Report on Active Management of the Norwegian Government Pension Fund – Norway

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Executive Summary

This report contains a quantitative evaluation of the investment performance of *Folketrygdfondet's* fund *Statens Pensjonsfond Norge*, henceforth referred to as the Fund. The Norwegian Ministry of Finance instructed MSCI to evaluate the Fund's historical track record for the period 1998Q1-2010Q2, with a particular emphasis on possible exposures to systematic risk factors. The mandate from the Ministry of Finance requested that we prepare an evaluation of the Fund's performance including the following:

- *Distinguish between the total fund level and the four sub-portfolios (Norwegian equities, Norwegian fixed income, Nordic equities, and Nordic fixed income).*
- *Specify to what extent the investments have been based on obtaining exposure to different systematic risk factors, including possibly time-varying exposure to these factors, and the significance of this exposure with respect to the Fund performance.*
- *Hold the results from the quantitative analysis up against the fact that the Fund's asset allocation and governance structure has changed significantly since 1998.*

Active returns are defined as the difference in returns between the managed portfolio and the benchmark. An important first finding is that all of the four sub-portfolios – Norwegian equity, Norwegian fixed income, Nordic equity, and Nordic fixed income – tracked their benchmarks rather closely. The ex post tracking error for the total Fund was 1.46% annualized. All sub-portfolios except the Norwegian fixed income portfolio had positive mean active returns when measured over the entire sample period, but none of the mean active returns was statistically distinguishable from zero at conventional significance levels.

Next, we performed CAPM regressions, where expected returns are determined by the portfolio's exposure to its benchmark and the benchmark return. All sub-portfolios had less than full market exposure. This means that all sub-portfolios recorded a beta coefficient relative to the benchmark of less than one. In many cases, we can conclude that this underexposure is statistically significant. The CAPM alpha estimate is higher than the mean active return, albeit statistically insignificant in all four cases. Finally, we included additional factors that have been shown to explain cross-sectional differences in returns. For the equity portfolios, we included size and value factors as additional regressors. For the fixed income portfolios, we included factors that capture duration and credit bets. We performed rolling window regressions to assess time-varying alphas and factor exposures.

Looking at the sub-portfolios individually, the mean active return for the Norwegian equity portfolio was positive, but small. This portfolio had a market beta significantly less than one. This yielded a CAPM alpha higher than the mean active return, but still not statistically significant. Using the Fama-French three-factor model, we observed that the Fund had a significantly negative exposure to the size factor, which resulted in a three-factor alpha higher than the one-factor alpha and significantly different from zero at the 10% level, but not at the 5% level.

We observed the same pattern for the Nordic equity portfolio. The market beta was less than one and the portfolio had negative exposure to both the size and the value factors. The alpha estimates for the Nordic portfolio were positive but lower than the corresponding estimates for the Norwegian portfolio and not statistically significant.

The Norwegian fixed income portfolio had a market beta significantly less than one when estimated over the entire sample. Rolling window analysis showed that both the exposure to the benchmark and the exposure to the credit factor have been increasing since 2006. Currently, the estimated credit factor exposure is significantly positive. We did not estimate significant alpha in any of the models for any period.

The Nordic fixed income portfolio, which started in February 2007, has the shortest existence of the four sub-portfolios. This portfolio's benchmark exposure was slightly below one and the one-factor alpha was positive, but not significant.

After presenting the results for each sub-portfolio, we proceed to describe the active investment performance for the entire Fund, which is an aggregate of the four sub-portfolios. The investment mandate for the total Fund changed several times during the period we reviewed. In particular, weights assigned to asset classes and countries, and the designated benchmarks changed on several occasions. Partly for this reason, the active returns for the total Fund appear to be the result of active investment decisions taken at the level of each of the four sub-portfolios rather than asset allocation bets at the total Fund level. The results for the total Fund are consistent with the results for the individual equity and fixed income portfolios. The mean active return was positive but not significant. The one-factor CAPM alpha was higher than the mean active return because of a beta less than one, but it was still not statistically distinguishable from zero. The negative exposures to size and value carry over to the total Fund level, producing an alpha estimate that was positive and borderline significant at the 5% level when the benchmark excess return, size, value, and the swap spread are included as risk factors.

In sum, it seems that active management added rather than detracted from the Fund's performance: the contribution to total returns from active management was positive but small. The mean active returns were positive but statistically indistinguishable from zero. The alpha estimates indicate that the Fund achieved those positive active returns despite a negative exposure to systematic risk factors.

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1. Introduction

Folketrygdfondet (FTF) is a state-owned entity which is responsible for managing Statens Pensjonsfond Norge (SPN) and Statens Obligasjonsfond. This report examines the investment performance of SPN exclusively. The returns on the managed portfolios are compared with the returns on the designated benchmark portfolios, currently set by the Norwegian Ministry of Finance. In this analysis, we examine separately the performance for each of the four sub-portfolios: 1) Norwegian equity, 2) Norwegian fixed income, 3) Nordic equity, and 4) Nordic fixed income. Our aim is to assess whether FTF has achieved higher returns on the managed portfolios than the benchmark portfolios, and in particular, whether FTF has been able to deliver risk-adjusted abnormal returns. By risk-adjusted returns, we mean returns corrected for exposure to known risk factors, such as the market excess return, small-capitalization stocks, and fixed income securities with credit risk. One challenge encountered in the analysis is that the benchmarks for some of the sub-portfolios have undergone substantial changes during the sample period. This is especially true for the fixed income portfolios.[1]

The Norwegian equity portfolio has had the OSEBX as its benchmark since July 1, 2001, and the Oslo Børs Totalindeks prior to that date. The Nordic equity portfolio, currently consisting of stocks listed on the Swedish, Danish, and Finnish stock exchanges, has had the Nordic Benchmark Index (VINXB) as its benchmark since January 31, 2007. It is constructed by excluding Norwegian and Icelandic securities from the VINX index. Prior to January 2007, the reference index was the FTSE Norex 30, again excluding Norwegian stocks. The Norwegian fixed income portfolio has had a number of benchmarks since December 1997. Since February 24, 2009, its performance is measured against an index consisting of the Barclays Capital Global Treasury Aggregate Norway and Barclays Capital Global Aggregate Norway ex Treasuries indices, weighted by 30% and 70% respectively. Prior to that date, the benchmark consisted of various DnB swap indices and Oslo Stock Exchange government bond indices. The Nordic fixed income portfolio has had the Barclays Capital Global Aggregate Scandinavia ex Norway index as its benchmark since the portfolio was formed in February 2007. Currently, the benchmark consists of bonds issued by Swedish, Danish, and Finnish issuers. Bonds issued in the currencies SEK, DKK, EUR, GBP, and USD are eligible for inclusion in the benchmark. As of the end of the sample period, June 30, 2010, the assets under management (AUM) were distributed with 50.1% in Norwegian equity, 34.8% in Norwegian fixed income, 9.2% in Nordic equity, and 5.9% in Nordic fixed income.

Most effort will go into explaining the return on the Norwegian portfolios as these have the longest return history and, in addition, as of June 30, 2010, they represented more than 85% of the AUM.

2. Descriptive Statistics

As a first step in the evaluation of the active management of the Fund, we report the most common statistics for the distribution of absolute and active returns. Table 1 reports descriptive statistics for the portfolios that comprise the fund SPN and for the total Fund itself. For each sub-portfolio and for the total Fund, we report descriptive statistics for the actual portfolio return, the benchmark return, and the active return. The active return is defined as the difference between the portfolio return and the benchmark return throughout. All returns are reported in NOK. Note that the mean and median can be quite different in some cases, in particular for the Norwegian equity portfolio. The table shows that the Norwegian equity portfolio had the highest and the Nordic equity the lowest mean return. The

[1] This is described further in the GIPS compliant reports available on FTF's web pages (http://www.ftf.no/no/c-283-GIPS-rapporter.aspx).

Norwegian equity portfolio also had the largest standard deviation of active returns, which is commonly referred to as the tracking error. The largest negative return for the Fund and the Norwegian equity portfolio occurred in August 2008, during the peak of the financial crisis. A kurtosis greater than three indicates that the distribution of returns has fatter tails than a normal distribution, which is true for all the portfolios. In general, most utility functions imply that investors prefer high mean and skewness and low standard deviation and kurtosis.

Figure 1 displays graphs of the cumulated benchmark returns for each of the four portfolios and Figure 2 shows the same graphs for the active returns. The financial crisis, which culminated with the bankruptcy of Lehman Brothers in September 2008, is marked as a vertical bar in the figures. The benchmark returns on the equity portfolios were large and negative during the crisis, whereas the fixed income benchmarks avoided large losses. The active returns on the two equity portfolios were positive during the crisis, but turned negative when the markets recovered. As we examine further later, this is due to a less than full market exposure for the equity portfolios, which implies that both large losses and gains in the benchmark are to some extent muted in the portfolio returns. The active returns on the Norwegian fixed income portfolio were zero or negative prior to the financial crisis, after which they have turned positive. The Nordic fixed income portfolio also had zero or negative returns until the first quarter of 2009, after which they have been predominantly positive.

3. Factor Models

In the next sections, we provide risk-adjusted assessments of the returns obtained by SPN by using factor models. In particular, we postulate asset pricing models for expected returns and gauge the success of active management by the size and significance of the alpha, where alpha is the intercept in a time series regression of excess returns on risk factors

$$R_{p,t} - R_{f,t} = a + \sum_i b_i \times f_{i,t} + e_t. \tag{1}$$

In the above equation, $R_{p,t}$ is the return on the SPN portfolio and $R_{f,t}$ is the risk-free rate. The risk-free rate is taken to be the one-month zero coupon spot rate from the '*Norway Government Debt Benchmark - Zero Coupon*' curve from RiskMetrics. The b_i, estimated by least squares, are exposures to the risk factors $f_{i,t}$. The e_t terms are the residuals. The intercept from the regression model, a, represents a risk-adjusted measure of abnormal returns. If the intercept is positive and significant after controlling for all systematic risk factors, then we say that active management has significantly added value in a way that could not have been achieved by passive exposure to risk factors.

In our choice of factors, we follow the criteria set forth in the Ang, Goetzmann, and Schaefer (2009) (AGS) report: the factors must be widely recognized both in the academic literature and among practitioners, the set of factors must be parsimonious, and they must be tradable. The last requirement is important because when the factors are tradable, the intercept can be interpreted as a return: risk-adjusted outperformance or underperformance. When the factor portfolios do not represent traded assets, this interpretation is lost.

The AGS report focuses on partial correlations between active returns and systematic risk factors, where benchmark excess returns are excluded from the set of risk factors. Unlike the AGS report, we do not focus on partial correlations of active returns. Instead, we focus on time series regressions with portfolio excess returns on the left hand side and a constant and systematic risk factors on the right hand side. We do include benchmark excess returns as a risk factor and, as we shall see, this is important. The reason is that the Fund has a market beta which is significantly less than one. We need to control for this in order to accurately gauge the exposures to the remaining risk factors.

We focus on risk-adjusted returns and typically find that the Fund has a higher risk-adjusted return than mean active return, which is mainly due to negative exposure to risk factors. It could be argued that FTF's mandate is to deliver positive active returns and these are a product of both alpha (selection) and beta risk (allocation). For that reason, we also highlight estimates of mean active returns and their significance throughout the report and when appropriate compare these with alpha estimates from various factor models.

4. Equity Portfolios

The Norwegian equity portfolio has an arithmetic mean active return of 1.22% annualized. The Nordic equity portfolio, which started in May 2001, has a mean active return of 0.26% annualized. FTF has thus achieved higher returns than the designated benchmarks both for the Norwegian and the Nordic equity portfolios. The associated t-statistics (0.89 and 0.37 respectively) are too small to reject the null hypothesis that the true active return is zero at conventional significance levels. However, mean active returns are in themselves not a good measure of investment performance. Positive active returns in a boom market could be due to leveraging market exposure and, as such, does not necessarily represent skill on the manager's part. Similarly, negative active returns during a market rally could be due to less than full market exposure and could represent prudence rather than a lack of skill. Better measures of investment performance are therefore obtained by adjusting returns for exposure to systematic risk factors, as described in the previous section.

4.1 The Norwegian Equity Portfolio

We start by computing the alpha relative to a single index model, an empirical counterpart to the Capital Asset Pricing Model (CAPM). For simplicity, we shall refer to a regression model relative to a broad market index as a CAPM model in the remainder of the document, although this is inaccurate as the market portfolio from CAPM is supposed to comprise all assets. We estimate the model

$$R_{p,t} - R_{f,t} = a + b \times \left(R_{b,t} - R_{f,t}\right) + e_t, \tag{2}$$

where the single factor, $R_{b,t} - R_{f,t}$, is the benchmark return in excess of the risk-free rate. Panel A of Table 2 reports the alpha and beta estimates when this model is estimated over the entire sample period. The second column shows the mean active return and shows that, while positive, it is statistically indistinguishable from zero. The third column shows the annualized alpha estimate. It is positive and greater than the mean active return. However, the GMM-corrected t-statistic of 1.43 is too low to reject the null hypothesis that alpha is zero, even at the 10% level.[2] The fourth column shows the estimate of the beta versus the benchmark. At 0.92, it is significantly less than one. The corresponding t-statistics have been computed relative to a null hypothesis that the true beta relative to the benchmark is one. The less than full market exposure helps explain why the alpha estimate is greater than the mean active return. The last column shows the R^2 from the regression. The benchmark explains 97.2% of the variation in portfolio returns.

[2] All t-statistics are constructed using standard errors that are corrected for autocorrelation and heteroskedasticity according to the Newey and West (1987) procedure.

It has been recognized both in academia and by practitioners that there are other systematic risk factors than the market excess return. The most prominent alternative asset pricing model for equities is the Fama-French (1993) three-factor model, which includes a size factor and a value factor in addition to the market excess return. The Fama-French model is estimated by

$$R_{p,t} - R_{f,t} = a + b \times \left(R_{b,t} - R_{f,t}\right) + s \times SMB_t + h \times HML_t + e_t, \quad (3)$$

where SMB is the return on a portfolio which is long small-capitalization stocks and short large-capitalization stocks and HML is long stocks with high book-to-market value and short stocks with low book-to-market value.

As a proxy for the size factor, we have used the return on the hedging portfolio constructed by taking a long position in the Oslo Børs Small Cap Index (OSESX) and a short position in the OBX Total Return Index (OBX). The Oslo Børs Small Cap Index is a total return (i.e. dividend adjusted) index which consists of the 10% lowest capitalized stocks. The OBX Total Return Index consists of the 25 most liquid stocks in the Oslo Børs Benchmark Index (OSEBX) as measured by six-month trading volume.

The value factor is constructed by taking a long position in the MSCI Norway standard value index and a short position in the MSCI Norway standard growth index. Throughout, we have used the standard MSCI value and growth indices. An alternative would be to use the investable value and growth indices.[3] The reason we choose the standard indices over the investable counterparts is the better data quality of the standard indices in the early part of the sample. In the last section of this document, we briefly discuss the implications of using the investable value and growth indices and how it affects our inferences.

Figure 3 shows a time series plot of cumulative returns on the three Fama-French factors. The cumulated returns are constructed as the cumulative sums of the factor returns. All factors have yielded positive returns when we examine the entire sample, but the cumulated market excess return has been negative on several occasions during the sample period.

Panel B of Table 2 reports the alpha, market beta, size exposure, and value exposure when the Fama-French three-factor model is used as the asset pricing model. The Fama-French model yields a higher estimate of alpha than the CAPM model. Alpha is now 1.72% annualized, up from 1.48% in CAPM. The alpha estimate is also more significant with a t-value of 1.75 versus 1.43 for CAPM. This means that the Fama-French alpha is significantly different from zero at the 10% level, but not at the 5% level. The reason for the increase in alpha is the negative exposure that the Norwegian equity portfolio has had to the Norwegian size and value factors. The exposure to the size factor is negative and highly significant, which means that the Norwegian equity portfolio is overweight large stocks relative to the benchmark. In the Fama-French model, where small-capitalization stocks are riskier, this means that the Fund is achieving higher returns by taking less risk, which is rewarded in the form of a higher alpha. Also in the Fama-French model, the Fund continues to be significantly underweight the market excess return factor. The small negative exposure to the value factor is statistically insignificant. Most of the variation in portfolio returns is explained by the benchmark alone. Hence, moving from CAPM to the Fama-French model only marginally increases the explanatory power from 97.2% to 97.5%.

Both the CAPM and the Fama-French model yield a beta relative to the market excess return which is significantly less than one. If a fraction of the equity portfolio is kept as cash or as short-term money market instruments, this contributes to the portfolio having a less than full exposure to the equity benchmark. Alternatively, the low beta could be due to holding stocks that are less “risky” than the

[3] More information about the MSCI Global Investable Market Indices Methodology can be found at http://www.mscibarra.com/eqb/methodology/meth_docs/MSCI_May10_GIMIMethod.pdf.

market. In CAPM or the Fama-French three-factor model, the portfolio manager is not penalized for having an average exposure to the market excess return which is less than one. In these models, exposure to risk factors is neither good nor bad when we are examining risk-adjusted performance. The implication is, however, that FTF's Norwegian equity portfolio typically has had positive active returns when the market has crashed and negative active returns when the market has rallied. The mean active return conditional on a positive benchmark return is -3.55% annualized. In contrast, it is 7.99% conditional on a negative benchmark return. A market beta less than one could be a desired situation for the Fund or it could reflect unwanted negative active market exposure.

As discussed above, the Norwegian equity portfolio has a significantly negative exposure to the size factor, which indicates that the Fund holds more large-capitalization stocks than the benchmark. If the mandate is simply to create excess returns, then positive exposure to known risk factors may be desirable. However, FTF has communicated to us that tilting the portfolio toward small-capitalization Norwegian stocks is not easily attainable for a manager their size. The AUM in the Norwegian equity portfolio amount to close to 10% of the market value of the OSEBX benchmark index and more than 80% of the OSESX small-capitalization index. Obtaining positive exposure to the size factor may therefore be difficult for FTF without incurring substantial market impact costs.

Other factors in addition to the size and value factors have been identified both in the academic literature and by portfolio managers. The most prominent among these is arguably the momentum factor (see, for example, Jegadeesh and Titman, 1993). Unreported results show that the Fund has no significant exposure to the momentum factor and including it does not materially change our results. Another potential risk factor is liquidity as investors require compensation for holding illiquid securities (see, Næs, Skjeltorp, and Ødegaard, 2008).[4] Including a liquidity factor does not alter our conclusions either. In the remainder, we therefore focus on two models – the CAPM and the Fama-French model – and do not explore additional factors further.

4.1.1 Time-Varying Performance and Factor Exposure

In the previous section, we estimated the model using the entire sample period from 1998:01 to 2010:06. In this section, we examine whether the risk-adjusted performance and the factor exposures have varied over time. Figure 4 shows time-varying estimates of alpha from the Fama-French model. In the upper panel, we have estimated the model using a rolling window of 24 observations. The plot reveals that alpha has been small but positive for most of the sample. The dotted lines, which represent two standard error bands, show that the rolling alpha seldom has been significantly different from zero at the 5% level. The lower panel shows alpha estimates using an expanding window.

Figure 5 shows time-varying factor exposures to the market excess return, the size factor, and the value factor for the Norwegian equity portfolio. Factor exposures are estimated from rolling 24-month window regressions. The market beta minus one is almost always below zero and hence the portfolio has had less than full market exposure for the majority of the period. It appears the Fund reduced the market exposure just prior to the peak of the financial crisis, which may have contributed to positive active returns in 2008. On the other hand, it also appears that beta was reduced during 2004 and 2005, which were years with high equity returns. This may have contributed negatively to active returns. The size exposure has been mainly negative and the value exposure has oscillated around zero.

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[4] The momentum and liquidity factors are available from Professor Bernt Arne Ødegaard's web page.
http://finance.bi.no/~bernt/financial_data/ose_asset_pricing_data/index.html

4.1.2 Comparison with other Funds

In this section, we compare the performance of SPN with the performance of other mutual funds with a similar mandate in the Norwegian market. To ensure an unbiased comparison, we include only the period from 1998:01 to 2009:12 in this analysis. It should be stressed that we have used gross returns for SPN but net returns for the other equity mutual funds, where the net returns are obtained by deducting from the gross returns all fees charged by the mutual fund except purchase fees and redemption fees. The reason for not including costs for SPN is that we do not have net returns from SPN. We have tried to adjust for this by deducting a plausible cost estimate from the gross returns. The sample ends in 2009:12 rather than 2010:06 because we do not have mutual fund data for the first half of 2010, but the omission of the last six months should not materially affect the conclusions drawn.

Sørensen (2009) shows that there is a substantial survivorship bias in the Norwegian equity mutual fund market; funds with poor performance are more likely to exit the sample. For an unbiased assessment, we compare the return on FTF's equity portfolio with the returns on all funds that existed between 1998 and 2009, including defunct funds. We start by ranking funds based on the alpha estimate from the Fama-French model. By this criterion, the Fund is number 36 of 97. As mentioned, the return series used in the analysis are before costs. However, FTF reports that costs are low at around 10 basis points per year. Deducting a conservative estimate of 20 basis points per year does not significantly alter the conclusions. The equity portfolio is then ranked as number 40 of 97 by alpha value. If we rank funds based on active returns alone, the Fund is ranked as number 39.

These results are consistent with the factor loadings we estimated above. FTF has had less than full market exposure and negative size exposure. Sørensen (2009) shows that the average Norwegian equity mutual fund has neutral market exposure and positive exposure to the size factor, i.e. a small-capitalization tilt. Hence, it is not surprising that the ranking of FTF's Norwegian equity portfolio improves as we control for systematic risk factors (from 39 to 36). The factor loadings partly explain why SPN historically has tended to outperform the average mutual fund when the market has fallen and when large-capitalization stocks have outperformed small-capitalization stocks.

4.2 The Nordic Equity Portfolio

In this section, we examine the investment performance of the Nordic equity portfolio, which had its first monthly return in 2001:05. Table 1 shows that the return on the Nordic equity portfolio has been less than half of the return on the Norwegian equity portfolio. The Nordic equity portfolio is not currency hedged. Therefore, part of the return is due to changes in the foreign exchange rates between NOK and SEK, DKK, and EUR. If the currency decomposition in the portfolio differs from that in the benchmark, this represents an active investment decision. The average currency weights for Sweden, Denmark, and Finland in the Nordic equity portfolio were 60.2%, 15.9%, and 23.9%, respectively. The average weights of the actual portfolio deviated little from the benchmark (60.3%, 15.8%, and 23.9%). We do not separately consider currency exposures as risk factors in this report. The annualized returns in NOK on the MSCI Sweden, Denmark, and Finland indices from 2001:05 to 2010:06 were 7.06%, 8.17%, and -2.32% respectively.

Like we did for the Norwegian equity portfolio, we evaluate whether the active returns for the Nordic equity portfolio can be explained by exposure to systematic risk factors. We construct Nordic size and value factors by first computing size and value factors for each of the Nordic countries Sweden, Denmark, and Finland. For this purpose we use the MSCI small-capitalization and large-capitalization indices for the size factor and the MSCI standard value and growth style indices for the value factor. The

Nordic size and value factors are then constructed as the weighted sums of the individual country size and value factors

$$SMB_{nordic} = \mathrm{w_{swe}} \times \mathrm{SMB_{swe}} + \mathrm{w_{den}} \times \mathrm{SMB_{den}} + \mathrm{w_{fin}} \times \mathrm{SMB_{fin}}, \tag{4}$$

$$HML_{nordic} = \mathrm{w_{swe}} \times \mathrm{HML_{swe}} + \mathrm{w_{den}} \times \mathrm{HML_{den}} + \mathrm{w_{fin}} \times \mathrm{HML_{fin}}, \tag{5}$$

where w is the benchmark weight for each of the three Nordic countries. Panel A of Table 3 shows alpha and market beta relative to CAPM. In Panel A, the 0.28% alpha is close to but slightly higher than the mean active return. Neither is significantly different from zero. The beta relative to the market is slightly less than one, but is precisely estimated, so this difference is significant at the 5% level. Remarkably, the model captures almost all variation in portfolio returns with an R^2 of 99.7%.

Figure 6 shows the cumulative Nordic factor returns. The solid line shows that the benchmark excess returns have been volatile and the cumulative excess returns are only marginally positive by the end of the sample period. The cumulated size and value factors, constructed according to Equations (4) and (5) above, are positive over this sample period, with the value factor recording the highest mean return.

In Panel B of Table 3, we have included the Nordic size and value factors as additional regressors. While we cannot expect much of an increase in the R^2, we do find significant exposures to our risk factors. Including size and value reduces the market beta further. The Nordic equity portfolio records a significant negative exposure to the size factor and a borderline significant negative exposure to the value factor. Since both these factors carry positive risk premiums over this sample, the alpha estimate is increased substantially relative to the CAPM model. The Fama-French alpha estimate is 0.68% per year, but not significant using GMM-corrected standard errors.

The returns differed markedly between Sweden, Denmark, and Finland. For example, overweighting the Danish market relative to the Finnish would have resulted in outperformance. In Table 4, we therefore proceed to estimate whether excess exposure to any of the three markets explains the returns. The model is estimated using the Nordic equity benchmark excess return as the first factor and the MSCI indices in NOK for Sweden, Denmark, and Finland less the Norwegian risk-free rate as additional regressors. The Fund appears to have been underweight exposure to Sweden and Denmark and hence we estimate a slightly higher intercept using this model.

4.2.1 Time-Varying Performance and Factor Exposure

We perform time-varying analysis of alpha and factor exposures for the Nordic equity portfolio in the same way we did for the Norwegian. Figure 7 shows time-varying alpha estimates relative to the Fama-French model with two standard error bands. The upper panel shows a rolling 24-month window and the lower panel shows an extending window. Both plots indicate an upward trend in alpha, but as the standard errors show, alpha is not positive enough to conclude that it is significantly different from zero in a statistical sense. In Figure 8, we have graphed the time-varying factor exposures. In the first half of the portfolio's existence, it had relatively neutral factor exposures. However, in the second half, it shows a downward trend in market and size exposure. Since late 2007, there has been an increase in the value exposure.

4.3 Summary of Findings for Equity Portfolios

We conclude the section about the equity portfolios with a brief summary of the key findings. Both the Norwegian and Nordic equity portfolios have positive mean active returns, but the mean is so small and the standard error so large that we cannot reject the null hypothesis that the true mean is zero. Both portfolios record a regression coefficient versus the market excess return which is significantly less than one. This result is robust to choosing either CAPM or Fama-French as the asset pricing model.

Whether we consider mean active returns, alpha relative to CAPM, or alpha relative to the Fama-French model, the Norwegian equity portfolio has performed better than the Nordic equity portfolio. This is true both if we look at the actual coefficient estimate and at its corresponding t-value.

5. Fixed Income Portfolios

In this section, we analyze the active returns on the two fixed income portfolios of the Fund. As was the case for the equity portfolio, FTF's mandate to manage the fixed income portfolios changed substantially over the time period under scrutiny. In 1998, regulations stipulated that at least 80% of the Fund should be invested in interest-bearing securities. Currently, this ratio is brought down to a 40% strategic target allocation weight. The other important change is related to the widening of the mandate. In 1998, the Fund could only invest in fixed income instruments issued by the Norwegian government or Norwegian companies. In 2006, regulations allowed investment in other Nordic securities, and a separate Nordic fixed income portfolio was launched in March 2007. Currently, the target weight of Nordic (excluding Norway) instruments in the fixed income portfolio is set to 15%. At the same time, the allocation inside the fixed income portfolio has significantly shifted away from government-issued securities. Up until 2007, the bulk of the portfolio (~80%) was invested in government bonds when - subsequent to a change in regulations - this weight was reduced to ~30%. The benchmarks have followed the evolution of the mandate.

The changing regulations and the consequent shifts in allocations have important implications for our report. The opportunity set available to the Fund has been widening since 1998. The increase in the target weight of the equity portion also points to a general tendency over time that has allowed the Fund to pursue increasingly riskier investment styles. The widening mandate has also provided more room for the implementation of various active strategies. Based on these observations, we do not expect to find signatures of fixed strategies throughout the whole history of the Fund. On the contrary, our statistical analysis has to be adapted to the detection of changing patterns over time. In our approach, we have addressed this issue by carrying out analysis on rolling windows, and by looking at the post-2007 period separately.

5.1 The Norwegian Fixed Income Portfolio

A general picture of the management of the Fund can be obtained from the simple regression model which we referred to as the CAPM-model in the equity section. This model provides insights on the overall risk level taken by the Fund, as well as the overall ability of the Fund's management to generate risk-adjusted return. These two measures are encompassed in a regression of the portfolio excess return on the benchmark excess return. The regression equation is the same as in the case of the equity portfolio (see Equation (2)).

As a first step, we have performed this analysis for the Norwegian fixed income portfolio. As we indicated in the introduction, due to changes in the Fund's regulations, calculating these numbers for the whole period can give only an incomplete picture of the Fund's active performance. We have therefore also performed the same analysis on smaller, rolling windows.

Results for the model estimated over the whole sample are reported in Panel A of Table 5. From the table we draw two conclusions. First, the beta of 0.85 and its very low p value indicate that for the period from January 1998 to June 2010, the fixed income portfolio has had lower risk than the benchmark. Second, the small positive alpha (0.19% annually) cannot be distinguished from zero at the usual significance levels. The high R^2 shows that a big fraction of the Fund's return can be statistically explained by the benchmark's return. We will come back to this fact when trying to break down further the active return of the Fund. Over the full period, even if the mean active return on the Norwegian fixed income portfolio was slightly negative, the Fund has generated a small positive risk-adjusted return according to CAPM. They are, however, both statistically indistinguishable from zero.

After this first static picture, we try to detect possible time varying patterns in general risk exposure and active return. The benchmark's beta coefficient calculated using 24-month rolling windows provides a more interesting picture (see Figure 9). After 2001 and until 2006, the portfolio's general risk level was on a downward trend and the rolling beta remained below one until the Lehman crisis. After October 2008, our estimated portfolio beta rose above the neutral level of one. With regards to the extreme turbulence of this period it is difficult to draw definite conclusions here; this increase in beta could indicate either an active decision to eliminate the overall deviation from the benchmark, or could also be the result of increased correlation between assets during the financial crisis. Figure 9 also shows an earlier period, around 2002, when the fixed income portfolio had a benchmark beta very close to one. When we use the same rolling windows to estimate the Fund's alpha, we detect only a few windows between mid-2002 and mid-2004 where the alpha estimate was significantly positive.

5.1.1 Systematic Factors

We have seen in the previous section that the simple CAPM model already explains most of the variation in returns. This fact foreshadows our difficulties finding other sources of the Fund's active return. Adding more factors could only marginally contribute to the explanatory power of our model. In the definition of the fixed income factors, we follow the criteria set forth in Section 3.

It is generally recognized in the academic literature that the main systematic factors (or risk premiums) that can explain active fixed income returns are related to interest rate and credit risks (see, for example Chen, Roll, and Ross, 1986 and Fama and French, 1993). A short description of the factors is given below.

- *Term factor*. This factor relates to the greater risk associated with longer maturity fixed income instruments. Algebraically, this factor can be described as the difference in returns on a long term bond and a short term bond (or bond portfolio). The expected premium on this risk factor can be collected by borrowing short term debt and lending long term debt.
- *Credit (swap) factor*. This risk factor is related to the higher risk of lower credit quality issuers. In principle, investors accepting to bear this higher credit risk are compensated by the higher yield offered on these instruments. Algebraically, the return to this factor is the difference in returns on a long term corporate bond and a long term government bond (assumed to have no credit risk). If data are sufficiently granular, this factor can be further refined according to a credit quality classification scheme and risk premiums for bearing increasing levels of credit risk can be estimated. For example, the difference in returns between A and AAA-rated, BBB and A-rated bonds and so on. As we will explain in more detail below, due to the scarcity of data, we use the swap curve to construct a proxy credit factor, hence the more appropriate 'swap factor' denomination.
- Other sources of risk have also been identified in the literature. For example, fixed income securities can have different degrees of trading activity. The uncertainty of returns on a bond due to thin trading is called liquidity risk. Investors require a compensation for this risk and thus,

over the long term, a liquidity premium can be collected by going long less liquid bonds and short more liquid bonds. This assumption is backed by empirical evidence in some markets (for the US market, see the AGS report and references therein). The relatively narrow Norwegian bond market makes it difficult to construct a bond liquidity factor for the purpose of this report. Therefore, we have decided to exclude the liquidity factor from our model.

After considering the specifics of the Norwegian market and data, we have decided to include a term and a credit (swap) factor in addition to the benchmark excess return factor in our model.

5.1.2 Active Bets or Factor Risks

We start by reviewing the construction of the term and credit factors used in our model, as it is done in a manner which is different from the usual approach. Usually, return series for these factors are constructed using sub-indices of government or broad market fixed income indices. The Norwegian bond market, however, is quite narrow, so it is not uncommon that the government bond index contains very few (sometimes just one or two) constituents for a considerable period of time. Unfortunately, this makes it difficult to build meaningful sub-indices for our purpose. Therefore, we have opted for a different approximation method which uses monthly government bond yield curve and swap rate data to construct total return series representing returns to certain segments of the fixed income market in Norway. The mathematical details of the derivation of total returns in this approach are described in the Appendix.

Concretely, our term factor for Norway, aimed at capturing the risk premium associated with holding longer maturity bonds, is defined as the difference between the total return on five-year government bonds and the risk-free rate which is taken to be the one-month zero coupon spot rate, both from the Norwegian government curve from RiskMetrics – the same as for the analysis of the equity portfolios. The choice of the five year point of the yield curve is motivated by two considerations. First, bond index data indicate that during the period considered here, the ten+ year segment of the government bond market was not very active, for some periods there were no new issues. Second, the five year point offered better explanatory power for our model than neighboring points on the yield curve.

Our credit factor is based on swap rates which we take as a proxy for yields on corporate bonds which have some – although quite small – credit risk. This choice deserves some further justification. Since counterparties in swap transactions include mainly large commercial and investment banks, insurance companies or large operating companies, the risk of their default is expected to be built into the swap rates. There are, however, a number of reasons why swap spreads are smaller and less sensitive to the credit quality of the counterparties than corporate credit spreads. Namely, the principal amount is netted out in an interest rate swap, credit enhancement devices are used for lower credit quality borrowers and finally poorly-rated firms might simply fall out of the swap market. On the other hand, swap rates have the advantage that they represent rates in a fairly liquid market and that they are available for various maturities. For all these reasons, we think that using swap rates as proxies for credit risk is justified. For consistency, the choice of the point on the swap yield curve is dictated by the choice of the long end of the term factor— that is, we define the credit factor as the difference in returns between five-year "corporate bonds" (constructed out of five-year swap rates) and five-year government bonds.

In Figure 11, we display the cumulative performance of the credit and term factors. Both of them have offered a premium during the sample period, although the return on the term factor has not been consistent. Indeed, the period started off with a surge in short term rates, which remained above or very close to long term rates until 2003, so the term factor started to deliver significant positive returns only then. On the contrary, the cumulative performance of the credit factor has been smaller, but less volatile. In summary, gaining consistent positive exposure to these systematic risk factors throughout the whole history of the Fund would have increased active returns.

With the definition of our systematic risk factors, we are now in position to augment the simple CAPM with the term and credit factors and estimate the coefficients using the following regression model

$$R_{p,t} - R_{f,t} = a + b \times \left(R_{b,t} - R_{f,t}\right) + b_{term} \times TERM_t + b_{credit} \times CREDIT_t + e_t. \quad (6)$$

The results for this three-factor model are summarized in Panel C of Table 5. The inclusion of two additional factors increased somewhat the explanatory power of the model (R^2 of 92%). The slight decrease in estimated alpha to an annualized 0.17% (statistically still non-significant) indicates that some of the active returns found in the previous one-factor analysis can be explained by exposure to systematic factors. Indeed, from this model we estimate a significant positive exposure to the credit factor, whereas the small positive exposure to the term factor turns out to be non-significant. However, we have to be aware of one potential drawback of the model: collinearity is present as the term and benchmark factors are highly correlated (see Table 6). This implies for instance that it is difficult statistically to distinguish between a negative term bet (which would reduce the portfolio's duration relative to the benchmark) and a less than full exposure to the benchmark.

One possible way to eliminate the collinearity problem in this case is to remove the term factor return from the regression. This setting corresponds to the following regression equation

$$R_{p,t} - R_{f,t} = a + b \times \left(R_{b,t} - R_{f,t}\right) + b_{credit} \times CREDIT_t + e_t. \quad (7)$$

Estimation results for the total sample period are summarized in Panel B of Table 5. The explanatory power of the model increases very slightly compared to the R^2 of the CAPM-model.

The exposure to the benchmark factor is the same as for the CAPM and the exposure to the credit factor is positive and significant in this model. Since the credit factor offered a premium during the sample period, a positive exposure implies that part of the alpha found in the simple benchmark model was in fact due to a systematic exposure to the credit factor. The alpha in this model is thus lower: 0.15% annually.

To detect a possible time-varying exposure to the credit factor, we again use 24-month rolling window periods. There is no important change in the time-varying benchmark beta and the alpha of the Fund is not significant (see Figure 12). On the other hand, the exposure to the swap factor turns positive in 2007, and keeps rising until recently (see Figure 13). After October 2008, our estimate is clearly significant. This observation is in line with the information available to us on the history of the Fund's investments. In 2006, a substantial amount of non-tradable government bonds (NOK 102 billion) was returned to the government, changing completely the relative allocation of the Fund's assets between the government and corporate sector. As for the insignificance of the credit factor exposure prior to October 2008, we must bear in mind that the Fund was mainly invested in government bonds until 2006. Hence, our time-varying credit exposures are consistent with the updated Fund mandate.

5.1.3 A Closer Look at Factors Since 2007

To take into account the sharp change in 2006, we have also performed separate sub-period analyses of the Fund's returns for the two periods before and after January 2007. In addition, for the latter period, we have received data from FTF on bank and industry bond yield spreads over five-year swap rates. We use these to construct bank and industry credit factors for the period January 2007 – June 2010.

Although one can argue that banks are the most important players in the swap market, the swap rates are not necessarily equal to yields on bonds issued by banks. As mentioned in the previous section, the functioning of the swap market (e.g. netting of principal and interest payments) means that swaps in general bear lower credit risk.

Technically, the bank and industry credit factors could be constructed in two different ways, either taking the swap returns or the government bond returns as the baseline. Their interpretation as returns to systematic strategies would change accordingly. The other factors used in the model also have to be defined consistently. We estimated exposures using both variants.

The variant which uses the government bond returns as baseline allows comparison with the previous swap factor. In Figure 14 we show that these new factors have underperformed the swap factor since January 2007, due to the widening of the spreads over the swap rates. As of June 2010, bank and industrials spreads have not returned to their 2007 levels yet. Our analysis on this 42-month period suggests that the Fund's return was not significantly exposed to the industry credit factor; therefore we present only the regression results obtained with the bank credit factor.

As a reference point, in Panels A and B of Table 7, we show factor exposures to our previous benchmark and swap factors using the short period January 2007 – June 2010. These estimates are in line with the intuition we gained from the 24-month rolling window analysis: benchmark beta is above one and there is a significant positive exposure to the credit factor.

In the new model, the bank factor exposure turns out to be significant, and we find a small increase in the explanatory power of the model. At the same time, the benchmark beta is very close to the beta of the simple benchmark model (see Panels C and D of Table 7). The swap and bank factor exposures are also very close to each other. We find, however, that alpha has increased considerably in this model. This is explained by the fact that the Fund had positive exposure to the bank factor which offered a negative cumulative performance over the period. This could be an indication of selection skills in that the Fund avoided the worst performing corporate bonds.

For the sake of completeness we have also performed an analysis of the preceding period January 1998 – December 2006 using the original benchmark and swap factors. Results are summarized in Table 8. In this period, the benchmark beta estimate is especially low (0.79) and the swap factor beta is positive but insignificant. In addition, during this period, we find a negative alpha (-0.11% annualized).

5.1.4 Summary of Findings for the Norwegian Fixed Income Portfolio

Active returns are small, positive and statistically insignificant, whether measured as alpha in the three-factor regression or simply as the mean difference between the portfolio and benchmark returns.

The Fund has maintained a lower risk exposure on average than the benchmark. However, the cumulative active return so far has also been negative. The exposure to the credit factor over the whole period is small, positive, and significant. This small overall credit exposure could be the result of time-varying patterns. Indeed, the regression analysis using 24-month rolling windows reveals an important change in October 2008 in the portfolio's exposure to systematic risk factors. Prior to that date, we estimate a significant negative exposure to the term factor and an insignificant exposure to the credit factor. Around that date, the exposure to the term factor started to gradually change sign, whereas the exposure to the credit factor jumped dramatically. Currently, both exposure estimates are positive.

For the period starting January 2007, we had the possibility to calculate exposure to more specific credit factors using data on bank and industrial bond yields. Based on the new data, we did not find important differences for the factor exposures compared to the analysis based on swap rates. Benchmark beta and exposure to credit strategies are fairly similar. Alpha, on the other hand, more than doubles, due to the much worse performance of the bank factor.

5.2 The Nordic Fixed Income Portfolio

Investments in Nordic fixed income instruments started in February 2007, which means we have 40 monthly observations. Currently, the target weight of Nordic instruments in the fixed income portfolio is set to 15%.

The short history available in itself puts serious restrictions on the significance of our estimates. Taking into account the time necessary to actually build up the portfolio and implement meaningful active strategies, the effective length of the sample period is even further reduced. For these reasons, we expect to see results with low statistical significance.

Again, we start by taking a general picture on the management of the Fund using a CAPM regression model (see Equation 2). Results for the Nordic fixed income portfolio are reported in Panel A of Table 9. The model fit is extremely good in this case (R^2 of 99%). Alpha is 0.54% annually, which is higher than in the case of the Norwegian fixed income portfolio, although it is not significant at the usual levels. The beta coefficient (0.98) is very close to one, and is only significantly different from one at the 10% level. All in all, these first numbers seem to indicate a very low overall deviation from the benchmark.

5.2.1 Systematic Factors

Although the very high fit of the benchmark factor model leaves little room for additional factors, we followed a similar approach as in the case of the Norwegian fixed income portfolio. We construct term and credit factor return series for each of the three markets similarly to our factor construction for the Norwegian fixed income portfolio.

For the Swedish and Danish markets we define the term factor as the difference in total returns between five-year government bonds and one-month zero coupon government bills (based on the government curves from RiskMetrics). The credit factor in these markets is defined as the difference in total returns between five-year corporate bonds (constructed from the swap rates) and five-year government bonds. For the Finnish market we had to alter this construction due to limited data availability. The short end of the term factor is constructed out of two-year government bond yields.

Results of this regression are shown in Panel B of Table 9. As expected, we hardly gain any further insights on the sources of active returns. The benchmark beta in this model is slightly above one, which would indicate a slightly higher overall portfolio risk than benchmark risk. This observation is in line with the recently rising benchmark beta of the Norwegian fixed income portfolio. All factors remain non-significant.

Since collinearity between the systematic factors is less of a problem in this case, we have also run two separate regressions keeping the benchmark, and the group of term factors or the group of credit factors only (see Panels C and D of Table 9) to see if there is a general systematic exposure either to the term or to the credit factors. The results indicate a significant negative exposure to the Finnish credit factor and a significant positive exposure to the Finnish term factor.

5.2.2 Summary of Findings for the Nordic Fixed Income Portfolio

Both the average active return and the alpha in the simple regression on the benchmark excess return are positive (0.48% and 0.54% annualized respectively) but statistically non-significant. The beta of the portfolio relative to the benchmark is slightly below one, but this difference is statistically non-significant. Inclusion of country-specific term and credit risk factors in the model adds little to explaining the sources of active returns. We found significant negative exposure to the Finnish credit factor and positive exposure to the Finnish term factors only. Given the very short life of this portfolio and the geographical diversity of its holdings, the statistical insignificance of most of the results is not surprising.

6. Total Fund

In this section, we examine the active investment performance of the total Fund. In previous sections, we analyzed the active returns in each of the four sub-portfolios separately. We now examine how the results for those units aggregate. We have shown that when a single index (CAPM) factor model is estimated over the entire sample period, all four sub-portfolios have less than full market exposure – each portfolio records a beta value versus the benchmark excess return which is less than one. This is particularly pronounced for the equity portfolios. If there were zero alpha and the single index model were a perfect asset pricing model, the negative active exposure would automatically induce a negative correlation between the benchmark and active returns.

Figure 15 shows a bar plot of annualized benchmark and active returns for the total Fund. For consistency with FTF's reporting, the annual benchmark returns are constructed as the product of twelve monthly gross returns. The annual active return is computed as the simple difference between the annualized portfolio and benchmark returns. Visual inspection of the bar plot indicates a negative relation between the benchmark return and the active return each year, consistent with the less than full market exposure. The simple linear correlation (Pearson correlation) between the annual benchmark and active returns is -0.78. Using monthly returns instead of annual reduces this correlation to -0.53. This partly explains why the Fund has tended to outperform the benchmark when the market has fallen, such as during the financial crisis. Similarly, it explains why the Fund often underperformed relative to the benchmark during market rallies.

The mandate of FTF has changed several times since inception. The Norwegian equity and fixed income portfolios were present from the beginning, but the composition of the Norwegian fixed income benchmark has undergone substantial changes. The first return on the Nordic equity portfolio was in 2001:05 and the first return for the Nordic fixed income portfolio was in 2007:03. Figure 16 shows the weights per sub-portfolio from 1997:12 to 2010:06. The graph shows a significant change in mandate by year-end 2006, when the weight in the Norwegian equity portfolio was increased from around 20% to around 50%. At the same time, the weight in Nordic equity was increased. The effect of these changes in mandate was a large and sudden drop in the weight assigned to the Norwegian fixed income portfolio. The change in mandate and benchmark presents some challenges for gauging the risk-adjusted performance at the overall Fund level.

We start by computing the risk-adjusted return relative to the benchmark as we have done for the four sub-portfolios. Panel A shows that the alpha is 0.47% per year, which is substantially higher than the mean active return for the Fund. This is because the Fund as a whole has a significant underexposure to the benchmark excess return. Neither the mean active return nor the alpha is significant in this model.

Next, we examine whether the total Fund has had a systematic tilt toward a particular asset class over the sample. Equity holders have a residual claim on the assets of a firm and expected returns on equity are in general higher than on bonds. Therefore, a systematic overweight in equity would increase the Fund's expected return, but would not necessarily reflect skill on the Fund's part. At each month end, we construct the weight assigned to a sub-portfolio as AUM in NOK in that unit divided by the total Fund value in NOK. Using those weights, we construct a total equity benchmark return series as the weighted sum of the return on the Norwegian and Nordic equity benchmarks. We construct a total fixed income benchmark in a similar manner. We assess whether excess exposure to equity can explain the total Fund outperformance by constructing an additional factor which is long the Fund equity benchmark and short the Fund fixed income benchmark. Risk-adjusted return is then computed by regressing the total Fund return in excess of the risk-free rate on the Fund benchmark excess return and the long equity, short fixed income portfolio described above. Panel B shows that there is only a very small and insignificant excess exposure to equity. Therefore, the alpha estimate from this model is almost identical to the CAPM alpha.

Finally, we consider a model where we include the total Fund benchmark excess return, a Fund size factor, a Fund value factor, and the Norwegian swap spread factor. The total size and value factors are constructed by value-weighting the Norwegian and Nordic size and value factors according to the Fund benchmark weights. We have not included a total Fund credit factor. The Norwegian fixed income portfolio was 100% NOK until 2008 and the Nordic fixed income portfolio started in 2007. Because of the changing mandate, a total Fund credit factor is not included as this might pick up spurious correlations. Panel C of Table 10 shows that the total Fund size exposure continues to be significantly negative. In this specification, neither the exposure to the value factor nor the swap spread factor is significantly different from zero. Using these factors, the alpha estimate is borderline significant at the 5% level.

For comparison with the AGS report, we assess the extent to which portfolio and active returns are explained by the benchmark and the systematic factors. The variance decomposition suggested on p. 74 of the AGS report applied to FTF's total Fund attributes 2.89% of the variance of returns to active management and 97.11% to the benchmark. This is close to the R^2 from the CAPM regression for the total Fund as these measure similar but not identical quantities.

In Panel C of Table 10, we find that the systematic factors explain 98.1% of the variation in the total Fund's excess returns. If we consider active returns instead of excess returns as the left hand side variable in the regression, the R^2 changes. In that case, we find that the benchmark excess returns, size, value, and the swap spread return explain 32% of the variation in active returns.

6.1 Effect of Changing from Standard to Investable Value Factor

In the analysis, we have used the standard MSCI value and growth indices. As mentioned, the investable value and growth indices differ from the standard ones and do affect our inferences with respect to value exposure. If we use a value factor constructed from the investable value and growth indices, we find that the Norwegian portfolio has positive, but insignificant exposure to the value factor. The sign is thus reversed, but the exposure is in both cases statistically indistinguishable from zero. For the Nordic equity portfolio, the exposure changes from being significantly negative to being identically equal to zero. For the total Fund, the value exposure continues to be negative and insignificant. For brevity, these results are not tabulated.

6.2 Summary of Findings Total Fund

The results for the total Fund appear to follow from the findings for the four sub-portfolios according to the weight of each sub-portfolio in the total Fund. In particular, we find that the total Fund has less than full market exposure and a significant negative exposure to the size factor, i.e. the Fund is overweight large-capitalization stocks relative to the index. Our estimates of alpha tend to increase as we control for additional risk factors, because the Fund in most cases has had negative active exposure to these. By the same reasoning, this is why we find that alpha from the factor models is higher than the mean active return.

We have run additional tests that have been omitted from the final report for brevity. For example, we tested whether our finding that market beta is less than one could be due to stale pricing by including additional lags of the market excess return, as suggested by, for example, Asness, Krail, and Liew (2001). Loadings on additional lags were, however, all insignificant and did not alter our estimates of risk-adjusted performance. We also tested whether the Fund was more exposed to market increases than decreases and vice versa but found that the differential exposure was statistically insignificant.

In general, the Fund appears to have added some value by active management, but not enough to make us able to conclude that mean active returns or alpha are truly greater than zero in a statistical sense.

Appendix A – Computing Par Returns from Zero Coupon Spot Rates

RiskMetrics uses zero coupon spot curves to discount cash flows. The zero coupon rates are derived from coupon bonds. However, most practitioners prefer to think in terms of par curves rather than zero coupon curves. The par rate, c_{τ_N}, for a specific time to maturity τ_N can be obtained from the zero coupon curve by solving for the coupon rate that prices the issue at par

$$100 = \sum_{j=1}^{M} \frac{100 \times c_{\tau_N}/k}{\left[1 + \frac{y(t,\tau_j)}{k}\right]^{k\tau_j}} + \frac{100}{\left[1 + \frac{y(t,\tau_N)}{k}\right]^{k\tau_N}}.$$

In the above equation, $y(t,\tau_j)$ is the zero coupon spot rate at time t for maturity $t + \tau_j$, k is the compounding frequency, and c_{τ_N} is the par rate for maturity τ_N. M is the number of coupons that the bond pays between time t and $t + \tau_N$.

Once we have obtained the par rate for a specific maturity, we can construct a par bond for that maturity. We can, for example, construct a hypothetical 10 year par bond, where we assume that today, t_1, is the issue date, which implies that there is exactly 10 years to maturity

$$100 = \frac{100 \times c_{10}}{[1 + y(t_1,\tau_1)]^1} + \frac{100 \times c_{10}}{[1 + y(t_1,\tau_2)]^2} + \cdots + \frac{100 \times (1 + c_{10})}{[1 + y(t_1,\tau_{10})]^{10}}$$

We have assumed that the above par bond has an annual coupon frequency. We know that today, at issuance, this bond has accrued zero interest, so both the dirty and the clean price of the bond is par

$$100 = V(t_1) = P(t_1) + AI(t_1),$$

Where V denotes the dirty price of the bond, P is the clean price and AI is the accrued interest since last coupon payment. Next period, $t_2 = t_1 + \Delta t$, we can compute the price of the bond using the yield curve prevailing at t_2, taking into account that the bond issue has aged by Δt (see, for example, Finger, 1996). The dirty price at t_2 is

$$V(t_2) = \frac{100 \times c_{10}}{[1 + y(t_2,\tau_1)]^{1-\Delta t}} + \frac{100 \times c_{10}}{[1 + y(t_2,\tau_2)]^{2-\Delta t}} + \cdots + \frac{100 \times (1 + c_{10})}{[1 + y(t_2,\tau_{10})]^{10-\Delta t}}$$

The return on the bond over the period is thus

$$R(t_1,t_2) = \frac{P(t_2) + AI(t_2) - P(t_1) - AI(t_1) + C(t_1,t_2)}{P(t_1) + AI(t_1)}$$

Where $C(t_1,t_2)$ denotes the t_2 value of coupon or other payments to the bond holder. Replacing the dirty price of the bond with 100 and assuming that there are no payments between t_1 and t_2, we have

$$R(t_1,t_2) = \frac{P(t_2) + AI(t_2)}{100} - 1$$

In order to construct a bond return series, we can use the zero coupon curves to construct a 10-year par bond at each month-end over the sample. We compute the holding period return on the par bond as illustrated above and then reinvest the amount in a new par bond, i.e. we rebalance the portfolio at each month-end such that we always hold a 10-year par bond at the beginning of each month.

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Table 1: Descriptive statistics

The table shows descriptive statistics for the Fund and each of the sub-portfolios. The first column gives an abbreviated name for the portfolio in question. Nwy is short for Norway, Ndc is short for Nordic, and the Fund is the sum of all sub-portfolios. Eq stands for equity and FI stands for fixed income. Pf is short for the actual portfolio, Bm is the benchmark, and Act are the active returns. The second column shows the date of the first return for the sub-portfolio. The third column shows the number of return observations. The fourth column is the annualized mean arithmetic return and the fifth is the median return. The sixth column is the annualized standard deviation. Columns seven to ten show minimum and maximum monthly returns and the month in which that return occurred. The last two columns show skewness and kurtosis. All returns are shown in percentage points.

Portfolio	Start Date	Obs	Mean	Median	Std Dev	Min	Min Date	Max	Max Date	Skew	Kurt
Fund Pf	1998:01	150	6.01	7.98	8.57	-12.60	2008:08	8.40	2009:04	-1.47	10.31
Fund Bm	1998:01	150	5.65	7.25	9.26	-13.06	2008:08	9.22	2009:04	-1.47	10.26
Fund Act	1998:01	150	0.36	0.02	1.46	-1.00	2009:03	2.15	2008:09	0.77	6.30
Nwy Eq Pf	1998:01	150	8.85	18.09	23.16	-23.95	2008:08	14.28	2009:04	-0.96	4.76
Nwy Eq Bm	1998:01	150	7.63	20.58	24.79	-25.22	2008:08	15.83	2009:04	-0.92	4.56
Nwy Eq Act	1998:01	150	1.22	0.59	4.38	-4.42	2000:07	4.02	2000:10	-0.12	4.11
Ndc Eq Pf	2001:05	110	4.45	9.59	22.17	-15.78	2002:11	18.57	2009:03	-0.25	3.44
Ndc Eq Bm	2001:05	110	4.18	9.13	22.84	-15.70	2002:11	20.48	2009:03	-0.21	3.58
Ndc Eq Act	2001:05	110	0.26	0.03	1.43	-1.92	2009:03	2.40	2008:09	1.12	16.73
Nwy FI Pf	1998:01	150	6.06	5.68	2.51	-1.78	1998:07	2.71	2008:10	0.34	3.66
Nwy FI Bm	1998:01	150	6.12	6.08	2.82	-2.27	2004:03	2.97	2003:04	0.12	4.28
Nwy FI Act	1998:01	150	-0.06	0.10	0.89	-0.92	2004:01	1.12	2004:03	0.41	7.35
Ndc FI Pf	2007:03	40	6.91	3.99	8.68	-8.27	2008:12	7.64	2008:11	-0.36	6.42
Ndc FI Bm	2007:03	40	6.43	2.43	8.85	-8.11	2008:12	8.13	2008:11	-0.11	6.22
Ndc FI Act	2007:03	40	0.48	0.11	0.82	-0.50	2008:11	0.73	2009:04	0.73	4.39

Table 2: Risk-Adjusted Performance and Factor Exposures Norwegian Equity Portfolio

This table shows risk-adjusted abnormal returns and factor exposures for the Norwegian equity portfolio. The estimate of alpha, a, has been annualized by multiplying by 12. The standard errors used in the construction of the t-statistics and the p values have been GMM-corrected to account for heteroskedasticity and autocorrelation. The sample period is 1998:01 to 2010:06.

	$E[R_a]$	a	b	s	h	R^2
			Panel A: CAPM			
Coefficient	1.22	1.48	0.92			97.2%
T-statistic	0.89	1.43	-4.98			
P value	0.38	0.16	0.00			
			Panel B: Fama French Three-Factor Model			
Coefficient	1.22	1.72	0.91	-0.09	-0.02	97.5%
T-statistic	0.89	1.75	-5.75	-3.95	-0.89	
P value	0.38	0.08	0.00	0.00	0.38	

Table 3: Risk-Adjusted Performance and Factor Exposures Nordic Equity Portfolio

This table shows risk-adjusted abnormal returns and factor exposures for the Nordic equity portfolio. The estimate of alpha, a, has been annualized by multiplying by 12. The standard errors used in the construction of the t-statistics and the p values have been GMM-corrected to account for heteroskedasticity and autocorrelation. The sample period is 2001:05 to 2010:06.

	$E[R_a]$	a	b	s	h	R^2
			Panel A: CAPM			
Coefficient	0.26	0.28	0.97			99.7%
T-statistic	0.37	0.47	-2.46			
P value	0.72	0.64	0.02			
			Panel B: Fama French Three-Factor Model			
Coefficient	0.26	0.68	0.96	-0.04	-0.01	99.8%
T-statistic	0.37	1.42	-4.21	-3.24	-2.07	
P value	0.72	0.16	0.00	0.00	0.04	

Table 4: Risk-Adjusted Performance and Market Exposures by Country Nordic Equity Portfolio

This table shows risk-adjusted performance and factor exposures by market. The results are obtained from a model where, in addition to the benchmark excess return, the returns on the MSCI indices in Sweden, Denmark, and Finland are included as regressors. The sample period is 2001:05 to 2010:06.

	a	b	swe	den	fin	R^2
Coefficient	0.51	0.99	-0.02	-0.03	0.01	99.7%
T-statistic	0.80	-0.30	-0.87	-1.58	1.33	
P value	0.43	0.76	0.38	0.12	0.19	

Table 5: Risk-Adjusted Performance and Factor Exposures Norwegian Fixed Income Portfolio

This table shows risk-adjusted performance and factor exposures for the Norwegian fixed income portfolio. The CAPM model includes only the benchmark excess return as a regressor. The panels below contain results for models which include systematic factors representing strategies based on interest rate and credit risk premiums. Alpha is reported as an annualized percentage. The sample period is 1998:01 to 2010:06.

Panel A: CAPM					
	a	b			R^2
Coefficient	0.19	0.85			90.6%
T-statistic	0.80	-3.09			
P value	0.43	0.00			
Panel B: Two-Factor Model					
	a	b		Swap	
Coefficient	0.15	0.85		0.15	91.5%
T-statistic	0.68	-3.09		1.97	
P value	0.50	0.00		0.05	
Panel C: Three-Factor Model					
	a	b	Term	Swap	
Coefficient	0.17	0.77	0.07	0.18	91.8%
T-statistic	0.75	-1.96	0.89	2.54	
P value	0.46	0.05	0.38	0.01	

Table 6: Correlation Matrix Norwegian Fixed Income Factors

This table shows the correlations between the Norwegian fixed income risk factors. The sample period is 1998:01 to 2010:06.

	Benchmark	Term factor	Swap factor
Benchmark	1.00	0.89	-0.04
Term factor	0.89	1.00	-0.21
Swap factor	-0.04	-0.21	1.00

Table 7: Sub-Period Analysis Norwegian Fixed Income – January 2007 to June 2010

This table shows risk-adjusted performance and factor exposures for the Norwegian fixed income portfolio also, but for a restricted sample period: 2007:01 to 2010:06 and it also includes results based on different models. To enable comparison, the first two panels show results based on two models used in Table 5. The last two panels show how the inclusion of a Bank factor changes the inferences. Alpha is reported as an annualized return.

Panel A: CAPM					
	a	b			R^2
Coefficient	0.29	1.12			87.4%
T-statistic	0.72	1.97			
P value	0.47	0.06			
Panel B: Two-Factor Model with Swap Factor					
	a	b	Swap		
Coefficient	0.20	1.13	0.21		91.2%
T-statistic	0.50	2.50	2.74		
P value	0.62	0.02	0.01		
Panel C: Two-Factor Model with Bank Factor					
	a	b		Bank	
Coefficient	0.52	1.10		0.16	94.0%
T-statistic	1.67	2.23		5.00	
P value	0.10	0.03		0.00	
Panel D: Three-Factor Model					
	a	b	Swap	Bank - Swap	
Coefficient	0.53	1.09	0.16	0.17	94.0%
T-statistic	1.72	1.94	1.72	5.53	
P value	0.09	0.06	0.09	0.00	

Table 8: Sub-Period Analysis Norwegian Fixed Income – January 1998 to December 2006

This table shows risk-adjusted performance and factor exposure for the Norwegian fixed income portfolio also, but for a restricted sample period: 1998:01 to 2006:12. Alpha is reported as an annualized percentage.

	a	b	Swap	R^2
Coefficient	-0.11	0.79	0.07	95.5%
T-statistic	-0.63	-5.08	1.24	
P value	0.53	0.00	0.22	

Table 9: Risk-Adjusted Performance and Factor Exposures Nordic Fixed Income

This table shows risk-adjusted performance and factor exposures by market and by groups of factors, as well as for the CAPM model. Alpha is reported as an annualized percentage. The sample period is 2007:03 to 2006:10.

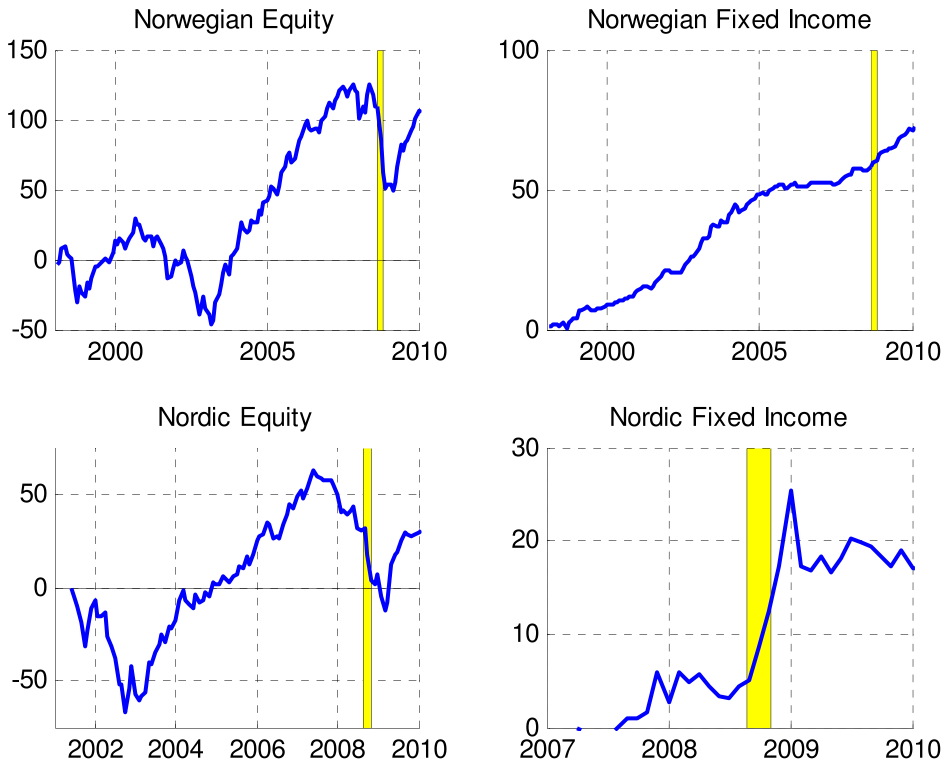
	a	b	term swe	term den	term fin	swap swe	swap den	swap fin	R^2
Panel A: CAPM									
Coefficient	0.54	0.98							99.1%
T-statistic	0.78	-1.70							
P value	0.44	0.10							
Panel B: Term and Swap Exposure by Market									
Coefficient	0.58	1.02	-0.07	0.11	-0.04	-0.06	0.15	-0.13	99.4%
T-statistic	1.06	0.64	-1.15	0.67	-0.36	-0.61	0.98	-0.72	
P value	0.30	0.53	0.26	0.51	0.72	0.54	0.33	0.47	
Panel C: Term Exposure by Market									
Coefficient	0.63	1.01	-0.12	-0.04	0.18				99.3%
T-statistic	1.00	0.62	-1.74	-1.13	2.74				
P value	0.32	0.54	0.09	0.27	0.01				
Panel D: Swap Exposure by Market									
Coefficient	0.40	0.99				0.15	0.00	-0.20	99.3%
T-statistic	0.76	-0.37				0.75	0.05	-2.44	
P value	0.45	0.71				0.46	0.96	0.02	

Table 10: Risk-Adjusted Performance and Factor Exposures Total Fund

This table shows the risk-adjusted performance and factor exposures for the total Fund. Panel A reports the results from a CAPM regression, where the total Fund benchmark represents the market. In Panel B, a portfolio which is long the total Fund's equity benchmark and short the total Fund's fixed income benchmark is added as an additional regressor. In Panel C, size and value factors for the total Fund, and the Norwegian swap spread factor are included as regressors.

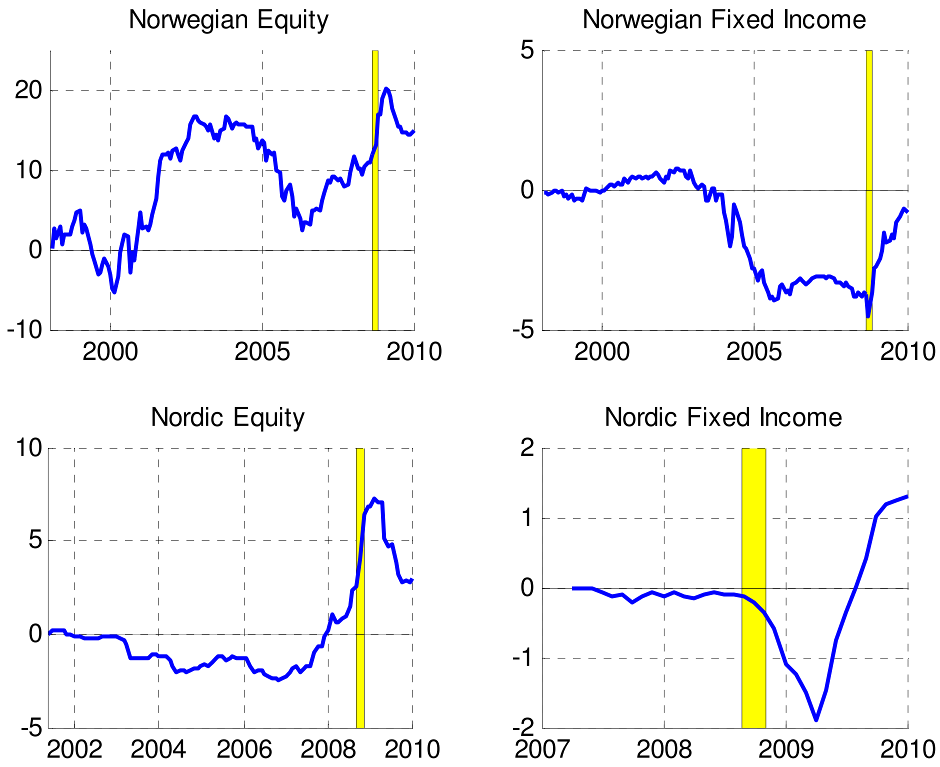
	$E[R_a]$	a	b	eq-fi	s	h	swap nor	R^2
				Panel A: CAPM				
Coefficient	0.36	0.47	0.92					98.0%
T-statistic	0.72	1.43	-7.07					
P value	0.47	0.16	0.00					
				Panel B: Asset Allocation Long-Short Portfolio				
Coefficient	0.36	0.48	0.90	0.01				98.0%
T-statistic	0.72	1.48	-4.97	1.16				
P value	0.47	0.14	0.00	0.25				
				Panel C: Fama French and Swap Spread Factor				
Coefficient	0.36	0.57	0.91		-0.02	-0.01	0.08	98.1%
T-statistic	0.72	1.95	-7.89		-2.91	-0.79	0.77	
P value	0.47	0.05	0.00		0.00	0.43	0.44	

Figure 1: Benchmark Returns by Sub-Portfolio



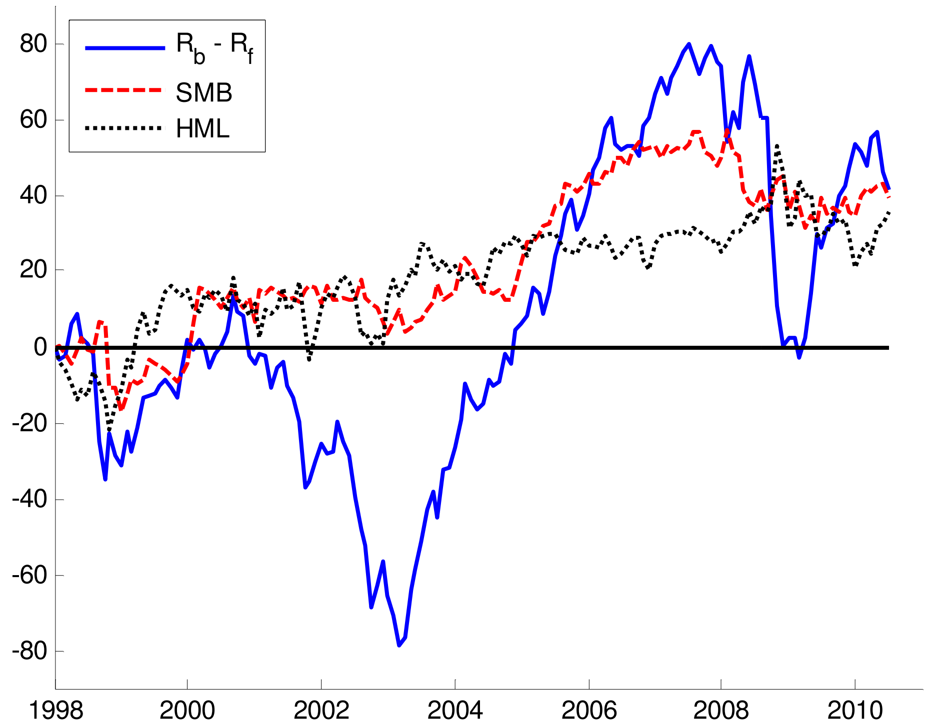
This figure shows the cumulated benchmark return on the four sub-portfolio portfolios. The cumulated benchmark returns are defined as the cumulative sum of each period's benchmark return. The vertical bar marks the date of the bankruptcy of Lehman Brothers, September 15, 2008. (Note that the scales are not the same for all graphs.)

Figure 2: Active Returns by Sub-Portfolio



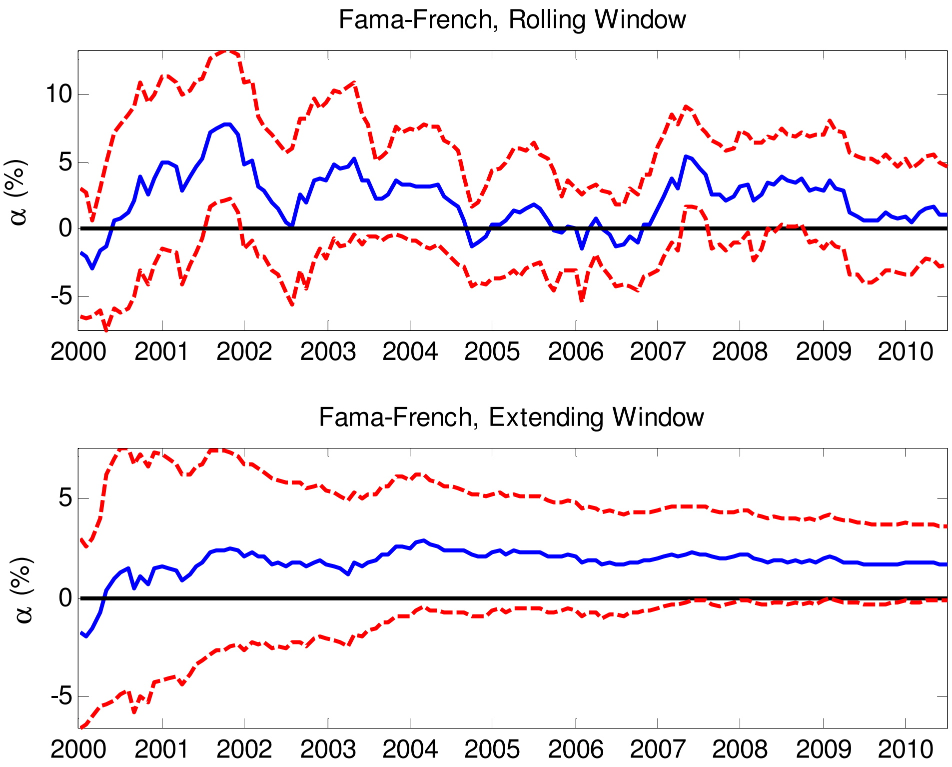
This figure shows the cumulated active return on the four sub-portfolio portfolios. The cumulated active returns are defined as the cumulative sum of each period's active return. Hence, it is zero at inception and ends above zero if active management has added value and below zero if active management has had a negative contribution to returns. The vertical bar marks the date of the bankruptcy of Lehman Brothers, September 15, 2008. (Note that the scales are not the same for all graphs.)

Figure 3: Cumulative Factor Returns Norwegian Equity



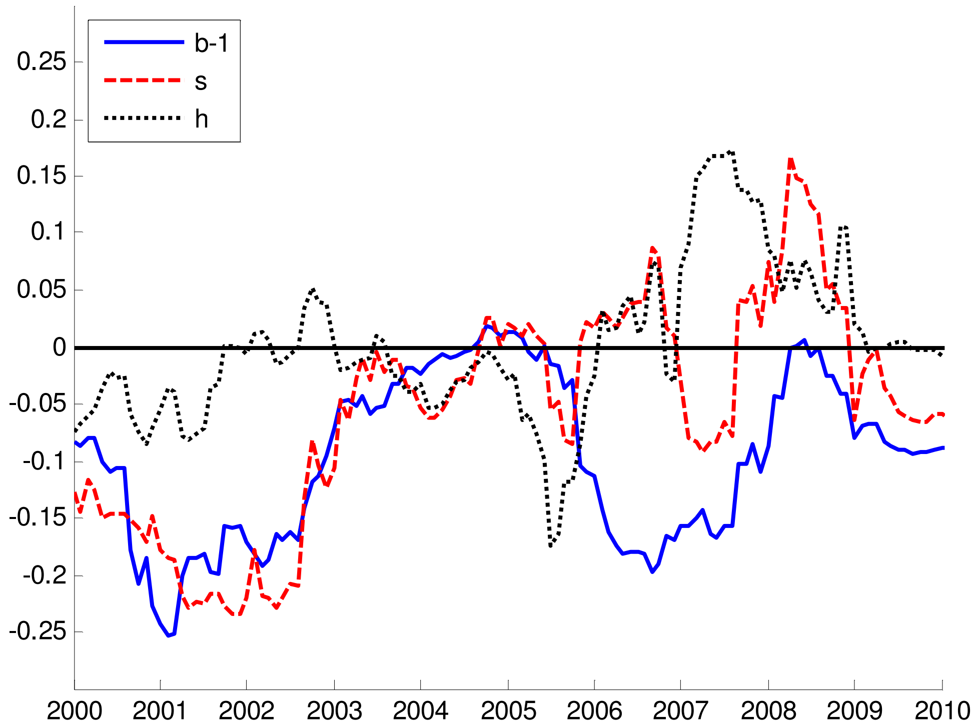
This figure shows the cumulated returns on the Norwegian equity market in excess of the risk-free rate, the Norwegian size factor, and the Norwegian value factor.

Figure 4: Time-Varying alpha Norwegian Equity Portfolio



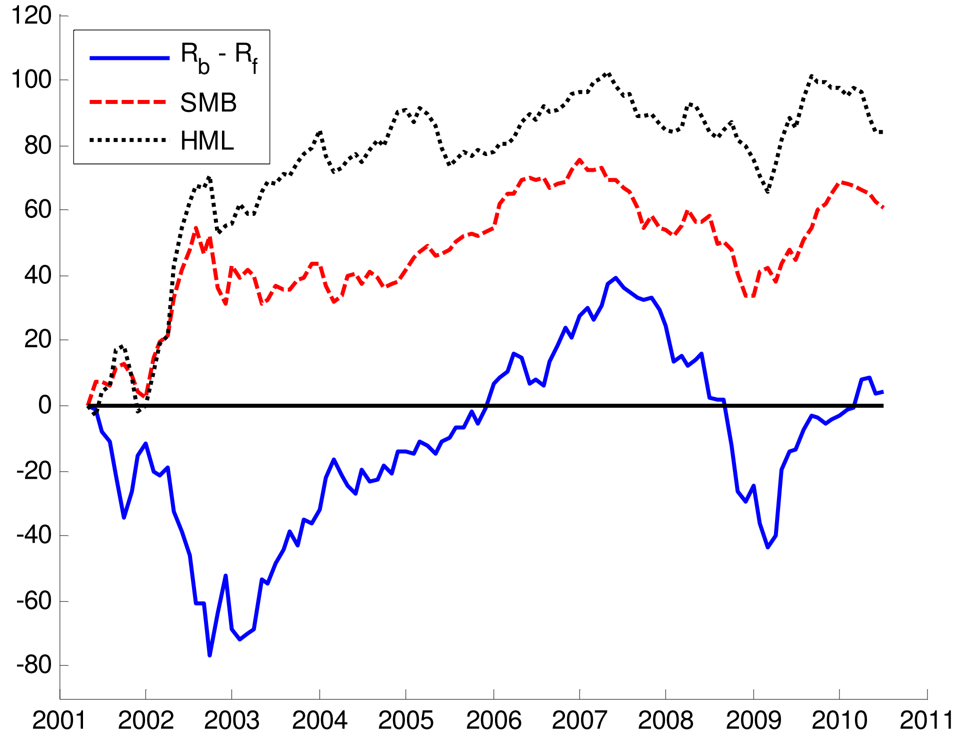
This figure shows the time-varying alpha from the Fama-French three-factor model. The window length is 24 months. The solid line shows the alpha estimate and the dotted lines represent two standard error confidence bounds.

Figure 5: Time-Varying Factor Exposures Norwegian Equity Portfolio



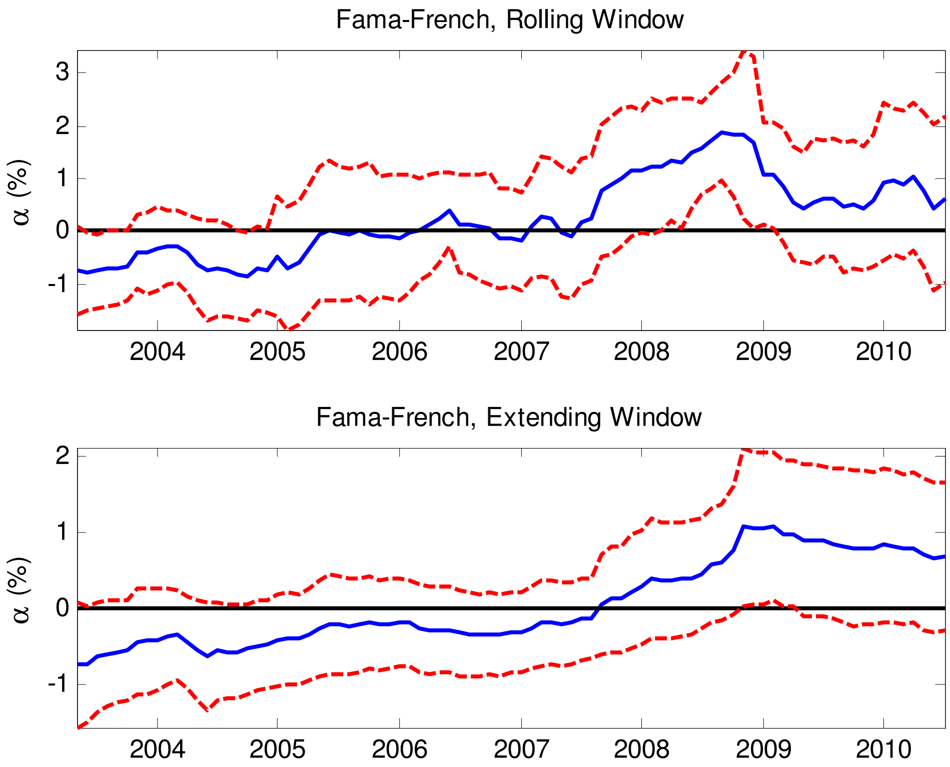
This figure shows the time-varying exposures to the market risk premium (b), the size factor (s), and the value factor (h) using rolling window regressions. The graph shows the exposure to the market risk premium in excess of 1 (full market exposure). The window length is 24 months.

Figure 6: Cumulative Factor Returns Nordic Equity



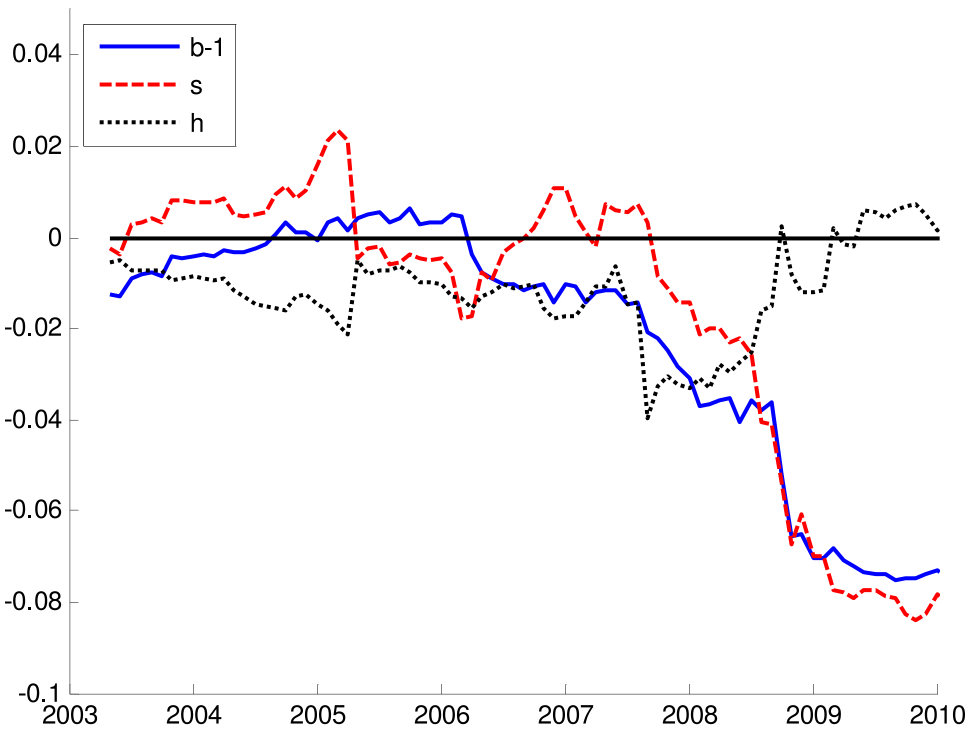
This figure shows the cumulated returns on the Nordic equity market in excess of the risk-free rate, the Nordic size factor, and the Nordic value factor. The Nordic size and value factors are constructed by weighting the MSCI small-capitalization, large-capitalization, value, and growth indices for Sweden, Denmark, and Finland according to the benchmark weights.

Figure 7: Time-Varying alpha Nordic Equity Portfolio



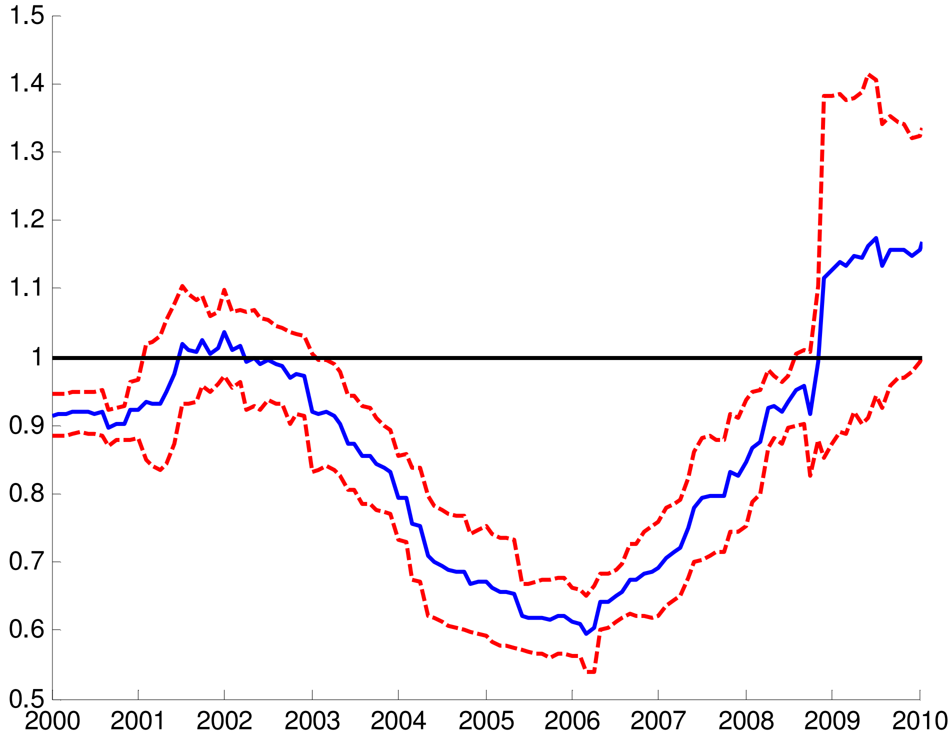
This figure shows the time-varying alpha from the Fama-French three-factor model. The window length is 24 months. The solid line shows the alpha estimate and the dotted lines represent two standard error confidence bounds.

Figure 8: Time-Varying Factor Exposures Nordic Equity Portfolio



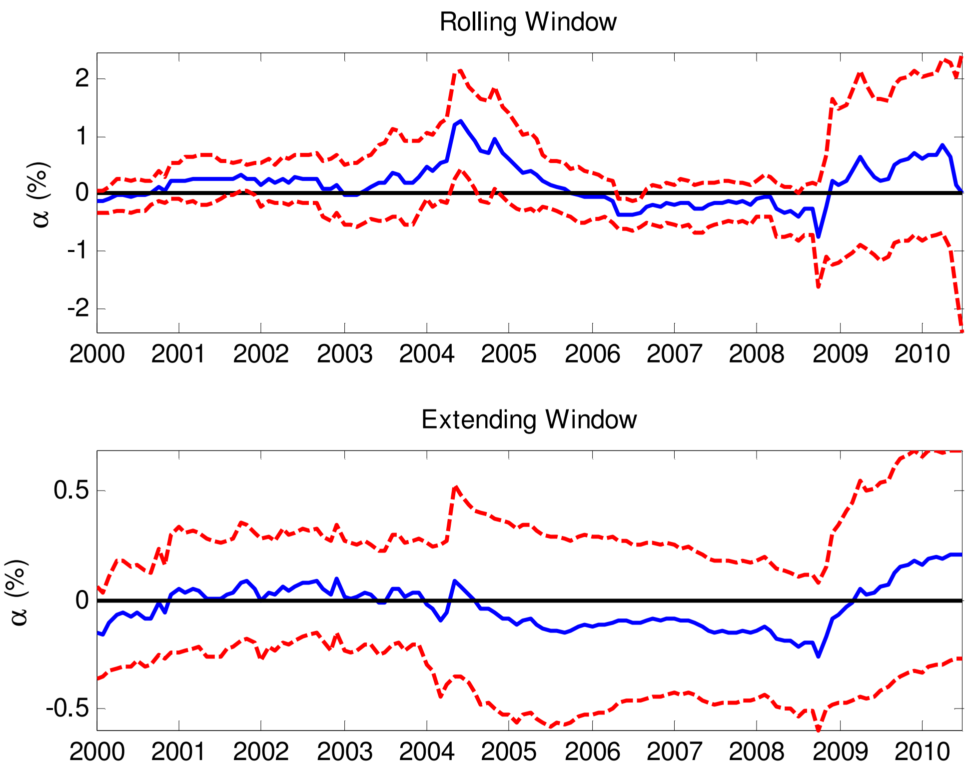
This figure shows the time-varying exposures to the market risk premium (b), the size factor (s), and the value factor (h) using rolling window regressions. The graph shows the exposure to the market risk premium in excess of 1 (full market exposure). The window length is 24 months.

Figure 9: Time-Varying Benchmark beta Norwegian Fixed Income Portfolio



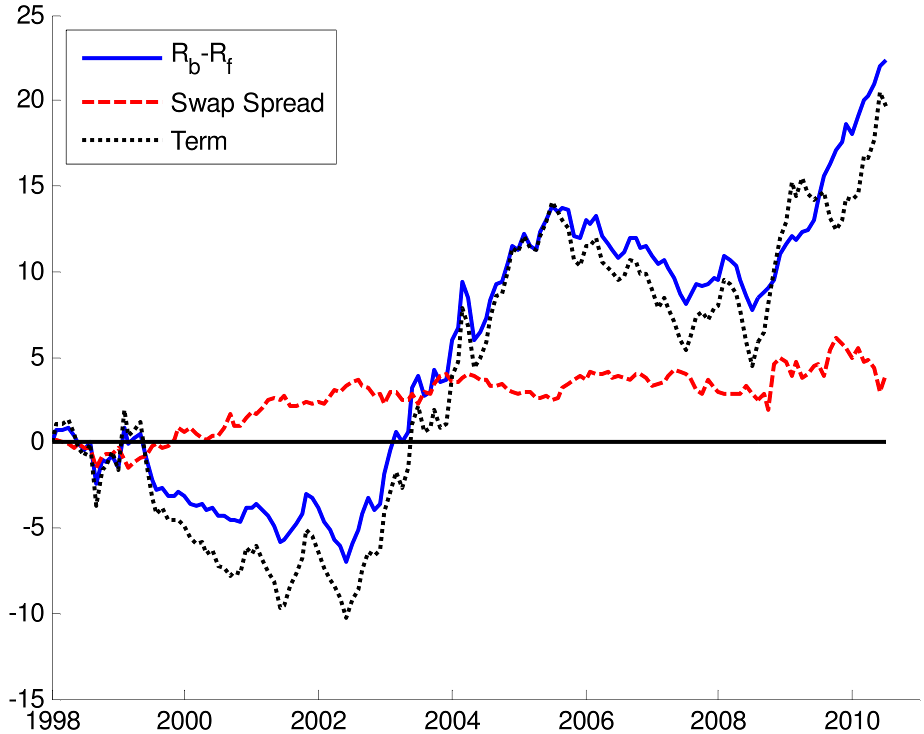
This figure shows the time-varying exposures to the "market risk" premium, or benchmark beta estimated from the CAPM-model. The window length is 24 months; the solid line shows the beta estimate, and the dotted lines represent two standard error confidence bounds.

Figure 10: Time-Varying CAPM alpha Norwegian Fixed Income Portfolio



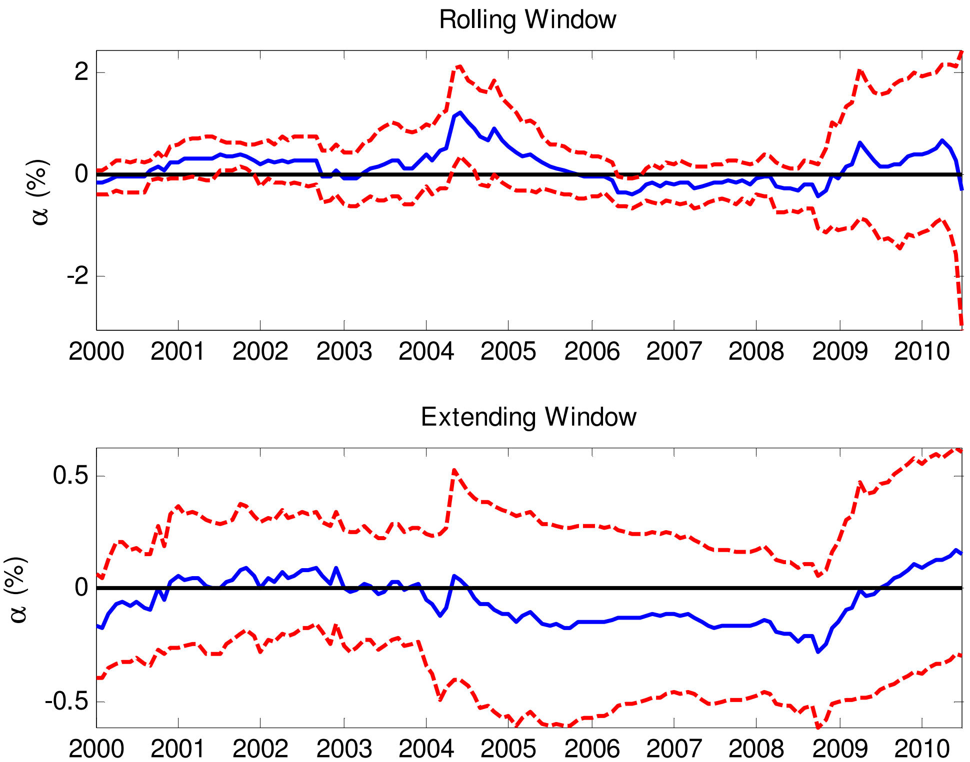
This figure shows the time-varying alpha from the CAPM-model. The window length is 24 months. The solid line shows the alpha estimate and the dotted lines represent two standard error confidence bounds.

Figure 11: Cumulative Factor Returns Norwegian Fixed Income



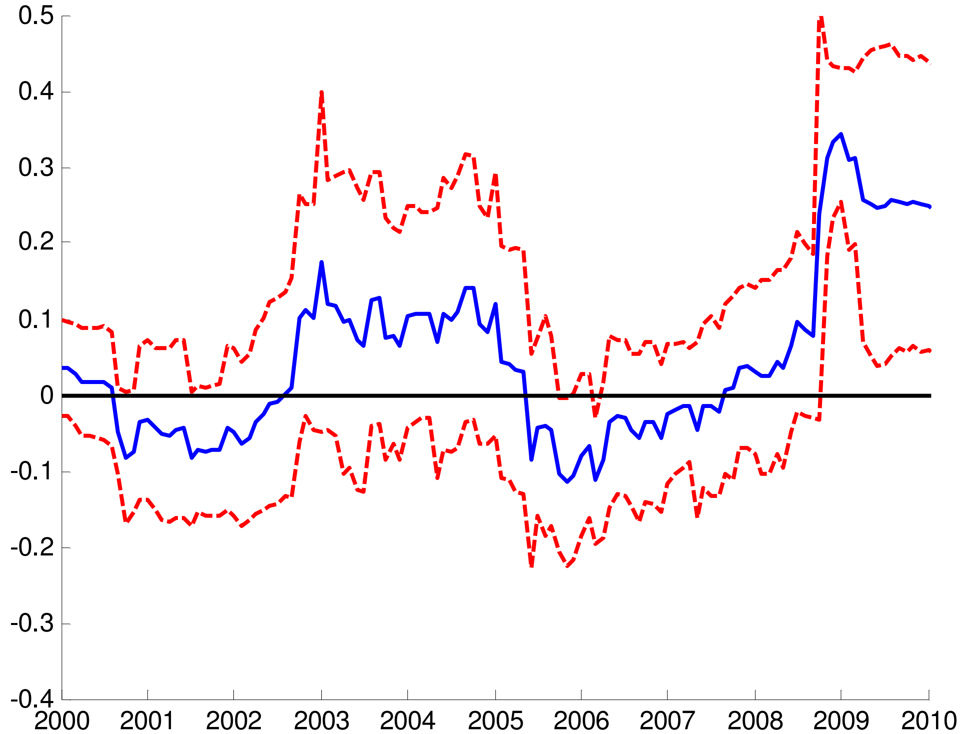
This graph shows the cumulative sum of monthly returns to the three factors we constructed: the benchmark (or market) factor, and the term and swap factors. The construction of the term and swap factors is detailed in the text. The term factor is aimed at proxying the difference in returns between five-year government bonds and one-month government bills. The swap factor is aimed at proxying the differenc in returns between five-year swaps and five-year government bonds.

Figure 12: Time-Varying Two-Factor alpha Norwegian Fixed Income



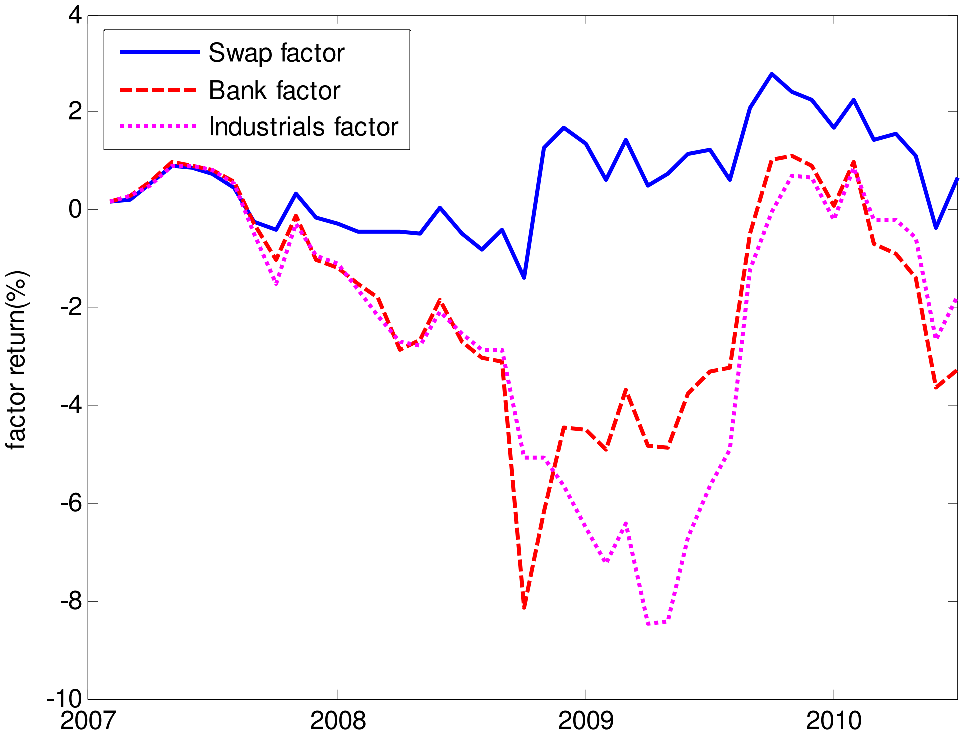
This figure shows the time-varying alpha from the two-factor model, which uses the benchmark and the swap factors. The window length is 24 months. The solid line shows the alpha estimate and the dotted lines represent two standard error confidence bounds.

Figure 13: Time-Varying Swap Factor Exposure Norwegian Fixed Income Portfolio



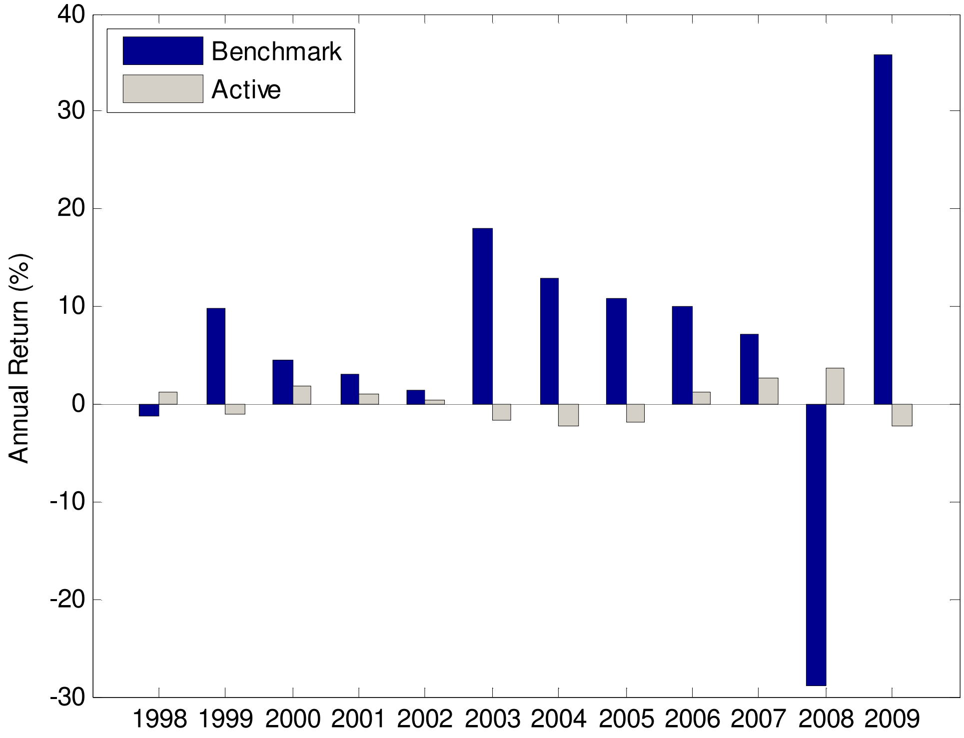
This figure shows the time-varying exposures to the swap factor estimated from the two-factor model which uses the benchmark and the swap factors. The window length is 24 months; the solid line shows the beta estimate, and the dotted lines represent two standard error confidence bounds.

Figure 14: Cumulative Returns of Swap, Bank, and Industrials Factors



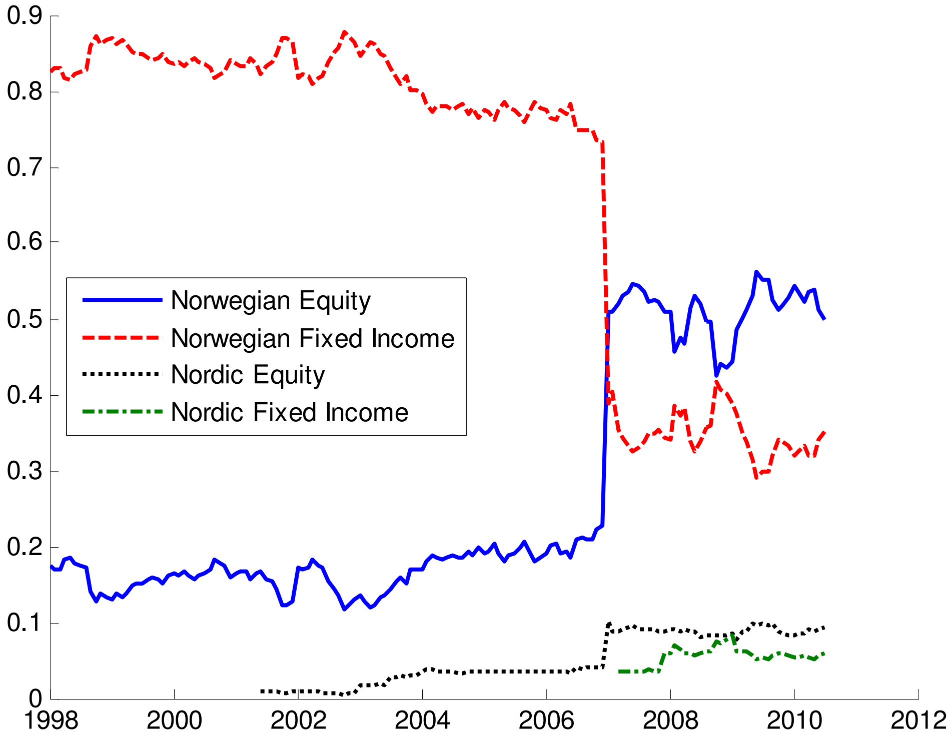
This figure shows bank and industrials factor returns. The factors returns are defined as the difference in returns between proxy bank or industrials bond returns and five-year government bond returns.

Figure 15: Annual Benchmark and Active Returns Total Fund



The graph shows benchmark returns and active returns aggregated to an annual frequency. The annual returns are computed as the product of gross returns. The annual active return is the simple difference between the annualized portfolio and benchmark returns.

Figure 16: Sub-Portfolio Benchmark Weights



This figure shows the benchmark weight assigned to each of the four sub-portfolios over the sample period.

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