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# A quantitative analysis of Nordic hedge fund performance during changing market conditions

Master's Thesis

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## **Abstract**

In this paper we investigate the performance of Nordic hedge funds in terms of their ability to earn abnormal returns during the period 2003-2011. We further test for the presence of short-term persistence during the period of disturbed market conditions. The single-index and four-factor models are used in order to estimate the traditional performance measures for individual funds as well as for portfolios of funds. The regression-based parametric approach is utilized to detect the presence of persistence. Our results suggest that Nordic hedge funds in general are able to “beat the market”, however the results are insignificant for the majority of funds and a much higher degree of statistical significance is found for portfolios of funds. We find no evidence of performance persistence through changing market conditions, though we confirm the presence of short-term persistence in the beginning of market downturn.

**Keywords:** abnormal return, multi-factor model, investment style, disturbed market conditions, performance persistence

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## 1. Introduction

The term “hedge fund” was first presented in the US and further developed by a sociologist Albert Winslow Jones in 1949 (Brown et al. 1999, p.93). Hedge funds are defined as highly unregulated private investment partnerships with a large flexibility of using a broad range of instruments like short-selling, derivatives, leverage and arbitrage on different markets in order to achieve an absolute return target (market neutral). The minimum investment required by hedge funds is usually high and their access is limited to wealthy individuals and institutional investors (Capocci 2004, p.55).

Hedge funds are similar to the more traditional investment vehicles (mutual funds) in that they manage their investment portfolios by holding positions in publicly traded securities (Brown et al. 1999, p.92). However, unlike mutual funds, they are not required to disclose private information (e.g. their performance and asset holdings) publicly, which gives them much more flexibility to make their investment decisions and choose among different asset classes (Liang 1998, p.1-2). Hedge fund managers are allowed to invest in both domestic and international markets (including equities, debt and derivatives) and even take undiversified positions, which imply higher risk-return tradeoffs (Brown et al. 1999, p.92). The possibilities of mutual funds are considerably limited in that sense. Mutual funds are regulated and must therefore strictly follow all disclosure requirements in order to inform investors and have a limited access to the risky activities (Ackermann et al. 1999, p.834). Another substantial difference between hedge funds and mutual funds is the special fee structure which is only characteristic for hedge funds and is designed to motivate managers (Liang 1998, p.2). On average, hedge fund managers receive 1 percent in annual management fee and an additional incentive fee, which is approximately 14 percent of the annual profits. This incentive fee is established in order to align the manager’s interest with the fund’s performance and is paid only after a hurdle rate or “high water mark” is achieved, meaning that a fund manager is rewarded only after the fund has recovered for past losses. For mutual fund managers, incentive fees are not that common and instead are mostly related to fund size (Ackermann et al. 1999, p.834).

During the 1990s, the hedge fund industry has experienced rapid growth in terms of both the number of new established funds and their rate of growth in assets under management. This resulted in a number of studies related to hedge fund performance analyses and their ability to earn abnormal returns (Liang 1998, p.2-3). One of the first studies in that field was the study by Fung and Hsieh (1997). They examined the performance of US hedge funds and found that hedge funds follow highly dynamic trading strategies, which are dramatically different from those of mutual funds (Fung& Hsieh 1997). A similar comparison study was made by Ackermann et al. (1999). They found that hedge funds have been able to systematically outperform mutual funds. Another relevant study was conducted by Brown et al. (1999) who analyzed the performance of US offshore hedge funds during the period 1989 to 1995 and found that hedge funds were able to outperform the S&P 500 index in terms of higher Sharpe ratio and positive Jensen alphas.

Edwards & Caglayan (2001) and Capocci & Hubner (2004) analyzed the performance of hedge funds based on multi-factor models, comprising 6 to 11 different factors and came to the conclusion that approximately 25% of the funds were able to earn excess returns, measured by significantly

positive Jensen alphas. According to Liew & Vassalou (2000), risk factors like SMB and HML suggested by Fama & French (1992, 1993) have been identified in literature for being good indicators of macroeconomic trends, and plausible of explaining asset returns. Thus the use of a multi-factor model when estimating hedge funds' excess returns seems appropriate and reasonable.

Persistence in hedge fund performance is the subject of numerous articles. Baquero et al. (2004) consider the effect of biases when estimating the performance persistence of hedge funds and report the presence of short-term persistence. Agarwal (2000) uses two-period and multi-period approaches for hedge fund analysis and reports the same findings. Significance of manager skills for hedge fund returns is confirmed through several methods by Harri (2004). The author reports that hedge funds belonging to "Market neutral" and "Fund of Funds" investment styles demonstrate strongest persistence as well as confirms that hedge funds take advantage of market inefficiencies. Brown et al. (1999) finds weak proof of persistence when analyzing the performance of US offshore hedge funds, while Boyson (2008) in turn discovers quarterly performance persistence among young hedge fund managers who outperform the old managers.

In the Nordic region the hedge fund industry is far less mature than its US counterpart, and not as many studies have been done yet related to the Nordic hedge fund performance. However, a few Master theses have already been written on the subject. By using a single-factor and three-factor models Gyllenhammar et al. (2007) found that Nordic hedge funds seem to deliver abnormal returns, while Anderberg & Cederholm (2007), on the other hand, find that only a few Nordic hedge funds were able to deliver significantly positive alphas.

The first Nordic hedge fund was launched in Sweden in 1996 by the Stockholm-based Brummer&Partners group<sup>1</sup>. By January 2003, an additional 27 hedge funds were opened in the Nordic area with the majority of funds located in Sweden (74%) and belonging to "Equities" style (56%). Industry experienced the boom during 2007-2009 when the number of operating funds reached 120. However, already during 2009 some hedge funds closed, while in January 2011 over 30% of existing Nordic funds closed<sup>2</sup>.

The purpose of this paper is to investigate the performance of Nordic hedge funds in terms of their ability to earn excess returns during different economic conditions evaluated on the basis of the stock market performance. We estimate the traditional performance measure (known as Jensen's alpha) by applying a single-index model. The analysis is further extended by the multi-factor model based on the work of Fama&French (1993) and Carhart (1997).

This study contributes to the existing literature in several ways. First, we extend the analysis of hedge fund performance to the Nordic region and take into account countries such as Sweden, Norway, Denmark, Finland and Iceland. Second, we use the most recent and updated data available on the monthly net returns of individual hedge funds during the period March 2003 to February 2011, which allows us to take into account the effect of different market conditions on the performance of hedge

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<sup>1</sup> <http://www.hedgefundsreview.com/hedge-funds-review/profile/1648885/brummer-partners>

<sup>2</sup> Hedge Nordic database, [www.hedgenordic.com](http://www.hedgenordic.com)

funds. We divide our estimation period in two sub-periods, where the first sub-period accounts for a relatively steady growth in the market, while the second sub-period is representing both the downturn caused by the financial crisis of 2008-2009 and upturn in the market that followed. We estimate the excess returns measured by alphas for both individual funds and portfolios of funds by using the single-index /four-factor models for each sub- period. Our intention is to clarify what types of Nordic hedge funds according to their investment styles have performed better during different market conditions mentioned above. Third, we examine if hedge funds are able to demonstrate the short-term persistence in their performance during the period of disturbed market conditions (2007-2011). We also define hedge fund “winners” within each investment style during the period 2007-2011 based on the nonparametric statistical procedure. The intention is to make a recommendation for potential international investors to pick hedge fund “stars” and avoid the hedge fund “dogs.”

Focusing exclusively on the Nordic region somewhat limits our analysis. That means that the number of hedge funds in the analysis is relatively small and the time period is also constrained to the last eight years, therefore the number of observations is limited. Further, when constructing the multi-factor model, we consider only four factors: market index, momentum factor and the two factors related to fund characteristics - size and value.

We find that although hedge funds belonging to different investment styles in general were able to earn abnormal returns during the period 2003-2011, the results are not statistically significant for the majority of funds. The portfolio results calculated for each style are similar to the results of individual funds and show a much higher degree of statistical significance, indicating the presence of severe biases in the individual fund sample. During the steady growth in the market, the styles “Equities” and “Managed futures & CTA” stand out, while during the disturbed market conditions, the styles “Multi strategy” and “Managed futures & CTA” are considered to be the “best performers”. However, comparing the results from the two-year sample to those of the four-year sample, we conclude that the choice of the estimation period considerably influences the obtained results.

The presence of performance persistence is confirmed in the beginning of the market downturn. Although the majority of funds do not demonstrate consistent results through changing market conditions, we were able to find a hedge fund “star” within “Equities” and a hedge fund “dog” within “Multi strategy.”

The structure of the paper is as follows: Section 2 introduces the theoretical framework. Section 3 describes the data and discusses the methodology. Empirical results are presented in section 4, while sections 5 and 6 discuss and conclude the results. Reference list and appendix are given at the end of the paper.

## 2. Theoretical Framework

The chapter defines traditional performance measures as Sharpe ratio and Jensen's alpha based on the CAPM assumptions. The CAPM is often referred to be a single-factor model where asset returns are assumed to be linearly related to the return of the market portfolio. The theoretical approach is further extended by the presentation of two multi-factor models introduced by Fama&French and Carhart, where additional risk factors are taken into account in order to explain asset returns.

### 2.1 Traditional Performance Measures

Over the years, two performance measures have been widely used when ranking alternative portfolios of fund managers: the Sharpe ratio and Jensen's alpha (Cuthbertson 2004, p.170)

The Sharpe ratio is in practice mainly used to rank alternative portfolios based on their historical performance in terms of the expected return per unit of risk. The Sharpe ratio is defined for any portfolio (i) as (Cuthbertson 2004, p.170):

$$SR_i = \frac{ER_i - r}{\sigma_i} \quad (1)$$

Where  $ER_i$  is the expected return on portfolio (i),  $r$  - the risk-free rate and  $\sigma_i$  is a measure of volatility associated with the investment in portfolio (i). The Sharpe ratio measures the slope of the line from riskless asset ( $R_f, 0$ ) to portfolio (i) with  $(ER_i, \sigma_i)$  and is at its maximum value when the optimal weights to invest in risky assets are found - this is the "tangency portfolio." When comparing the performances of different mutual/ hedge funds, the two key assumptions are made (Cuthbertson 2004, p.170-171):

- 1) You should invest in the "best" portfolio, which is defined as the one with the highest historical Sharpe ratio
- 2) Any fund chosen has a zero correlation with the existing portfolio

The alpha as a performance measure was presented in Jensen in 1968 (Brooks 2008, p.67) and equals the intercept in the following CAPM regression (NEKM26 lecture notes, p.45):

$$R_{Pt} - R_{ft} = \alpha_P + \beta_P(R_{mt} - R_{ft}) + \varepsilon_{Pt} \quad t = 1, 2, \dots, T \quad (2)$$

Where  $R_{Pt} - R_{ft}$  is the excess return of the fund P at time t;  $(R_{mt} - R_{ft})$  is a market risk premium;  $\varepsilon_{Pt}$  is an error term;  $\alpha_P$  and  $\beta_P$  are the intercept and the fund's volatility relative to the market respectively, defined as (NEKM26 lecture notes, p.45):

$$\beta_{qm} = \frac{Cov[R_P, R_m]}{VAR[R_m]} \quad (3)$$

The intercept of the equation (2) is usually known as Jensen's alpha ( $\alpha$ ). The parameter defines whether the fund outperforms or underperforms the market index. Condition when  $\alpha = 0$  implies the

standard CAPM. A positive and significant  $\alpha$  is interpreted as that the fund is beating the market and is able to earn abnormal returns in excess of that given by the CAPM/SML, while a negative and significant  $\alpha$  states that the fund manager has underperformed relative to the beta risk of the portfolio (Brooks 2008, p.67).

## 2.2 APT Framework

The Arbitrage Pricing Theory (APT) was introduced by Ross in 1976 as an alternative to the CAPM. The CAPM is often referred to as the “single-factor model” due to the fact that only one factor in terms of the fund’s co-movement with the market index (measured by beta) influences expected returns. APT can be more general than CAPM and allow for multiple risk factors to affect the expected returns (Campbell et al. 1997, p.219-220). The idea behind the APT is that riskless arbitrage opportunities will be eliminated and it is assumed that investors have homogeneous expectations. The APT as a multi-factor model may be summed up in the following two equations (Cuthbertson 2004, p.185):

$$R_{it} = \alpha_p + \sum_{j=1}^k b_{ij} F_{jt} + \varepsilon_{it} \quad (4)$$

$$ER_{it} = \lambda_0 + \sum_{j=1}^k b_{ij} \lambda_j \quad (5)$$

In equation (4), the return of the fund  $i$  is linearly related to a set of  $k$ -factors  $F_{jt}$ , which are common across all funds and measure the systematic risk (e.g. fund characteristics); the  $b_{ij}$  are known as factor loadings and are specific to the fund  $i$  and thus assuming that  $E(\varepsilon_{it}) = 0$ , we see that it is the sensitivity of the fund  $i$  to the  $F_{jt}$  factor that determine the expected return. Two additional assumptions are made to the equation (4) (Cuthbertson 2004, p.183):

- a)  $E(\varepsilon_i \varepsilon_j) = 0$  for all  $i \neq j$  and all time periods
- b)  $E[\varepsilon_i (F_j - EF_j)] = 0$  for all funds and factors and all  $t$

which implies that a) idiosyncratic risk is uncorrelated across funds and b) implies that unsystematic risk is independent of the factors  $F$ .

In equation (5), the  $\lambda_0 = ER_z$  or  $r$ , which is the risk-free rate (if the riskless borrowing and lending exist); the  $\lambda_0$  and  $\lambda_j$  are constant for all funds and  $\lambda_j$  is interpreted as the “price” that depends on the amount of the fund’s exposure (factor loading in terms of e.g. beta) to the  $F_j$  factor (Cuthbertson 2004, p.183-186).



### 2.2.1 Three-Factor Model of Fama & French

Fama & French (1992) suggested the three-factor model based on the APT framework as an alternative to the traditional CAPM in order to provide a better explanation of cross-sectional variation of asset returns. The Fama&French's three-factor model (1992) extends the CAPM's assumption of a single exposure to the market risk factor of asset returns, and takes into account two additional risk factors related to firm characteristics: size and book-to market equity. The three-factor model is as follows (Rohleder et al 2007, p.3):

$$R_{it} - r_{ft} = \alpha_i + \beta_{1i}(R_{mt} - r_{ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_t + \varepsilon_{it} \quad (6)$$

Where  $R_{it} - r_{ft}$  = excess asset return

$(R_{mt} - r_{ft})$  = excess return on the market portfolio

$SMB$  = stands for "small (cap) minus big" and represents the premium for investing in the portfolios of small capitalization stocks compared to large (cap) portfolios.

$HML$  = stands for high (BE/ME) minus low and indicates the premium for taking a long position on portfolios of high book-to-market stocks and short position on the portfolios of low B/M stocks.

In the above mentioned formula,  $\beta_1$  is still representing the asset's sensitivity to the market risk factor, while  $\beta_2$  and  $\beta_3$  are proxies for sensitivities to the risk factors SMB/ HML.

### 2.2.2 Carhart's four-factor model

The three-factor model of Fama&French (1992) works certainly better in explaining asset returns than traditional CAPM. However, the three-factor model does not take into consideration the cross-sectional variation in momentum-sorted portfolio returns and Carhart states that it is just the significant loadings on the one-year momentum factor that makes the estimates from the four-factor model economically different from the CAPM (Carhart 1997, p.61). Therefore, Carhart (1997) extends the Fama&French's three-factor model by adding one more risk factor that captures the one-year momentum anomaly and the model is as follows (Rohleder et al 2007, p.3):

$$R_{it} - r_{ft} = \alpha_i + \beta_{1i}(R_{mt} - r_{ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_t + \beta_{4i}Mom_t + \varepsilon_{it} \quad (7)$$

Where  $(R_{it} - r_{ft})$  = the return on a portfolio in excess of the risk-free rate

$(R_{mt} - R_{ft})$  = the excess return on the market proxy

$SMB/HML$  = factor-mimicking portfolios for size and book-to-market equity respectively

$Mom$  = the difference in return between a portfolio of past winners (defined as top 30% based on their market cap) and a portfolio of past losers ( defined as bottom 30% based on their market cap).

### 3. Data and Methodology

*The following chapter contains of two parts. The first part gives a description of the data and continues with a detailed explanation of the estimation periods chosen for the study. Several biases are also mentioned when dealing with the hedge fund data and a possible solution for the empirical part of the study is presented. The second part of the chapter covers and discusses the methodology which accurately introduces and explains all of the models and methods used.*

#### 3.1 Data

Data over performance of Nordic hedge funds is taken from the Hedge Nordic database and includes information about all Nordic hedge funds active in the period from 1996 when the first fund was registered to 2011 when there are 126 registered funds. The database provides an opportunity to study the performance of hedge funds in 5 Nordic countries: Sweden, Denmark, Norway, Finland and Iceland (represented by one hedge fund). Hedge funds are divided into 5 different groups based on the following investment strategies: Equities, Fixed Income, Multi Strategy, Managed Futures & CTA and Fund of Funds (FoF). Styles can be defined as the following:

*Equities* - includes funds taking long /short positions in undervalued and overvalued stocks and in derivatives in attempt to stay market neutral and earn abnormal returns. Some of the funds invest in stocks in specific sector or style<sup>3</sup>.

*Fixed Income* - earns on mispriced fixed income securities and derivatives. Funds considered being risky though delivering relatively low returns<sup>4</sup>.

*Multi strategy* - employ several investment strategies and have low market risk due to diversification<sup>5</sup>.

*Managed futures & CTA* - invests in futures contracts, commodities and foreign currencies through commodity trading advisors (CTAs). Having no or low correlation with traditional asset classes the funds are considered to provide a great diversification value in portfolios<sup>6</sup>.

*Fund of funds* - hold the portfolio of shares in other hedge funds<sup>7</sup>.

The Hedge Nordic database gives information about monthly net returns of the individual hedge funds, leverage, management and performance fees and some other quantitative statistics. It also provides the Nordic hedge index (NHX).

Though some researchers (Christiansen et al 2004; Fung & Hsieh 1997) exclude “Fund of Funds” from their analysis, we decide to include them in our study as they constitute the relatively big part of Nordic hedge funds and represent own strategy.

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<sup>3</sup> <http://www.barclayhedge.com/research/educational-articles/hedge-fund-strategy-definition/hedge-fund-strategy-equity-long-short.html>

<sup>4</sup> <http://www.barclayhedge.com/research/educational-articles/hedge-fund-strategy-definition/hedge-fund-strategy-fixed-income.html>

<sup>5</sup> [http://www.eurekahedge.com/news/04may\\_archive\\_japan\\_multistrategy.asp](http://www.eurekahedge.com/news/04may_archive_japan_multistrategy.asp)

<sup>6</sup> <http://www.barclayhedge.com/research/educational-articles/managed-futures-articles/managed-futures-overview.html>

<sup>7</sup> <http://www.barclayhedge.com/research/educational-articles/hedge-fund-strategy-definition/hedge-fund-strategy-fund-of-funds.html>

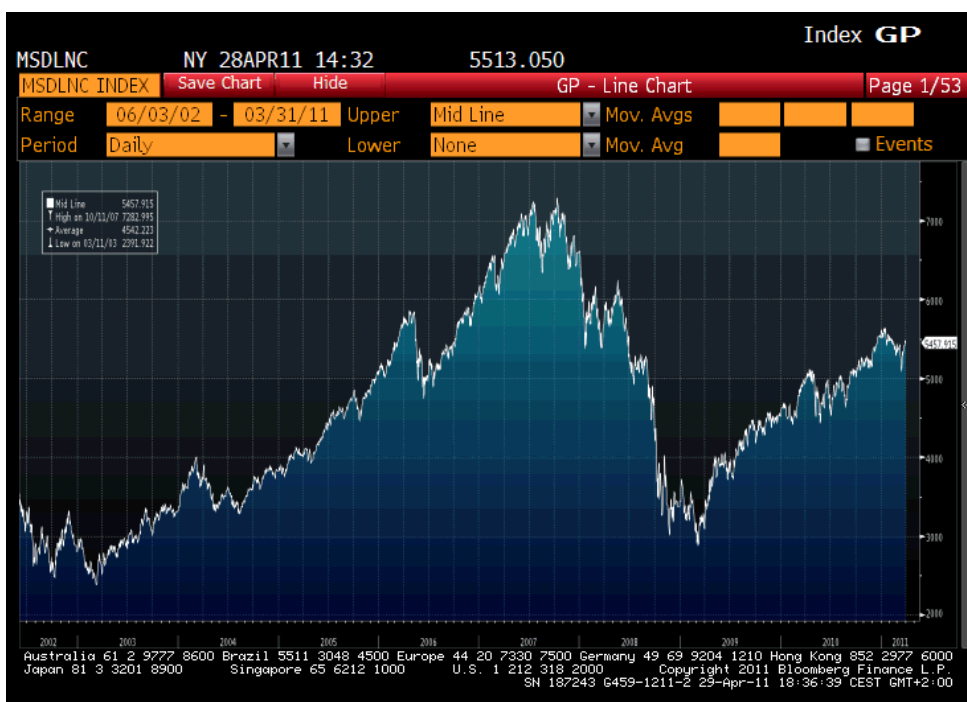
We focus our study on the period March 2003 to February 2011 when the most Nordic hedge funds operated. Selected period is long enough to allow us examine the performance of hedge funds during different economic conditions including the effect of the last financial crisis. The chart below over the performance of MSCI Nordic provided by Bloomberg indicates two significantly different periods in the stock market history within the timeframe of our analysis:

- March 2003- June 2007 (expansion period of the market)
- July 2007- March 2011 (period of disturbed market conditions)

The index is chosen as the representative of the Nordic stock market performance and considered to be a good indicator of changing economic conditions as stock prices are the leading indicators of the business cycle (Fregert et al. 2005, p.252).

We choose therefore to divide the analysis of the returns of Nordic hedge funds into two sub periods. However, in order to provide comparable results we choose two equal periods of 48 months: March 2003-February 2007 and March 2007- February 2011. Though market downturn began in July 2007 we believe that our choice is well justified for the comparability reasons.

**Graph 1 – Performance of MSCI Nordic during the period 2003-2011**



In our sample we include hedge funds that were operational throughout the whole sample sub-period, henceforth defined as full-data survivors. Thus, we restrict each of our samples to funds with a minimum of 48 months of return history in order to receive reliable regression results. Funds not meeting this criterion, especially funds that survived only for a short period of time or funds that started

to operate in the middle/ end of the sample period, are excluded systematically. We are aware of the fact that this kind of restriction can heavily bias and impair the results, and limit our study significantly. Therefore we deal with this survivorship bias problem by constructing and analyzing the performance of unbiased portfolios described further in the paper.

We develop our analysis by focusing closer on the sub-period 2007- 2011 as this period includes both stock market fall and market recovery phase. By studying closely the MSCI Nordic performance we observe that those two phases are approximately equal in the length. Therefore we decide to create two 24- month periods that reflect different market conditions:

- March 2007- February 2009 (recession phase)
- March 2009- February 2011 (recovery phase)

In this part of our empirical analysis we examine the performance of all hedge funds that earlier were defined as full-data survivors. Since during 2007-2011 the biggest amount of hedge funds operated on the Nordic market, our sample size is larger compared to 2003-2007. First 24-month period (March 2007-February 2009) includes 92 hedge funds; second 24-month period (March 2009- February 2011) includes 59 hedge funds. Variation in amount of funds is explained by the big amount of funds that opened in 2007 and funds closed during 2010.

Bearing in mind that not all hedge funds existed during the specified analysis period and were excluded from the study we are aware of the problems with several biases. Fung and Hsieh (2000) point out the following potential biases that may arise when dealing with the hedge fund data: selection bias, instant history bias, survivorship bias and multi-period collection bias (Fung & Hsieh 2000).

Selection bias may arise when hedge fund managers report performance information only on successful funds. However, the effect of this bias is limited, according to authors (Fung & Hsieh 2000, p.299). Information provided by the Hedge Nordic, we believe, allow us to minimize the problem of selection bias due to the database requirements. Hedge Nordic provides the Nordic hedge index (NHX) and in order to present the correct values of the index, the Hedge Nordic database strives to include information about all hedge funds, not only successful ones<sup>8</sup>. Though some of the small funds may not be included in the index, we assume that those excluded funds are not representative and will not significantly influence the analysis.

Instant history bias is the result of backfilling the performance information for funds recently added to database for the period between the inception date and the date of entry. Different databases report different size of the biases (Fung & Hsieh 2000, p.298). Studying Hedge Nordic database we observe that reported inception date coincides with the date of the first performance reports.

Survivorship bias concerns differences in returns of survived and dead hedge funds. Defunct hedge funds usually demonstrate lower performance and studying returns of exclusively alive funds would give incorrect picture of hedge fund industry (Fung & Hsieh 2000, p.294). According to Liang (2000) survivorship bias exceeds 2 % per year and varies across styles (Liang 2000, p.309). We observe in

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<sup>8</sup> <http://www.hedgenordic.com/?pageid=47>

Hedge Nordic database that from January 2011 around 40 hedge funds have no longer performance information.

Last bias mentioned by Fung and Hsieh is multi-period sampling bias explained as requirement of sufficient history before inclusion into the study (Fung & Hsieh 2000, p.305). Following the previous researches we decide to exclude hedge funds with history of performance shorter than 24 months from our analysis in order to avoid multi-period sampling bias (Edwards & Caglayan 2001, p.1008). We therefore exclude 5 hedge funds that were open in the end of 2009.

It is worth notices that a big part of Nordic hedge funds is represented by the investment strategy "Funds of Funds" which according to Fung and Hsieh demonstrate least biases (Fung & Hsieh 2000, p.300-301). Therefore we think that results of our study will be reliable.

Portfolios of funds constructed for each style provide a good benchmark in order to discover potential biases. Constructing portfolios for each sub-period we include all hedge funds that existed during the analyzed period as they appear. Portfolios are equally-weighted. We thereafter compare portfolio results for each period with the results obtained for respective period for our full-data survivors.

### 3.2 Methodology

We base our method on numerous articles presented earlier. The analysis of Nordic hedge funds performance will be conducted by estimating Jensen's performance index (measured by alpha) and multi-factor model. Though some researches mean that alpha is an inappropriate measure of performance for the hedge funds due to the fact that returns of the hedge funds tend to be not normally distributed (Agarwal 2000), most researches share other opinion (e.g. Edwards & Caglayan 2001).

To estimate excess returns for individual hedge funds we use a one-factor model based on CAPM with the excess market return as the explanatory variable. The model is as following (Rohleder et al 2007, p.3):

$$(1) R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \text{ (Jensen's alpha)}$$

Where  $R_{it}$  is the monthly return on hedge fund,  $R_{ft}$  the risk-free rate and  $(R_{mt} - R_{ft})$  is the market excess return provided by Kenneth R. French<sup>9</sup>.

Due to the fact that hedge funds tend to actively use dynamic trading/investment strategies, the returns of individual hedge funds are expected to depend on different economic risk factors. We therefore continue the analysis by using the Carhart's four-factor model, with "momentum" as an additional risk factor to the Fama&French's three-factor model. The results from the two models will be compared in order to see which one provides better explanation of hedge funds performance. In four-factor model the returns of individual funds are regressed on the three historical Fama&French benchmark factors:

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<sup>9</sup> [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html#Research](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Research)

the excess market return ( $R_{mt} - R_{ft}$ ), *SMB* (size factor), *HML* (book-to-market factor) and *Mom* (momentum factor) proposed by Carhart. Our multi-factor model is as following (Rohleder et al 2007, p. 3):

$$(2) R_{it} - r_{ft} = \alpha_i + \beta_{1i}(R_{mt} - r_{ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_t + \beta_{4i}Mom_t + \varepsilon_{it} \text{ (Carhart's alpha)}$$

where  $R_{it}$  is the monthly return on hedge fund,  $R_{ft}$  the risk-free rate,  $(R_{mt} - R_{ft})$  is the excess market return,  $SMB_t$  and  $HML_t$  are factor mimicking portfolios for size and book-to-market and  $Mom_t$  factor mimicking portfolio for momentum. Interest rate we use in the model is represented by 1-month T- bill rate (US Citigroup BIG) and is downloaded from Datastream. T-bill return is calculated logarithmically. The factors are downloaded from the French data library<sup>10</sup> where *SMB* (small minus big) is calculated as the difference in the performance of small and big portfolios; *HML* (high minus low) is calculated as difference in the performance on value and growth portfolios<sup>11</sup>. *Mom* is defined as the spread between the performance of a portfolio of past winners and a portfolio of past losers (Bauer et al.2005, p.354). Detailed explanation on factor calculations is provided on the webpage of Kenneth R. French.

Classical linear regressions for each individual fund give estimates of Carhart/ Jensen alphas. Then averages within each investment style and for all hedge funds are calculated.

Analyses are performed for individual funds as well as for style portfolios for two 48 month periods (March 2003-February 2007, March 2007-February 2011) and two 24 month periods (March 2007-February 2009, March 2009-February 2011). Obtained results should provide the insight into changing factor exposure of different styles of funds to different economic conditions. From that point of view the last two sub-periods are particularly interesting.

For style portfolios we calculate Sharpe ratio for each specified period in order to see which styles have demonstrated the best risk-adjusted return. The diagrams over portfolio returns against market return demonstrate the volatility of hedge funds belonging to different investment styles as well as provide support to our findings of hedge funds excess returns.

After the estimation of alphas for individual funds and portfolios we continue with testing for short-term performance persistence during the period March 2007 to February 2011. In our sample we include only the individual hedge funds that have existed for the whole estimation period (2007-2011), which gives us a final sample of 44 hedge funds (including all investment styles).

Persistence in the performance of hedge funds could indicate the significance of manager skills for returns (Edwards & Caglayan 2001, p.1004). Hedge fund managers employ highly dynamic trading strategies in order to constantly exploit new market inefficiencies and “beat the market.” Thus, the existence of performance persistence would imply market inefficiency (Harri & Brorsen 2004). To investigate the issue of persistence, we test the null hypothesis that  $\beta = 0$  (implying “no

<sup>10</sup> [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html#HistBenchmarks](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#HistBenchmarks)

<sup>11</sup> [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data\\_Library/f-f\\_factors.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html)

persistence”) by using the following regression-based parametric method (Harri & Brorsen 2004, p.135):

$$(3) r_{it} = \alpha_i + \sum_{k=1}^K \beta_k r_{i(t-k)} + \varepsilon_{it}$$

where  $i = 1, \dots, n$ ;  $t = 1, \dots, T$ ;  $\varepsilon_{it} \sim (0, \sigma_{i\varepsilon}^2)$

We conduct the tests at half-yearly and yearly basis and define ( $r_{it}$ ) as the return of a hedge fund belonging to a particular investment style minus the average style return of all hedge funds belonging to the same style for the same period. We regress the current period ( $r_{it}$ ) on the previous period ( $r_{i(t-k)}$ ) and interpret a positive and significant slope coefficient as the existence of persistence in performance.

Agarwal et al (2000) state that it may not be fair to compare the performance of hedge fund managers following different investment styles strategies due to the significant difference in risk-return trade-offs. Besides, in the following investment styles: “Fixed Income”, “Multi strategy” and “Managed futures & CTA”, we do only have a few hedge funds (< 10 funds) and therefore running the regressions for each particular style in our case would not be appropriate. Thus, we decide to estimate the regressions with all of the data and make general conclusions (for all investment styles) regarding the rejection of null hypothesis.

Due to the small and not proportional size of our sample, we cannot use nonparametric methods (e.g. cross-product ratio test and chi-square test) to examine the performance persistence (Cortez et al. 2001). However, we still do the sorts based on the “winners and losers” idea for each individual fund within each investment style and summarize the results in appendix. The hedge fund is defined as a “winner” if its average return is strictly above the style median return in each particular period; otherwise it is a “loser” (Agarwal et al 2000). The findings are presented on half-yearly and yearly basis, and the percentage of winning return periods is calculated for individual funds within each style in the sample.

As data for hedge fund returns tends to be not normally distributed, in the last step of the analysis we look at skewness and kurtosis of the returns in order to get an insight in reliability of our results. For a variable to be normally distributed, skewness should be zero and kurtosis should be 3 (Gujarati 2006, p.192).

## 4. Empirical Results

*This chapter presents the main empirical results obtained on the methodology applied to our data. The alpha estimates are calculated based on the single-index and multi-factor models for both individual funds and portfolios of funds on a 4-year basis. The estimation period covers both the steady growth in the market (2003-2007) and the period of the disturbed market conditions (2007-2011). For comparison reason, the analysis continues with the same estimations of alphas on a 2-year basis, however, only considering the period of disturbed market conditions (2007-2011). Further, the regression-based parametric approach is used in order to detect the short-term persistence in performance of hedge funds. The section ends with application of a nonparametric statistical procedure to define "winners" within each investment styles and test for normality.*

### 4.1 Estimating Excess returns: 2003-2007/ 2007-2011

#### 4.1.1 Estimating Excess returns for individual funds

The excess returns are measured as the estimated alphas in the following two models (Rohleder 2007, p.3):

$$(1) R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it}$$

$$(2) R_{it} - r_{ft} = \alpha_i + \beta_{1i}(R_{mt} - r_{ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_t + \beta_{4i}Mom_t + \varepsilon_{it}$$

Table I and II below summarize the results of two measures of hedge funds' excess returns for each 4-year sample period: Jensen's alpha estimated by the single-index model on Equation (1) and Carhart's alpha estimated by the four-factor model on Equation (2). Both performance measures are estimated by running classical linear regressions in Excel for each individual fund and averages are taken within each investment style and for all hedge funds.

**Table I - Measures of Excess Returns by Investment Style during March 2003 to February 2007**

2003-2007	Single Index model			Carhart's four-factor model					
	Alpha	Mkt	Adj R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom	Adj R <sup>2</sup>
All Hedge Funds	0.650	0.188	0.074	0.499	0.212	-0.029	0.193	0.059	0.090
Equities	0.670*	0.141**	0.089	0.621**	0.123**	0.055**	0.072**	0.074**	0.119
Fixed Income	0.326*	0.050**	-0.005	0.206**	0.011**	0.056**	0.160**	-0.011**	-0.001
Multi strategy Managed futures & CTA	0.380**	0.068**	-0.002	0.237**	0.062**	0.020**	0.188*	0.049**	-0.037
Fund of funds	1.721**	0.403**	0.107	1.502**	0.557**	-0.292**	0.242**	-0.036**	0.098
	0.155**	0.276*	0.179	-0.072**	0.308*	0.013**	0.302**	0.219*	0.274

\* Significant at 10% level

\*\* Not significant at 10% level



When looking at the alpha values presented in the table above we see that hedge funds under different investment styles on average were able to “beat the market”, recording a positive alpha (except Carhart’s alpha for “Fund of funds”). However, these findings are only statistically significant (at 10% level) in the case of “Equities” and “Fixed Income” estimated by the single-index model.

The conclusion from the regression results for explanatory factors is that they have low explanatory value in the regression and most of the results are highly insignificant. Still, we note that “Fund of Funds” has almost the highest market risk exposure among other investment styles in terms of beta value (Mkt), which is also significant according to both measures. Another interesting aspect is that “Fund of Funds” is the only investment style that exhibit significant and positive momentum loading, while “Multi strategy” is the only investment style that exhibit significant and positive premium on the HML factor.

When measuring the goodness of fit of respective regression model (Adjusted R2), we see that on average the regression results obtained for all hedge funds from the multi-factor model provide a slightly higher value of R2 than from the single-index model. However, in general both models seem to have low explanatory power of hedge funds’ excess returns.

**Table II** - Measures of Excess Returns by Investment Style during March 2007 to February 2011

2007-2011	Single Index model			Carhart's four-factor model					
	Alpha	Mkt	Adj R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom	Adj R <sup>2</sup>
All Hedge Funds	0.456	0.129	0.172	0.406	0.143	-0.006	-0.141	-0.096	0.208
Equities	0.337**	0.295*	0.264	0.234**	0.300*	0.045**	-0.223**	-0.162**	0.299
Fixed Income	0.919*	0.153*	0.188	0.796*	0.163*	-0.001**	-0.309**	-0.244*	0.257
Multi strategy	0.450**	0.098*	0.208	0.405**	0.110*	0.002**	-0.122**	-0.078**	0.256
Managed futures & CTA	0.353**	-0.004**	0.028	0.411**	0.000**	-0.050**	0.103**	0.076**	0.004
Fund of funds	0.221**	0.105*	0.170	0.181**	0.141*	-0.024**	-0.154**	-0.070**	0.224

\* Significant at 10% level

\*\* Not significant at 10% level

From table II above we conclude that during the period 2007-2011 an absolute winner in terms of significantly “beating the market” according to both measures is definitely the group of hedge funds representing “Fixed Income” investment style. The average Jensen/Carhart alpha for this particular style is 0.919/0.796. This finding is statistically significant at 10% level, while positive alphas for all other investment styles are insignificant. We also see that in general Carhart alphas tend to be lower than Jensen alphas which are due to the greater exposure to different risk factors.

During the period 2007-2011 we get highly significant beta values (Mkt) with both models for almost all investment styles (except Managed futures & CTA). This indicates the exposure to

market risk among almost all investment styles during the above mentioned period. Especially “Equities” exhibit the highest market risk exposure according to both models. These findings are statistically significant at 10% level.

The loadings for other explanatory factors like size (SMB) and value (HML) are negative and insignificant for all investment styles and keep adding no explanatory value to the hedge fund behavior. The momentum (Mom) coefficient is now significantly negative for “Fixed Income”, indicating momentum contrarian strategies.

It is also worth notices that compared to the previous period the R2 is now significantly higher for both models, indicating the greater explanatory power of our regression models.

In table III below we provide some descriptive statistics on the individual funds obtained by the estimation of equation (1) and (2) for each hedge fund during each sub-period.

*Sub-period 1 (2003-2007):* Of all 27 hedge funds in the sample with “Equities” as the largest representative group ( 15 funds out of 27)  $\approx 78\%$  of hedge funds have shown significantly positive Jensen alphas compared to  $\approx 44\%$  with significantly positive Carhart alphas (both at 10% significance level). However, the difference in percentage of funds with positive and significant market risk exposure (beta) between single/multi-factor models is not big (59% against 48%). The SMB factor seems to be the weakest indicator of the performance of hedge funds (only 1 fund  $\approx 4\%$  out of 27 is positive and significant), while HML factor adds less explanatory power (with  $\approx 15\%$  of positive and significant funds) than Mom factor ( $\approx 41\%$  of positive and significant funds) to the hedge funds behavior.

*Sub-period 2 (2007-2011):* The sample size is now larger, including in total 44 hedge funds, where “Equities” is still representing the largest category based on the number of funds included in the sample (22). The percentage of funds with significantly positive Jensen alphas is now only  $\approx 32\%$  compared to  $\approx 23\%$  of funds with significantly positive Carhart alphas. The difference in percentage of funds with positive and significant market risk exposure (beta) between single/multi-factor models is now even smaller (64% against 66%). The percentage of funds with positive and significant SMB factor is now  $\approx 2\%$ , while none of the funds have positive and significant either HML or Mom factors.

**Table III** – Descriptive Statistics on the Excess Returns of Individual Hedge Funds during two sub-periods: March 2003 to February 2007 and March 2007 to February 2011

	<u>2003-2007</u>						<u>2007-2011</u>					
	<i>All Hedge Funds</i>	<i>Equity</i>	<i>Fixed Income</i>	<i>Multi strategy</i>	<i>Managed futures &amp; CTA</i>	<i>Fund of funds</i>	<i>All Hedge Funds</i>	<i>Equity</i>	<i>Fixed Income</i>	<i>Multi strategy</i>	<i>Managed futures &amp; CTA</i>	<i>Fund of funds</i>
Number of funds	27	15	2	2	2	6	44	22	3	5	4	10
% of funds with positive significant Jensen alphas	78%	93%	100%	50%	50%	50%	32%	23%	100%	60%	50%	10%
% of funds with positive significant Beta (single-index)	59%	60%	none	none	50%	100%	64%	68%	67%	60%	none	80%
% of funds with positive significant Carhart alphas	44%	67%	none	50%	50%	17%	23%	18%	67%	40%	50%	10%
% of funds with positive significant Beta (four-factor)	48%	40%	none	none	50%	100%	66%	73%	67%	60%	25%	70%
% of funds with positive significant SMB factor	4%	7%	none	none	none	none	2%	5%	none	none	none	none
% of funds with positive significant HML factor	15%	7%	none	none	none	50%	none	none	none	none	none	none
% of funds with positive significant Mom factor	41%	33%	none	none	none	100%	none	none	none	none	none	none

Note: Significance level 10%. Significantly negative factors are not included in the table.

#### 4.1.2 Estimating Excess returns for portfolios of funds

Regression results for each style portfolio are presented in the tables IV and V below. We observe directly that results are much different from the reported earlier averages of individual full-data survivors. Jensen alphas for the period 2003-07 are all significant at 10% level and the highest alphas are those of “Managed futures & CTA” (1.24) and “Equities” (0.79). However, Carhart alphas seem to be slightly lower than Jensen alphas but still give the same rankings of significant styles. In comparison to our previous findings, the observed differences indicate heavy bias in our individual fund results.

Regression results for the beta value (Mkt) are significant in both models for most of the styles. While factors like HML and Mom are adding more explanatory power to the behavior of portfolio of funds compared to the previous results on individual basis. The Momentum (Mom) factor is now significantly positive for “Equities”, “Multi strategy” and “Fund of funds”. Though value factor (HML) is important for explaining returns of “Fixed Income”, “Managed futures & CTA” and “Fund of funds”, size (SMB) factor does not show importance for any style as the results for all styles are insignificant. Adjusted R-squared indicates a good fit of our regression models and is still higher when using the four-factor model.

Sharpe ratio calculated for the period 2003-2007 crowns “Equity” and “Multi strategy” as winning styles. As stock market conditions were good this result is not unexpected.

**Table IV - Measures of Excess Returns by Style Portfolios during March 2003 to February 2007**

2003-2007	Single Index model			Carhart's four-factor model					Sharpe ratio	
	Alpha	Mkt	Adj R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom		Adj R <sup>2</sup>
Equities	0.7929*	0.1696*	0.2206	0.7641*	0.1719*	0.0326**	0.0456**	0.1034*	0.2890	1.1145
Fixed Income	0.3343*	0.0767*	0.0586	0.1521**	0.0787**	-0.0001**	0.2354*	0.0396**	0.2088	0.6067
Multi strategy	0.5687*	0.1387*	0.2471	0.4891*	0.1266*	0.0469**	0.1117**	0.0838*	0.3113	1.0579
Managed futures & CTA	1.2402*	0.4607*	0.2051	0.81256*	0.5511*	-0.1699**	0.5286*	0.0315**	0.2973	0.7110
Fund of funds	0.2186*	0.2141*	0.3099	0.0256**	0.2255*	0.0269**	0.2578*	0.1573*	0.4425	0.4854

\* Significant at 10% level

\*\* Not significant at 10% level

Table V below presents the estimated alpha results and Sharpe ratio for portfolios of funds during the period of disturbed market conditions (2007-2011).

**Table V - Measures of Excess Returns by Style Portfolios during March 2007 to February 2011**

2007-2011	Single Index model			Carhart's four-factor model					Sharpe ratio	
	Alpha	Mkt	Adj R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom		Adj R <sup>2</sup>
Equities	0.3562*	0.2103*	0.5234	0.2874*	0.2145*	0.0343**	-0.1482*	-0.1035**	0.5424	0.2370
Fixed Income	0.4628**	0.2431*	0.3411	0.3417**	0.2602*	-0.0408**	-0.3393*	-0.2708*	0.4524	0.2153
Multi strategy	0.3710*	0.0974*	0.2643	0.3133*	0.1073*	0.0007**	-0.1502*	-0.1077*	0.3380	0.3652
Managed futures & CTA	0.4596**	0.0058**	-0.0214	0.5100*	0.0587**	-0.1198**	-0.0183**	0.0402**	-0.0221	0.2324
Fund of funds	0.1387**	0.0958*	0.2080	0.1198**	0.1298*	-0.0512**	-0.1185*	-0.0544**	0.2293	0.1347

\* Significant at 10% level

\*\* Not significant at 10% level

We note that highly significant Jensen / Carhart alphas we had in our full-sample survivors' analysis for "Fixed income" is half smaller and insignificant. Instead we get significantly positive Jensen/ Carhart alphas for "Equities" and "Multi strategy" ("Managed futures & CTA" is only significant for Carhart's alpha). Though coefficients for other style portfolios are somewhat different from reported earlier averages, they are in general consistent. Important to mention negative value for adjusted R2 we obtain for "Managed futures & CTA". Hence the chosen factors and model explain poorly the style return during this period.

According to Sharpe ratio the best performing style during 2007-2011 is "Multi strategy". This style is also the one of two that shows positive Jensen/ Carhart alpha.

## 4.2 Estimating Excess returns: 2007-2009/ 2009-2011

### 4.2.1 Estimating Excess returns for individual funds

We now divide the period from March 2007 to February 2011 into two equal sub-periods and estimate Jensen/ Carhart alphas for each 2-year sample period in the same way as before. Tables VI and VII below summarize the results.

From table VI below we see that according to both performance measures almost all investment styles (except "Fund of funds" estimated by Carhart's model) have generated a positive alpha during the recession period in the economy. However, none of them is statistically significant at 10% level.

**Table VI - Measures of Excess Returns by Investment Style during March 2007 to February 2009**

2007-2009	Single Index model			Carhart's four-factor model					
	Alpha	Mkt	Adj R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom	Adj R <sup>2</sup>
All Hedge Funds	0.324	0.116	0.130	0.150	0.154	-0.085	-0.257	-0.143	0.201
Equities	0.240**	0.208**	0.197	0.014**	0.237**	0.039**	-0.316**	-0.175**	0.297
Fixed Income	0.238**	0.288**	0.179	0.021**	0.319**	-0.097**	-0.544**	-0.446**	0.310
Multi strategy Managed futures & CTA	0.316**	0.028**	0.168	0.188**	0.062**	-0.082**	-0.147**	-0.055**	0.228
Fund of funds	0.659**	-0.057**	0.015	0.582**	-0.007**	-0.257**	-0.071**	0.001**	-0.016
	0.168**	0.111**	0.091	-0.056**	0.157**	-0.028**	-0.206**	-0.042**	0.185

\* Significant at 10% level

\*\* Not significant at 10% level

Further, the table VI reveals that the premium on the SMB and HML factors is in almost all cases negative. The same is true for the momentum loadings for all hedge funds on average. While beta values (Mkt) are positive (except for “Managed futures& CTA”) to some extent indicating the market risk exposure among Nordic hedge funds. But once again, we could not find any statistical significance in the above mentioned results. The adjusted R2-values are still significantly higher when using the multi-factor model.

**Table VII - Measures of Excess Returns by Investment Style during March 2009 to February 2011**

2009-2011	Single Index model			Carhart's four-factor model					
	Alpha	Mkt	Adj R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom	Adj R <sup>2</sup>
All Hedge Funds	0.502	0.125	0.126	0.497	0.110	-0.064	0.087	0.013	0.167
Equities	0.582**	0.237**	0.217	0.545**	0.168**	0.002**	0.205**	0.047**	0.278
Fixed Income	1.616*	0.080**	0.023	1.573*	0.051**	-0.029**	-0.028**	-0.083**	0.080
Multi strategy Managed futures & CTA	-0.012**	0.164**	0.253	-0.016**	0.198**	-0.049**	-0.183**	-0.110**	0.298
Fund of funds	-0.025**	0.081**	-0.012	0.029**	0.084**	-0.199**	0.328**	0.168**	-0.036
	0.351**	0.063**	0.150	0.352**	0.048**	-0.045**	0.114**	0.042**	0.213

\* Significant at 10% level

\*\* Not significant at 10% level

By looking at the table VII, we can directly state the dominant ability of the hedge funds belonging to the “Fixed Income” to earn abnormal returns during the period of 2009-2011. Both Jensen and Carhart alphas (1.616 / 1.573) are superior positive and significant at 10% level. An interesting comparison can be made to the alpha results obtained during 2007-11 for the same investment style. According to both models, alphas are significantly lower (0.919/ 0.796) in the 4-year sample which indicates the importance of different time-periods chosen for alpha estimation. However, for this particular

investment style we could not find any statistical significance in the fund manager's ability to "beat the market" during the period of 2007-2009 and thus find the alpha results estimated on the 2-year rolling basis to be more accurate and reliable.

Another notable remark is that when doing estimations on the 2-year sample period, none of the investment styles show positive significant beta values (Mkt), compared to the estimations on the 4-year basis for the same period (2007-11), where almost all of the investment styles have shown highly significant beta values (Mkt). This can well be due to the differences in sample sizes for four respective two-year periods, since much more funds have existed and were included in the 2-year sample.

In table VIII below follows some descriptive statistics on the individual funds for each 2-year sample period.

*Sub-period 1 (2007-2009):* Due to the fact that each of our sample periods is now only 24 months, we were able to include much more funds (compared to 2007-11) and thus we have 92 hedge funds in total. "Equities" is still representing the largest category (44 funds out of 92). The percentage of funds with significantly positive Jensen alphas is only  $\approx 11\%$  compared to  $\approx 8\%$  of funds with significantly positive Carhart alphas (both at 10% significance level). The difference in percentage of funds with positive and significant market risk exposure (beta) between single/multi-factor models is still very small (48% against 54%). Among all investment styles, only "Equities" have a few funds with positive and significant risk exposure to the SMB, HML and Mom factors.

*Sub-period 2 (2009-2011):* The sample size is now lower with 59 hedge funds included in total due to the fact that a big amount of funds closed during 2010. The percentage of funds with significantly positive Jensen/ Carhart alphas is higher (25% and 27% respectively). However, it seems like the market risk exposure (beta) for funds estimated by the single-index model is higher than when doing the estimation by using the multi-factor model. "Equities" is still the only investment style that exhibits some positive and significant exposure to the SMB factor (7%), while HML and Mom factors seem to add more explanatory power. Now even a few hedge funds belonging to the "Fund of funds" have shown significantly positive exposure to the above mentioned factors.

**Table VIII – Descriptive Statistics on the Excess Returns of Individual Hedge Funds during two sub-periods: March 2007 to February 2009 and March 2009 to February 2011**

	<u>2007-2009</u>						<u>2009-2011</u>					
	All Hedge Funds	Equity	Fixed Income	Multi strategy	Managed futures & CTA	Fund of funds	All Hedge Funds	Equity	Fixed Income	Multi strategy	Managed futures & CTA	Fund of funds
Number of funds	92	44	7	14	7	20	59	28	3	9	8	11
% of funds with positive significant Jensen alphas	11%	11%	none	7%	14%	15%	25%	25%	100%	22%	none	55%
% of funds with positive significant Beta (single-index)	48%	59%	43%	36%	none	50%	53%	57%	33%	56%	13%	73%
% of funds with positive significant Carhart alphas	8%	7%	none	7%	14%	10%	27%	29%	100%	22%	none	55%
% of funds with positive significant Beta (four-factor)	54%	68%	43%	36%	none	60%	39%	50%	none	56%	none	36%
% of funds with positive significant SMB factor	3%	7%	none	none	none	none	3%	7%	none	none	none	none
% of funds with positive significant HML factor	3%	7%	none	none	none	none	7%	7%	none	none	none	18%
% of funds with positive significant Mom factor	2%	5%	none	none	none	none	5%	7%	none	none	none	9%

Note: Significant at 10% level



#### 4.2.2 Estimating Excess returns for portfolios of funds

When estimating alphas for individual funds in the 2-year sample, we have included significantly more full-sample survivors which should lead to more reliable results. Portfolio analysis confirms this expectation. In table IX we see that the alpha estimations obtained by the single-index/ multi-factor models are very similar to the findings for individual funds reported earlier in the 2-year sample. Jensen/ Carhart alphas are insignificant for all investment styles, while Carhart alpha is negative for “Equities” and “Fund of funds”. However, in contrary to our full-data survivors’ results, portfolio results indicate significant market risk exposure for all styles except “Managed futures & CTA” (in four-factor model) and “Managed futures & CTA” and “Multi strategy” (in single-index model).

Size (SMB) factor is insignificant for all styles, while book-to-market (HML) factor is significantly negative for almost all styles (except “Managed futures & CTA”). This style once more differs from the others with its notably higher Sharpe ratio (0.3584) during 2007-2009. However, by looking at the negative R2 for this particular style, it seems that none of the models can provide good explanation of its return during the market downturn.

**Table IX** - Measures of Excess Returns by Style Portfolios during March 2007 to February 2009

2007-2009	Single Index model			Carhart's four-factor model					Sharpe ratio	
	Alpha	Mkt	Adj.R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom		Adj R <sup>2</sup>
Equities	0.2039**	0.1786*	0.3422	-0.0398**	0.2162*	0.0269**	-0.2913*	-0.1290**	0.5101	-0.1529
Fixed Income	0.2379**	0.2875*	0.2915	0.0211**	0.3190*	-0.0966**	-0.5445*	-0.4457*	0.4483	-0.1752
Multi strategy	0.2878**	0.0575**	0.0468	0.1255**	0.0958*	-0.0697**	-0.1787*	-0.0622**	0.2092	0.1352
Managed futures & CTA	0.7061**	-0.0164**	-0.0435	0.5404**	0.0488**	-0.2014**	-0.0651**	0.0840**	-0.0350	0.3584
Fund of funds	0.1848**	0.1112*	0.1333	-0.0400**	0.1564*	-0.0217**	-0.2080*	-0.0440**	0.2515	-0.0645

\* Significant at 10% level

\*\* Not significant at 10% level

The final period 2009-2011 includes recovery phase of the stock market. It is especially interesting to see if the results are somewhat similar to those of the previous period of falling stock market 2007-2009 and if “Managed futures & CTA” still demonstrates the best risk-adjusted result (Sharpe ratio). The table X below shows that only “Fixed Income” have positive significant alpha during 2009-2011 according to both single-index and four-factor models. It is interesting to notice that this style has the highest Sharpe ratio during this period and the lowest Sharpe ratio during the previous period. “Fixed Income” demonstrates therefore the largest variation in performance which is consistent with its style characteristic.

**Table X - Measures of Excess Returns by Style Portfolios during March 2009 to February 2011**

2009-2011	Single Index model			Carhart's four-factor model					Sharpe ratio	
	Alpha	Mkt	Adj R <sup>2</sup>	Alpha	Mkt	SMB	HML	Mom		Adj R <sup>2</sup>
Equities	0.3639**	0.2327*	0.5446	0.3297**	0.1731*	-0.0047**	0.1651**	0.0296**	0.6067	0.6860
Fixed Income	1.1913*	0.1080*	0.1194	1.1265*	0.0677**	-0.0038**	-0.0872**	-0.1355*	0.3537	1.1313
Multi strategy Managed	0.1976**	0.1512*	0.4778	0.1617**	0.1256*	0.0016**	-0.0321**	-0.0660**	0.5720	0.6088
futures & CTA	-0.1308**	0.1050**	0.0323	-0.0805**	0.1238**	-0.1381**	0.1992**	0.1215**	-0.0099	0.0924
Fund of funds	0.1822**	0.0783*	0.2457	0.1879**	0.0677*	-0.0845*	0.1230*	0.0394**	0.3501	0.5643

\* Significant at 10% level

\*\* Not significant at 10% level

“Managed futures & CTA” demonstrates the lowest Sharpe ratio and is the only style that has negative alphas. Hence it does not show stable performance. However, once again we observe that our models have poor fit for explaining performance of hedge funds belonging to this style.

During both 2007-2009 and 2009-2011 “Fixed income” is the only style with significantly negative Momentum (Mom) factor. “Fund of funds” demonstrates significantly positive premium on the (HML) factor during market recovery while it was significantly negative during the market downturn. The beta value (Mkt) is significant and positive for most of the styles during both periods (with “Fixed Income” having according to single-index model the highest exposure to the difficult market conditions).

To summarize: Values for Jensen alpha are lower for portfolios than for full-sample survivors and inconsistent with previous reported results in case of Carhart alpha and factor exposures. Adjusted R-squared for portfolio regressions is much higher than for individual funds.

Plotting the portfolio returns against a market return represented by the MSCI Nordic we can observe differences in styles (see Appendix, Diagrams I-II). We see that all funds outperformed the market during almost all estimation periods which is confirmed by the positive alphas and that only two styles performed worse than the market during 2007-2009. “Managed futures & CTA” shows highest returns during the financial crisis while “Fixed Income” is the worst performer during the same period.

Variation in the monthly returns of hedge fund portfolios during 2003-2011 is higher than that of the market. Though it is similar across most styles it seems to be lower for “Multi strategy” and very high for “Managed futures & CTA” (see Appendix, Diagram III).

### 4.3 Persistence

We test for the presence of short-term persistence among all investment styles in the sample on a half-yearly and yearly basis during the period 2007-2011. We test the hypothesis which implies that funds that obtain a superior return in the current period have also obtained a superior return in the previous period. The results are presented in tables XI and XII below.

**Table XI – Performance persistence analysis (6 months)**

		Beta	SE	t-stat	P-value
<b>2007-08</b>	<i>I</i>	0.1729	0.2058	0.8399	0.4057
	<i>II</i>	0.4781	0.1485	3.2191	0.0025
	<i>III</i>	1.3640	0.3375	4.0417	0.0002
<b>2008-09</b>	<i>I</i>	-0.5641	0.1073	-5.2591	0.0000
	<i>II</i>	0.1596	0.0618	2.5806	0.0134
<b>2009-10</b>	<i>III</i>	0.0595	0.2119	0.2807	0.7803
	<i>I</i>	0.0604	0.1068	0.5653	0.5749

Note: Significance level 10%

By looking at the table XI, we see that hedge funds (in general) were able to show persistence during 2007-2008 (II and III periods), and in the middle of 2009 (II period). The slope coefficients (beta) are highly significant and positive. However, during the recovery phase in the market (end of 2009-2011), none of the investment styles in the sample demonstrate significant results (at 10% level), and thus we cannot reject the null hypothesis of “no persistence.”

**Table XII – Performance persistence analysis (1 year)**

	Beta	SE	t-stat	P-value
<b>2007-08</b>	1.4374	0.3382	4.2508	0.0001
<b>2008-09</b>	-0.5750	0.1026	-5.6045	0.0000
<b>2009-10</b>	0.0447	0.0942	0.4751	0.6372

Note: Significance level 10%

The results obtained in the 1-year estimation are quite similar to the previous findings. In the beginning of heavy downturn in the market (2007-2008), we get highly significant and positive beta, which states the presence of persistence in performance among hedge funds. During 2008-

2009 we get highly significant but negative beta, which indicates that hedge funds in our sample are not able to constantly “beat the market.” While under an early recovery phase (2009-2010), we cannot find any statistical evidence for the presence of persistence in performance (due to highly insignificant results).

#### **4.4 Defining “winners” for investment styles**

In order to pick hedge fund “stars” and “dogs” within each investment style during the period 2007-2011, we take the average return for each individual fund and compare it to the style median return in each particular period. The results are presented in Appendix (Table XIII) on half-yearly and yearly basis. For “Equities” we can define hedge fund “Grand Haven Capital Neutral Fund” as a “star” compared to other funds following the same investment strategy. It was able to generate return strictly above style median in 88% of cases on a 6-months basis and 100% on a yearly basis. The hedge funds like “Stella Nova Hedgefund”, “Nordic Alpha plc” and “Grand Haven Capital Fund” are all winners in 50% of cases on half-yearly/ yearly basis. Another interesting finding is within the investment style “Multi strategy.” The hedge fund “Aventum Pension” is definitely a “dog” in relation to others within the same style, since it is not able at all to demonstrate an average return above its style median. Within other styles clear “stars / dogs” cannot be detected.

#### **4.5 Test for normality**

Hedge funds belonging to different investment styles demonstrate different skewness/kurtosis (see Appendix, Table XIV). We observe that for the three of investment styles the obtained results for skewness and kurtosis indicate that the returns are close to normally distributed. While the returns of “Multi strategy” and “Equity” are somewhat skewed to the left (-0.1 and -0.3 respectively), “Managed futures & CTA” is skewed to the right (with average 0.4). However, our results for “Fixed income” and “Fund of funds” indicate very high values for kurtosis as well as negative skewness. Average value for kurtosis for “Fixed income” is 11.1 (much above 3 which is characteristic to normal distribution). Thus our regression results for this particular style are unreliable. Considering the fact that this style seemed to perform best during some of the analyzed periods, we conclude that this actually might not be the case.

## 5. Discussion

*This chapter evaluates and discusses the empirical results obtained in the previous chapter.*

### 5.1 Evaluating hedge fund performance during different economic conditions

We find that during the expansion phase of the market (2003-2007) almost all of the investment styles were able to “beat the market” and deliver excess returns in terms of both positive Jensen/Carhart alphas. However, most of those alpha estimates are highly insignificant (at 10% level) in the case of individual funds. More significant alpha results are obtained when constructing the portfolios of funds. The same is true for the explanatory factors. By looking at the individual funds during the above mentioned period, we get highly insignificant results for the market risk exposure (Mkt) among almost all of the investment styles, while the reverse is true for the portfolios of funds. Also, the factors like (HML) and (Mom) seem to add significantly more explanatory value to hedge fund behavior in the case of portfolios. All of this indicates the presence of severe biases in our individual fund sample which considerably affect the results. Thus, we are prone to rely on the results obtained in our unbiased benchmark- namely style portfolios including all operating funds during the studied period.

When analyzing the ability of different investment styles to earn abnormal returns during the disturbed market conditions (2007-2011), we see that alpha results estimated on the individual basis are once again not consistent with the results of the portfolios. For individual funds, we get “Fixed Income” style as the only one (statistically significant) which is able to “beat the market” according to both single-index and multi-factor models, while the portfolio results point out several other styles with significantly positive alphas. However, we were able to find consistency in the results for the beta value (Mkt). Both methods state that almost all of the investment styles are significantly exposed to the market risk during the turbulence period 2007-2011, which makes sense. The factors (HML) and (Mom) are still better at explaining hedge fund returns in the case of portfolios, although the premium on both risk factors is significantly negative for almost all of the investment styles. The general finding regarding the (SMB) factor is that it seems to be the weakest indicator of the hedge fund performance due to its highly insignificant results during the whole estimation period (2003-2011).

Since the period 2007-2011 contains both a market downturn and a recovery phase, we analyze it more deeply on a 2-year rolling basis and find quite interesting differences in the estimation results. It is worth noting that alpha results estimated on the individual basis are fully consistent with the results of portfolios in the 2-year sample. Both methods state that during a heavy market downturn (2007-2009) hedge fund manager’s ability to “beat the market” is not statistically significant for all of the investment styles, while during a recovery phase (2009-2011) both methods point to “Fixed Income” as the only style with significantly positive alphas. However, all other factors still add more explanatory and significant value in the case of portfolios of funds. Due to the above mentioned we find the alpha results estimated on the 2-year sample to be more accurate and in a better way reflecting different market conditions.

By looking at the adjusted R2 values, we state that it is presumably better to use a multi-factor model in explaining hedge fund returns. We have mentioned earlier that hedge fund managers tend to follow highly dynamic trading strategies with an extremely large flexibility of using different investment options as e.g. short selling, leverage and trading in derivatives in order to enhance their returns or reduce systematic risk. Thus, the exposure of hedge fund returns to multiple risk factors may prove to be more useful and appropriate than the exposure to a single market benchmark as in the case of a single-index model.

### **5.1.1 General findings for “protruding” investment styles**

We notice that hedge funds belonging to “Managed futures & CTA” have shown interesting results during the whole estimation period. According to the results of portfolios, during the upturn in the market (2003-2007), they were able to earn the highest significant (at 10% level) abnormal returns. However, during the turbulence period in the market (2007-2011), it was a single style that has consistently demonstrated an insignificant exposure to the market risk factor (Mkt) and a highest variation in the risk-adjusted returns (measured by Sharpe ratio). We also note the poor ability of our models (due to the lowest adjusted R2 during the whole estimation period) in explaining returns of hedge funds belonging to that particular style. The main reason could be that the traditional linear models for this particular style are inappropriate, and the use of other non-linear models would be more suitable, although we found the returns of this style to be fairly normally distributed.

In our analysis, we also find interesting results for “Fixed Income” investment style. It is the only style that was able to significantly “beat the market” and deliver abnormal returns during the recovery phase in the market (2009-2011) according to estimations on both individual basis and portfolios of funds. However, we regard those results to be not reliable due to the fact that returns for this particular style turned out to be not normally distributed.

### **5.2 Persistence in the performance of hedge funds**

We find that hedge funds in our sample (in general) were able to show short-term persistence in performance at the beginning of the market downturn. Nevertheless, they were not able to hold it until the beginning of the recovery phase.

## 6. Conclusion

Analysis of the performance of Nordic hedge funds during 2003-2011 reveals that hedge funds are able to earn abnormal returns. However, alphas are insignificant for all of the investment styles during the period of the market downturn (2007-2009). Results for the portfolios of funds are significant in most of the cases and indicate that results for individual funds are biased.

We find that factors in both single-index and four-factor models in general show low explanatory power (particularly SMB factor which is expected to be a good indicator of macroeconomic conditions). Risk exposure for “Managed futures & CTA” is poorly reflected by either of the models. However, four-factor model is more appropriate in explaining hedge fund returns as it gives higher adjusted R-squared values for all investment styles.

Comparing the results from the two-year sample to those of the four-year sample, we can conclude that a shorter horizon gives more correct and accurate picture of the performance of hedge funds. Analysis conducted for two 48-month periods indicate “Equities” and “Managed futures & CTA” as best performing styles during 2003-2007 and “Multi strategy” and “Managed futures & CTA” during 2007-2011. Dividing the last 48-month period into two sub- periods, we find that “Managed futures & CTA” was the best performing style during the market downturn (however, only according to the Sharpe ratio) and “Fixed Income” during market recovery. In general, ranking of styles according to the Sharpe ratio is different from that of the Jensen/Carhart measure.

None of the investment styles have shown consistent results throughout the changing market conditions. Persistence analysis confirms the presence of short-term persistence during 2007-2008 and no persistence during 2008-2009 among the hedge funds in the sample. Hence, the performance of hedge funds is market-dependent. We also find one hedge fund “star” within “Equities” which was able to consistently outperform other funds belonging to the same style as well as hedge fund “dog” within “Multi strategy”.

We conclude that the Nordic hedge fund industry is an interesting alternative for international investors due to the positive results obtained for some of the investment styles in the study. However, short performance history of Nordic hedge funds and abnormally distributed returns may cause misleading results. Therefore further analysis is required. Non-linear models might be one of the aspects of further research particularly for some of the investment styles as performed statistical analysis reveals that hedge funds belonging to “Fixed Income” and “Fund of Funds” show high value of kurtosis.

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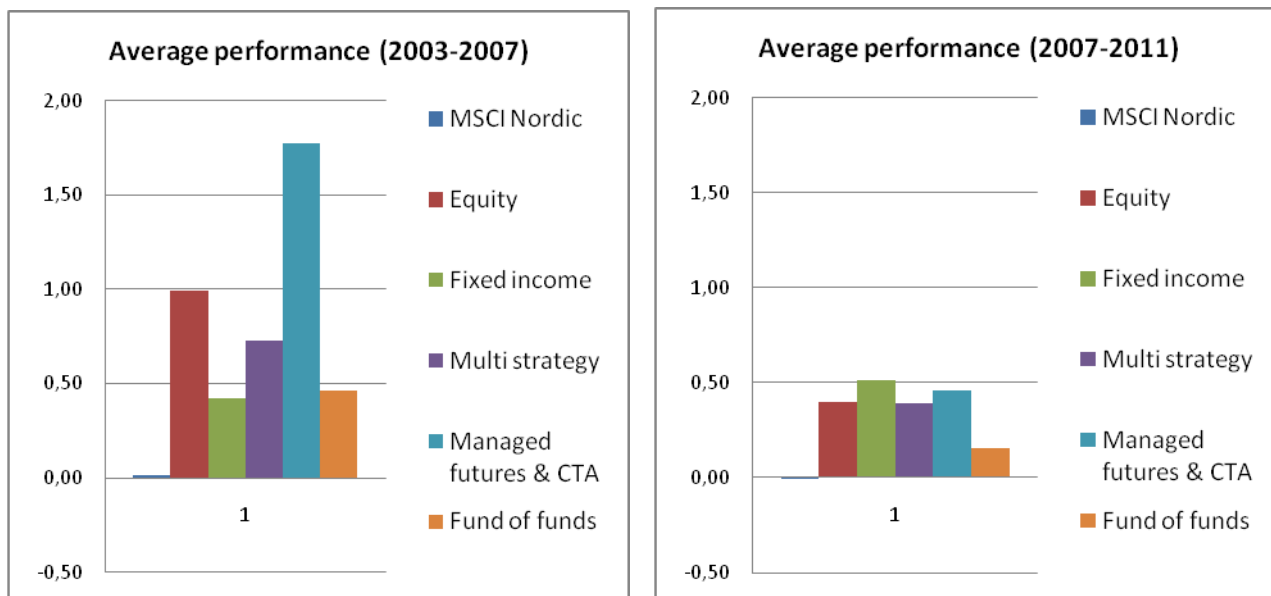
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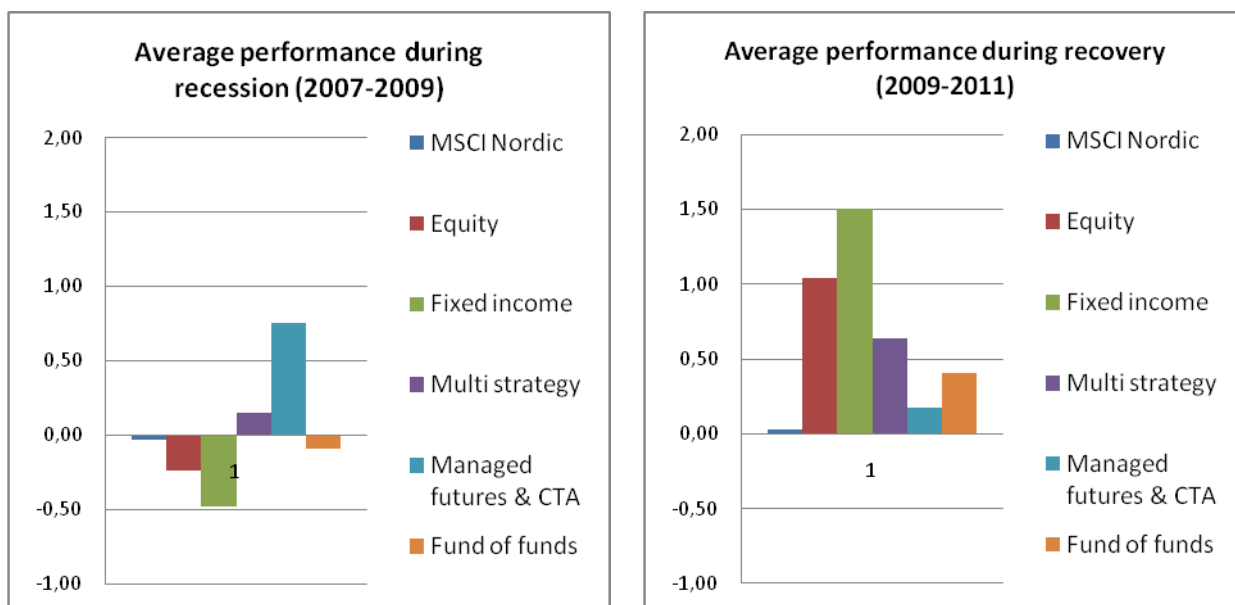
## Appendix

**Diagram I- Average performance of Nordic hedge funds and the stock market during 2003-2011**



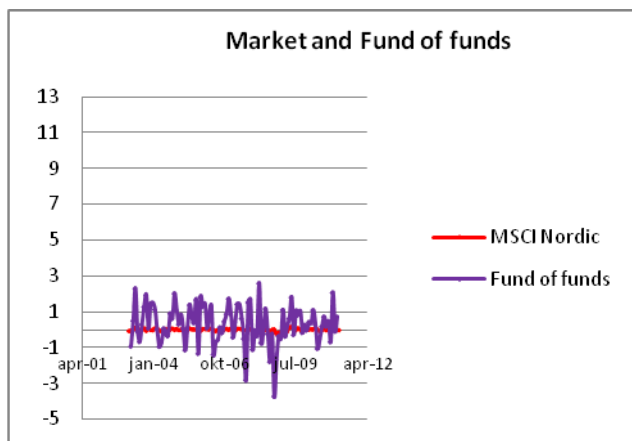
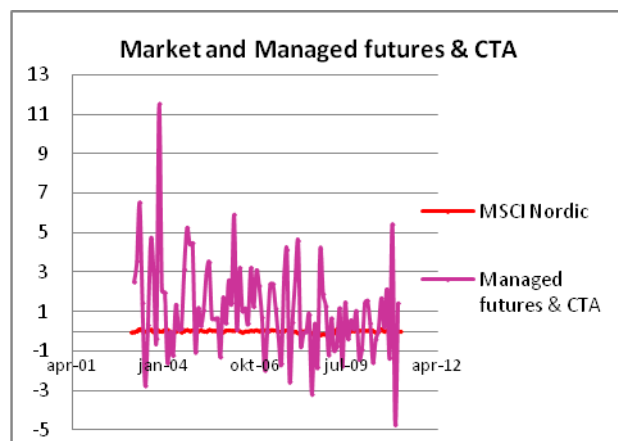
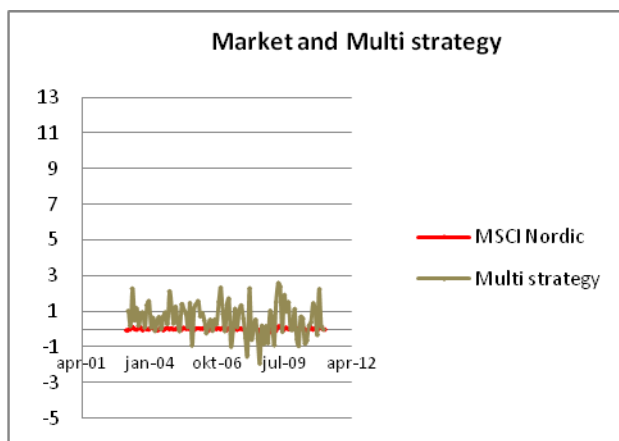
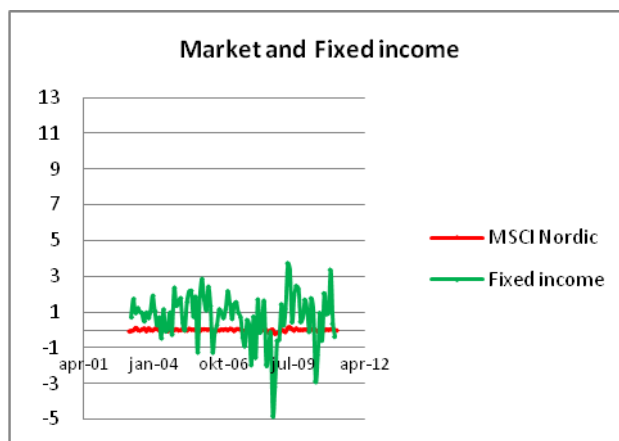
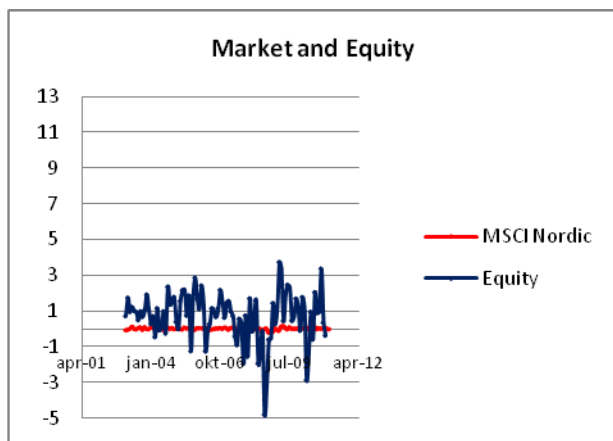
*Note: Average portfolio and market monthly returns during two 48-month periods*

**Diagram II- Average performance of Nordic hedge funds and the stock market during 2007-2011**



*Note: Average portfolio and market monthly returns during two 24-month periods*

**Diagram III- Monthly portfolio returns and market return during 2003-2011**



**Table XIII- Percentage of winning return periods for individual funds during 2007-2011**

<b><u>Equities</u></b>	<b>6 months</b>	<b>1 year</b>
<i>Edge</i>	63%	50%
<i>Explora</i>	38%	50%
<i>Explora European Small &amp; Mid Cap Fund</i>	50%	25%
<i>Gladiator Fond</i>	63%	75%
<i>Grand Haven Capital Fund</i>	50%	50%
<i>Grand Haven Capital Neutral Fund</i>	88%	100%
<i>Graal</i>	25%	25%
<i>Handelsbanken Europa Hedge Selektiv</i>	38%	50%
<i>IPM Global Tactical Asset Allocation Fund A Class</i>	75%	75%
<i>Jyske Invest Hedge Markedsneutral - Aktier</i>	38%	25%
<i>Midas Equity Fund</i>	25%	50%
<i>Nordea European Equity Hedge Fund</i>	38%	50%
<i>Nordea Nordic Equity Hedge Fund</i>	25%	25%
<i>Nordic Absolute Return Fund</i>	50%	75%
<i>Nordic Alpha plc</i>	50%	50%
<i>Nordic Omega plc</i>	63%	75%
<i>P&amp;N Idea</i>	63%	50%
<i>P&amp;N Yield</i>	50%	25%
<i>Radar</i>	25%	25%
<i>Stella Nova Hedgefund</i>	50%	50%
<i>AAM Absolute Return Fund Class A (USD)</i>	63%	50%
<i>AAM Absolute Return Fund Class B (NOK)</i>	63%	50%
<b><u>Fixed Income</u></b>		
<i>Asgard Fixed Income Fund I Limited</i>	38%	25%
<i>Excalibur</i>	25%	50%
<i>HP Hedge</i>	38%	25%
<b><u>Multi strategy</u></b>		
<i>Alpha 15 Fund</i>	38%	25%
<i>Aventum Pension</i>	0%	0%
<i>Fourth Moment Macro</i>	50%	50%
<i>GMM</i>	63%	75%
<i>IPM Global Currency Fund</i>	50%	50%
<b><u>Managed futures &amp; CTA</u></b>		
<i>Navitas Power Fund SPC - Fundamental Portfolio</i>	63%	50%
<i>Navitas Power Fund SPC - Technical Portfolio</i>	13%	25%
<i>SEB Asset Selection</i>	63%	75%
<i>Shepherd Energy Fund</i>	63%	50%

**Fund of Funds**

<i>Agenta Hedge</i>	63%	50%
<i>BI Pension Hedge Stabil (PAL)</i>	63%	50%
<i>DnB NOR Global Hedge</i>	50%	75%
<i>DnB NOR Prisma</i>	38%	50%
<i>Ekvator Absolut</i>	50%	50%
<i>Ekvator Trygghet</i>	50%	75%
<i>eQ Active Hedge</i>	50%	75%
<i>Eufex Hedge non-UCITS Fund</i>	38%	25%
<i>Guide Multihedge</i>	63%	25%
<i>OPM Alfa</i>	38%	25%

*Note: Winners are defined within each investment style*

**Table XIV- Skewness and Kurtosis of individual hedge funds**

<b><u>Equity</u></b>	<b>Skewness</b>	<b>Kurtosis</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>
<i>3C Edge</i>	0,993	4,411	0,578	0,385	1,891
<i>Adapto Nordic 100</i>	-0,152	-0,167	0,167	0,300	2,000
<i>Adriego Fund</i>	0,037	-0,516	0,608	0,770	1,747
<i>Alcur</i>	1,252	3,234	0,599	0,510	0,561
<i>Altos Advantage</i>	-0,640	0,145	-0,118	0,600	4,564
<i>Archipel</i>	0,150	1,254	0,331	0,340	1,639
<i>Avenir</i>	-1,009	2,136	0,420	0,475	1,831
<i>Carnegie WorldWide Long/Short Fund</i>	-1,126	2,543	0,844	1,530	3,196
<i>Catella Europa Hedge</i>	0,424	0,579	0,160	0,180	1,301
<i>Catella Hedgefond</i>	-0,841	1,433	0,512	0,610	1,051
<i>CB Hedge Europe</i>	0,031	0,683	-0,034	-0,190	5,136
<i>Cicero AMplus</i>	-0,794	0,986	-0,035	0,150	2,531
<i>Consepio</i>	0,207	1,751	0,711	0,745	3,708
<i>Cresco</i>	0,178	0,615	1,143	-0,050	9,317
<i>Danske Hedge European Equity</i>	0,214	-0,044	0,862	0,410	3,497
<i>DLG Aktiefond</i>	-0,734	1,677	1,649	2,025	6,163
<i>Edge</i>	-0,408	2,470	1,201	1,110	4,440
<i>Eikos</i>	-0,408	1,529	0,545	0,545	1,442
<i>Emeralt Fund</i>	-0,888	0,147	-0,105	1,010	4,600
<i>Evli Hedgefond</i>	0,170	2,599	0,425	0,280	1,263
<i>Explora</i>	-0,123	4,222	0,526	0,675	1,770
<i>Explora European Small &amp; Mid Cap Fund</i>	-1,663	4,788	0,174	1,025	6,050
<i>Futuris</i>	0,432	0,462	1,000	0,945	3,135
<i>Gladiator Fond</i>	-1,847	7,489	1,181	1,830	5,786
<i>Grand Haven Capital Fund</i>	-0,457	1,105	1,303	2,170	8,138
<i>Grand Haven Capital Neutral Fund</i>	0,378	-0,047	1,474	0,315	5,069
<i>Graal</i>	-1,587	4,890	0,330	0,380	0,869
<i>Handelsbanken Europa Hedge Selektiv</i>	-0,601	2,138	0,224	0,355	1,227
<i>Hedgeforeningen Mermaid Nordic</i>	-0,180	0,181	0,549	0,625	2,028
<i>IPM Global Tactical Asset Allocation Fund A Class</i>	0,634	0,915	1,174	0,900	3,373

<i>Jyske Invest Hedge Markedsneutral - Aktier</i>	-1,415	3,313	-0,017	0,360	3,808
<i>Manticore</i>	0,302	0,956	0,642	0,610	2,225
<i>Midas Equity Fund</i>	-0,184	0,121	0,211	0,125	3,154
<i>Navitor Nordic Hedge</i>	-0,323	5,191	0,175	0,155	1,278
<i>Nordea European Equity Hedge Fund</i>	-1,594	6,503	0,333	0,455	1,120
<i>Nordea Nordic Equity Hedge Fund</i>	-1,029	3,187	0,299	0,350	1,030
<i>Nordic Absolute Return Fund</i>	-0,633	7,052	0,628	0,160	2,801
<i>Nordic Alpha plc</i>	-0,763	5,319	0,733	0,725	3,284
<i>Nordic Omega plc</i>	-0,471	3,494	0,658	0,660	4,056
<i>P&amp;N Idea</i>	-0,950	4,552	0,803	1,425	6,290
<i>P&amp;N Yield</i>	-0,726	6,582	0,447	0,570	1,238
<i>Radar</i>	0,013	3,277	0,323	1,480	8,332
<i>RAM ONE</i>	0,742	9,425	0,550	0,830	3,385
<i>Sector CogniMetrica</i>	-0,148	2,399	0,396	0,580	2,297
<i>Sector Healthcare</i>	0,165	-0,078	0,857	0,840	1,392
<i>Sector Maritime Investments</i>	-0,337	1,559	0,689	0,510	3,208
<i>Sector Zen Fund</i>	0,201	0,429	0,853	0,510	4,836
<i>Sharp</i>	-0,861	1,645	0,544	1,050	5,168
<i>Stella Nova Hedgefond</i>	0,007	3,444	0,513	0,555	1,217
<i>Taiga Fund</i>	-0,575	1,139	1,981	2,895	3,781
<i>Thyra Hedge</i>	-1,660	4,707	0,328	0,590	2,805
<i>Zenit</i>	-0,284	0,246	0,468	0,495	2,257
<i>AAM Absolute Return Fund Class A (USD)</i>	0,199	0,368	0,847	1,270	2,502
<i>AAM Absolute Return Fund Class B (NOK)</i>	0,281	0,988	1,013	1,250	2,242

### **Fixed income**

	<b>Skewness</b>	<b>Kurtosis</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>
<i>Asgard Fixed Income Fund I Limited</i>	-0,489	5,461	0,924	0,840	2,076
<i>Danske Hedge Fixed Income Strategies</i>	-2,240	17,530	0,798	0,545	3,224
<i>Danske Hedge Mortgage Arbitrage Fund</i>	-2,537	13,186	0,219	0,510	2,353
<i>Excalibur</i>	0,557	2,323	0,530	0,515	1,403
<i>HP Hedge</i>	-2,058	6,345	0,781	1,280	3,549
<i>Nordea Fixed Income Hedge Fund</i>	-4,898	31,766	-0,273	0,590	5,505
<i>SEB Hedge Fixed Income</i>	0,406	1,028	0,266	0,190	0,794

### **Multi strategy**

	<b>Skewness</b>	<b>Kurtosis</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>
<i>Alpha 10 Fund</i>	-0,154	-0,609	0,095	-0,090	2,667
<i>Alpha 15 Fund</i>	0,036	-0,423	0,253	0,135	4,104
<i>Aventum Pension</i>	-0,454	0,612	0,332	0,410	1,471
<i>Boreas Capital Fund</i>	0,163	-0,314	0,085	-0,280	8,647
<i>Carlsson Norén Macro Fund</i>	0,436	-0,363	0,194	0,075	0,984
<i>Defined Risk 12</i>	1,004	4,026	0,627	0,700	2,919
<i>Defined Risk 18</i>	1,119	4,174	0,977	0,710	4,572
<i>Defined Risk 6</i>	0,475	3,381	0,402	0,510	1,520
<i>Evli Macrohedge</i>	2,395	9,110	0,231	0,140	0,681
<i>Fourth Moment Macro</i>	-0,090	0,351	0,655	0,795	2,344
<i>GMM</i>	-0,106	0,490	0,763	0,640	1,356
<i>IPM Global Currency Fund</i>	0,715	0,815	0,547	0,260	3,016
<i>Nektar</i>	0,454	0,790	0,863	0,675	2,335

**Odyssey Emerging Markets Multi Strategy Fund Ltd**

<i>Protect</i>	-0,247	0,573	0,266	0,605	1,952
<i>Sector Polaris</i>	-0,565	1,178	0,303	0,375	1,311
<i>Stability</i>	-0,206	-0,064	0,558	0,640	1,934
<i>Tanglin Fund</i>	-0,923	1,737	0,509	0,500	0,290
<i>Traction Yield</i>	-1,153	6,128	0,513	0,680	2,323
<i>Warren Diversified</i>	0,135	1,043	0,337	-0,020	2,933
<i>WH Invest</i>	-3,151	14,896	0,199	0,640	3,007
	-2,001	5,674	0,550	1,270	2,809

**Managed futures & CTA**

	<b>Skewness</b>	<b>Kurtosis</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>
<i>AMDT Hedge</i>	-0,415	0,240	0,789	0,980	2,663
<i>Contango Commodity Fund</i>	0,266	2,883	-0,468	-0,490	3,166
<i>Estlander &amp; Partners Global XL</i>	-0,076	0,887	0,520	-0,190	6,408
<i>Lynx</i>	0,342	0,474	1,185	1,550	4,064
<i>Navitas Power Fund SPC - Fundamental Portfolio</i>	1,064	4,546	1,683	1,600	4,992
<i>Navitas Power Fund SPC - Technical Portfolio</i>	0,298	2,467	1,745	1,500	5,923
<i>NorWatt Energy AS</i>	0,096	3,415	-0,148	0,130	3,020
<i>Rho Altius 1XL Program</i>	0,756	2,253	0,969	-0,010	5,395
<i>Rho Citius 1XL Program</i>	0,329	0,065	-0,435	-0,595	2,617
<i>Rho Fortius 1:2 Program</i>	0,491	0,059	-0,575	-1,100	3,723
<i>SEB Asset Selection</i>	0,298	0,572	0,691	0,790	2,464
<i>Sector EuroPower Fund</i>	0,590	2,297	0,677	0,220	3,990
<i>Shepherd Energy Fund</i>	0,264	5,221	0,285	0,260	2,683
<i>Spektrum</i>	0,598	-0,127	0,988	0,120	3,569

**Fund of funds**

	<b>Skewness</b>	<b>Kurtosis</b>	<b>Mean</b>	<b>Median</b>	<b>Std</b>
<i>Abacus</i>	-0,265	0,167	0,134	0,240	1,296
<i>Agenta Hedge</i>	-1,231	2,180	0,277	0,590	1,459
<i>AIP Global Diversified Ltd.</i>	0,554	2,136	0,044	-0,240	4,503
<i>BI Pension Hedge Stabil (PAL)</i>	-0,576	2,883	0,350	0,260	1,444
<i>Brunner Multi-Strategy</i>	-0,184	0,442	0,671	0,525	1,319
<i>DnB NOR Global Hedge</i>	-0,909	1,107	0,375	0,580	1,432
<i>DnB NOR Prisma</i>	-1,266	2,507	0,359	0,600	1,543
<i>Ekvator Absolut</i>	-2,122	7,741	0,274	0,675	2,554
<i>Ekvator Trygghet</i>	-2,363	12,087	0,365	0,470	1,030
<i>Eliksir</i>	-0,644	2,578	0,237	0,250	0,920
<i>eQ Active Hedge</i>	-0,958	2,350	0,338	0,560	1,444
<i>Eufex Hedge non-UCITS Fund</i>	-4,810	30,039	0,064	0,065	1,668
<i>FMG Global Fund</i>	-2,334	9,079	-0,040	0,290	2,513
<i>Guide Hedgefond 2</i>	-0,494	2,243	0,316	0,295	0,721
<i>Guide Multihedge</i>	-2,295	11,072	0,287	0,530	1,515
<i>Max fund of funds</i>	-1,565	4,025	-0,031	0,100	1,566
<i>OPM Alfa</i>	-1,943	5,496	0,442	0,720	1,279
<i>OPM Global Hedge</i>	-0,996	1,484	0,346	0,470	1,293
<i>OPM Nordic Hedge</i>	-0,860	2,365	0,315	0,440	1,041
<i>OPM Omega SEK</i>	-1,960	6,504	0,148	0,350	1,070
<i>Thenberg Fond-i-Fond</i>	-0,727	1,033	-0,295	0,000	3,073
<i>WarrenWicklund Multi-Strategy Fund, Dublin</i>	-0,529	1,913	0,340	0,400	1,168