.99 | 5.19 | 10.74 | 3.94 |
| DNB Obligasjon 20 A | 11.87 | 5.07 | 7.69 | 0.89 |
| DNB Obligasjon 20 C | 11.85 | 5.05 | 8.88 | 2.08 |
| DNB Obligasjon 20 D | 11.86 | 5.06 | 10.17 | 3.37 |
| Eika Obligasjon | 7.71 | -0.01 | 6.01 | -1.71 |
| KLP Obligasjon 3 år | 8.05 | 1.25 | 6.80 | 0.00 |
| Nordea Obligasjon II | 9.32 | 2.28 | 7.65 | 0.61 |
| PLUSS Pensjon | 10.66 | 2.94 | 6.47 | -1.25 |
| Alfred Berg Obligasjon | 23.51 | 7.53 | 18.65 | 2.66 |
| Danske Bank Institusjon | 12.33 | 5.47 | 11.08 | 4.22 |
| DNB Kreditt D | 15.34 | 8.64 | 13.68 | 6.98 |
| DNB Obligasjon E | 16.47 | 9.77 | 14.81 | 8.11 |
| DNB Obligasjon A | 16.33 | 9.62 | 11.80 | 5.10 |
| KLP Kredittobligasjon | 10.96 | 4.23 | 9.50 | 2.76 |
| Nordea Obligasjon III | 11.72 | 4.86 | 10.39 | 3.52 |
| KLP Statsobligasjon | -8.48 | -9.90 | -9.40 | -10.82 |
| Storebrand Statsobligasjon | -2.98 | -10.71 | -4.23 | -11.96 |
| KLP Obligasjon 5 år | 8.07 | 1.26 | 6.81 | 0.00 |
| Handelsbanken Obligasjon A | 5.76 | -1.97 | 2.51 | -5.22 |
| **Mean** | 9.93 | 2.73 | 7.45 | 0.25 |
| **Standard Deviation** | 6.37 | 5.57 | 5.94 | 5.31 |

Table A8.1: Displays the estimated monthly active return both gross and net of expenses in basis points in excess of the reported and KLP benchmark during the time period 2010-2019. In addition the mean and the standard deviation for the sample are also reported. The calculation is based on equation 2.3 in section 2 ($\overline{R}_{A,i} = \frac{1}{T}\sum_{t=1}^{T} R_{A,it}$).

**Table A8.2:** Active Return - 2015-2019 Sample Period

| | Gross active return($\overline{R}^{G}_{i,A}$) | | | Net active return($\overline{R}^{N}_{i,A}$) | | |
|---|---|---|---|---|---|---|
| Fund | Reported | KLP | NBP | Reported | KLP | NBP |
| Alfred Berg Kort Stat | 4.62 | -2.93 | -0.06 | 0.00 | -7.55 | -4.68 |
| KLP Obligasjon 1 år | 7.32 | 0.83 | 3.02 | 6.49 | 0.00 | 2.18 |
| PLUSS Obligasjon | 11.85 | 4.85 | 7.03 | 9.74 | 2.74 | 4.92 |
| PLUSS Rente | 11.97 | 4.97 | 7.16 | 7.77 | 0.77 | 2.95 |
| Odin Norsk Obligasjon C | 9.91 | 3.56 | 5.33 | 5.74 | -0.60 | 1.17 |
| Nordea Statsobligasjon II | -0.37 | -6.47 | -5.19 | -1.71 | -7.81 | -6.53 |
| C Worldwide Obligasjon | 6.72 | 0.62 | 0.50 | 3.80 | -2.30 | -2.42 |
| Danske Invest Norsk Obligasjon | 9.42 | 4.68 | 4.56 | 6.02 | 1.29 | 1.17 |
| DNB Obligasjon 20 E | 8.42 | 4.17 | 4.05 | 7.18 | 2.93 | 2.81 |
| DNB Obligasjon 20 A | 8.28 | 4.03 | 3.91 | 4.10 | -0.15 | -0.27 |
| DNB Obligasjon 20 C | 8.27 | 4.02 | 3.90 | 5.31 | 1.06 | 0.94 |
| DNB Obligasjon 20 D | 8.30 | 4.05 | 3.93 | 6.60 | 2.35 | 2.23 |
| Eika Obligasjon | 6.31 | 0.22 | 0.10 | 4.60 | -1.49 | -1.61 |
| KLP Obligasjon 3 år | 5.08 | 0.83 | 0.71 | 4.25 | 0.00 | -0.12 |
| Nordea Obligasjon II | 5.53 | 0.80 | 0.68 | 3.86 | -0.87 | -0.99 |
| PLUSS Pensjon | 2.80 | 2.92 | 2.80 | -1.41 | -1.29 | -1.41 |
| Storebrand Kreditt IG 20 | 6.84 | 2.11 | 1.99 | 5.58 | 0.85 | 0.73 |
| Alfred Berg Obligasjon | 11.41 | 4.45 | 3.88 | 6.69 | -0.28 | -0.85 |
| Danske Bank Institusjon | 9.94 | 5.56 | 4.99 | 8.69 | 4.31 | 3.74 |
| DNB Kreditt D | 9.89 | 5.83 | 5.26 | 8.24 | 4.18 | 3.61 |
| DNB Obligasjon E | 11.38 | 7.33 | 6.76 | 9.73 | 5.67 | 5.10 |
| DNB Obligasjon A | 11.25 | 7.19 | 6.62 | 7.10 | 3.05 | 2.48 |
| KLP Kredittobligasjon | 6.88 | 2.76 | 2.19 | 6.05 | 1.93 | 1.36 |
| Nordea Norsk Kreditt | 7.92 | 3.53 | 2.96 | 4.17 | -0.21 | -0.78 |
| Nordea Norsk Kreditt I | 7.84 | 3.46 | 2.89 | 6.59 | 2.21 | 1.64 |
| Nordea Obligasjon III | 6.82 | 2.43 | 1.86 | 5.39 | 1.01 | 0.44 |
| Nordea Obligasjon NO | 5.19 | 0.81 | 0.24 | 4.65 | 0.27 | -0.30 |
| Storebrand Norsk Kreditt IG | 8.86 | 3.04 | 3.91 | 7.19 | 1.37 | 2.24 |
| KLP Statsobligasjon | 3.39 | -3.60 | -4.09 | 2.56 | -4.43 | -4.92 |
| Storebrand Statsobligasjon | -1.02 | -4.99 | -5.48 | -2.27 | -6.24 | -6.73 |
| KLP Obligasjon 5 år | 2.97 | 0.83 | -0.68 | 2.14 | 0.00 | -1.51 |
| Handelsbanken Obligasjon A | 2.51 | -1.46 | -2.97 | -0.23 | -4.20 | -5.72 |
| **Mean** | 7.27 | 2.20 | 2.27 | 5.03 | -0.04 | 0.03 |
| **Standard Deviation** | 3.28 | 3.30 | 3.36 | 2.97 | 3.21 | 3.14 |

Table A8.2: Displays the estimated monthly active return both gross and net of expenses in basis points in excess of the reported, KLP and NBP benchmark during the time period 2015-2019. In addition the mean and the standard deviation for the sample are also reported. The calculation is based on equation 2.3 in section 2 ($\overline{R}_{A,i} = \frac{1}{T}\sum_{t=1}^{T} R_{A,it}$).

# A9 Value Added

**Table A9.1:** Value Added - 2010-2019 Sample Period

| | Gross value added($\overline{V}_i^G$) | | Net value added($\overline{V}_i^N$) | |
|---|---|---|---|---|
| Fund | Reported | KLP | Reported | KLP |
| Alfred Berg Kort Stat | 0.31 | -0.32 | -0.05 | -0.68 |
| KLP Obligasjon 1 år | 1.26 | 0.18 | 1.08 | 0.00 |
| PLUSS Obligasjon | 1.40 | 0.77 | 1.19 | 0.56 |
| PLUSS Rente | 0.12 | 0.07 | 0.08 | 0.03 |
| Odin Norsk Obligasjon C | 0.71 | 0.17 | 0.46 | -0.08 |
| Nordea Statsobligasjon II | -0.09 | -0.58 | -0.20 | -0.69 |
| C Worldwide Obligasjon | 0.48 | 0.14 | 0.35 | 0.01 |
| Danske Invest Norsk Obligasjon | 1.80 | 0.82 | 1.30 | 0.32 |
| DNB Obligasjon 20 E | 6.61 | 2.82 | 5.87 | 2.08 |
| DNB Obligasjon 20 A | 0.56 | 0.20 | 0.36 | -0.00 |
| DNB Obligasjon 20 C | 0.16 | 0.07 | 0.12 | 0.03 |
| DNB Obligasjon 20 D | 0.39 | 0.15 | 0.33 | 0.08 |
| Eika Obligasjon | 0.34 | 0.01 | 0.27 | -0.07 |
| KLP Obligasjon 3 år | 0.44 | 0.07 | 0.37 | 0.00 |
| Nordea Obligasjon II | 2.49 | 0.64 | 2.08 | 0.23 |
| PLUSS Pensjon | 0.02 | 0.01 | 0.01 | -0.00 |
| Alfred Berg Obligasjon | 9.42 | 3.46 | 7.02 | 1.06 |
| Danske Bank Institusjon | 8.55 | 4.30 | 7.70 | 3.46 |
| DNB Kreditt D | 6.06 | 3.57 | 5.28 | 2.78 |
| DNB Obligasjon E | 17.50 | 11.06 | 15.55 | 9.11 |
| DNB Obligasjon A | 1.81 | 1.16 | 1.28 | 0.63 |
| KLP Kredittobligasjon | 2.80 | 0.99 | 2.43 | 0.62 |
| Nordea Obligasjon III | 3.28 | 1.37 | 2.88 | 0.97 |
| KLP Statsobligasjon | -2.50 | -1.76 | -2.83 | -2.09 |
| Storebrand Statsobligasjon | -1.60 | -11.21 | -2.18 | -11.78 |
| KLP Obligasjon 5 år | 0.54 | 0.09 | 0.45 | 0.00 |
| Handelsbanken Obligasjon A | 0.46 | -0.15 | 0.19 | -0.41 |
| **Mean** | 2.35 | 0.67 | 1.90 | 0.23 |
| **Standard Deviation** | 4.14 | 3.38 | 3.69 | 3.12 |

Table A9.1: The table displays the estimated monthly value added in million NOK in excess of the reported, KLP and NBP benchmark for each fund in the time period 2010-2019. The calculation is based on equation 2.6 in section 2 ($\overline{V}_i = \frac{1}{T}\sum_{t=1}^{T} V_{it}$).

**Table A9.2:** Value Added - 2015-2019 Sample Period

| | Gross value added($\overline{V}_i^G$) | | | Net value added($\overline{V}_i^N$) | | |
|---|---|---|---|---|---|---|
| Fund | Reported | KLP | NBP | Reported | KLP | NBP |
| Alfred Berg Kort Stat | 0.31 | -0.20 | -0.01 | -0.01 | -0.53 | -0.33 |
| KLP Obligasjon 1 år | 1.17 | 0.13 | 0.46 | 1.04 | 0.00 | 0.32 |
| PLUSS Obligasjon | 1.59 | 0.70 | 0.98 | 1.32 | 0.43 | 0.70 |
| PLUSS Rente | 0.10 | 0.04 | 0.06 | 0.06 | -0.00 | 0.02 |
| Odin Norsk Obligasjon C | 1.22 | 0.32 | 0.56 | 0.82 | -0.08 | 0.16 |
| Nordea Statsobligasjon II | -0.02 | -0.39 | -0.31 | -0.11 | -0.48 | -0.40 |
| C Worldwide Obligasjon | 0.43 | 0.05 | 0.04 | 0.27 | -0.11 | -0.12 |
| Danske Invest Norsk Obligasjon | 1.81 | 0.77 | 0.76 | 1.21 | 0.17 | 0.16 |
| DNB Obligasjon 20 E | 4.93 | 2.17 | 2.18 | 4.20 | 1.44 | 1.44 |
| DNB Obligasjon 20 A | 0.18 | 0.09 | 0.09 | 0.06 | -0.02 | -0.03 |
| DNB Obligasjon 20 C | 0.13 | 0.06 | 0.06 | 0.09 | 0.02 | 0.02 |
| DNB Obligasjon 20 D | 0.29 | 0.12 | 0.12 | 0.23 | 0.06 | 0.07 |
| Eika Obligasjon | 0.50 | 0.02 | 0.02 | 0.38 | -0.10 | -0.11 |
| KLP Obligasjon 3 år | 0.51 | 0.08 | 0.08 | 0.43 | 0.00 | -0.00 |
| Nordea Obligasjon II | 1.33 | 0.13 | 0.10 | 0.90 | -0.30 | -0.33 |
| PLUSS Pensjon | 0.03 | 0.01 | 0.01 | 0.02 | -0.00 | -0.00 |
| Storebrand Kreditt IG 20 | 1.23 | 0.53 | 0.47 | 1.01 | 0.31 | 0.25 |
| Alfred Berg Obligasjon | 9.09 | 3.58 | 3.21 | 5.51 | -0.01 | -0.38 |
| Danske Bank Institusjon | 8.11 | 4.94 | 4.32 | 7.01 | 3.84 | 3.22 |
| DNB Kreditt D | 7.04 | 4.16 | 3.80 | 5.88 | 3.00 | 2.64 |
| DNB Obligasjon E | 18.41 | 12.66 | 11.62 | 15.73 | 9.98 | 8.94 |
| DNB Obligasjon A | 2.04 | 1.37 | 1.27 | 1.31 | 0.65 | 0.55 |
| KLP Kredittobligasjon | 1.24 | 0.53 | 0.41 | 1.08 | 0.37 | 0.26 |
| Nordea Norsk Kreditt | 0.02 | 0.01 | 0.01 | 0.01 | -0.00 | -0.00 |
| Nordea Norsk Kreditt I | 1.10 | 0.51 | 0.43 | 0.92 | 0.33 | 0.25 |
| Nordea Obligasjon III | 2.73 | 1.02 | 0.79 | 2.17 | 0.46 | 0.24 |
| Nordea Obligasjon NO | 1.15 | 0.24 | 0.12 | 1.05 | 0.14 | 0.02 |
| Storebrand Norsk Kreditt IG | 8.89 | 4.79 | 4.09 | 7.12 | 3.02 | 2.32 |
| KLP Statsobligasjon | -0.06 | -2.44 | -2.71 | -0.58 | -2.96 | -3.23 |
| Storebrand Statsobligasjon | -0.16 | -0.66 | -0.79 | -0.32 | -0.81 | -0.95 |
| KLP Obligasjon 5 år | 0.53 | 0.12 | -0.07 | 0.42 | 0.00 | -0.19 |
| Handelsbanken Obligasjon A | 0.39 | -0.25 | -0.37 | 0.01 | -0.63 | -0.75 |
| **Mean** | 2.38 | 1.10 | 0.99 | 1.85 | 0.57 | 0.46 |
| **Standard Deviation** | 3.97 | 2.64 | 2.42 | 3.30 | 2.09 | 1.90 |

Table A9.2: The table displays the estimated monthly value added in million NOK in excess of the reported and KLP benchmark for each fund in the time period 2015-2019. The calculation is based on equation 2.6 in section 2 ($\overline{V}_i = \frac{1}{T}\sum_{t=1}^{T} V_{it}$).

# A10 Regression Tables

## A10.1 Single-Index Model

**Table A10.1:** Single-Index Model - Regression Table

| | Gross | | | Net | | |
|---|---|---|---|---|---|---|
| Fund | $\alpha$ | $\beta_{NORM}$ | $R^2_{Adjusted}$ | $\alpha$ | $\beta_{NORM}$ | $R^2_{Adjusted}$ |
| Alfred Berg Kort Stat | -0.008 | 0.212*** | 0.362 | -0.054*** | 0.212*** | 0.363 |
| | (-0.633) | (-14.173) | | (-4.322) | (-14.177) | |
| KLP Obligasjon 1 år | -0.013 | 0.490*** | 0.693 | -0.021 | 0.490*** | 0.693 |
| | (-0.995) | (-6.711) | | (-1.638) | (-6.711) | |
| PLUSS Obligasjon | -0.035 | 0.895 | 0.526 | -0.056 | 0.894 | 0.526 |
| | (-0.667) | (-0.533) | | (-1.071) | (-0.536) | |
| PLUSS Rente | -0.034 | 0.895 | 0.534 | -0.076 | 0.894 | 0.534 |
| | (-0.666) | (-0.531) | | (-1.498) | (-0.535) | |
| Odin Norsk Obligasjon | -0.013 | 0.670 | 0.443 | -0.055 | 0.669 | 0.443 |
| | (-0.252) | (-1.524) | | (-1.048) | (-1.526) | |
| Nordea Statsobligasjon II | -0.127** | 0.807 | 0.343 | -0.140** | 0.806 | 0.343 |
| | (-2.214) | (-0.799) | | (-2.446) | (-0.801) | |
| C Worldwide Obligasjon | -0.182*** | 1.625*** | 0.904 | -0.211*** | 1.625*** | 0.903 |
| | (-10.605) | (11.239) | | (-12.306) | (11.232) | |
| Danske Invest Norsk Obligasjon | -0.174*** | 1.842*** | 0.926 | -0.208*** | 1.843*** | 0.927 |
| | (-8.732) | (9.416) | | (-10.671) | (9.425) | |
| DNB Obligasjon 20 E | -0.164*** | 1.741*** | 0.954 | -0.176*** | 1.741*** | 0.954 |
| | (-12.304) | (12.763) | | (-13.255) | (12.761) | |
| DNB Obligasjon 20 A | -0.164*** | 1.730*** | 0.954 | -0.205*** | 1.729*** | 0.954 |
| | (-12.307) | (12.761) | | (-15.525) | (12.612) | |
| DNB Obligasjon 20 C | -0.164*** | 1.731*** | 0.955 | -0.193*** | 1.731*** | 0.955 |
| | (-12.343) | (12.831) | | (-14.579) | (12.816) | |
| DNB Obligasjon 20 D | -0.163*** | 1.728*** | 0.954 | -0.180*** | 1.727*** | 0.954 |
| | (-12.304) | (12.585) | | (-13.602) | (12.570) | |
| Eika Obligasjon | -0.152*** | 1.402*** | 0.842 | -0.169*** | 1.403*** | 0.842 |
| | (5.304) | (3.358) | | (-5.926) | (3.368) | |
| KLP Obligasjon 3 år | -0.129*** | 1.296* | 0.813 | -0.137*** | 1.296* | 0.813 |
| | (-3.486) | (1.895) | | (-3.711) | (1.895) | |
| Nordea Obligasjon II | -0.155*** | 1.465*** | 0.855 | -0.172*** | 1.465*** | 0.855 |
| | (-4.605) | (3.120) | | (-5.010) | (3.119) | |
| PLUSS Pensjon | -0.088*** | 1.164 | 0.879 | -0.130*** | 1.163*** | 0.879 |
| | (-5.887) | (-0.533) | | (-8.716) | (-0.707) | |
| Storebrand Kreditt IG 20 | -0.162*** | 1.595*** | 0.889 | -0.174*** | 1.595*** | 0.889 |
| | (-6.304) | (4.438) | | (-6.792) | ( 4.437) | |
| Alfred Berg Obligasjon | -0.106*** | 1.383*** | 0.915 | -0.153*** | 1.382*** | 0.917 |
| | (-6.442) | (6.389) | | (-9.552) | (6.378) | |
| Danske Bank Institusjon | -0.154*** | 1.765*** | 0.896 | -0.166*** | 1.765*** | 0.896 |
| | (-5.283) | (6.348) | | (-5.712) | (6.348) | |
| DNB Kreditt D | -0.138*** | 1.680*** | 0.962 | -0.154*** | 1.680*** | 0.962 |
| | (-12.006) | (16.300) | | (-13.479) | (16.284) | |
| DNB Obligasjon E | -0.129*** | 1.721*** | 0.948 | -0.146*** | 1.722*** | 0.948 |
| | (-10.720) | (18.902) | | (-12.090) | (18.867) | |
| DNB Obligasjon A | -0.129*** | 1.709*** | 0.948 | -0.170*** | 1.709*** | 0.948 |
| | (-10.792) | (19.193) | | (-14.277) | (19.120) | |
| KLP Kredittobligasjon | -0.133*** | 1.450*** | 0.897 | -0.142*** | 1.450*** | 0.897 |
| | (-4.349) | (3.387) | | (-4.621) | (3.387) | |
| Nordea Obligasjon Stars A | -0.163*** | 1.700*** | 0.953 | -0.201*** | 1.699*** | 0.953 |
| | (-13.749) | (12.249) | | (-16.887) | (12.707) | |
| Nordea Obligasjons Stars S | -0.166*** | 1.707*** | 0.954 | -0.178*** | 1.707*** | 0.954 |
| | (-14.349) | (12.711) | | (-15.429) | (12.706) | |
| Nordea Obligasjon III | -0.165*** | 1.635*** | 0.943 | -0.179*** | 1.636*** | 0.944 |
| | (-10.530) | (9.758) | | (-11.543) | (9.771) | |
| Nordea Obligasjon NO | -0.080 | 0.973 | 0.148 | -0.085 | 0.972 | 0.148 |
| | (-1.015) | (-0.051) | | (-1.083) | (-0.051) | |
| Storebrand Norsk Kreditt IG | -0.118*** | 1.463*** | 0.868 | -0.134*** | 1.463*** | 0.868 |
| | (-4.338) | (4.425) | | (-4.951) | (4.422) | |
| KLP Statsobligasjon | -0.244* | 1.848 | 0.393 | -0.252** | 1.848 | 0.393 |
| | (-1.920) | ( 1.475) | | (-1.986) | (1.475) | |
| Storebrand Statsobligasjon | -0.229** | 1.663 | 0.367 | -0.242** | 1.663 | 0.367 |
| | (-1.996) | (1.274) | | (-2.105) | (1.274) | |
| KLP Obligasjon 5 år | -0.264*** | 2.268*** | 0.715 | -0.272*** | 2.268*** | 0.715 |
| | (-2.922) | (3.273) | | (-3.015) | (3.273) | |
| Handelsbanken Obligasjon A | -0.318*** | 2.475*** | 0.653 | -0.346*** | 2.473*** | 0.652 |
| | (-2.716) | (3.490) | | (-2.960) | (2.869) | |
| Equally weighted portfolio | -0.139*** | 1.460*** | 0.941 | -0.161*** | 1.456*** | 0.941 |
| | (-6.457) | (6.131) | | (-7.503) | (6.130) | |

*Note:* *p<0.10; **p<0.05; ***p<0.01

A10.1: The table reports the average monthly alphas in %, the and adjusted $R^2$ for each fund gross and net of expenses employing the single- index model. The model parameters are estimated using time- series regression model through OLS. Newey and West (1987) corrected t-statistics robust to serial correlation and heteroskedasticity (with an optimal lag length using a Bartlett Kernel) are shown in parenthesis. The sample period is from 2015 through 2019. Calculation are based on equation 5.1 in section 5 ($R_{it} = \alpha_i + \beta_i NORM_t + \epsilon_{it}$). H0=0 for $\alpha$ and H0=1 for $\beta_{NORM}$.

# A10.2 Multi-Index Model

**Table A10.2:** Multi-Index Model - Regression Table

| | Gross | | | | | | Net | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fund | $\alpha$ | $\beta_{STX}$ | $\beta_{NORM1}$ | $\beta_{NORM2}$ | $\beta_{NORM3}$ | $R^2_{Adjusted}$ | $\alpha$ | $\beta_{STX}$ | $\beta_{NORM1}$ | $\beta_{NORM2}$ | $\beta_{NORM3}$ | $R^2_{Adjusted}$ |
| Alfred Berg Kort Stat | -0.045*** | 0.191* | 0.621*** | -0.054 | -0.012 | 0.583 | -0.091*** | 0.193* | 0.618*** | -0.054 | -0.011 | 0.586 |
| | (-3.780) | (1.664) | (2.765) | (-0.340) | (-0.066) | | (-7.683) | (1.698) | (2.765) | (-0.338) | (-0.062) | |
| KLP Obligasjon 1 år | -0.057*** | -0.233** | -0.389** | 1.198*** | 0.216 | 0.899 | -0.066*** | -0.233** | -0.389** | 1.200*** | 0.216 | 0.891 |
| | (-4.441) | (-2.528) | (-2.001) | (10.325) | (1.463) | | (-5.133) | (-2.528) | ( -2.001) | (10.325) | (1.463) | |
| PLUSS Obligasjon | -0.065* | -0.197 | -3.805*** | 2.648*** | 1.985*** | 0.841 | -0.087** | -0.195 | -3.808*** | 2.649*** | 1.984*** | 0.842 |
| | (-1.950) | (0.746) | (-8.433) | (6.291) | (3.104) | | (-2.573) | (-0.739) | (-8.453) | (6.309) | (3.106) | |
| PLUSS Rente | 0.014 | -0.096 | -3.841*** | 2.479*** | 2.147*** | 0.845 | -0.028 | -0.093 | -3.845*** | 2.480*** | 2.146*** | 0.845 |
| | (0.599) | (-0.371) | (-8.985) | (7.113) | (4.879) | | (-0.918) | (-0.385) | (-8.693) | (7.051) | (3.901) | |
| Odin Norsk Obligasjon | -0.023 | -0.342* | -3.037*** | 2.542*** | 1.111** | 0.8871 | -0.065*** | -0.342* | -3.036*** | 2.542*** | 1.111** | 0.887 |
| | (-0.968) | (-1.912) | (-7.446) | (8.745) | (2.645) | | (-2.681) | (-1.912) | (-7.446) | ( 8.747) | (2.646) | |
| Nordea Statsobligasjon II | -0.087*** | 0.740*** | 0.260*** | -0.009 | -0.054 | 0.970 | -0.101*** | 0.741*** | 0.259*** | -0.009 | -0.055 | 0.970 |
| | (-9.686) | (20.545) | (5.443) | (-0.241) | (-0.848) | | (-11.164) | (20.692) | (5.478) | (-0.234) | (-0.851) | |
| C Worldwide Obligasjon | -0.080*** | -0.057** | 0.115 | 0.991*** | -0.164* | 0.979 | -0.109*** | -0.058** | 0.115 | 0.991*** | -0.164* | 0.980 |
| | (-9.361) | (-2.394) | (1.591) | (23.024) | (-1.866) | | (-12.764) | (-2.395) | (1.593) | (23.011) | (-1.867) | |
| Danske Invest Norsk Obligasjon | -0.058*** | 0.002 | -0.382*** | 1.213*** | 0.080 | 0.982 | -0.092*** | -0.002 | -0.375*** | 1.209*** | 0.082 | 0.982 |
| | (-6.536) | (0.043) | (-4.590) | (15.135) | (0.723) | | (-10.089) | (-0.036) | (-4.475) | (14.404) | ( 0.701) | |
| DNB Obligasjon 20 E | -0.057*** | -0.033 | -0.345*** | 0.945*** | 0.300** | 0.977 | -0.069*** | -0.033 | -0.346*** | 0.948*** | 0.299** | 0.977 |
| | (-6.021) | (-0.635) | (-4.138) | (11.759) | (2.332) | | (-7.332) | (-0.632) | (-4.142) | (11.762) | (2.336) | |
| DNB Obligasjon 20 A | -0.057*** | -0.032 | -0.347*** | 0.946*** | 0.296** | 0.978 | -0.099*** | -0.031 | -0.348*** | 0.945*** | 0.296** | 0.977 |
| | (-6.074) | (-0.618) | (-4.186) | (11.853) | (2.335) | | (-10.517) | (-0.605) | (-4.200) | (11.874) | (2.342) | |
| DNB Obligasjon 20 C | -0.057*** | 0.033 | -0.343*** | 0.945*** | 0.295** | 0.977 | -0.087*** | -0.032 | -0.343*** | 0.944*** | 0.294** | 0.977 |
| | (-6.105) | (-0.624) | (-4.088) | (11.896) | (2.339) | | (-9.229) | (-0.620) | (-4.084) | (11.890) | (2.334) | |
| DNB Obligasjon 20 D | -0.057*** | -0.032 | -0.348*** | 0.941*** | 0.301** | 0.977 | -0.074*** | -0.032 | -0.347*** | 0.941*** | 0.301** | 0.977 |
| | (-6.075) | (-0.624) | (-4.236) | (11.772) | (2.385) | | (-7.887) | (-0.617) | (-4.239) | (11.797) | (2.381) | |
| Eika Obligasjon | -0.072*** | 0.015 | 0.345*** | 0.570*** | -0.032 | 0.978 | -0.089*** | 0.014 | 0.344*** | 0.568*** | -0.029 | 0.978 |
| | (-8.521) | (0.321) | (3.762) | (13.202) | (-0.406) | | (-10.498) | (0.303) | (3.731) | ( 12.981) | (-0.358) | |
| KLP Obligasjon 3 år | -0.058*** | -0.060 | 0.543*** | 0.402*** | -0.029 | 0.981 | -0.067*** | -0.060 | 0.543*** | 0.402*** | -0.029 | 0.981 |
| | (-9.228) | (-1.421) | (7.871) | (8.439) | (-0.523) | | (-10.550) | (-1.422) | ( 7.872) | (8.439) | (-0.523) | |
| Nordea Obligasjon II | -0.072*** | -0.014 | 0.440*** | 0.467*** | 0.046 | 0.968 | -0.089*** | -0.014 | 0.440*** | 0.468*** | 0.046 | 0.968 |
| | (-6.041) | ( -0.284) | (5.548) | (4.373) | (0.336) | | (-7.434) | (-0.284) | (5.548) | (4.374) | ( 0.337) | |
| PLUSS Pensjon | -0.018* | -0.064 | -0.449*** | 0.582*** | 0.455*** | 0.912 | -0.060*** | -0.064 | -0.449*** | 0.582*** | 0.455*** | 0.913 |
| | (-1.863) | (-0.924) | (-4.489) | (4.327) | ( 2.788) | | (-6.124) | (-0.921) | (-4.508) | (4.338) | ( 2.791) | |
| Storebrand Kreditt IG 20 | -0.059*** | -0.121* | -0.334** | 1.128*** | 0.045 | 0.956 | -0.072*** | -0.121* | -0.334** | 1.128*** | 0.044 | 0.956 |
| | (-3.845) | (-1.931) | (-2.306) | (11.269) | (0.267) | | ( -4.664) | (-1.930) | (-2.304) | (11.271) | (0.263) | |
| Alfred Berg Obligasjon | -0.030** | -0.035 | -0.205** | 0.368** | 0.624*** | 0.909 | -0.077*** | -0.036 | -0.205** | 0.366** | 0.625*** | 0.911 |
| | (-2.030) | (-0.470) | (-2.046) | (2.549) | (3.462) | | (-5.246) | ( -0.482) | ( -2.069) | ( 2.541) | (3.431) | |
| Danske Bank Institusjon | -0.039** | 0.019 | -0.640*** | 1.237*** | 0.192 | 0.948 | -0.052*** | 0.019 | -0.640*** | 1.238*** | 0.192 | 0.948 |
| | (-2.587) | ( 0.181) | (-4.088) | (10.213) | (1.081) | | (-3.412) | (0.181) | (-4.088) | ( 10.213) | (1.081) | |
| DNB Kreditt D | -0.049*** | 0.005 | -0.494*** | 0.358*** | 1.037*** | 0.970 | -0.065*** | 0.005 | -0.495*** | 0.357*** | 1.038*** | 0.970 |
| | (-5.122) | (0.086) | (-5.297) | (4.851) | (8.416) | | ( -6.852) | (0.092) | (-5.301) | 4.849) | 8.422) | |
| DNB Obligasjon E | -0.036*** | 0.030 | -0.667*** | 0.406*** | 1.120*** | 0.935 | -0.052*** | 0.030 | -0.667*** | 0.406*** | 1.122*** | 0.935 |
| | (-2.820) | (0.363) | (-7.244) | ( 4.210) | (8.026) | | (-4.125) | ( 0.367) | (-7.248) | ( 4.206) | ( 8.031) | |
| DNB Obligasjon A | -0.036*** | 0.031 | -0.665*** | 0.406*** | 1.111*** | 0.935 | -0.077*** | 0.032 | -0.667*** | 0.404*** | 1.113*** | 0.935 |
| | (-2.816) | (0.381) | (-7.222) | (4.208) | (7.956) | | (-6.105) | (0.388) | (-7.236) | (4.194) | ( 7.973) | |
| KLP Kredittobligasjon | -0.059*** | -0.068 | 0.208** | 0.152** | 0.608*** | 0.962 | -0.068*** | -0.068 | 0.208** | 0.152** | 0.608*** | 0.962 |
| | (-4.710) | (-1.342) | (2.305) | (2.484) | (8.000) | | (-5.372) | (-1.343) | (2.305) | ( 2.484) | ( 7.999) | |
| Nordea Obligasjon Stars A | -0.072*** | -0.034 | -0.321** | 0.426*** | 0.857*** | 0.965 | -0.111*** | -0.034 | -0.321** | 0.425*** | 0.856*** | 0.965 |
| | (-4.686) | (-0.560) | (-2.628) | (7.037) | (6.228) | | (-7.109) | (-0.560) | ( -2.628) | ( 7.036) | (6.227) | |
| Nordea Obligasjon Stars S | -0.074*** | -0.035 | -0.320** | 0.422*** | 0.863*** | 0.964 | -0.086*** | -0.035 | -0.320** | 0.422*** | 0.863*** | 0.964 |
| | (-4.613) | (-0.565) | (-2.647) | (7.247) | (6.321) | | (-5.395) | (-0.566) | (-2.647) | ( 7.246) | 6.321 | |
| Nordea Obligasjon III | -0.074*** | -0.010 | -0.103 | 0.551*** | 0.491*** | 0.977 | -0.088*** | -0.011 | -0.105 | 0.549*** | 0.497*** | 0.977 |
| | (-6.614) | (-0.215) | (-1.065) | (8.449) | (4.332) | | (-7.848) | (-0.240) | (-1.092) | (8.236) | (4.350) | |
| Nordea Obligasjon NO | -0.012 | -0.158 | 0.818* | 0.865** | -0.931 | 0.181 | 0.018 | -0.158 | 0.818* | 0.865** | -0.931 | 0.181 |
| | (-0.212) | (-0.960) | (1.691) | (2.233) | (-0.957) | | (-0.300) | (-0.959) | (1.690) | ( 2.233) | (-0.956) | |
| Storebrand Norsk Kreditt IG | -0.032* | -0.043 | -0.673*** | 0.689*** | 0.688*** | 0.900 | -0.049** | -0.043 | -0.672*** | 0.689*** | 0.687*** | 0.900 |
| | (-1.651) | (-0.520) | (-4.813) | (6.993) | (3.765) | | (-2.510) | (-0.520) | (-4.810) | ( 6.991) | (3.761) | |
| KLP Statsobligasjon | -0.080*** | 0.781*** | 0.238*** | -0.098** | 0.045 | 0.984 | -0.089*** | 0.781*** | 0.238*** | -0.098** | 0.045 | 0.984 |
| | (-7.152) | (18.492) | (3.748) | (-2.079) | (0.645) | | (-7.894) | (18.492) | (3.748) | (-2.079) | (0.644) | |
| Storebrand Statsobligasjon | -0.0788*** | 0.874*** | 0.028 | 0.004 | -0.018 | 0.994 | -0.091*** | 0.874*** | 0.028 | 0.004 | -0.018 | 0.994 |
| | (-10.360) | (34.246) | (0.859) | (0.137) | (-0.449) | | (-12.006) | (34.245) | (0.860) | (0.138) | (-0.449) | |
| KLP Obligasjon 5 år | -0.058*** | 0.011 | 0.709*** | 0.250*** | -0.118** | 0.984 | -0.067*** | 0.011 | 0.709*** | 0.250*** | -0.1180** | 0.984 |
| | (-6.062) | (0.284) | (11.289) | (6.287) | ( -2.141) | | (-6.928) | ( 0.284) | ( 11.288) | (6.287) | (-2.141) | |
| Handelsbanken Obligasjon A | -0.0974*** | 0.058 | 0.902*** | 0.111** | -0.083 | 0.979 | -0.125*** | 0.055 | 0.906*** | 0.105* | -0.078 | 0.979 |
| | (-7.310) | (0.954) | (8.174) | (2.071) | (-1.130) | | (-8.711) | (0.872) | (8.293) | (1.921) | (-1.033) | |

*Note:* *p<0.10; **p<0.05; ***p<0.01

Table A10.2: The table reports the estimated monthly alphas in %, the and adjusted $R^2$ for the multi- index model gross and net of expenses. The model parameters are estimated using time- series regression model through OLS. Newey and West (1987) corrected t-statistics robust to serial correlation and heteroskedasticity (with an optimal lag length using a Bartlett Kernel) are shown in parenthesis. The sample period is from 2015 through 2019. Calculation are based on equation 5.2 in section 5 ($R_{it} = \alpha_i + \beta_{i,STX}STX_t + \beta_{i,RM1}RM1_t + \beta_{i,RM2}RM2_t + \beta_{i,RM3}RM3_t + \epsilon_{it}$).

## A10.3 Asset Class Factor Model

**Table A10.3:** ACFM Regression table

| | Gross | | | | | | Net | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fund | $\alpha$ | $\beta_{STX}$ | $\beta_{NORM1}$ | $\beta_{NORM2}$ | $\beta_{NORM3}$ | $R^2_{Adjusted}$ | $\alpha$ | $\beta_{STX}$ | $\beta_{NORM1}$ | $\beta_{NORM2}$ | $\beta_{NORM3}$ | $R^2_{Adjusted}$ |
| Alfred Berg Kort Stat | -0.064*** | ***0.397 | 0.565** | 0.000 | 0.037 | 0.583 | -0.111*** | 0.400*** | 0.562** | 0.000 | 0.038 | 0.586 |
| | (-8.551) | (3.716) | (2.511) | (0.000) | (0.245) | | (-14.722) | (3.761) | (2.509) | (0.000) | (0.255) | |
| KLP Obligasjon 1 år | -0.060*** | 0.000 | 0.000 | 1.000 | 0.000 | 0.821 | -0.068*** | 0.000 | 0.000 | 1.000 | 0.000 | 0.821 |
| | (-9.501) | (0.000) | (0.000) | (0.000) | (0.000) | | (-10.825) | (0.000) | (0.000) | (0.000) | (0.000) | |
| PLUSS Obligasjon | -0.020 | 0.000 | 0.000 | 1.000 | 0.000 | 0.173 | -0.041 | 0.000 | 0.000 | 1.000 | 0.000 | 0.173 |
| | (-0.771) | (0.000) | (0.000) | (0.000) | (0.000) | | (-1.587) | (0.000) | (0.000) | (0.000) | (0.000) | |
| PLUSS Rente | -0.020 | 0.000 | 0.000 | 1.000 | 0.000 | 0.173 | -0.041 | 0.000 | 0.000 | 1.000 | 0.000 | 0.173 |
| | (-0.771) | (0.000) | (0.000) | (0.000) | (0.000) | | (-1.587) | (0.000) | (0.000) | (0.000) | (0.000) | |
| Odin Norsk Obligasjon | -0.032 | 0.000 | 0.000 | 1.000 | 0.000 | 0.272 | -0.075*** | 0.000 | 0.000 | 1.000 | 0.000 | 0.272 |
| | (-1.603) | (0.000) | (0.000) | (0.000) | (0.000) | | (-3.637) | (0.000) | (0.000) | (0.000) | (0.000) | |
| Nordea Statsobligasjon II | -0.095*** | 0.805*** | 0.195*** | 0.000 | 0.000 | 0.969 | -0.108*** | 0.805*** | 0.195*** | 0.000 | 0.000 | 0.969 |
| | (-14.157) | (24.117) | (5.855) | (0.000) | (0.000) | | (-16.178) | (24.208) | (5.853) | (0.000) | (0.000) | |
| C Worldwide Obligasjon | -0.094*** | 0.036 | 0.046 | 0.917*** | 0.000 | 0.974 | -0.123*** | 0.036 | 0.047 | 0.917*** | 0.000 | 0.974 |
| | (-12.125) | (0.931) | (0.876) | (32.014) | (0.000) | | (-15.874) | (0.936) | (0.877) | (32.034) | (0.000) | |
| Danske Invest Norsk Obligasjon | -0.094*** | 0.036 | 0.047 | 0.917*** | 0.000 | 0.974 | -0.123*** | 0.036 | 0.047 | 0.917*** | 0.000 | 0.974 |
| | (-12-125) | (0.931) | (0.876) | (32.014) | (0.000) | | (-15.874) | (0.936) | (0.877) | (32.034) | (0.000) | |
| DNB Obligasjon 20 E | -0.063*** | 0.000 | 0.000 | 0.942*** | 0.058 | 0.958 | -0.076*** | 0.000 | 0.000 | 0.942*** | 0.058 | 0.958 |
| | (-6.246) | (0.000) | (0.000) | (7.585) | (0.465) | | (-7.464) | (0.000) | (0.000) | (7.581) | (0.468) | |
| DNB Obligasjon 20 A | -0.065*** | 0.000 | 0.000 | 0.933*** | 0.067 | 0.958 | -0.107*** | 0.000 | 0.000 | 0.932*** | 0.068 | 0.958 |
| | (-6.332) | (0.000) | (0.000) | (7.682) | (0.547) | | (-10.417) | (0.000) | (0.000) | (7.681) | (0.559) | |
| DNB Obligasjon 20 C | -0.065*** | 0.000 | 0.000 | 0.933*** | 0.067 | 0.958 | -0.094*** | 0.000 | 0.000 | 0.933*** | 0.067 | 0.958 |
| | (-6.361) | (0.000) | (0.000) | (7.706) | (0.550) | | (-9.263) | (0.000) | (0.000) | (7.703) | (0.555) | |
| DNB Obligasjon 20 D | -0.065*** | 0.000 | 0.000 | 0.929*** | 0.071 | 0.958 | -0.082*** | 0.000 | 0.000 | 0.928*** | 0.072 | 0.958 |
| | (-6.328) | (0.000) | (0.000) | (7.617) | (0.585) | | (-7.998) | (0.000) | (0.000) | (7.632) | (0.589) | |
| Eika Obligasjon | -0.084*** | 0.096* | 0.312*** | 0.536*** | 0.056 | 0.973 | -0.101*** | 0.095* | 0.311*** | 0.534*** | 0.059 | 0.973 |
| | (-10.744) | (1.984) | (3.887) | (12.609) | (0.949) | | (-12.911) | (1.971) | (3.870) | (12.516) | (1.002) | |
| KLP Obligasjon 3 år | -0.074*** | 0.055 | 0.456*** | 0.354*** | 0.095 | 0.971 | -0.083*** | 0.055 | 0.496*** | 0.354*** | 0.095 | 0.971 |
| | (-9.524) | (1.334) | (5.310) | (5.847) | (1.046) | | (-10.592) | (1.335) | (5.308) | (5.845) | (1.046) | |
| Nordea Obligasjon II | -0.079*** | 0.033 | 0.421*** | 0.448*** | 0.098 | 0.969 | -0.096*** | 0.034 | 0.421*** | 0.448*** | 0.098 | 0.969 |
| | (-9.808) | (0.789) | (5.818) | (5.358) | (0.923) | | (-11.876) | (0.791) | (5.817) | (5.359) | (0.925) | |
| PLUSS Pensjon | -0.070*** | 0.070 | 0.000 | 0.398*** | 0.532** | 0.807 | -0.112*** | 0.070 | 0.000 | 0.398*** | 0.532*** | 0.807 |
| | (-3.360) | (0.872) | (0.000) | (3.292) | (3.070) | | (-5.374) | (0.878) | (0.000) | (3.290) | (3.066) | |
| Storebrand Kreditt IG 20 | -0.084*** | 0.000 | 0.000 | 1.000 | 0.000 | 0.913 | -0.097*** | 0.000 | 0.000 | 1.000 | 0.000 | 0.913 |
| | (-5.520) | (0.000) | (0.000) | (0.000) | (0.000) | | (-6.3424) | (0.000) | (0.000) | (0.000) | (0.000) | |
| Alfred Berg Obligasjon | -0.057*** | 0.047 | 0.000 | 0.273** | 0.681*** | 0.893 | -0.104*** | 0.047 | 0.000 | 0.271** | 0.682*** | 0.893 |
| | (-3.863) | (0.936) | (0.000) | (2.192) | (4.877) | | (-7.097) | (0.953) | (0.000) | (2.176) | (4.916) | |
| Danske Bank Institusjon | -0.050*** | 0.000 | 0.000 | 1.000 | 0.000 | 0.901 | -0.062*** | 0.000 | 0.000 | 1.000 | 0.000 | 0.901 |
| | (-3.033) | (0.000) | (0.000) | (0.000) | (0.000) | | (-3.802) | (0.000) | (0.000) | (0.000) | (0.000) | |
| DNB Kreditt D | -0.047*** | 0.000 | 0.000 | 0.387** | 0.613*** | 0.941 | -0.063*** | 0.000 | 0.000 | 0.386** | 0.614*** | 0.941 |
| | (-4.163) | (0.000) | (0.000) | (2.334) | (3.670) | | (-5.621) | (0.000) | (0.000) | (2.327) | (3.700) | |
| DNB Obligasjon E | -0.032** | 0.000 | 0.000 | 0.444** | 0.556** | 0.892 | -0.049*** | 0.000 | 0.000** | 0.443 | 0.557** | 0.892 |
| | (-2.018) | (0.000) | (0.000) | (2.107) | (2.644) | | (-3.059) | (0.000) | (0.000) | (2.103) | (2.646) | |
| DNB Obligasjon A | -0.033** | 0.000 | 0.000 | 0.437** | 0.563*** | 0.892 | -0.075*** | 0.000 | 0.000 | 0.435** | 0.565*** | 0.892 |
| | (-2.110) | (0.000) | (0.000) | (2.116) | (2.725) | | (-4.727) | (0.000) | (0.000) | (2.105) | (2.73) | |
| KLP Kredittobligasjon | -0.070*** | 0.0112 | 0.176* | 0.119* | 0.694*** | 0.960 | -0.079*** | 0.011 | 0.176* | 0.119* | 0.694*** | 0.960 |
| | (-7.775) | (0.225) | (1.963) | (1.973) | (6.803) | | (-8.694) | (0.226) | (1.962) | (1.972) | (6.802) | |
| Nordea Obligasjon Stars A | -0.070*** | 0.000 | 0.000 | 0.459*** | 0.541*** | 0.950 | -0.107*** | 0.000 | 0.000 | 0.458*** | 0.542*** | 0.950 |
| | (-6.651) | (0.000) | (0.000) | (2.810) | (3.316) | | (-10.217) | (0.000) | (0.000) | (2.808) | (3.322) | |
| Nordea Obligasjon Stars S | -0.071*** | 0.000 | 0.000 | 0.458*** | 0.542*** | 0.950 | -0.083*** | 0.000 | 0.000 | 0.458*** | 0.542*** | 0.950 |
| | (-6.637) | (0.000) | (0.000) | (2.809) | (3.323) | | (-7.812) | (0.000) | (0.000) | (2.809) | (3.325) | |
| Nordea Obligasjon III | -0.081*** | 0.000 | 0.000 | 0.526*** | 0.474*** | 0.975 | -0.095*** | 0.000 | 0.000 | 0.524 | 0.476 | 0.975 |
| | (-10.961) | (0.000) | (0.000) | (6.477) | (5.847) | | (-12.848) | (0.000) | (0.000) | (6.327) | (5.744) | |
| Nordea Obligasjon NO | -0.067 | 0.179 | 0.413 | 0.408 | 0.000 | 0.182 | -0.072 | 0.180 | 0.412 | 0.408 | 0.000 | 0.182 |
| | (1.247) | (0.615) | (1.063) | (2.358) | (0.000) | | (-1.347) | (0.616) | (1.062) | (2.359) | (0.000) | |
| Storebrand Norsk Kreditt IG | -0.060*** | 0.000 | 0.000 | 0.599*** | 0.401** | 0.835 | -0.077*** | 0.000 | 0.000 | 0.599*** | 0.401** | 0.835 |
| | (-2.939) | (0.000) | (0.000) | (3.045) | (2.038) | | (-3.753) | (0.000) | (0.000) | (3.047) | (2.039) | |
| KLP Statsobligasjon | -0.085*** | 0.834*** | 0.166*** | 0.000 | 0.000 | 0.983 | -0.094*** | 0.834*** | 0.166*** | 0.000 | 0.000 | 0.983 |
| | (-8.006) | (21-336) | (4.239) | (0.000) | (0.000) | | (-8.788) | (21.332) | (4.239) | (0.000) | (0.000) | |
| Storebrand Statsobligasjon | -0.096*** | 0.946*** | 0.000 | 0.010 | 0.044 | 0.983 | -0.109*** | 0.946*** | 0.010 | 0.000 | 0.044 | 0.983 |
| | (-9.093) | (27.585) | (0.152) | (0.000) | (0.956) | | (-10.270) | ((27.564) | (0.151) | (0.000) | (0.956) | |
| KLP Obligasjon 5 år | -0.083*** | 0.086 | 0.698*** | 0.148** | 0.068 | 0.968 | -0.092*** | 0.086 | 0.698*** | 0.148** | 0.068 | 0.968 |
| | (-5.578) | (1.659) | (7.035) | (2.508) | (0.674) | | (-6.132) | (1.659) | (7.032) | (2.506) | (0.675) | |
| Handelsbanken Obligasjon A | -0.101*** | 0.063 | 0.872*** | 0.065* | 0.000 | 0.979 | -0.128*** | 0.060 | 0.878*** | 0.062* | 0.000 | 0.979 |
| | (-8.228) | (1.096) | (10.465) | (1.903) | (0.000) | | (-10.453) | (1.020) | (10.468) | (1.922) | (0.000) | |

*Note:* *p<0.10; **p<0.05; ***p<0.01

A10.3: The table reports the estimated monthly alphas in %, the and adjusted $R^2$ for the restricted asset class factor model both net and gross of expenses. The model parameters are estimated through OLS, and the estimated standard errors are robust to heteroskedasticity (Huber, 1967). The parameters are calculation based on the methodology of Blake et al. (1993) and Dietze et al. (2009) ($R_{it} = \alpha_i + \beta_{i,STX}STX_t + \beta_{i,RM1}RM1_t + \beta_{i,RM2}RM2_t + \beta_{i,RM3}RM3_t + \epsilon_{it} \;\; s.t \;\; \sum_{j=1}^{K}\beta_{ij} = 1 \, and \;\; \beta_{ij} \geq \; 0$).