Nordic Market Mutual Fund Performance and Persistence

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Abstract:

This thesis investigates the performance and the persistence of performance for Nordic equity mutual funds using advanced statistical techniques for the time period 1997-2016. The estimate of the performance measure, alpha, is obtained by regressing excess returns on a 1-, 3- and 4-factor return model, fitted using local equities. It is shown that the estimates are not normally distributed for 35-45 % of the funds so two similar statistical bootstrap techniques, utilizing cross-sectional characteristics of all data in the sample, are employed to obtain a better estimate of the probability density function of the estimators of alpha. Persistence is estimated by first constructing a Kalman filter based on the factor models, from which the dynamic coefficients are obtained via a maximum likelihood approach. The estimated dynamic alphas are utilized for the construction of contingency tables, which count the ranking of funds from one time period to the next, and a regression based approach.

The results indicate that not a single mutual fund in the Nordic countries generates significant and positive risk-adjusted returns, but there is more evidence of the opposite case. The lowest decile of ranked funds in Norway and Denmark are found to underperform the market. In Sweden, this phenomenon extends to the 8th and 9th decile, indicating that almost all mutual funds are underperforming. Persistence is found to exist in strong form for up to three months after the initial sorting of funds, while weaker evidence is found for the periods of one to two years. In general, it is found that the larger markets (Norway, Sweden) have less evidence of positive or neutral risk-adjusted performance and are characterized by weaker persistence in performance. These results are hypothesized to be caused by stronger forms of market efficiency in these larger markets.

Keywords: Dynamic alpha, risk-adjusted return, bootstrap, Kalman filter, skill or luck

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1 INTRODUCTION

Mutual funds provide an investor the opportunity to conveniently diversify security holdings and to delegate the day-to-day investment decisions to a third party manager. This is partially an explanation for the small investors' preference towards mutual funds in the recent 20 to 30 years. In the Nordic market the first mutual fund emerged in Denmark in year 1956 (Bechmann & Rangvid 2007) and then in Sweden two years later (Petterson, Helgesson & Hård af Segerstad 2009). In Norway and Finland, mutual funds were established around 1982 and 1987, respectively (Gjerde & Sættem 1991; Korkeamäki & Smythe 2004). A large fraction of these funds are actively-managed, which means that the manager attempts to allocate the resources in such a way that the returns exceed the reported benchmark.

The ability of mutual fund managers to beat the benchmark is a topic that has been thoroughly studied during the last decades (see for example: Guercio & Reuter 2014 and Fama & French 2010). The notion of sustained abnormal performance is in contrast with the modern portfolio theory and the efficient market hypothesis, which state that greater returns can only be achieved by taking on greater risk. The research performed within this field suggests that, in general, actively-managed mutual funds are unable to generate risk-adjusted returns in excess of the market after transaction costs and fund expenses have been accounted for. However, there are indications that a few mutual funds are able to do so.

Abnormal performance is in this context usually measured by performing a regression on a factor model and then investigating the magnitude and statistical significance of the estimated intercept coefficient. For illustrative purposes, this factor model can represent the capital asset pricing model (CAPM), with the risk free interest rate transferred to the left hand side:

$$R_{i,t} - r_{f,t} = \alpha_i + \beta_{\mathrm{i},1}(R_{m,t} - r_{f,t}) + \varepsilon_{i,t}, \tag{1}$$

where $R_{i,t}$ is the return on managed portfolio i at time t, $r_{f,t}$ is the risk-free interest rate, α_i is the regression intercept, $\beta_{\mathrm{i},1}$ is a factor loading, $R_{m,t}$ is the return of the market portfolio and $\varepsilon_{i,t}$ is an error term. If this model is able to capture all of the trends in the economy that generate returns, then the estimated intercept coefficient (alpha) is not significantly different from zero. On the other hand, if this coefficient is positive, then there are some indications that the mutual fund manager is successfully able to employ some trading strategy that generate abnormal risk-adjusted performance. These strategies most commonly include the ability to identify and purchase stocks valued below the intrinsic asset value and the ability to anticipate a change in market dynamics and adjust the risk exposure of the portfolio accordingly. In essence, stock picking and market timing ability.

Previous studies rely heavily on traditional ordinary least squares (OLS) methods for estimating the performance coefficient. The underlying assumptions are that the estimated alphas and betas obtained from the fitted model follow a normal distribution. However, as Kosowski et al. (2006) suggests, these estimated coefficients are inherently non-normal. This was found to be especially true for mutual funds in the extreme ends of the performance ranking (i.e. the “best” and “worst” funds). These are coincidentally the entities of greatest interest, which consequently question the results of previous findings that base the conclusions on statistical tests assuming a normal distribution.

A further issue related to OLS estimations is that these tend to, especially with the capital asset pricing method, either over- or underestimate the magnitude of betas. This issue arises because the current models describing the sources of asset returns are unable to capture all factors that drive the market (see for example Fama & French 2015). As Mamaysky, Spiegel & Zhang (2007) discuss, an underestimation of mutual fund betas leads to a compensating overestimation of alphas. The same holds for the reverse case; an overestimated beta leads to underestimated alphas. The implication of this is that extreme values for estimated alphas occur more frequently than called for. This issue also contributes to question the accuracy and validity of previous research.

To overcome these issues two more advanced methods are utilized for investigating performance. The first is the bootstrap methodology suggested by Kosowski et al. (2006) and its modified version by Fama & French (2010), which essentially estimates a more precise distribution of the estimators of alphas, which in turn leads to more accurate conclusions. The other method is the state-space Kalman filter which also allows for better estimation of performance persistence, as compared to rolling OLS models (Chen & Corbett 2015). The Kalman filter yields, by means of maximum likelihood estimation, estimates of dynamic factor coefficients, which can be utilized for measuring the degree of persistence in risk-adjusted performance from one time period to the next. Persistence of performance refers in this context to the continuous over- or underperformance of risk-adjusted returns for a prolonged period of time. This will in this study be investigated by ranking the funds into quintiles and then evaluating the degree of persistence in the rankings. Additionally, post-formation portfolio returns are estimated for the quintiles and a Fama-MacBeth based regression is applied to the dynamic estimates.

1.1 Purpose of the study

The purpose of this study is to investigate if there is proof of positive risk-adjusted performance, net of fees, among the mutual funds in the Nordic countries and whether this performance can be expected to persist.

1.2 Scope and limitations of the study

The Nordic market is in this thesis defined as Finland, Sweden, Norway and Denmark. Iceland and the autonomous regions of these countries are, due to limited availability of data, excluded from this study. The data consist of monthly returns for the period ranging from January 1997 to March 2016. Funds are included in the sample if they invest over 70 % of the capital in domestic equities.

1.3 Contribution

This study contributes to the existing research within this field by the utilization of the two bootstrap techniques on Nordic mutual fund data. There is to date no previous research on the Danish and Finnish mutual fund market where these two bootstrapping techniques have been utilized. However, these methods have been previously implemented on Swedish and Norwegian mutual fund data, so in this case the contribution is the verification of previous findings, as the data frequency and time periods are different.

In addition to the matters mentioned above, the Kalman filter approach for measuring performance persistence has not been utilized before with Nordic mutual fund data. This method will also contribute by providing evidence of past market characteristics due to the dynamic factor coefficient estimation.

1.4 Structure of the thesis

- **Chapter 2** summarizes the relevant theory concerning mutual funds by including a review of the efficient market hypothesis and relevant topics from agency theory. This chapter also contains a section about the regulatory framework that governs fund managers and institutions.

- **Chapter 3** provides an overview of the recent research into mutual fund performance and persistence. This chapter emphasizes studies related to the Nordic markets, but the most relevant and prominent international studies are included as well.

- **Chapter 4** presents the methodology utilized for finding performance, which includes the two statistical bootstrap techniques. In addition, the central concepts of the Kalman filter and how the dynamic coefficients obtained from this method can be utilized for measuring risk-adjusted persistence is introduced.

- **Chapter 5** reveals the data sources from which the sample utilized in this study is obtained. The factor returns and how these were calculated are shown among the summary statistics for all the time series used.

- **Chapter 6** contains the main evidence from each of the Nordic markets separately. This chapter begins with initial evidence of performance based on equally-weighted portfolios of funds. The next section contains the bootstrapped evidence which allows for more reliable conclusions regarding managerial over- or underperformance. Followed by this are the results from the three approaches utilized for measuring performance persistence.

- **Chapter 7** contains the discussion regarding the findings of this study and attempts to validate the methodology and results.

- **Chapter 8** presents the concluding remarks.

2 THEORY

The most relevant theoretical framework concerning mutual fund performance is the concepts of efficient markets and agency theory. The former states that securities in the marketplace are to some degree fairly priced, making abnormal risk-adjusted returns impossible to achieve. The latter is concerned with the relationship between the principal (the investor) and the agent (the mutual fund manager). These concepts will be explained in this chapter, along with the Berk & Green (2004) model for mutual funds. Preceding these sections is a short discussion on the workings of mutual funds, and the last section of this chapter presents the most relevant excerpts from European mutual fund legislation.

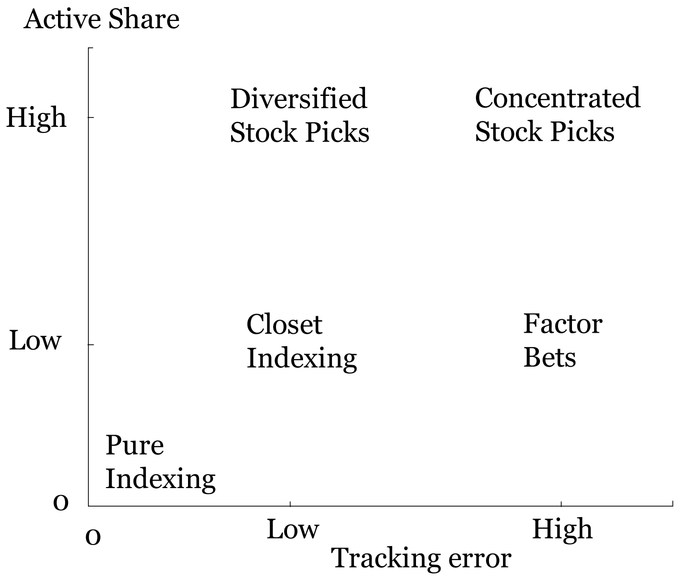
2.1 Mutual funds

A mutual fund is a shared investment vehicle which consists of a portfolio of stocks or other securities, which is selected and upheld by the mutual fund manager. The benefits of investing in these entities is that investors can both enjoy economies of scale in obtaining information and receive a well-diversified portfolio at reduced transaction costs. Additionally, specialized funds give the investor access to markets that may be closed to small-scale investors, such as real estate or primary bond markets. The drawback is that the delegation of responsibility to a third party induces agency costs, which occurs when the manager's interest differs from the investor's, a topic which is discussed in more detail in Section 2.3.

Generally, mutual funds are divided into open-ended, closed and hedge funds, with the foremost being the most common and is consequently the scope of this study. Closed funds and hedge funds differs in the sense that the invested capital cannot be freely withdrawn at the convenience of the investor. In contrast, open-ended funds allows for daily withdrawal of capital, which serves as a way of reducing agency costs as investors can punish a misbehaving manager by taking their money elsewhere. However, a drawback of this is that the fund may face a sudden liquidity crisis if many investors withdraw their invested money simultaneously, which may force the manager to make sub-optimal decisions to increase fund liquidity. (Lückoff 2010)

Another important classification is the separation of active and passive mutual funds. Active managers strive to exploit market inefficiencies and gain abnormal returns while passive funds aim to reduce trading costs by replicating a reference index. The level of activity among active managers is varying widely, based on empirical evidence of investigations into the tracking error and active share of mutual funds. The former of these two (tracking error) measures the deviations of returns (or return volatility) from the reported benchmark index, while the active share by Cramers & Petajisto (2009) is the percentage of portfolio holdings that is different from the benchmark. These authors suggest that active mutual funds can be classified into four categories based on the magnitude of these two measures (see Figure 1).

Figure 1 The different types of active managers (Cremers & Petajisto 2009)



A low active share in combination with a low tracking errors indicates that the manager is engaging in closed indexing, a phenomenon where a fund charges a high fee but is delivering a portfolio comparable to a passive fund (Petajisto 2013). A high tracking error in combination with a low active share is a sign of market or sector timing behavior (factor bets). The opposite scores means diversified stock picks, where stocks are fundamentally analyzed and selected from all market sectors. Finally, a high tracking error and a high active share, the most active category of them all, describes a manager who is both trying to identify the best future sector of the economy and the best stock within it. (Lückoff 2010)

Whether or not managers can utilize these strategies to generate returns in excess of a passive strategy depends on the level of market efficiency. Mutual fund managers are able to utilize economies of scale to invest in information gathering which may yield an edge over competing investors. However, if the market is fully efficient, then the value of additional information is equal to the cost of obtaining it. This is related to the efficient market hypothesis which is described in the following section. (Lückoff 2010)

2.2 Efficient market hypothesis

The efficient market hypothesis presents the idea that security prices are fairly priced conditional on some information set. It is generally divided into three forms depending on the strictness of its definition: the weak form, semi-strong form and strong form. The weak form states that the information set, which investors use to price assets, is limited to only the past price history of the security. The semi-strong form builds on the weak form but also includes all publically available information (such as financial statements, stock splits, new equity offers etc.). The strong form, being the strictest of them all, assumes that all information, public and private, is reflected in the price of the asset. (Fama 1970)

The implication of the strongest form on mutual fund performance is that no manager should be able to generate abnormal returns, as all securities are always fairly priced making stock picking and market timing impossible. Consequently, a test of managerial outperformance is also a test of the strong and semi-strong form of the efficient market hypothesis. However, the strong form is unlikely to hold up in most cases and the weaker forms of market efficiency are usually considered more valid. This implies that a mutual fund manager can generate abnormal returns by obtaining private information about securities (for example by investing time and money in fundamental analysis of stocks).

Berk & Green (2004) develop a model that is often cited in mutual fund literature. The model attempts to explain most of the common trends observed in the performance and persistence of mutual fund returns. It assumes that the total costs of a fund (including transaction costs and other expenses, such as the cost of obtaining information) follows a positive quadratic relationship with fund size. Investors are able to identify past abnormal performance based on the return history of mutual funds, and direct cash to the best performers. This implicates that a fund with a good past performance will receive a positive net inflow of cash, which will increase the assets under management which in turn increases the costs for the mutual fund until an equilibrium between performance and expenses is reached. This model can be used to explain why abnormal performance is rare and why persistence is short lived.

2.3 Agency theory

Since investing in mutual funds involves the delegation of responsibility of one's capital to a third party, agency costs are unwillingly created. The stakeholders of a fund includes, but is not limited to: the investor, the manager and the issuing institution. The first of these three, the investor, is primarily interested in maximizing the return on invested capital and is secondarily interested in the assumed risks. The mutual fund manager is more concerned about personal compensation and career prospects while the issuing company cares most about maximizing the income from fund fees. These factors are to a large degree intertwined to each other, but there is still enough room for moral hazard to occur, which is when the managers' actions diverges from the interest of the investors. The frequency of this occurrence is dependent on how well the principal is able to supervise the actions of the agent (Eisenhardt 1989), which in the case of mutual funds is limited to observations of the returns of the funds. (Lückoff 2010)

Since investors generally evaluate mutual funds by comparing performance among its peers, herding becomes an issue. Managers have less incentive to apply extreme strategies that diverges radically from the common group for two reasons: either he or she may experience a loss of fate in the strategy employed, since the large majority does not engage in it, or he or she takes shelter in the crowd. If the common strategy of funds turns out badly, then no individual manager is blamed since external circumstances is a more prominent cause; but if a single manager goes against the crowd and fails then the individual gets all the blame. Additionally, in order to differentiate oneself from the crowd during evaluation periods different deceiving techniques may be applied. Two examples of this, which has been historically used, are portfolio pumping and window dressing. The former occurs when a manager purchases more of the stocks held in the portfolio the day before the reporting date in hope of causing an upwards price pressure for the stock and thus create a short term boost in portfolio value. The latter refers to the discarding of underperforming or unfavorable securities during the days before the portfolio holdings have to be reported, with the intention to hide the bad decisions from the investors. (Lückoff 2010)

In addition to these issues, the mutual fund institution might employ various strategies to increase the profits from operations at the cost of investors. This can be achieved by either reducing the costs or by increasing the income from fees. One of the more common approaches for reducing costs is to avoid active trading and engage in closet indexing, a concept which was already introduced in Section 2.1. On the other hand, to increase income the mutual funds' assets under management must grow since fees are usually charged as a percentage of total assets. Since capital inflows respond positively to previous performance, it is advantageous to keep funds with high returns in the spotlight while underperforming funds gets merged or are closed down. A mutual fund family, which consist of several funds issued by the same institution, might opt to create a "star" fund which attracts attention and capital with the hope that it spills over to the other funds in the family. The performance of this star fund may be achieved by transferring performance from other funds to this via various methods. Another approach is to start a large variety of closed-ended funds with a minor amount of seed money. After some amount of time these funds are evaluated and the best-performing funds are taken public while the rest are discarded. The performance from this evaluation period is then utilized in the marketing of the successful funds, even though the abnormal returns were likely caused by luck. This is an issue known as incubation bias (Evans 2010). (Lückoff 2010)

All of these conflicts of interest cause an actual cost to the investors which unfortunately is not easy to evaluate. However, some of these can be reduced by applying an appropriate legal framework which prevents these strategies, a topic briefly introduced in the follow section. External control and transparency of fund operations are also important methods of governance. The open-ended fund is for this reason the most commonly used form since it is able to effectively reduce agency costs.

2.4 Regulations

Mutual funds in Europe are governed by the UCITS (Undertakings for Collective Investment in Transferable Securities) directives. The UCITS, which was first adapted in 1985, serves to standardize the regulations across European states to allow for cross-country trading and marketing of mutual funds. The funds in the sample of this study has been regulated by four revisions of this directive, starting from the original (annotated UCITS I) to the current version which was adopted in 2014: UCITS V. All of the amendments to the original directive has concerned issues unrelated to the initial investment restrictions, which are the most relevant entities to this study. These restrictions are set in place to ensure that mutual funds invest in liquid and transparent securities with sufficient diversification to avoid unnecessary risk. In general, the following investment vehicles are allowed (Müller & Ruttiens 2013, p. 21):

- Transferable securities listed in regulated markets (includes equities, bonds and closed end funds)
- Money market instruments with a maturity of 397 days or less
- Other UCITS funds (although 10 % of the assets may be allocated to non-UCITS funds)
- Bank deposits and listed derivatives.

Restricted investments include real estate, precious metals, money lending and short selling (although this can be replicated with derivatives). Mutual funds are also restricted from borrowing money for investment purposes. In order to satisfy the diversification limits the individual weight of a security in the portfolio may not exceed 10 % and the sum of securities with a weight greater than 5 % may not exceed 40 % of the total asset value (European Union 1985).

In addition to these requirements, individual member states may impose stricter rules on mutual funds. Furtherly, all Nordic countries in this study has implemented ways to circumvent the UCITS directive via a special permit issued by the local financial authority, but the vast majority is compliant with UCITS rules.

3 SUMMARY OF RECENT RESEARCH

This chapter provides an overview of the most relevant previous research that has been conducted during the last decade. The summary begins from an international perspective in Section 3.1 and moves on to present the country-specific studies in Sections 3.2 – 3.5. Section 3.6 presents cross-country studies that contain the Nordic countries as defined in this thesis. The final section of this chapter summarizes the findings from the recent research into the Nordic market. All of the data in the studies of this chapter is based on monthly returns and net of all expenses, unless explicitly stated otherwise.

3.1 Global

Carhart (1997) investigated the persistence of US mutual funds in the period ranging from 1962 to 1993 by utilizing the Fama-French (1993) 3-factor model with the addition of an extra factor capturing the one year price momentum of stocks. This 4-factor model is commonly utilized within this field of research and will from here on be referred to as the Carhart factors. He finds indications of persistence ranging for one year, but only weaker evidence for persistence in the subsequent two to five years. Additionally, he only finds slight evidence of skill among mutual fund managers, based on the ability to generate returns in excess of the fund expenses. Only the top decile of funds are able to recover their expenses and beat the market. Moreover, expense ratios, portfolio turnover and load fees (front-end and back-end fees incurred when buying or selling fund shares) are found to, on average, have a negative impact on the performance of the funds.

Kosowski et al. (2006) develop a new method based on a statistical bootstrap applied to the residuals of a factor model (in this case the Carhart factors) to estimate the probability density function of mutual fund alpha estimates, since these are shown to be non-normally distributed. Since this method is a central part of the thesis it will be explained in greater detail in Chapter 4, and from here on this method will be referred to as the Kosowski method. Aside from developing the specifics of this bootstrap implementation, they also apply it on US market data from January 1975 to December 2002. They find that the top decile of mutual funds (ranked on performance) exhibit evidence of superior performance that is not due to sampling variation (i.e. luck). The other end of the performance spectrum presents significant negative performance, net of fees, but when these are removed no major evidence of underperformance is found. This strengthens the theory that mutual funds on average underperform on a scale related to the fund fees.

They also investigate persistence using this novel method. An important contribution to the academic discussion is that persistence, similar to performance, may be attributed to luck. The evidence from the Kosowski bootstrap method suggest that the top decile (and perhaps second best decile) of mutual funds has positive persistence, at least in the short run.

Cuthbertson, Nitzsche & O'Sullivan (2008) adapts the Kosowski method for the UK market with an extensive data set spanning from April 1975 to December 2002. Various factor models are tested, including the Carhart factors, but the Fama-French 3 factor model is found to best describe the returns on UK mutual funds. The authors find that between 5 to 10 % of managers are able to outperform the market in a way not attributable to luck. At the other end of the spectrum, the bad funds' performance is attributed to bad skill, as opposed to being unlucky. Furthermore, the authors investigate the time variation of the factor loadings of portfolios of mutual funds by using a recursive OLS method and the Kalman filter to estimate dynamic alpha coefficients. They find that for the top performing funds, the Fama-French 3 factor model loadings show little variation, including the alpha estimates. Similar traits are found in the bottom end of the performance scale. Finally, Carhart's (1997) methodology is utilized for investigating persistence, which is not found among the winner funds, but is more prominent among the loser funds.

Fama & French (2010) base their study on the Kosowski method, but modify it in order to capture the effect of cross correlations of mutual fund returns. This is achieved by resampling the residuals and factor returns jointly. This method will also be utilized in this thesis and therefore it is explained in more detail in Chapter 4 and is from here on referred to as the Fama & French modification. They use a data set consisting of monthly US market returns for the time period from 1984 to 2006 and utilize CAPM, Fama & French's 3 factor model and the Carhart factors for measuring alpha. They find that in general, funds underperform the market by the size of the fees and that only a few mutual funds are able to recover their expenses. They also compare the results, obtained from their bootstrap modification, to the results from Kosowski et al. (2006). This comparison shows that when cross correlation is accounted for, evidence of outperformance is reduced. They attribute this partly to the superiority of their method, but also to their improved data set, which contains less survivorship bias and does not suffer from incubation bias.

Even if the Fama & French modification shows sign of producing better estimates of mutual fund performance, their model is not necessarily better in all situations. Section 4.3 includes a brief discussion about the advantages and drawbacks of both the Kosowski and the Fama & French methods.

3.2 Denmark

The market for Danish mutual funds has been thoroughly covered by the studies of Christensen 2003, 2005 & 2013. In Christensen (2003) he utilizes a CAPM framework and a multi-factor extension of it (containing a global return- and Danish government bond index, aside from local market return indices) to investigate performance. The data is from October 1994 to January 2002 and includes a sample of 44 funds. Christensen (2005) utilizes a data set from January 1996 to June 2003 consisting of 47 funds and the same factor models as in the previous study. One important addition to this later research paper is that persistence is also measured. The general conclusion from these two studies is that the Danish mutual funds show no evidence of any positive return for this period and only some evidence of significant negative performance. The persistence is found to be weak, at most.

In Christensen (2013) this topic is revisited with a new dataset starting from November 2000 and ending in November 2010, but the methods utilized remain the same. The results exhibit similar traits as the ones before, but in the more recent dataset one equity fund is found to be positively significant and 7 % of all funds in the sample (which include funds with a global scope and fixed-income funds) shows evidence of positive performance. On average, the Danish funds have an estimated alpha of -1.80, which is statistically significant at a 5 % confidence level.

3.3 Finland

Sandvall (2000) investigates the persistence of Finnish mutual funds, using weekly data for the time period 1.1.1995-30.06.1998 and a CAPM framework for calculating abnormal returns. Funds are in this study, based on the previous time periods performance, divided into winner (top 30 %) or loser (bottom 30%) portfolios. These are held constant for 6 months, after which a new ranking takes place, implying a total of six performance periods. Persistence is investigated from three perspectives: equity funds, bond funds and balanced funds (containing both equities and bonds) with at most 18, 15 and 12 funds in each category. The amount of data is small and the time period short, which is due to the emerging nature of the Finnish mutual fund industry at the time. The results of the study is that the past winners and, surprisingly, losers in the equity-fund category outperform the benchmark in subsequent time periods indicating positive persistence for both of these subdivisions. The bond funds exhibit similar traits but at a smaller magnitude. For the mixed funds no positive persistence was found, only negative for the past loser category.

Westerholm & Kuuskoski (2003) undertake a different approach for measuring mutual fund performance. Instead of utilizing risk-adjusted returns or benchmark indices, they compare the returns of Finnish mutual funds, for the period ranging from January 1995 to May 2000, against the return on three classes of investors: small, medium and large portfolio holders. The private investors are randomly sampled from a database of Finnish equity holders and divided into the three portfolios based on the amount of capital invested in securities. They find that the small investors underperform with respect to the mutual funds while the medium investors generate similar returns gross of expenses. However, when transaction costs and taxes are accounted for even these underperform with respect to mutual funds. Only the largest group of investors is able to beat the professionals, which can partially be explained by a difference in trading strategies.

3.4 Norway

Sørensen (2009) use an exhaustive survivorship-bias free sample of most of the Norwegian market from 1982 to 2008 and studies the performance and persistence of local mutual equity funds. The methods utilized are the CAPM, Fama-French 3-factor model and the Carhart factors combined with the Kosowski bootstrap method with the Fama & French modification. He only finds one fund manager that is able to generate positive and significant abnormal returns based on evidence from the bootstrap, while the average monthly alpha estimate is reported as in the range of 0.02 to 0.15 depending on the method utilized (Carhart factors being the strictest). However these alpha estimates are not found to be significant at any level.

In addition, he estimates dynamic alphas by means of rolling and extending ordinary least squares and finds weak signs of past superior performance. However, this ceased to exist at the time around year 1995 to year 2000. This is an indication that the market has previously not been fully efficient, an anomaly which was likewise found in the Swedish market by Flam & Vestman (2014). These anomalies are likely caused by a lack of competition during the earlier years but not anymore during the later ones. Finally he also measures the persistence of fund performance in the same manner as Carhart (1997), but finds no evidence of dependable persistence.

Gallefoss et al. (2015) contribute to the research of Norwegian mutual funds by utilizing a data set consisting of daily returns (January 2000 to December 2010), which is unusual in mutual fund performance literature. Similar to Sørensen (2009), they utilize the Kosowski et al. (2006) bootstrap methodology, but without the Fama & French (2010) addition, as they found no significant difference between these methods. The higher frequency of the data allows for a more dynamic estimation to be employed. The alphas of the mutual funds are re-estimated annually for a more comprehensive overview of the progression of factors coefficients. The results for the performance of Norwegian mutual funds are partly in contrast to the results from Sørensen (2009). The top decile of mutual funds (as opposed to only the top fund) gives evidence of significant risk-adjusted returns and the reverse case is found for the bottom decile of funds which shows negative returns. Based on the daily data, the average annual alpha is estimated to be -1.9 %, which closely corresponds to the average level of expense ratios in the Norwegian fund industry. Evidence from an investigation into persistence of performance suggest that it can last for up to one year and that the negative persistence is more common than the positive persistence.

3.5 Sweden

Dahlquist, Engström & Söderlind (2000) investigate performance and persistence in a Swedish context from the end of 1992 to the end of 1997. The model for measuring risk-adjusted returns is some unreported constant factor model and a conditional model, which is attributed to a paper by Ferson & Shaft (1996). The data set contains open-ended common funds (referred to as Equity I) and special funds providing tax benefits (Equity II), as well as bond and money market funds. Their findings suggest that the Equity I funds show excess returns in the range of 0.5 % annually, but only 10 % of these are statistically significant and in general not persistent. The Equity II funds generate on average -1 % in abnormal returns, but without evidence of persistence. Similar negative performance is found among the bond- (-0.5 % annual estimated alpha) and money market funds (-0.9 %), out of which the latter is the only one with indications of persistence. Additionally, the study finds a negative relationship between fund size and abnormal returns.

Engström (2004) uses a dataset which spans the years 1996 to 2000. He measures performance by utilizing two different methods: the first is the risk adjusted return estimated from CAPM (with and without the Ferson & Shaft conditional factors) and the second is an annually replicated portfolio for each fund. The latter method provides information of the extra value added by the active trading of managers, by comparing the returns from a constant portfolio to the manager's dynamic portfolio. The study is divided into general funds and small funds. The replicating portfolio method is also utilized for measuring the impact of forced trades, which occur when funds due to regulations need to reduce the holdings of individual securities. He finds that forced trading has a negative effect on performance for the small funds.

A recent study by Flam & Vestman (2014) captures most of the recent history of the Swedish mutual fund market by including a sample of monthly returns from January 1993 to December 2013. The performance is measured utilizing CAPM, Fama & French's 3-factor and Carhart's 4-factor model and the distribution of alpha estimates is generated in the way suggested by Kosowski et al. (2006). The authors find a clear break in estimated alphas during the years 2001-2002; before this date alphas are to a large extent positive for many funds but afterwards this effect disappears. The authors attribute this phenomenon to a large exposure to IT stocks during the IT-bubble and to increased competition due to an increase of the number of mutual funds on the market. The number of mutual funds in the data set doubled after the year 2002, which may be linked to a reform in pension saving legislations. Further evidence of a fundamental change in the industry is indicated by the mutual funds outstanding performance for the years 1993-2001. The average gross return in excess of the market index for this period was 3.2 %, but in subsequent years this advantage was reduced to zero.

The result of this study is that for the earlier time period average abnormal returns are in the range of 3.55 %, annually, and for the following time period this is reduced to -0.18 %. Out of a sample of 124 mutual funds, only one has indications of skill (gross of expenses) as measured by the bootstrapping method while nine funds (likewise gross of expenses) show indications of significant underperformance. There is no indication of skill among fund managers net of expenses. The persistence was also tested using the methodology in Carhart (1997) and the results indicate that persistence is diminished after two years. The authors conclude that, based on the results for performance and persistence, there is little evidence of skill among Swedish mutual fund managers in the later years.

3.6 Cross-country studies that include Nordic countries

Ferreira et al. (2012) perform a study, which is to their best knowledge, the most extensive cross-country study on performance of mutual funds, measured by the amount of countries included and data on funds collected. The study contains the four Nordic countries that are defined as the scope in this thesis, along with a large variety of other developed countries. The sample includes monthly returns on actively-managed funds for the time period 1997-2007. The study contains a large set of mutual funds from the Nordic countries: Denmark has 192 reported funds, Finland 150, Norway 126 and Sweden 242. The abnormal risk-adjusted performance is measured using the Carhart factors whose proxy indices are individually created for each country based on portfolios of local stocks.

Due to the wide scope of the study, individual countries are not scrutinized closely and as an effect, only the average estimated alpha is reported. Unfortunately the t-statistics of the alphas are omitted, so there is no information regarding the statistical significance of the findings. Nevertheless, the average estimated alphas reported are (on a quarterly basis): Denmark 1.36, Finland 0.43, Norway -0.74 and Sweden -0.08.

Another finding of the paper is that the negative effect of increased assets under management, as reported by Berk and Green (2004), is not found outside of the US. This finding persist even when the difference between the average size of US and non-US funds is accounted for. The authors explain the size effect by the liquidity constrains that US managers face, due to dealing with small and domestic stocks.

Vidal-García et al. (2016) utilize an even more comprehensive data set consisting of daily returns for 35 countries (including Denmark, Finland, Norway and Sweden) during the period from 1.1.1990 to 31.12.2013. Compared to Ferreira et al. (2012), this dataset contains fewer mutual funds from the Nordic countries (Denmark: 50, Finland: 45, Norway: 100 and Sweden: 176), which may be attributed to stricter requirements for inclusion.

They mainly investigate short-term persistence by using a few alternative methods, but performance is also included in the study. They utilize the Kosowski method on Carhart factors to obtain estimates of the significance of alpha. They find that, on a global scale, Danish mutual funds have the best performance and persistence of all the Nordic mutual funds and are followed by Norway and Finland, which are placed in the middle of the rankings. Surprisingly, Sweden is the worst performer of all the countries included in the study both from a performance and persistence point of view. Persistence of abnormal returns is found to be present for all funds in all countries, at least for the 3 month period which is utilized for assessing it.

Similar to Ferreira et al. (2012), the study also investigates if fund size is related to performance. It seems that Finland, Norway and Sweden have a significant positive relation to size while Denmark does not. Another interesting finding is that the performance of all of the countries in the sample has a negative relation with expense ratios, except for Finland.

3.7 Summary of Nordic market

The most striking finding in this literature overview is the conflicting reports from the Danish market. Christensen (2003, 2005 & 2013) finds no evidence of positive performance, while both of the cross-country studies ranks Denmark among the top countries on a global scale measured by performance. This is very puzzling, on one hand, the Christensen studies have the advantage of local market knowledge and Denmark is the main focus of these papers. On the other hand, the cross-country studies utilize a more refined model, as the Carhart factors are utilized, compared to the CAPM in the previous studies. This thesis will aid in solving this puzzle, as results from both the CAPM and multi-factor models are reported, which provide more evidence for Danish mutual fund performance.

Another interesting find is the break in market efficiencies observed around the new millennium. Sørensen (2009) and Flam & Vestman (2014) presents evidence of this for the Swedish and Norwegian market by reporting results from multiple time periods. The earlier half of Nordic mutual fund history (before year 2002) is characterized by frequent occurrence of positive abnormal risk-adjusted returns, which is drastically reduced in the later half. This thesis will provide more evidence of historical outperformance in all four countries, as the Kalman filter is able to estimate the dynamic factor coefficients throughout the sample period.

Since the introduction of the bootstrapping methods by Kosowski et al. (2006) and Fama & French (2010) these have gained ground within this field of research. Results obtained from the utilization of these novel methods are reported for Sweden and Norway, but do not exists for Finland and Denmark (expect for the cross-country study by Vidal-García, but this does not go into detail for specific countries). The contribution of this thesis is to bring more evidence of over- or underperformance, measured by the Kosowski and Fama-French methods, in the Nordic marketplace. Additionally, this study serves to add more research about mutual funds from Finland and Denmark, two countries which have previously not been thoroughly studied.

To summarize the results from this section, the current outlook is that in general, mutual funds in the Nordic countries are likely to underperform the market by a percentage that matches the fund fees. One or few more mutual funds are likely to exhibit superior results that are not solely due to luck or random sampling variation. Net of fees, the other end of the performance scale will probably be populated by a larger number of funds that show evidence of bad skill, rather than lack of luck, although in most cases this can be attributed to the negative alpha caused by the commission that the mutual fund manager charges. Performance persistence is expected to be present, but only for a limited period. Table 1 summarizes the results from the Nordic market in a tabular format.

Table 1 Summary of research into mutual funds in Nordic markets

Time period	Method/Model	Performance	Persistence	Author(s)
		Denmark		
1994-2002	Multi-index CAPM	No positive performance, but some evidence of negative		Christensen (2003)
1996-2003	Multi-index CAPM	No positive performance, but some evidence of negative	Weak evidence of persistence	Christensen (2005)
2000-2010	CAPM	7 % of funds exhibit positive performance. More evidence of negative performance		Christensen (2013)
		Finland		
1995-1998	CAPM		Strong evidence of positive persistence	Sandvall (2000)
1995-2000	Replicating portfolio	Large investor are able to produce returns greater than mutual funds		Westerholm & Kuusakoski (2003)
		Norway		
1982-2008	Carhart factors with Fama & French bootstrap	Weak evidence of bootstrapped adjusted performance	No persistence among winner or loser mutual funds	Sørensen (2009)
2000-2010	Carhart factors with Kosowski bootstrap	Top decile of funds outperform market (confirmed by bootstrap). Funds largely underperform by the size of fund fees	Positive persistence up to one year among winner and loser funds	Gallefoss et al. (2015)
		Sweden		
1992-1997		Indications of positive performance in general		Dahlquist, Engström & Söderlind (2000)
1996-2000	Extended CAPM	On average, funds exhibit positive performance		Engström (2004)
1993-2013	1-, 3- & 4- factor models with Kosowski bootstrap	Positive performance before 2001-2002, after which evidence is greatly reduced (confirmed by bootstrap)	Evidence of persistence for up to 2 years	Flam & Vestman (2014)

4 METHODOLOGY

This chapter introduces the methodology for estimating the performance and persistence of the mutual funds. The first section presents all of the models utilized for measuring risk-adjusted returns, the second section presents the bootstrapping method by Kosowski et al. (2006) followed by the Fama & French (2010) modification. The final sections in this chapter presents the Kalman filter and how it can be utilized for measuring the persistence of mutual fund performance.

4.1 Risk adjusted return models

In order to control for the various levels of risk that the mutual funds encounter, a model that incorporates suitable control variables for these exposures is necessary. For this purpose several alternative models are considered: the first is the capital asset pricing model of Sharpe (1964) and Lintner (1965), which was already given in the introduction of this thesis. The second is the Fama & French (1993) three factor model which builds on the CAPM by including two extra variables:

$$R_{i,t} - r_{f,t} = \alpha_i + \beta_{i,1}(R_{m,t} - r_{f,t}) + \beta_{i,2}SMB_t + \beta_{i,3}HML_t + \varepsilon_{i,t}, \quad (2)$$

where SMB_t (small minus big) is a factor capturing the size effect measured by the market capitalization of stocks. HML_t (high minus low) is a similar factor which accounts for the growth or value aspect of stock returns. $\beta_{i,2}$ and $\beta_{i,3}$ are the respective factor loadings of SMB and HML.

The final model to be utilized is the Carhart (1997) four factor model. This consists of the same factors as in the three factor model, but is additionally appended with a factor capturing the momentum effect of stock prices. It is expressed as:

$$\begin{aligned} R_{i,t} - r_{f,t} = \alpha_i + \beta_{i,1}(R_{m,t} - r_{f,t}) + \beta_{i,2}SMB_t + \beta_{i,3}HML_t \\ + \beta_{i,4}MOM_t + \varepsilon_{i,t}, \end{aligned} \quad (3)$$

where MOM_t is the momentum factor and $\beta_{i,4}$ its associated coefficient.

The SMB factor in Equations 2-4 is better explained as the average return on a portfolio of stocks with lower market capitalization minus a portfolio of stocks with large market capitalization and it is expected to capture the effects of smaller stocks outperforming larger stocks. Likewise, HML is the difference between the returns of a value-oriented and a growth-oriented portfolio, which accounts for stocks with a historically low market-to-book ratio (value stocks) outperforming stocks with high market-to-book ratio (growth stocks). Finally, MOM is calculated as the average of a portfolio consisting of the previous highest performing stocks minus another consisting of the lowest performing stocks and captures the phenomena of price momentum in stock prices. Momentum is an anomaly that describes how stocks with a previously high average return continue to produce positive returns. The proxies used for the calculations of these factors and a more exhaustive overview of their construction is presented in Section 5.1.

There is some disagreement in financial literature about whether the factors represent a risk that the manager face or an opportunity set. Nevertheless, the multi-factor models are shown to better explain the sources of returns for individual portfolios and provide a better goodness of fit for the complete model. These factors can represent returns that can be obtained by implementing a simple trading strategy, for example: buying last year's winners and selling last year's losers. Therefore it is justified to measure mutual fund returns by controlling for these common factors and the resulting alpha estimates can be expected to be more precise (compared to a single factor model).

The choice of risk adjusted return model is based on the value of the Bayesian information criterion (BIC) for each market, as suggested by Kosowski et al. (2006) and Cuthbertson, Nitzsche & O'Sullivan (2008). It is given as:

$$BIC = -2 \log \mathrm{L}(\mathrm{y}) + k \log(N), \tag{4}$$

where $\log \mathrm{L}(\mathrm{y})$ represents the logarithmic likelihood function, k is the number of parameters (factors including the alpha intercept) and N is the number of observations. Even though the BIC picks a preferred model, the results of all of the competing models are presented in this thesis for comparison.

4.2 Kosowski bootstrap method

The distribution of estimated mutual fund alphas as generated by some factor model are not expected to be normally-distributed for a wide variety of reasons. Firstly, the individual returns on stocks included in a mutual fund portfolio are likely to be drawn from a distribution characterized by high levels of skewness and kurtosis. Due to the relatively few positions of securities included in a fund portfolio, the central limit theorem (which states that the mean of a large sample of non-normal random variables approaches normality as the sample size grows towards infinity) can't be applied to this. Secondly, the benchmark returns are also drawn from a non-normal distribution and may be co-skewed with the fund returns. Additionally, it is common that the time-series returns utilized in financial contexts suffers from autocorrelation and heteroscedasticity which may further aggravate non-normality of factor model alphas. The final reason for non-normality among individual funds is that managers frequently adjust their risk exposure (betas) in order to time bull or bear markets. (Kosowski et al. 2006)

The bootstrap procedure attributed to Kosowski et al. (2006) allows for estimation of the underlying probability distribution of the estimator of alpha as it consists of a resampling of the factor model residuals which in statistics is known as a bootstrap. The first step of the bootstrap as implemented by Kosowski et al (2006) is to estimate (using OLS) the coefficients of a factor model:

$$R_{i,t}^{e} = R_{i,t} - r_{f,t} = \hat{\alpha}_i + \sum_{j=1}^{K} \hat{\beta}_{i,j} f_{j,t} + \hat{\varepsilon}_{i,t}, \qquad (5)$$

where $R_{i,t}^{e}$ is the excess return (returns subtracted with the risk-free interest rate) for mutual fund i at time t and $\hat{\alpha}_i$ is the estimated alpha associated with this fund. $\hat{\beta}_{i,j}$ is the coefficient associated with factor return $f_{j,t}$ for all K factors in the model. This equation is a generalized representation of the factor model; see Section 4.1 for an overview of the models considered in this study. The estimated coefficients ($\hat{\alpha}_i$, $\hat{\beta}_{i,1}$ … $\hat{\beta}_{i,K}$) for each of the mutual funds in the sample are saved along with the vectors of residuals.

The residuals, $\hat{\varepsilon}_{i,t}$, for each fund are resampled by drawing a random sample, with replacement, of length T_i (T_i is the number of observations for the i:th mutual fund) from the vector of saved residuals associated with each mutual fund. This is repeated for all of the funds in the sample. These resampled residuals are utilized in the pseudo excess return model, which consists of the factor model used in Equation 5 with the constraint of a null hypothesis of no abnormal performance, in other words, $\alpha_i = 0$. This represents a universe where the mutual fund managers are only able to recover their costs of operations and no abnormal returns exist per definition. Equation 5 then becomes:

$$R_{i,t}^{e,b} = \sum_{j=1}^{K} \hat{\beta}_{i,j} f_{j,t} + \hat{\varepsilon}_{i,t}^{b}, \tag{6}$$

where $R_{i,t}^{e,b}$ are the bootstrapped excess pseudo returns that are obtained by inserting the bootstrapped residuals ($\hat{\varepsilon}_{i,t}^{b}$) into the factor equation. The bootstrapped pseudo-returns are then inserted into Equation 5, taking the place of the actual, observed returns. This model is re-estimated and a bootstrapped alpha, $\hat{\alpha}_i^b$, is obtained. This is repeated for all of the (i = 1 ... N) funds in the sample from which a $(1 \times N)$ vector of bootstrapped alphas is obtained. The estimated alphas in this vector are ranked from the lowest to the highest. This procedure is repeated for $b = 1, \ldots, B, \;\; B = 10000$, where b is the bootstrap iteration. This results in a $(B \times N)$ matrix of estimated alphas (B is the total number of bootstrap replications), whose rows are ranked in increasing order. The i:th column of this matrix yields a bootstrap approximation to the distribution of the ranked estimated alpha, $\hat{\alpha}_i$, associated with this column.

The significance of each estimated alpha ($\hat{\alpha}_i$) is determined by comparing this estimate to the bootstrapped distribution. For example, the estimate of the best fund in the sample ($\hat{\alpha}_{\text{best}}$) is compared to the distribution which is generated by the set consisting of the largest simulated alphas in each bootstrap iteration, which in this case is the last column. Note that this distribution may contain values attributed to another fund in the sample, depending on the outcome of the random draw of residuals.

This bootstrap is also performed with the t-statistic of the alpha estimator (adjusted with Newey & West (1987) standard errors), due to its attractive properties over the estimator itself. The latter tends to be inflated if the mutual fund that generates it only has a limited number of observations. Therefore it may occur as a spurious outlier in the extreme ends of the cross sectional distribution of alpha estimates. By utilizing the t-statistic of the estimator this problem is alleviated, since this takes into account the variance of the estimate, which tends to be higher when the observations are scarce, and therefore produces more accurate results when the performance measures are sorted from the best to the worst. The t-statistic can be thought of as a precision-adjusted estimate of alpha (Fama & French 2010). (Kosowski et al. 2006)

4.3 Fama & French bootstrap method

Fama & French (2010) modify the previous bootstrapping method by jointly sampling the factor returns and the residuals. This method begins in a similar way by estimating and saving the alphas, betas and residuals using Equation 5. Next, a $(T \times 1)$ vector representing a random sample of monthly observation data points is drawn from an uniform distribution and multiplied by T, the number of observations in the sample. Note that this T is the total length of the time period used (total number of months) and different from the variable T_i, which is the length of the observations for of a given fund i (which varies in length since funds begin and end at different periods of time).

This is rounded to the closest integer to represent an ordering of monthly observations in the data set (Sørensen 2009; Fama & French 2010):

$$\tilde{T}_b = \text{round}(T \times \{U_t(0,1)\}_{t=1}^{T}), \;\; b = 1 \dots 10000 \tag{7}$$

where $\tilde{T}_b$ is the time vector for bootstrap iteration b, and $U_t(0,1)$ is the uniform distribution that generates random values between 0 and 1. Next, the corresponding factor returns for these randomly sampled months are placed into a $(T \times K)$ matrix, where K is the number of factor returns. A similar procedure is performed with the residuals for each fund in the sample, resulting in a $(T \times N)$ matrix, where N is the number of mutual funds. With the null hypothesis of zero outperformance (α_i = 0), Equation 6 from the Kosowski method becomes:

$$R_{i,t}^{e,b} = \sum_{j=1}^{K} \hat{\beta}_{i,j} f_{j,t}^{b} + \hat{\varepsilon}_{i,t}^{b}, \tag{8}$$

where $f_{j,t}^{b}$ is the bootstrapped factor return. Note that the Kosowski method only samples the residuals of the factor model for a single fund, while the Fama-French method jointly samples the residuals and factor returns for all funds in the sample. The bootstrapped excess pseudo-returns are then inserted into the original factor model, which is subsequently re-estimated. This is repeated for all of the funds in the sample with the random draw of months kept constant for each simulation run. If a fund turns out to have fewer than 8 observations due to the random draw of months, it is discarded from that particular bootstrap iteration. The new series of simulated alphas is sorted in the same way as in the Kosowski method and a $(B \times N)$ matrix is obtained once the steps above are repeated for b = 1 … 10000 simulations.

A quantity with similar properties as the p-value is obtained for the estimated alpha by calculating the number of times the bootstrapped alpha is greater than the actual, estimated alpha (Sørensen 2009):

$$\%(Sim > Act)_{\alpha} = \frac{1}{B}\sum_{b=1}^{B} \mathbf{1}\,(\hat{\alpha}^{b}_{simulated} > \hat{\alpha}_{actual}), \quad (9)$$

where B is the total number of bootstraps (10 000), $\mathbf{1}()$ is an operator that takes on 1 if the statement it contains is true, $\hat{\alpha}^{b}_{simulated}$ is the simulated alpha for bootstrap iteration b and $\hat{\alpha}_{actual}$ is the alpha estimated initially. The corresponding value for the t-statistic is calculated in a similar manner as:

$$\%(Sim > Act)_{t-stat} = \frac{1}{B}\sum_{b=1}^{B} \mathbf{1}\,(t^{b}_{\alpha,simulated} > t_{\alpha,actual}) \quad (10)$$

where $t^{b}_{\alpha,simulated}$ and $t_{\alpha,actual}$ are the bootstrapped and actual t-statistics, respectively.

The major advantage of the Fama & French modification is that, since the same random sample of months apply to all fund simultaneously, the cross-correlation between the alpha estimates and the t-statistic of alpha is accounted for. Additionally, since the residuals and factors returns are also jointly sampled, any correlated heteroscedasticity and unexplained variation due to the under-specification of the factor models is captured.

The drawback of this method is that when the months are randomly sampled across the whole data set, there are individual funds that do not exist for some particular months. In fact, this is the case for the majority of the funds in the sample. The effects of this can be partially offset by utilizing the t-statistic of alpha, as it is based on the actual months during which a particular fund exists in the database. However, the degrees of freedom for this t-statistic are still affected, which leads to thinner tails in the bootstrapped distribution. Fama & French (2010) argue that this oversampling of short lived funds should be offset by an undersampling of other funds. However, their dataset consists of 273 months and on average 1308 funds for the whole period. The Nordic market dataset utilized in this study is only a fraction of this, so the balancing effect may not be as reliable. A general drawback that both methods suffer from is that any effects of autocorrelation of returns is lost in the random sampling. Additionally, the dynamic relationships of factor betas is likewise destroyed. (Fama & French 2010)

These two methodologies allow for better inference about the statistical significance of the performance of ranked funds and portfolios of ranked funds (deciles). Unfortunately, it is not possible to determine the significance of individual funds in the sample as the initial ranking of the funds (by alpha or t-statistic) is influenced by random sampling variation. While it is possible to obtain the probability distribution associated with, for example, the top fund in the sample, it is impossible to confidently identify said fund. This limitation is not a serious issue as this study is concerned with the cross-sectional performance of all the mutual funds in the market from an academic point of view. Nevertheless, Appendix 1 contains a list of all the funds included in the sample with the estimated coefficients measured by the four-factor model. The significance of the alpha estimates for individual funds is derived from a p-value which is adjusted with Newey-West (1987) standard errors. This is of course not entirely accurate due to the reasons listed previously in this chapter concerning the non-normality of estimated alphas, but it is reported as an alternative performance measure due to its applicability to individual funds.

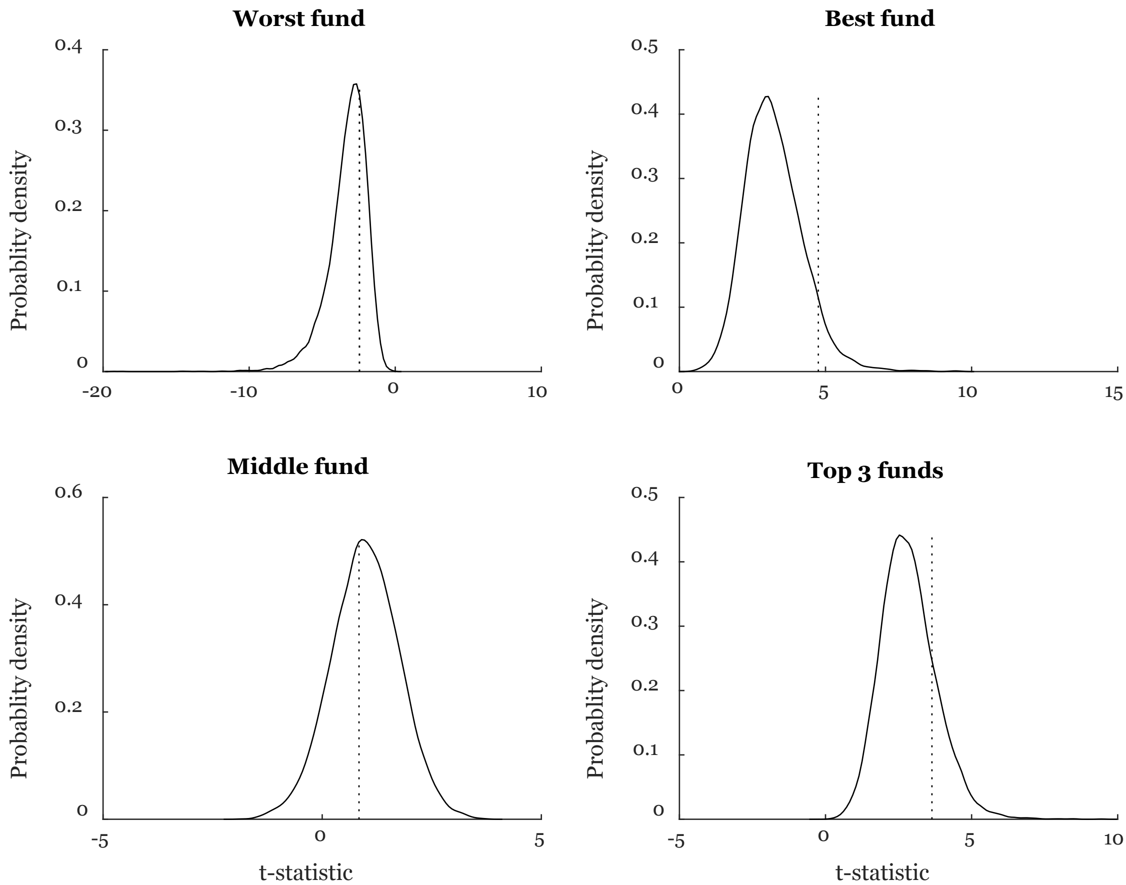
Since its introduction in a working paper initially published in 2009, the Fama & French (2010) method has been gaining more ground over the Kosowski method. However, in this study both of these methods are utilized and the outputs are compared. The former method is expected to yield less evidence of managerial outperformance compared to the Kosowski method. Matlab code for the execution of these two methods is found in Appendix 2.

4.4 Kernel density estimation

Kernel density estimator replaces a commonly-used histogram, to obtain a smooth estimate of the probability density function (pdf) of an estimator. This method estimates the pdf of estimated alphas by a non-parametric approach, which is beyond the scope of this thesis. The Matlab function *ksdensity* with the default bandwidth is utilized for this purpose.

Figure 2 presents the result for pdf's based on bootstrapped t-statistics of alphas in the Nordic market, which is here represented by Finland. The solid line represents the estimated probability density for each fund and the dotted line is the initial estimate of the t-statistic. From this figure it is clear that the estimated performance measure of the top and the bottom funds exhibit signs of severe non-normality, and are actually closer to a log-normal distribution. On the other hand, mutual funds in the middle of the spectrum are more normal. A Jarque-Bera test rejects normality of the errors for the top, bottom and top 3 funds even at a 0.5 % significance level. This serves to prove that inference regarding the performance of the top and the bottom funds based on a normal distribution is likely to give false results.

Figure 2 Distribution of mutual fund t-statistics of estimated alpha – evidence from the Finnish market



4.5 Kalman filter

The Kalman filter is a recursive algorithm which estimates directly unobservable variables as a function of the observed (noisy) state and the predicted (noisy) state (Mastro 2013). It is useful for estimating the dynamics of the factor model coefficients in a way that is superior to other methods (Nieto, Orbe & Zarraga 2014). The traditional OLS method produces only a single estimate of the factor coefficients and intercept, and assumes that these are constant over time. Traditionally, rolling- and recursive-window OLS techniques have been used to estimate the dynamics of alphas and betas, but this approach suffers from a few drawbacks. Firstly, the latest estimate is based on the average of the observations included in the window, which introduces a delay in the response to rapid market changes. Secondly, the selection of the window length is an arbitrary choice and it may have a great impact on the results (Chen & Tindall 2014). The Kalman filter allows for estimation of the time-varying coefficients unhindered by the issues outlined above.

The notation for the Kalman filter equations presented in this sections closely follows the notation used in Harvey (1990), which is the most intuitive when utilized in a financial context. The filter requires that the underlying equations (which in this case is the factor model) are presented in state-space form. This is given as:

$$y_t = Z_t x_t + \varepsilon_t, \tag{11}$$

where y_t is an observation from a time series (in this context mutual fund returns), Z_t is a $(1 \times m)$ vector known as the measurement model, x_t is the $(m \times 1)$ state vector and ε_t is a serially uncorrelated noise with zero mean and variance R_t. The state vector is generated by the following equation:

$$x_t = T_t x_{t-1} + \eta_t \tag{12}$$

where T_t is the $(m \times m)$ transition matrix and η_t is a $(m \times 1)$ vector of serially uncorrelated and zero-mean process noise defined by the covariance matrix Q_t. The recursive process of the Kalman filter begins by the prediction of the next state of the system:

$$\hat{x}_{t|t-1} = T_t \hat{x}_{t-1|t-1}, \tag{13}$$

and its error covariance:

$$P_{t|t-1} = T_t P_{t-1|t-1} T_t^T + Q_t, \tag{14}$$

where $P_{t|t-1}$ denotes the error covariance of the estimate given the previous error covariance. These two equations (Eq. 13 and 14) constitute the predictive part of the Kalman filter. This initial estimate of the next state is revised in the updating part of the filter as a weighted average of the predicted and observed state. The difference between the predicted outcome and the observed outcome is known as the innovation residual:

$$i_t = y_t - \hat{y}_{t|t-1} = y_t - Z_t \hat{x}_{t|t-1}. \quad (15)$$

where y_t is the observation for time t and $\hat{y}_{t|t-1}$ is the predicted observation given by Equation 11 (dropping the error term). The next step is to update the current state of the system:

$$\hat{x}_{t|t} = \hat{x}_{t|t-1} + K_t i_t, \quad (16)$$

where K_t is the Kalman gain which serves as the weighing factor of the predicted and observed state. This gain is given by:

$$K_t = P_{t|t-1} Z_t^T (F_t)^{-1}, \quad (17)$$

where F_t is the innovation covariance calculated as:

$$F_t = Z_t P_{t|t-1} Z_t^T + R_t. \quad (18)$$

The last thing the Kalman filter performs is the updating of the covariance of the state error. This can likewise be interpreted as a weighted average of the predicted and observed covariance and is given as:

$$P_{t|t} = (I - K_t Z_t) P_{t|t-1}, \quad (19)$$

where I is the identity matrix. Equations 13-19, that make up the Kalman filter are presented in Table 2 in the order in which they are actually calculated.

Table 2 Kalman filter equations

Prediction step	
$\hat{x}_{t|t-1} = T_t \hat{x}_{t-1|t-1}$	State prediction
$P_{t|t-1} = T_t P_{t-1|t-1} T_t^T + Q_t$	Covariance prediction
Update step	
$i_t = y_t - \hat{y}_{t|t-1}$	Innovation (measurement) residual
$F_t = Z_t P_{t|t-1} Z_t^T + R_t$	Innovation (residual) covariance
$K_t = P_{t|t-1} Z_t^T (F_t)^{-1}$	Kalman gain
$\hat{x}_{t|t} = \hat{x}_{t|t-1} + K_t i_t$	State correction
$P_{t|t} = (I - K_t Z_t) P_{t|t-1}$	Covariance correction

The Kalman filter is in this context used with the factor models described in Section 5.1. This means that the state equation represents the factor coefficients (exemplified here in conjunction with the 3-factor model, with the subscript '*i*' dropped):

$$x_t = \begin{bmatrix} \alpha_t \\ \beta_{1,t} \\ \beta_{2,t} \\ \beta_{3,t} \end{bmatrix}. \tag{20}$$

The observation model is the $(1 \times m)$ matrix consisting of the factor returns at time t:

$$Z_t = [1 \quad R_{MKT,t} \quad R_{SMB,t} \quad R_{HML,t}] \tag{21}$$

The transition model (T_t) describes the progression of the factor coefficients trough time. Numerous alternative models for this has been proposed, including a first order autoregressive process conditional on some information set (Mamaysky, Spiegel & Zhang 2008), a mean reversion process (Adrian & Franzoni 2009, a random coefficient process or a random walk (Cuthbertson, Nitzsche & O'Sullivan 2008; Chen & Corbett 2015). Since the last of these model has been proved to be advantageous for in- and out of sample tests (Faff, Hillier & Hillier 2000) and is the most adopted alternative it will also be utilized in this study. The random walk model for the factor coefficients is given by:

$$\alpha_t = \alpha_{t-1} + \epsilon, \tag{22}$$

$$\beta_{j,t} = \beta_{j,t-1} + \epsilon, \quad j = 1 \ldots K, \tag{23}$$

where ϵ is an independent and identically distributed variable following a normal distribution with zero mean and variance σ_j^2 and β_j is a coefficient from a factor model, where K is the number of factors. By implementing the random walk to the Kalman filter, the transition model simply becomes:

$$T_t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \tag{24}$$

The noise term of the random walk model is incorporated in the process covariance parameter, which becomes a matrix with the coefficient variances on the diagonal:

$$Q_t = \begin{bmatrix} \sigma_{\alpha}^2 & 0 & 0 & 0 \\ 0 & \sigma_{\beta 1}^2 & 0 & 0 \\ 0 & 0 & \sigma_{\beta 2}^2 & 0 \\ 0 & 0 & 0 & \sigma_{\beta 3}^2 \end{bmatrix}. \tag{25}$$

The final parameter to consider is the observation noise, which is given as:

$$R_t = \sigma_y^2. \tag{26}$$

The variables R_t and Q_t are unknown features of this model and are known as hyperparameters. These are estimated in conjunction with the Kalman filter by finding the maximum value of the logarithmic likelihood function. In the context of the Kalman filter as utilized here, this is given as (Mergner 2009, p. 29):

$$\log L(y) = -\frac{T}{2}\log(2\pi) - \frac{1}{2}\sum_{t=1}^{T} \log|F_t| - \frac{1}{2}\sum_{t=1}^{T} \imath_t{}' F_t^{-1} \imath_t \tag{27}$$

where T denotes the number of observations. The procedure for finding the set of parameters that minimize the variance of the estimate is as follows: first an initial qualified guess of the hyperparameters is supplied to the filter. Then the filter is run using these values and the logarithmic likelihood function is calculated. An optimization technique (for example, the Newton-Raphson method) is applied to the hyperparameters, which are continuously updated until the value of the likelihood function converges. In this thesis, the optimization is performed by the Matlab function *fmincon*, which allows the values of the hyperparameters to be constrained (in this case, the variance is limited to positive values only).

Since the optimization of the likelihood function is not guaranteed to find the global maximum, care must be taken for the selection of the initial set of parameters. The choice of initial hyperparameters is found to not be a critical decision in this application so the variance is arbitrarily set to 0.01^2 for R_t and the diagonal for Q_t. However, the initialization of the state vector plays a more important role in the search for the global maximum of the likelihood function and a misspecification of the starting point may lead to convergence to a local maximum. The values for the initial state vector is partially based on the whole sample OLS estimates, previous knowledge of the markets and trial and error. The chosen values that provide good convergences are exemplified here with the four factor model:

$$x_0 = \begin{bmatrix} \alpha_0 \\ \beta_{1,0} \\ \beta_{2,0} \\ \beta_{3,0} \\ \beta_{4,0} \end{bmatrix} = \begin{bmatrix} 0.05 \\ 0.95 \\ 0.2 \\ 0 \\ 0 \end{bmatrix}.$$

Since this initialization is not based on the actual data for the first observations it must be disregarded in subsequent calculations. Additionally, due to the high autocorrelation associated with the random walk model, the first 8 dynamic coefficient estimates are likewise unreliable and are regarded as training data for the filter and therefore also discarded. The rest of the estimates for $t = 9 \ldots T$ are utilized for further processing. Appendix 2 contains the Matlab code necessary for implementation of the Kalman filter.

4.6 Estimating persistence

The Kalman filter produces a time-series of risk-adjusted returns for all of the mutual funds in the sample which is utilized for measuring persistence. A quick but crude realization of this is to create a contingency table in the style of Carhart (1997). For this purpose, funds are ranked in quintiles based on the previous 12 months performance measure, which in this case are the estimated dynamic alphas obtained from the Kalman filter. These quintile portfolios are then recreated every 1, 3, 6 or 12 months. Persistence of the ranking for each quintile is determined by calculating the number of mutual funds preserving their rank in the subsequent period. In order for this procedure to work properly, funds without a sufficient number of observation in the pre and post ranking period are filtered out.

In order to obtain results in tabular format, next period risk-adjusted returns are also calculated for these quintile portfolios. Mutual funds are, in June each year, based on the preceding 12 months of performance sorted into these five portfolios. The average return is subsequently calculated for a 1, 3, 6 and 12 month look-ahead periods. The portfolios are recreated annually on a non-overlapping rolling basis, ensuring that portfolio performance is not influenced by autocorrelation. The statistical significance of the post-formation period is determined by p-values obtained from a bootstrap dissimilar to the Kosowski or Fama & French methods introduced earlier. The quintile performance bootstrap as utilized for this method tests the two-sided hypothesis that the post-formation performance is different from zero.

The final approach to evaluating persistence is the regression-based analysis similar to the Fama & Macbeth (1973) method, as suggested by Busse, Goyal & Wahal (2010) and Chen & Corbett (2015). It consists of estimations, for each month t, of the cross sectional model based on future performance (measured as risk-adjusted returns) regressed against lagged performance:

$$perf_{i,t} = \gamma_0 + \gamma_1 perf_{i,t-1} + \varepsilon, \qquad (28)$$

where $perf_i$ is the time dependent performance measure for mutual fund i and γ_0, γ_1 are regression coefficients. The resulting series of regression coefficients is averaged to obtain the final estimate of γ_0 and γ_1 and the standard errors of the mean coefficients are calculated and adjusted for serial correlation with Newey & West (1987) errors (Cochrane 2005, p.264).

Equation 28 includes a bias in the coefficient estimates as the dependent variable is based on estimates as opposed to actual observations. The effect of this is that the resulting estimate of the coefficient is smaller than the true value (Woolridge 2013). In the traditional Fama-MacBeth regression, the dynamic coefficients are estimated via a rolling OLS approach and the error-in-variable issue is usually corrected by the method outlined in Shanken (1992). However, since the dynamic coefficients in this thesis are obtained from a Kalman filter, this approach for adjusting the estimates is unavailable (Bakshi, Gao & Rossi 2015). Instead, this issue is acknowledged but not adjusted for.

5 DATA

The data for the sample of mutual funds is collected from the various institutions in respective countries that collects this kind of data. The time period that is selected for this study is from January 1997 to March 2016 and the frequency of returns is monthly. Since previous research emphasize the importance of using a survivorship-bias free sample (Carhart 1997; Sørensen 2009) defunct funds are included in this study. The funds that are selected for inclusion in the final sample have at least 70 % of the capital invested in domestic equities and consists of at least 12 monthly observations.

Data for the Danish market is provided by the Danish Investment Fund Association (Danish: Investeringsfondsbranchen; IFB). This sample consists of 47 funds starting from year 2000 and makes up the whole market for Danish equity funds. Finnish data is obtained from Investment Research Finland (Finnish: Suomen sijoitustutkimus) and has been appended by manual entry from *Rahastoraportti,* a monthly report published by the same company consisting of return data reported for Finnish mutual funds. This data set covers the whole universe of funds with Finnish equities as the reported category, for a total of 63 funds. Norwegian data is provided by Børsprosjektet at Norwegian School of Economics. This dataset consists of the daily net asset values (NAV) that mutual funds report. This value is the net of cost daily market value for the mutual fund portfolio. Monthly returns are calculated from daily NAV's by utilizing continuous compounding and reinvested dividends as:

$$R_{i,t} = \ln\left(\frac{NAV_{i,t} + D_{i,t}}{NAV_{i,t-1}}\right), \tag{29}$$

where $NAV_{i,t}$ is the reported end of month value for month t and $D_{i,t}$ is a dividend paid during t and $t-1$. The number of mutual funds in this sample is 105, which covers the great majority of Norwegian equity funds.

Data for Swedish mutual funds is provided by the Swedish Investment Fund Association (Swedish: Fondbolagens förening) for the period from May 1999 to February 2016 and like the Norwegian dataset consists of daily reported net asset values. The final sample consisting of 158 funds covers a large fraction of the available equity funds on the Swedish market. Descriptive statistics for all of these datasets are presented in Table 3.

Table 3 Descriptive statistics of sample

Country	Denmark	Finland	Norway	Sweden
Number of funds	47	63	105	158
Time period	01/2000 -03/2016	01/1997 -03/2016	01/1997 -03/2016	05/1999 -02/2016
Number of observations	5447	7503	14525	19001
Average return	0.0105	0.0082	0.0063	0.0057
Median return	0.0150	0.0094	0.0123	0.0091
Max	0.2600	0.4440	0.3490	0.3043
Min	-0.2049	-0.3050	-0.3576	-0.2441
Volatility	0.0535	0.0630	0.0658	0.0526
Skewness	-0.4714	0.2894	-1.0849	-0.3090
Kurtosis	2.3473	2.9426	3.2776	2.0748

As proxies for risk-free interest rates, the interbank offer rates of each country are utilized on a one month basis. These are EURIBOR (Finland), CIBOR (Denmark), NIBOR (Norway) and STIBOR (Sweden). The HELIBOR is utilized as the risk free interest rate proxy for Finland for the period before the Euro was introduced (1997-1999). The market return consists of the index that best represents the set of investable securities for mutual funds in each market (satisfying the criteria laid forward by the UCITS and country-specific legislations). The Swedish and Norwegian market both have an index that directly follows the trading rules of mutual funds: the SIXPRX and OSEFX index, respectively. For Finland and Denmark similar indexes exists, but these are not explicitly reported to be tracking the investment opportunity set of mutual funds. These are the market capped general indexes: OMXHCAPGI and OMXCCAPGI, which are limited so that the weight of an individual security making up the index may not be larger than 10 %. Additionally, the block of securities of 5 % market share or higher has a combined limited weight of 40 % in the calculation of the value-weighted returns (NASDAQ 2014). In essence, these also follow the diversification regulations of mutual funds which makes them suitable benchmarks.

The data for the calculations of the other factor returns (SMB, HML and MOM) are obtained from Thomson Reuters Datastream. This data consisting of the price-to-book ratio, market capitalization and total returns (price adjusted for dividend payouts) is obtained from user-created constituent lists consisting of both surviving and dead stocks. It is important to acknowledge that this data might include some bias due to the reasons listed in Ince & Porter (2006). That study was able to identify a few occurrences (for US equities) of financial restructuring events (for example stock splits) that were not recorded at the correct date. It also reports that Datastream utilizes a rounding process of prices before the calculation of the theoretical total return index, which may cause nontrivial changes in return percentages, an issue which is more prominent in small-cap stocks.

Additionally, parts of the data for company characteristics of non-surviving securities is missing in the early years of the sample. This may introduce some bias in the construction of the size and value/growth portfolios, which is carried over to the SMB and HML factors. To ensure that the results obtained from the utilization of these factor returns are reliable, these are in the next section compared to the two known alternative sources of factor returns: Stefano Marmi's (Sweden) and Bernt Ødegaard's (Norway) datasets.

5.1 Factor returns

Only one of the factor returns, the market risk premium, can be calculated directly based on a simple manipulation of two time series. The other factor returns; SMB, MHL and MOM are obtained by forming portfolios based on automated trading strategies and calculating the spread between the value-weighted or equally-weighted returns of a long and a short position in a combination of portfolios.

Table 4 2x3 sort with respect to size and book-to-market

		Book-to-market		
		Low (30 %)	Medium (40 %)	High (30 %)
Size	Small (50%)	Small Growth	Small Neutral	Small Value
	Big (50%)	Big Growth	Big Neutral	Big Value

The size and value/growth portfolios are formed by performing a dependent 2x3 sort based on book-to-market and size (measured by market capitalization) of all the listed stocks on an exchange (see Table 4). Sorting is performed based on the reported characteristics for each stock at the end of June and the portfolios are held constant for one year during which the value-weighted return for each of the six portfolios is calculated on a monthly basis. The final factor returns for SMB and HML are based on these six portfolios and are calculated as (Fama & French 1993; Ødegaard 2016):

$$SMB = \frac{1}{3}(Small\,Value + Small\,Neutral + Small\,Growth) - \frac{1}{3}(Big\,Value + Big\,Neutral + Big\,Growth), \quad (30)$$

$$HML = \frac{1}{2}(Small\,Value + Big\,Value) - \frac{1}{2}(Small\,Growth + Big\,Growth). \quad (31)$$

The momentum factor is obtained by sorting stocks into three portfolios (30-40-30 split) based on the preceding 11-months performance, measured by average returns. The momentum return for month t is the equally-weighted difference between the yield of the high and low momentum portfolios. The momentum portfolios are, unlike the SMB and HML portfolios, recreated every month.

These resulting factor returns are compared to the ones' calculated by other researchers. Data is found for the Swedish market for the time period 11/1992 to 3/2013[1] and from 08/1987 to 12/2015 for the Norwegian market[2]. The correlation of the factor returns calculated here to these external returns are in the range of 0.5 to 0.8 for Sweden and Norway, which clearly indicates that these time-series are similar to a large degree. Still, there is a notable deviation of these factor returns, which can be traced back to minor differences in calculations, methods and sources of data. A more exhaustive comparison of these factor returns can be found in Appendix 3.

Descriptive statistics for the calculated factor returns can be found in Table 5. As expected, the majority of the returns are on average positive, the only exception being the average and median SMB return of Denmark. This is some initial evidence that the size anomaly is not prominent in the Danish market, an observation that will be confirmed later in this study. Interestingly, the momentum strategy provides the highest average return during the years of this sample with a volatility on par with the other factor returns. Finally, Table 6 presents correlations among the factor returns calculated for this thesis. Panel A contains correlations between the factors, for a given country, and panel B shows correlations between the countries, for a given factor. The factor returns

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[1] Stefano Marmi data library: http://homepage.sns.it/marmi/Data_Library.html#Sweden (accessed 8.6.2016)

[2] Bernt Ødegaard data library: http://finance.bi.no/~bernt/financial_data/index.html (accessed 8.6.2016)

within each country are to a large degree uncorrelated with each other and the largest correlation are found among the excess market returns (labeled MKT) measured against the other factors. The cross-country correlations are likewise low, except for the excess market returns. This is expected as this variable is not strictly exogenous since it depends on the global market economy.

Table 5 Factor return summary statistics

This table is contains descriptive statistics for the calculated factor returns for the time period 01.1997-03.2016. The data is reported on a monthly basis for all of the four factor returns utilized in this study. The last column in this table is a simple equally-weighted average across all countries.

	Market excess return (MKT)				
	Denmark	**Finland**	**Norway**	**Sweden**	**Nordic average**
Average return	0.0076	0.0058	0.0032	0.0066	0.0058
Median return	0.0142	0.0111	0.0098	0.0081	0.0108
Max	0.1826	0.2350	0.1512	0.2189	0.1969
Min	-0.2188	-0.2143	-0.3246	-0.1815	-0.2348
Volatility	0.0511	0.0601	0.0688	0.0552	0.0588
Skewness	-0.9755	-0.1845	-1.5807	-0.2429	-0.7459
Kurtosis	2.8125	1.5942	5.3106	1.6669	2.8461
	Small minus big (SMB)				
Average return	-0.0057	0.0016	0.0037	0.0052	0.0012
Median return	-0.0056	-0.0009	0.0017	0.0014	-0.0008
Max	0.1206	0.1723	0.1426	0.2247	0.1650
Min	-0.3697	-0.1401	-0.1576	-0.0948	-0.1905
Volatility	0.0452	0.0442	0.0421	0.0439	0.0439
Skewness	-2.1877	0.5633	0.2163	0.8772	-0.1327
Kurtosis	17.9554	2.4553	1.4261	2.5616	6.0996
	High minus low (HML)				
Average return	0.0077	0.0028	0.0042	0.0032	0.0045
Median return	0.0076	-0.0003	0.0051	0.0018	0.0036
Max	0.5596	0.3316	0.1503	0.2461	0.3219
Min	-0.1635	-0.1758	-0.2099	-0.2055	-0.1887
Volatility	0.0601	0.0631	0.0480	0.0525	0.0559
Skewness	3.4877	0.8739	-0.5330	-0.0112	0.9544
Kurtosis	31.0720	4.7291	2.7684	3.8655	10.6088
	Momentum (MOM)				
Average return	0.0768	0.0658	0.1025	0.0927	0.0845
Median return	0.0719	0.0598	0.0952	0.0841	0.0778
Max	0.3207	0.2963	0.3860	0.3178	0.3302
Min	-0.0526	-0.1197	-0.0551	-0.1538	-0.0953
Volatility	0.0490	0.0526	0.0720	0.0632	0.0592
Skewness	1.0741	0.9775	0.8785	0.8568	0.9468
Kurtosis	3.1752	3.5498	1.6236	2.5274	2.7190

Table 6 Correlation matrices

This table presents the correlation of the factor returns within each market (Panel A) and across each country (Panel B). MKT is the excess market return, which is also known as R_m-r_f. SMB, HML and MOM are the other factor returns that are described in this section and in Section 5.1. DEN, FIN, NOR and SWE are the abbreviations of respective countries.

Panel A: Correlation between factor returns, per country

Denmark

	MKT	SMB	HML	MOM
MKT	1.00			
SMB	-0.47	1.00		
HML	0.02	-0.50	1.00	
MOM	-0.40	0.21	-0.17	1.00

Finland

	MKT	SMB	HML	MOM
MKT	1.00			
SMB	-0.48	1.00		
HML	-0.26	0.12	1.00	
MOM	-0.24	0.15	0.09	1.00

Norway

	MKT	SMB	HML	MOM
MKT	1.00			
SMB	-0.31	1.00		
HML	-0.12	-0.14	1.00	
MOM	-0.35	-0.02	-0.14	1.00

Sweden

	MKT	SMB	HML	MOM
MKT	1.00			
SMB	-0.20	1.00		
HML	-0.31	-0.27	1.00	
MOM	-0.26	0.00	0.13	1.00

Panel B: Correlation between the country returns, per factor

MKT

	DEN	FIN	NOR	SWE
DEN	1.00			
FIN	0.77	1.00		
NOR	0.79	0.84	1.00	
SWE	0.80	0.75	0.79	1.00

SMB

	DEN	FIN	NOR	SWE
DEN	1.00			
FIN	0.28	1.00		
NOR	0.16	0.43	1.00	
SWE	0.31	0.37	0.40	1.00

HML

	DEN	FIN	NOR	SWE
DEN	1.00			
FIN	0.13	1.00		
NOR	0.28	0.48	1.00	
SWE	0.19	0.21	0.40	1.00

MOM

	DEN	FIN	NOR	SWE
DEN	1.00			
FIN	0.37	1.00		
NOR	0.44	0.58	1.00	
SWE	0.53	0.39	0.53	1.00

6 RESULTS

This chapter presents the results obtained from the bootstrap simulations and the operations performed with the dynamic alphas obtained from the Kalman filter for each of the markets included in this study. The first section of this chapter presents the outcome of a standard regression performed on individual funds and equally-weighted market portfolios. Additionally, the dynamic factor coefficients retrieved from the Kalman filter are presented for the markets. The second to fifth sections presents the evidence from the bootstrap procedure for each country separately in alphabetical order (coincidentally also ordered from the smallest to the largest market). The sixth section of this chapter contains the results for performance persistence as measured by the Kalman filter.

6.1 Market characteristics

Table 7 presents a summary of the average performance in the Nordic market as estimated by utilization of the factor models. Panel A contains the results when the CAPM is used as the benchmark model. In Panel B and Panel C the Fama & French 3-factor model and Carhart's 4-factor model are the utilized benchmarks. These results show that the average estimated monthly alphas decrease as more factor returns are added to the model. This effect is likely achieved by the multi-factor models' abilities to capture more of the trends in the data, which is evident by the rising adjusted R^2. By leaving less unexplained variation in the data, these models' estimate of the alpha can be assumed to be more precise. However, the BIC criterion, which strictly penalizes additional factors in the model selection, rejects the four-factor model for all countries. For Denmark, it also rejects the three factor model, indicating that the simple CAPM model best describes Danish mutual fund risk-adjusted returns.

Denmark is also the country with the highest average estimated alpha, with an annualized abnormal return of 2.7 %, 2.5 % or 1.0 % depending on the model. In general, there seems to be a negative relationship between abnormal return and market size, as the average estimated alpha decreases as one moves towards the right in the table. A similar relationship is found among the average return in Table 3 (descriptive statistics). This is an indicator of how effective each market are. More developed markets, such as Sweden, are characterized by high levels of competition which makes positive abnormal returns harder to achieve, while the younger markets of Denmark and Finland presents more lucrative opportunities for managers to take advantage of.

Table 7 Average mutual fund coefficients

This table presents the average of the estimated coefficients for each of the three factor models utilized. The alpha in the first row of each panel is interpreted as the monthly abnormal return for each market. The betas are the estimated slope coefficients for the factor returns reported in parenthesis. The second to last row in each panel contains the Bayesian information criterion for the selected model. The last row in each panel presents the percentage of mutual funds whose residuals did not lead to the rejection of the normality of errors, at a 5 % significance level, by the Jarque-Bera test.

Country	Denmark	Finland	Norway	Sweden
Panel A: CAPM				
Average alpha	0.0022	0.0017	0.0001	-0.0018
β_1 (R_m-r_f)	0.9970	1.0029	0.9174	0.9087
Adjusted R^2	0.9011	0.8710	0.8933	0.8764
BIC	-673.28	-604.77	-736.49	-667.55
Percentage normally distributed	55.32	71.43	58.10	62.66
Panel B: 3-factor model				
Average alpha	0.0021	0.0016	-0.0002	-0.0020
β_1 (R_m-r_f)	1.0110	1.0426	0.9339	0.9107
β_2 (SMB)	0.0158	0.1800	0.1068	0.0704
β_3 (HML)	-0.0105	-0.0237	-0.0222	-0.0367
Adjusted R^2	0.9087	0.9012	0.9075	0.8958
BIC	-672.29	-619.91	-745.35	-683.48
Percentage normally distributed	57.45	63.49	55.24	53.80
Panel C: 4-factor model				
Average alpha	0.0008	0.0004	-0.0001	-0.0030
β_1 (R_m-r_f)	1.0135	1.0442	0.9324	0.9102
β_2 (SMB)	0.0139	0.1757	0.1046	0.0727
β_3 (HML)	-0.0103	-0.0260	-0.0227	-0.0336
β_4 (MOM)	0.0161	0.0176	-0.0011	0.0121
Adjusted R^2	0.9104	0.9021	0.9105	0.8972
BIC	-669.15	-618.10	-742.42	-681.14
Percentage normally distributed	57.45	61.90	56.19	54.43

Interestingly, both Norwegian and Swedish mutual funds have a lower average market coefficient (β_1) which indicates that they are employing a low-risk strategy, while Denmark and Finland have a market beta close to one. All countries have a strong positive load on the size-factor (SMB) and a negative value-factor (HML) loading. The sign and general magnitude of these estimated coefficients are robust when estimated against the third party factor returns found for Sweden and Norway, which indicates that the factor returns calculated in this thesis are credible (or that any bias is small enough to be negligible).

The last row of each panel in Table 7 reports the percentage of mutual funds whose errors are normally distributed based on a Jarque-Bera test at a 5 % significance level. The expected value of this measure is 95 %, since 5 % of the cases may be rejected due to random sampling variation. However, the typical value is in the range of 55-65 %, indicating that little under half of the funds in this sample have non-normally distributed errors. This proves that the classical way of hypothesis testing is not valid for this sample, as normally distributed errors is an underlying assumption which may not be violated (Brooks 2008, p.44).

In Table 8, the coefficients are re-estimated using an equally-weighted portfolio consisting of all of the mutual funds in the sample, which allows for determining the significance of the estimates. Newey & West (1984) corrected errors are utilized since diagnostic tests on the residuals of the fitted models indicate a presence of autocorrelation and heteroscedasticity. Unsurprisingly, the magnitudes of the estimated coefficients in this table are almost equal to the average coefficients observed in Table 7. However, unlike this preceding table, additional information is obtained from the statistical tests on the estimates. The Danish equally-weighted portfolio, unlike the other three countries, has insignificant (under a null hypothesis of zero) SMB and HML loadings. This is further evidence that the mutual funds in this country do not take advantage of size and value anomalies, or that these do not exist in exploitable form. The CAPM is therefore the most suitable alternative (among those considered in this study) to explain the cross-section of returns for this market.

Similarly, the four-factor model can be rejected for all of the Nordic countries as it is not selected by the Bayesian information criterion nor is the estimate of the momentum factor coefficient significantly different from zero. By examining the results of Table 8 by respective countries' preferred factor model, the following annualized abnormal returns are found: 2.18 %, 2.06 %, 0.00 % and -2.49 % (sorted by the order of appearance in this table). However, only the Danish and Swedish alpha estimates are significant while the Norwegian and Finnish three-factor alpha estimates cannot be statistically distinguished from zero even at a 5 % confidence level. Furthermore, Jarque-Bera tests for normality of the errors reject the null hypothesis, which means that accurate inference regarding the significance of the alpha estimates is impossible based on these reported results alone. The results of the bootstrapping techniques in Section 7.2 - 7.5 are able to provide a more accurate overview of these markets.

Table 8 Equally-weighted portfolio coefficients

This table presents the estimated coefficients for an equally weighted portfolio of all mutual funds in each country. The stars (*) and (**) indicate statistical significance at 5 % and 1 %, respectively against a two sided test that the true coefficient is zero. The unreported standard errors are adjusted for heteroscedasticity and autocorrelation. The assumption of normality is rejected for all model errors.

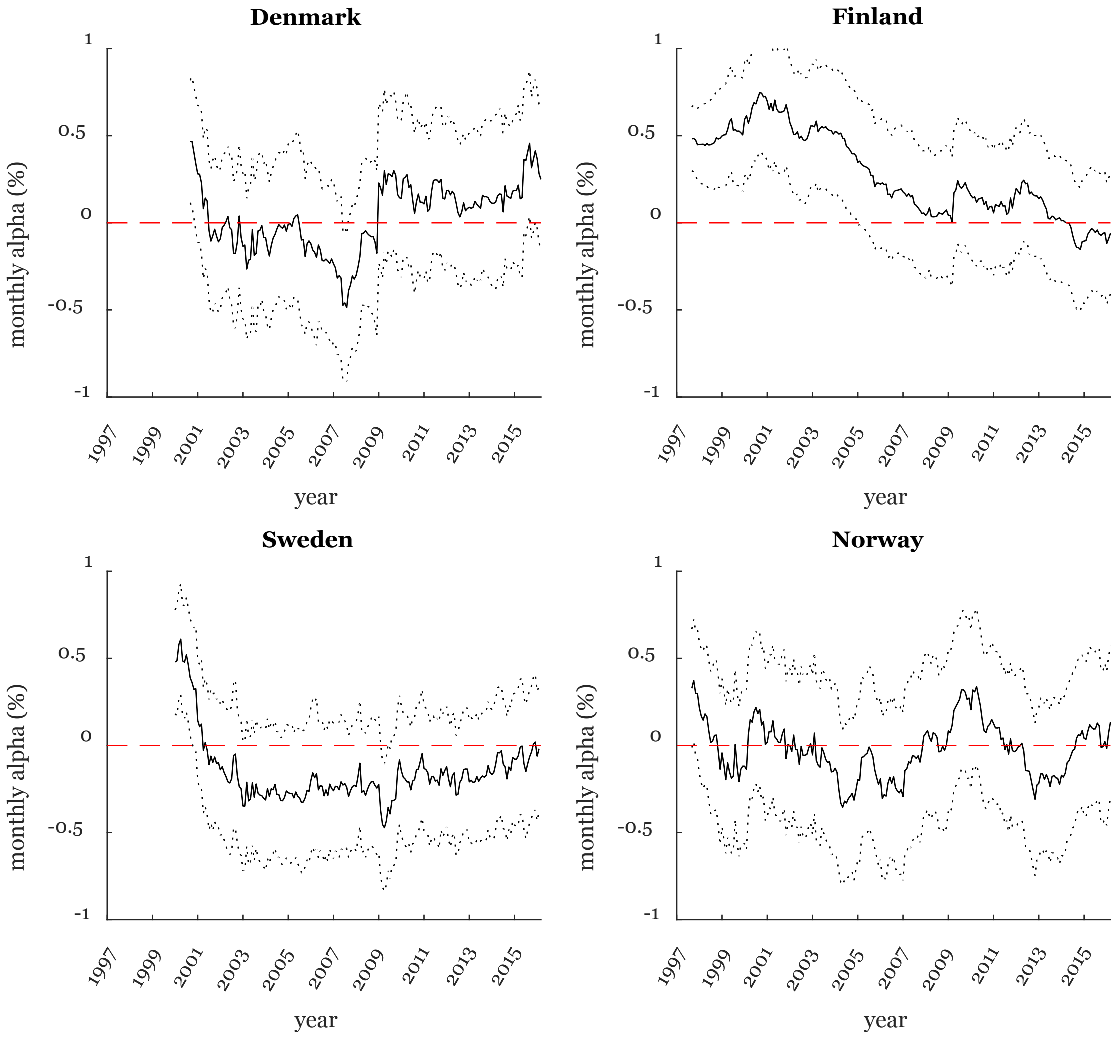
Country	Denmark	Finland	Norway	Sweden
		Panel A: CAPM		
Alpha	0.0018*	0.0020*	0.0003	-0.0019**
β_1 (R_m-r_f)	1.0015**	1.0010**	0.9236**	0.9156**
		Panel B: 3-factor model		
Alpha	0.0019**	0.0017	0.0000	-0.0021**
β_1 (R_m-r_f)	1.0071**	1.0338**	0.9433**	0.9083**
β_2 (SMB)	0.0117	0.1583**	0.1221**	0.0815**
β_3 (HML)	-0.0133	-0.0629**	-0.0416*	-0.0653**
		Panel C: 4-factor model		
Alpha	0.0004	0.0003	-0.0007	-0.0027**
β_1 (R_m-r_f)	1.0158**	1.0428**	0.9460**	0.9101**
β_2 (SMB)	0.0126	0.1571**	0.1240**	0.0821**
β_3 (HML)	-0.0110	-0.0635**	-0.0396*	-0.0656**
β_4 (MOM)	0.0185	0.0215	0.0060	0.0060

Figure 3 presents the dynamic (3-factor) alpha coefficients for the equally-weighted portfolios during the sample period for each country, as estimated by the Kalman filter. This figure presents some evidence of a prior outperformance of funds in Finland and in Sweden as the 95 % estimation error bands are above zero. The Danish and Norwegian estimated alphas are likewise initially positive, but quickly converge towards statistical insignificance.

There is some trace evidence of the findings of Flam & Vestman (2014) that Swedish mutual funds are on average beating the market up until 2001-2002. Unfortunately, the sample time period preceding these years is not sufficiently long to allow for more accurate conclusions. However, it is clear that the year 2001 presents a clear break in the Swedish market dynamics as the subsequent estimated alphas are clearly negative, although not significantly negative aside from a short period in 2009.

The Danish funds, while ranked as the best country by the OLS analysis, has a risk-adjusted performance indistinguishable from zero throughout the sample. There seem to be a break in performance around 2007-2009 after which estimated alphas are positive and towards the end of the sample nearly significant. The Finnish market on the other hand, exhibits an almost opposite reaction. The estimated three-factor alpha is positive and significant until the year 2006, and in the later years the estimate even becomes negative. These results are robust even when 1- and 4-factor models are utilized to generate the alpha estimates, which means that the dynamic alpha estimates for Denmark presented in Figure 3 are not greatly altered by being estimated by the 3-factor model.

Figure 3 3-factor alpha estimates with 95 % confidence interval



For completeness, the other four estimated dynamic factor coefficients for all markets are presented in Figure 4. The four factor model is utilized for this purpose, but unreported tests with the Kalman filter show that the estimated coefficients are not significantly altered by the inclusion of the extra variable. Due to space limitations, the error bands in this figure are selected according to the maximum (minimum) value observed among the four countries for each time point and yield the so-called envelope. Among these four subfigures the market beta is perhaps the most interesting as this might contain evidence of market timing behavior. This is indeed the case as both the Danish and Finnish mutual funds notably increase market risk exposure at the beginning of year 2009 probably expecting a bull market. In retrospect this was a wise decision as the early half of this year marked the end of the financial crisis of 2008 and the start of an upwards market. Similar attempts at market timing is found among the Finnish mutual funds in 2011 which marked the end of the euro debt crisis. Naturally, this is not infallible proof of market timing ability but it serves as an initial indicator worthy of a future in-depth investigation.

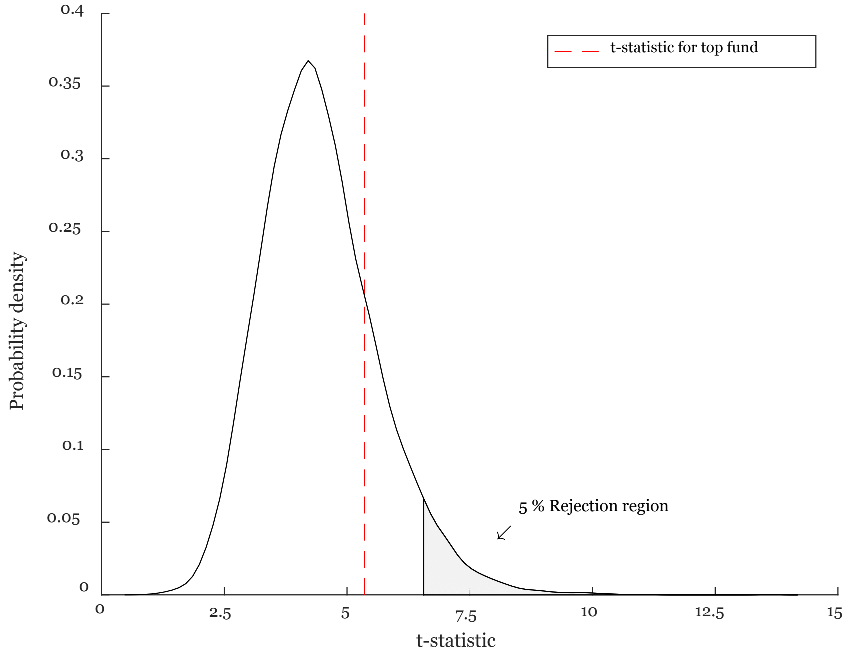
Figure 4 3-factor coefficient estimates with 95 % confidence interval envelope

6.2 Bootstrap evidence for Denmark

Table 9 contains the results from the 10000 simulation runs for each of the three models utilized with both bootstrap methods. The mutual funds in this sub-sample is ranked from the worst to the best according to the estimated alpha and then separately by the t-statistic of the alpha. In addition, the three worst (best) funds are separately reported along with the bottom (top) three deciles. The value %(Sim>Act) is reported for each the estimators. This value discloses how many of the simulated estimators exceed the initial estimate and can be interpreted as a p-value. A result is deemed positively significant if it has a positive estimator and a %(Sim>Act) value lower than 0.05 (corresponding to a 5 % significance level). What this essentially means is that among the 10000 bootstrap simulations only 5 % of the outcomes were ranked greater than the initial estimate. This indicates that the mutual fund manager associated with this simulated p-value is skilled as opposed to achieving a high alpha (or t-statistic) due to luck. In a similar manner, if the initial estimate is negative and the %(Sim>Act) value is greater than 0.95 the manager is assumed to possess bad skill. In other words, the result obtained by the manager cannot be explained by random chance alone (bad luck). Instead it is the manager's bad decisions, or the overcharging of fund fees, that are the drivers of bad returns (with a corresponding 5 % confidence level). Figure 5 illustrates how significance is determined based on an initial positive estimator (in this case the best Danish fund sorted on the t-statistic and based on the Fama & French 3-factor model and method). In this figure, the performance if this fund is deemed nonsignificant.

The outcome of the bootstrap simulations in Table 9 presents weak evidence of significantly positive returns among the Danish mutual funds. The Fama & French method finds no positive abnormal performance, but when funds are ranked based on the t-statistic of alpha, evidence of significantly bad performance is found among the 10 % worst ranked funds. This result is only found for the CAPM model (recall that this was the selected best fit model by the BIC). The Kosowski method on the other hand, is more prone to produce significant results due to its reliance on bootstrapped residuals only. In fact, evidence of positive outperformance is found up to the second decile, indicating that 80 % of all funds in the Danish market have genuine stock picking or market timing skill.

Figure 5 PDF of best Danish mutual fund sorted on the t-statistic



In summary, these two methods produce slightly different results raising the question of which of the outcomes are to be used. The Fama & French method is the obvious choice for two reasons. Firstly, this model is more strict, which is shown to be true not only for the Danish market, but also for the rest of the countries in this study. This is also the case in the two original papers; the Fama & French (2010) method produce less positive evidence than the Kosowski et al. (2006) method. The benefits of concentrating on the stricter method is that if evidence of positive (or negative) abnormal returns is found the conclusions are more robust. Secondly, the Fama & French method is superior over the other as more of the hidden relationships in the raw data is preserved in the jointly sampled bootstrap. Therefore, even though results are reported using the Kosowski method, the main focus should be shifted towards the Fama & French method in the results tables (Table 9-12). Likewise, even though results are shown using the raw alpha as the ranking method, the t-statistic is less prone to estimation error and should be regarded as more reliable.

Due to the limited use of the bootstrapping methods for the Danish funds, these results cannot be directly compared to the previous research. However, the findings of Christensen (2003, 2005 & 2013) can still be compared to these results, although his results are not taking the non-normality of alphas into account. Nevertheless, in his combined three studies no reliable evidence of significant positive performance is found which is also true for the sample in this thesis. The equally-weighted portfolio consisting of Danish funds has a significant abnormal return, but this result is more likely a statistical anomaly caused by the complex shape of the probability density of estimated alpha coefficients.

Table 9 Bootstrap results for the Danish market

The first row of each panel presents the estimated alpha for each group, the second and third row %(Sim>Act) presents the fraction of bootstrap outcomes greater than this value for the Fama&French (F&F) and Kosowski (Kos.) methods. In rows 4-6 this procedure is repeated with the t-stat of alpha. The first (and last) three columns contains the worst (best) funds in the ranking. The other columns contains the decile (dec) portfolios. Panel A presents results using the CAPM model, Panel B the results of the Fama&French 3-factor model and Panel C with the Carhart 4-factor model. Significant results (at 5%) are indicated by **bold** text.

decile/rank	Worst	2nd	3rd	1 dec	2 dec	3 dec	||	8 dec	9 dec	10 dec	3rd	2nd	Best
						Panel A: CAPM							
alpha	-0.007	-0.002	-0.002	-0.003	0.000	0.001		0.003	0.005	0.009	0.009	0.010	0.013
%(Sim>Act)(F&F)	0.768	0.623	0.680	0.707	0.770	0.839		0.972	0.987	0.972	0.979	0.988	0.980
%(Sim>Act)(Kos.)	0.729	0.140	0.126	0.536	0.000	**0.000**		**0.000**	**0.000**	**0.017**	**0.000**	**0.001**	**0.011**
t-stat	-2.760	-1.471	-1.329	-1.525	-0.177	0.488		2.325	2.584	3.680	3.182	4.249	5.101
%(Sim>Act)(F&F)	**0.992**	0.943	**0.954**	**0.956**	0.816	0.704		0.408	0.472	0.385	0.540	0.252	0.222
%(Sim>Act)(Kos.)	0.682	0.071	0.097	0.303	0.000	**0.000**		**0.000**	**0.000**	**0.008**	**0.000**	**0.000**	**0.003**
						Panel B: 3-factor model							
alpha	-0.004	-0.002	-0.001	-0.002	0.000	0.001		0.003	0.004	0.008	0.008	0.008	0.013
%(Sim>Act)(F&F)	0.535	0.583	0.631	0.626	0.749	0.835		0.976	0.992	0.989	0.992	0.996	0.987
%(Sim>Act)(Kos.)	0.215	0.077	0.019	0.180	0.000	**0.000**		**0.000**	**0.000**	**0.024**	**0.000**	**0.005**	**0.009**
t-stat	-1.382	-1.316	-1.119	-1.062	0.025	0.531		2.164	2.581	3.696	3.252	4.328	5.355
%(Sim>Act)(F&F)	0.850	0.921	0.926	0.885	0.746	0.677		0.472	0.478	0.394	0.521	0.243	0.202
%(Sim>Act)(Kos.)	0.007	0.026	0.022	0.032	**0.000**	**0.000**		**0.000**	**0.000**	**0.008**	**0.000**	**0.000**	**0.002**
						Panel C: 4-factor model							
alpha	-0.012	-0.006	-0.005	-0.006	-0.002	-0.001		0.002	0.004	0.009	0.009	0.011	0.011
%(Sim>Act)(F&F)	0.435	0.332	0.430	0.441	0.559	0.679		0.927	0.971	0.981	0.984	0.987	0.997
%(Sim>Act)(Kos.)	0.658	0.252	0.481	0.576	0.140	0.064		0.198	0.248	0.209	0.072	0.115	0.461
t-stat	-2.020	-1.523	-1.396	-1.454	-0.772	-0.462		0.836	1.265	1.694	1.585	1.698	2.048
%(Sim>Act)(F&F)	0.878	0.826	0.861	0.846	0.824	0.828		0.730	0.702	0.771	0.803	0.838	0.838
%(Sim>Act)(Kos.)	0.189	0.094	0.139	0.237	0.091	0.119		0.309	0.253	0.515	0.626	0.742	0.747

6.3 Bootstrap evidence for Finland

The results for the Finnish mutual funds are reported in Table 10. This table provides more evidence of the strictness of the Fama & French method as only one estimator is found to be significant, while the Kosowski method identifies plenty more. The only significant results from the preferred method is found for the best fund measured against the Carhart factors. This is weak evidence of managerial skill for this market. Consider a world where the true alpha of a mutual fund is always zero and the estimate of alpha is generated by a stochastic process. From an initial sample of 60 mutual funds 3 of these are expected to be significant at a 5 % level by random chance alone. These results only identify one significant fund and this is not robust across the different models, which severely questions the validity of this estimate.

The evidence of positive abnormal performance in the Finnish market is therefore weak. On the other hand, so is the evidence of negative and significant performance. Neither the Fama & French nor the Kosowski method identify any mutual funds in any of the models utilized that are either overcharging their customers or systematically make bad decisions. Therefore, the Finnish market seems to follow the model proposed by Berk and Green (2004), that abnormal returns are diminished due to competition until an equilibrium of a zero net alpha is achieved.

Table 10 Bootstrap results for the Finnish market

The first row of each panel presents the estimated alpha for each group, the second and third row %(Sim>Act) presents the fraction of bootstrap outcomes greater than this value for the Fama&French (F&F) and Kosowski (Kos.) methods. In rows 4-6 this procedure is repeated with the t-stat of alpha. The first (and last) three columns contains the worst (best) funds in the ranking. The other columns contains the decile (dec) portfolios. Panel A presents results using the CAPM model, Panel B the results of the Fama&French 3-factor model and Panel C with the Carhart 4-factor model. Significant results (at 5%) are indicated by **bold** text.

decile/rank	Worst	2nd	3rd	1 dec	2 dec	3 dec ||	8 dec	9 dec	10 dec	3rd	2nd	Best
						Panel A: CAPM						
alpha	-0.024	-0.007	-0.003	-0.007	-0.001	0.000	0.003	0.006	0.009	0.008	0.011	0.011
%(Sim>Act)(F&F)	0.074	0.008	0.010	0.114	0.337	0.591	0.871	0.828	0.874	0.931	0.878	0.957
%(Sim>Act)(Kos.)	0.907	0.654	0.133	0.785	0.028	0.000	**0.000**	**0.000**	0.132	0.054	0.082	0.446
t-stat	-2.185	-1.803	-1.578	-1.472	-0.396	0.221	1.862	2.287	2.844	2.784	2.912	3.821
%(Sim>Act)(F&F)	0.219	0.317	0.416	0.425	0.498	0.488	0.331	0.271	0.285	0.291	0.319	0.172
%(Sim>Act)(Kos.)	0.179	0.145	0.130	0.177	0.001	**0.000**	**0.000**	**0.000**	0.055	**0.007**	**0.036**	0.053
						Panel B: 3-factor model						
alpha	-0.018	-0.004	-0.004	-0.006	-0.002	0.000	0.003	0.005	0.010	0.010	0.011	0.013
%(Sim>Act)(F&F)	0.016	0.001	0.008	0.070	0.390	0.667	0.923	0.899	0.871	0.892	0.913	0.944
%(Sim>Act)(Kos.)	0.919	0.256	0.394	0.769	0.488	0.001	**0.000**	**0.000**	0.069	**0.002**	**0.026**	0.192
t-stat	-2.450	-2.078	-2.002	-1.880	-0.766	-0.055	2.040	2.390	3.166	3.086	3.088	4.754
%(Sim>Act)(F&F)	0.285	0.396	0.576	0.557	0.708	0.685	0.300	0.283	0.249	0.259	0.341	0.073
%(Sim>Act)(Kos.)	0.352	0.396	0.597	0.530	0.080	0.000	**0.000**	**0.000**	**0.032**	**0.001**	**0.020**	**0.014**
						Panel C: 4-factor model						
alpha	-0.010	-0.010	-0.005	-0.007	-0.003	-0.002	0.003	0.004	0.008	0.007	0.009	0.014
%(Sim>Act)(F&F)	0.004	0.022	0.028	0.085	0.376	0.618	0.918	0.950	0.978	0.990	0.991	0.994
%(Sim>Act)(Kos.)	0.257	0.612	0.162	0.500	0.634	0.828	0.092	0.144	0.347	0.480	0.453	0.462
t-stat	-1.776	-1.546	-1.500	-1.477	-1.060	-0.686	0.950	1.695	3.348	2.837	4.277	5.625
%(Sim>Act)(F&F)	0.197	0.316	0.485	0.501	0.796	0.828	0.698	0.527	0.197	0.354	0.060	**0.027**
%(Sim>Act)(Kos.)	0.022	0.026	0.070	0.167	0.398	0.441	0.114	**0.019**	**0.032**	**0.012**	**0.001**	**0.010**

6.4 Bootstrap evidence for Norway

Table 11 presents the results for the mutual funds in the Norwegian market. This table tells a similar story as the Finnish market, in that the Fama & French method is generally unable to identify any significant estimates. The only exception is when funds are sorted on the t-statistic and performance is measured by the 3-factor model. In this case, the 3rd worst fund and the second worst decile are found to be significantly underperforming at 5 %. No positive abnormal performance is found. On the other hand, when the Kosowski method is utilized there is slightly more evidence of positive risk-adjusted returns generated to investors. There is some evidence that the three best funds in the Norwegian economy are managed by skilled managers. Measured against the CAPM, the performance of the two best deciles is positive and significant, although the BIC selects the three-factor model as a better model for this market which makes this result less reliable.

Since there exits an alternative set of factor returns for Norway, a topic which was discussed in Section 5.1, the results in Table 11 are generated again to ensure that they do not arise due to bias in the calculated factor returns. Simulations are run with the exact setup as presented in this chapter and repeated with two different set of market returns: the one included in the online data library and the OSEFX (which is the mutual fund index utilized in this thesis). The results from this set of simulations, which is reported in compact form in Appendix 3, are to a large degree similar to the results presented in this section. However, this alternative dataset yields slightly more evidence of negative performance in the lowest deciles. Underperformance is found up to the 4th decile (measured with the Fama-French model against the 3-factor model and sorted on t-statistic), when the more representative OSEFX index is used to measure market returns. When this is replaced with the market returns obtained from the online data library 90 % of the mutual funds underperform significantly. However, this set of data represents a weighted average of the whole Oslo stock exchange which does not represent the set of assets that mutual funds can directly invest in (due to regulations). Nevertheless, the right hand side of Table 11 is not improved with the alternative data, which means that the conclusions regarding the general lack of positive skill among Norwegian mutual funds remain unaltered.

The results obtained from this subsection are directly comparable to those of Sørensen (2009), keeping in mind that his time period is 1982-2008. In his study he utilized the

Fama & French method with a 3-factor model to generate the zero-alpha distribution and yields a result table almost identical to Table 11. The only exception is that he is able to identify positive and significant performance for one fund whereas the results in thesis suggest that no Norwegian mutual funds managers possess significant skill. The top ranked fund in Sørensen's study is Warren Wicklund Norge, which is also included in the sample of this thesis, but it fails to exhibit outperformance in this study's results. The reason for this is that the ranking of the mutual funds for the comparison of simulated results is clouded by statistical uncertainty, making the exact ordering impossible to obtain. It is therefore likely that the top fund identified by Sørensen's study is not Warren Wicklund Norge, but rather some other fund. Another possible reason to the different outcome of the right hand side of the results table is that the superior performance of the top fund may be largely attributed to the time period preceding the time period of the sample in this thesis. Nevertheless, the large degree of similarity between this thesis and his study is a clear indication that the fund sample, factor returns and methodology is correctly implemented which gives more credibility to the conclusions obtained for the other Nordic markets.

The other Norwegian study that used a bootstrap to distinguish skill from luck is Gallefoss et al. (2015). That study is slightly different from the current one since they use daily data to measure risk-adjusted returns. As a result, the outcome is also different; the estimated alphas for the top and the bottom five funds are found to be significantly different from zero. However, it is stated that the Kosowski method is utilized in the generation of simulated alphas and t-statistics of alphas, which makes the outcome more comparable to the outcome presented in this section. It is additionally stated that the Fama & French method was also implemented, but that the results were basically the same. This is somewhat puzzling, as this chapter clearly shows that these two methods produce results that are to a large degree dissimilar.

Table 11 Bootstrap results for the Norwegian market

The first row of each panel presents the estimated alpha for each group, the second and third row %(Sim>Act) presents the fraction of bootstrap outcomes greater than this value for the Fama&French (F&F) and Kosowski (Kos.) methods. In rows 4-6 this procedure is repeated with the t-stat of alpha. The first (and last) three columns contains the worst (best) funds in the ranking. The other columns contains the decile (dec) portfolios. Panel A presents results using the CAPM model, Panel B the results of the Fama&French 3-factor model and Panel C with the Carhart 4-factor model. Significant results (at 5%) are indicated by **bold** text.

decile/rank	Worst	2nd	3rd	1 dec	2 dec	3 dec	||	8 dec	9 dec	10 dec	3rd	2nd	Best
Panel A: CAPM													
alpha	-0.011	-0.009	-0.009	-0.006	-0.002	-0.001		0.001	0.002	0.006	0.009	0.011	0.011
%(Sim>Act)(F&F)	0.149	0.242	0.356	0.370	0.519	0.653		0.861	0.924	0.911	0.870	0.874	0.935
%(Sim>Act)(Kos.)	0.938	**0.992**	**1.000**	0.925	0.842	0.631		0.131	0.150	0.086	**0.000**	**0.001**	0.051
t-stat	-2.588	-2.308	-2.032	-1.816	-1.332	-0.794		0.822	1.484	2.909	3.582	3.707	4.131
%(Sim>Act)(F&F)	0.746	0.812	0.798	0.803	0.930	0.885		0.616	0.474	0.238	0.123	0.159	0.191
%(Sim>Act)(Kos.)	0.401	0.497	0.425	0.586	0.893	0.719		0.250	**0.042**	**0.044**	**0.000**	**0.002**	**0.031**
Panel B: 3-factor model													
alpha	-0.011	-0.011	-0.009	-0.007	-0.002	-0.001		0.001	0.002	0.006	0.009	0.009	0.010
%(Sim>Act)(F&F)	0.143	0.302	0.344	0.409	0.546	0.695		0.902	0.952	0.950	0.907	0.937	0.970
%(Sim>Act)(Kos.)	**0.966**	**0.999**	**1.000**	**0.966**	0.924	0.849		0.348	0.198	0.092	**0.000**	**0.004**	0.067
t-stat	-3.584	-2.848	-2.769	-2.317	-1.440	-0.817		0.892	1.381	2.572	2.869	3.330	3.461
%(Sim>Act)(F&F)	0.929	0.937	**0.958**	0.916	**0.958**	0.906		0.628	0.579	0.393	0.373	0.301	0.417
%(Sim>Act)(Kos.)	0.903	0.894	**0.974**	0.845	**0.954**	0.755		0.141	0.107	0.101	**0.014**	**0.017**	0.139
Panel C: 4-factor model													
alpha	-0.007	-0.007	-0.007	-0.005	-0.003	-0.002		0.001	0.003	0.009	0.012	0.014	0.024
%(Sim>Act)(F&F)	0.007	0.021	0.045	0.122	0.358	0.558		0.847	0.907	0.925	0.930	0.932	0.763
%(Sim>Act)(Kos.)	0.056	0.131	0.319	0.467	0.619	0.888		0.967	0.619	0.143	**0.007**	**0.017**	**0.012**
t-stat	-2.505	-2.077	-1.971	-1.920	-1.178	-0.884		0.430	0.665	1.736	2.072	2.779	3.259
%(Sim>Act)(F&F)	0.508	0.589	0.684	0.768	0.835	0.851		0.726	0.778	0.644	0.658	0.499	0.445
%(Sim>Act)(Kos.)	0.275	0.198	0.287	0.632	0.669	0.846		0.963	0.990	0.565	0.594	0.167	0.242

6.5 Bootstrap evidence for Sweden

The last results from the simulations to be presented in this chapter is for the Swedish market and these can be found in Table 12. This table draws a grim picture of the Swedish mutual fund market as none of the two methods measured against any of the three factor models finds evidence of positive performance. On the other hand, there is plenty more evidence that mutual funds are bad, and significantly so. Depending on the measurement model utilized, up to 80-90 % of this market is characterized by significantly negative performance. The majority of the funds in Sweden are actively destroying the value of investors and only a small minority is barely able to recover their cost of operations. Although this result is extraordinary, it is not however, implausible.

In their original study, Fama & French (2010) find similar traits for the American mutual fund industry, namely that 50 % of the funds were beaten by the zero-alpha simulations. The results obtained here can also be compared to those of the study by Flam & Vestman (2014). In their study, they find that the performance of the first decile (consisting of 5 or 6 funds) is positive and significant at a 5% level for the time period 1993-2001. For the subsequent time period; 2002-2013, only one fund is found to exhibit positive performance, based on the bootstrapped results. At the other end of the ranking only the last decile of funds has significantly bad performance for this later time period, and the majority of the funds' estimated alphas are not significantly different from zero. However, this study is done with gross returns of mutual funds, whereas in this thesis, fund returns are measured on a net-of-cost basis. The combined conclusion of Flam & Vestman's (2014) study and this thesis is therefore that, gross of costs, evidence of abnormal returns is weak and once fund fees and costs are accounted for, no abnormal performance is left for the investors. Additionally, the average fund in the Swedish market is heavily limited by efficient markets and returns are as a consequence of this comparable to the general market return. The investors of these funds are then left with the average market return minus the expenses the mutual fund charges.

In order to verify that these results are not driven by inaccurate factor returns, the simulation are repeated with Stefano Marmi's dataset; utilizing both his proxy for market returns and the SIXPRX index. The results for 3-factor model is reported alongside the Norwegian results in Appendix 3. These complementing simulations do not alter the conclusions of this section, in contrast, the evidence against positive performance among Swedish mutual funds is strengthened.

Table 12 Bootstrap results for the Swedish market

The first row of each panel presents the estimated alpha for each group, the second and third row %(Sim>Act) presents the fraction of bootstrap outcomes greater than this value for the Fama&French (F&F) and Kosowski (Kos.) methods. In rows 4-6 this procedure is repeated with the t-stat of alpha. The first (and last) three columns contains the worst (best) funds in the ranking. The other columns contains the decile (dec) portfolios. Panel A presents results using the CAPM model, Panel B the results of the Fama&French 3-factor model and Panel C with the Carhart 4-factor model. Significant results (at 5%) are indicated by **bold** text.

decile/rank	Worst	2nd	3rd	1 dec	2 dec	3 dec ||	8 dec	9 dec	10 dec	3rd	2nd	Best
						Panel A: CAPM						
alpha	-0.010	-0.008	-0.007	-0.006	-0.004	-0.003	0.000	0.001	0.004	0.007	0.008	0.010
%(Sim>Act)(F&F)	0.311	0.378	0.504	0.717	0.945	**0.977**	0.996	0.997	0.994	0.994	0.991	0.985
%(Sim>Act)(Kos.)	0.872	**0.966**	**0.983**	0.925	**1.000**	**1.000**	1.000	0.975	0.221	0.051	0.052	0.130
t-stat	-6.983	-6.427	-6.141	-5.683	-4.373	-3.369	-0.137	0.510	1.615	2.215	2.216	3.398
%(Sim>Act)(F&F)	**0.999**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**0.997**	0.988	0.931	0.893	0.916	0.641
%(Sim>Act)(Kos.)	**0.995**	**1.000**	**1.000**	**0.999**	**1.000**	**1.000**	**1.000**	1.000	0.632	0.643	0.846	0.248
						Panel B: 3-factor model						
alpha	-0.012	-0.008	-0.007	-0.006	-0.004	-0.003	-0.001	0.000	0.003	0.004	0.005	0.009
%(Sim>Act)(F&F)	0.259	0.254	0.381	0.668	0.919	**0.961**	**0.998**	0.999	0.998	0.999	0.999	0.996
%(Sim>Act)(Kos.)	**0.958**	**0.974**	**0.977**	0.934	**1.000**	**1.000**	**1.000**	1.000	0.495	0.450	0.456	0.203
t-stat	-6.577	-6.343	-5.880	-5.302	-3.640	-3.106	-0.844	-0.053	1.091	1.464	1.806	2.645
%(Sim>Act)(F&F)	**0.996**	**0.999**	**1.000**	**0.999**	**1.000**	**1.000**	**1.000**	**0.999**	0.988	0.988	0.977	0.894
%(Sim>Act)(Kos.)	**0.989**	**1.000**	**1.000**	**0.998**	**1.000**	**1.000**	**1.000**	**1.000**	0.997	1.000	0.996	0.781
						Panel C: 4-factor model						
alpha	-0.020	-0.017	-0.014	-0.012	-0.007	-0.005	-0.001	0.001	0.004	0.006	0.007	0.009
%(Sim>Act)(F&F)	0.253	0.310	0.343	0.579	0.766	0.828	**0.980**	0.990	0.996	0.999	1.000	1.000
%(Sim>Act)(Kos.)	0.827	**0.950**	**0.959**	0.919	**1.000**	**1.000**	**1.000**	1.000	0.972	0.989	0.995	0.955
t-stat	-3.768	-3.560	-3.531	-2.974	-2.173	-1.764	-0.221	0.276	1.084	1.610	1.618	1.776
%(Sim>Act)(F&F)	0.937	**0.974**	**0.988**	**0.979**	**0.993**	**0.992**	**0.988**	0.981	0.971	0.977	0.990	0.994
%(Sim>Act)(Kos.)	0.799	**0.962**	**0.996**	0.943	**1.000**	**1.000**	**1.000**	1.000	0.998	1.000	1.000	1.000

6.6 Persistence

The contingency tables based on the persistence of performance rankings are presented in Figure 6 for the four different re-creation periods utilized. Panel A shows the outcome when the quintile portfolios are re-created on a monthly basis, Panel B when a three month period utilized, Panel C and Panel D contains the results of a semi-annual and annual re-creation period. As the first panel demonstrates, there is a high degree of persistence in the ranking of funds from one month to the next. Although it is not entirely possible to rule out that a large portion of this is caused by the high autocorrelation inherited from the random walk functional form assumed for the alphas. As the portfolio recreation period is increased to 3, 6 or 12 months the alphas have more time to adjust towards a fair value, which makes the subsequent panels (B to D) more reliable.

In panel B the outcome of rankings exhibits a more random spread, but extreme decreases or increases in performance rankings is nonetheless uncommon. With a 6 month evaluation interval, a large degree of the autocorrelated effects should be diminished. As Panel C of Figure 6 demonstrates, the ranking of funds are to a large degree preserved to the next 6 months formation period and the strongest persistence is found among the top and bottom quintiles. This is generally in line with previous research, that persistence is most prominent among the winners and losers. As the portfolio formation period is increased to 12 months, as shown in Panel D, the contingency of rankings approaches an even more random outcome. The exception of this is Denmark and Sweden, which still present strong preservation among the top and bottom quintiles while the Finnish and Norwegian mutual funds show no evidence of this.

In order to control for the autocorrelation issues mentioned earlier, the same procedure is repeated with a random coefficient transition model for the Kalman filter. This is likewise an autoregressive model, but the AR(1) constant is zero instead of one, as in the random walk model. The effect of this is that the estimated dynamic alpha is not dependent on the previous estimate which means that it can quickly react to changing performance and take on any value. However, the unreported outcome from this alternative set of results does not alter the conclusions drawn in this section. The contingency tables are to a very large degree similar to the ones reported here and any deviations can be explained by random sampling (estimation) variation. It is therefore justified to state that there is evidence of short term persistence in portfolio rankings.

Figure 6   Contigency tables

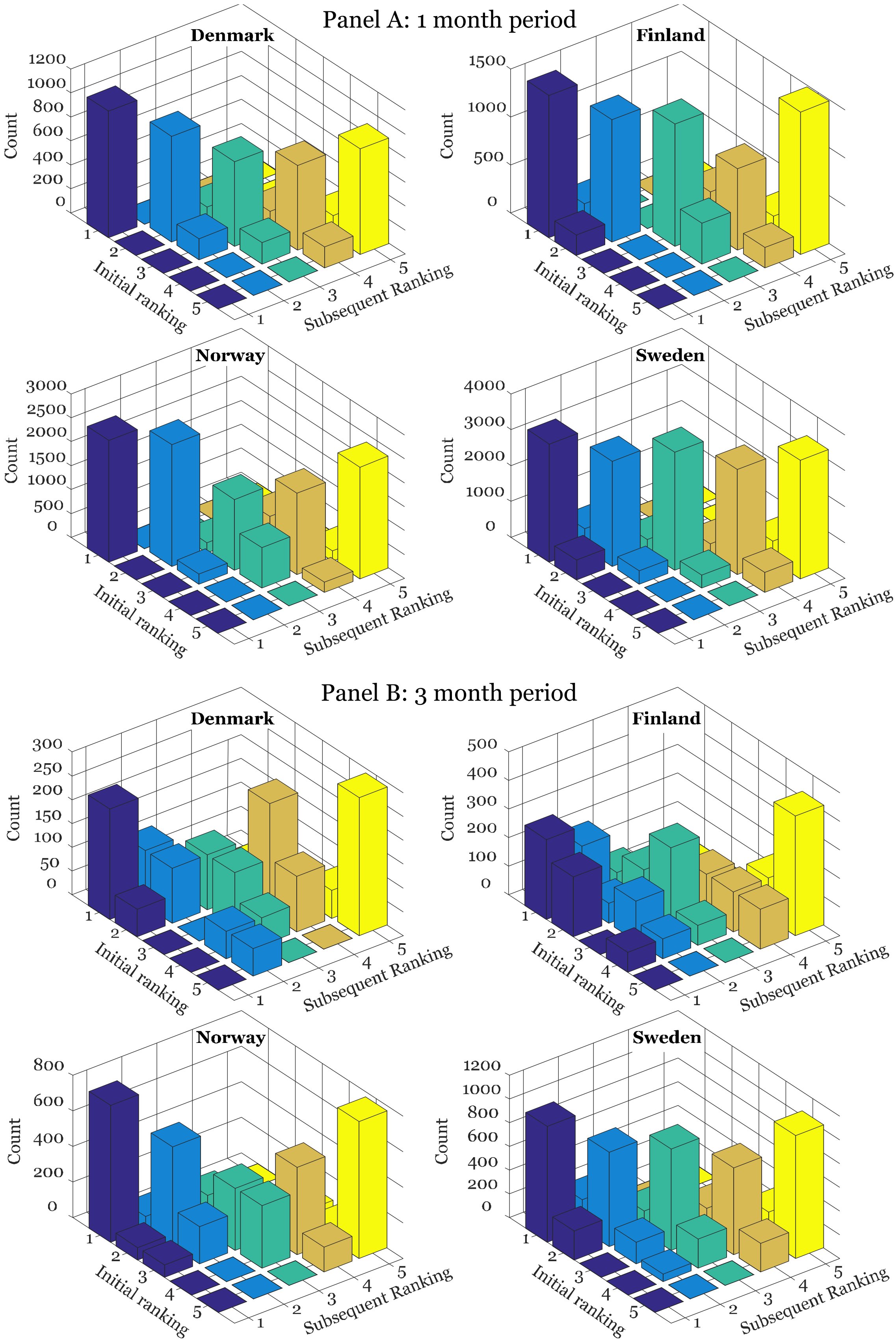
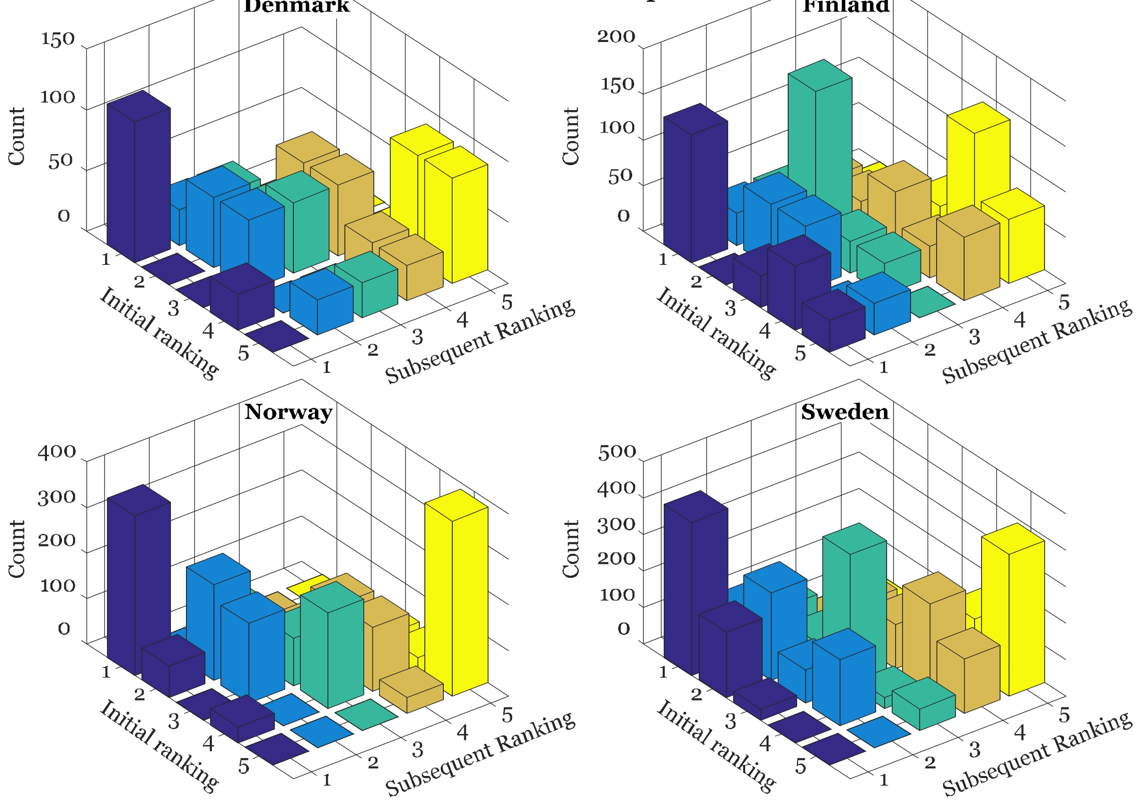
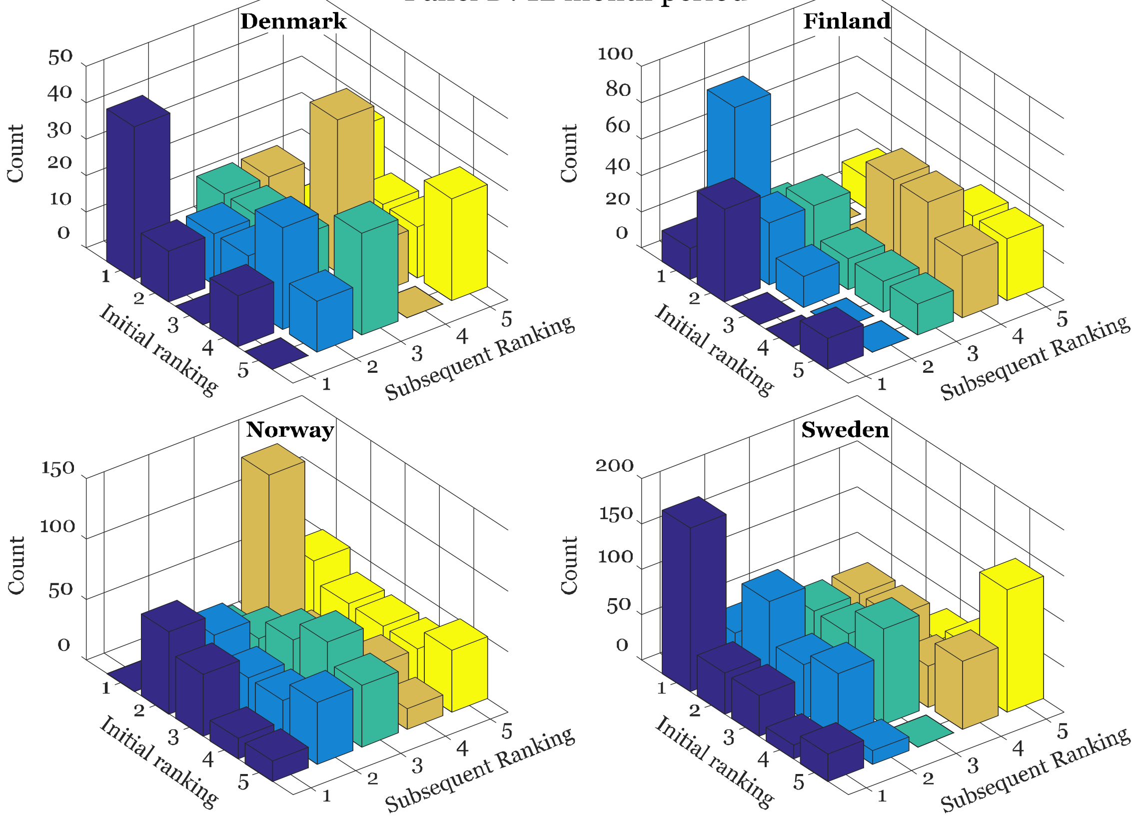


Figure 5 continued

Panel C: 6 month period



Panel D: 12 month period



Further evidence of persistence is reported in Table 13, where the significance of the next period returns is measured based on quintiles formed with the preceding year's performance. These five portfolios are formed in July each year to avoid seasonal effects which may cause bias in the next period returns. The significance of these returns are determined by a bootstrap which tests the two-sided hypothesis that risk-adjusted performance for a given quintile is zero.

This table suggests the existence of significant differences across the countries in this study. Danish and Finnish mutual funds are characterised by high levels of persistence in the top 40 % of annually ranked funds. This is evident by the positive and significant next period return which persists for 1, 3, 6 and even 12 months in the post-ranking period. While the Finnish market shows no signs of negative persistence, the last quintile of the Danish market is found to exhibit negative risk-adjusted returns in the month following the ranking.

Results for the Norwegian mutual funds present a different outcome. In this panel, the two worst quintiles presents negative and significant risk-adjusted returns for up to 12 months. On the other hand, there is also evidence of positive persistence among the best 20 % of mutual funds. In general, this market fits well within the universe of global recent research of mutual fund persistence, which broadly finds persistence in the top and bottom of the fund market.

As for the last country of this study, Swedish mutual funds show negative future performance for up to 80 % of the funds. Even if the best quintile presents a positive return for the subsequent months, this is diminished and becomes negative, and surprisingly, significant when this quintile portfolio is held for 12 months. This market shows clear evidence of reversion towards inferiority of mutual fund performance.

Table 13 Quintile portfolio risk-adjusted return persistence

Funds are in July each year, based on the previous 12 months of performance, ranked into five quintiles. The next 1, 3, 6 and 12 month's average returns are calculated and the two-sided p-values are obtained through bootstrapping for the null hypothesis that next-period returns are zero. Values significant at 5% are indicated by **bold** text.

	Denmark: 1-factor alpha				
	Quintile portfolio				
Holding period	Bottom 20 %	2	3	4	Top 20 %
1 month	**-0.0032**	0.0004	0.0008	**0.0033**	**0.0060**
	(0.007)	(0.714)	(0.435)	(0.034)	(0.004)
3 months	-0.0024	0.0000	0.0007	**0.0021**	**0.0048**
	(0.053)	(0.989)	(0.411)	(0.033)	(0.003)
6 months	-0.0016	0.0004	0.0010	**0.0021**	**0.0049**
	(0.222)	(0.605)	(0.279)	(0.022)	(0.003)
12 months	-0.0010	0.0006	0.0010	**0.0020**	**0.0037**
	(0.296)	(0.345)	(0.195)	(0.004)	(0.001)
	Finland: 3-factor alpha				
	Quintile portfolio				
Holding period	Bottom 20 %	2	3	4	Top 20 %
1 month	0.0008	0.0006	**0.0027**	**0.0021**	**0.0037**
	(0.430)	(0.432)	(0.026)	(0.018)	(0.003)
3 months	-0.0012	-0.0001	0.0015	**0.0027**	**0.0043**
	(0.202)	(0.914)	(0.214)	(0.032)	(0.009)
6 months	0.0004	0.0010	**0.0032**	**0.0029**	**0.0049**
	(0.741)	(0.299)	(0.014)	(0.002)	(0.000)
12 months	0.0008	0.0006	**0.0027**	**0.0021**	**0.0037**
	(0.425)	(0.432)	(0.022)	(0.017)	(0.003)
	Norway: 3-factor alpha				
	Quintile portfolio				
Holding period	Bottom 20 %	2	3	4	Top 20 %
1 month	**-0.0051**	**-0.0018**	0.0000	0.0002	**0.0030**
	(0.000)	(0.007)	(1.000)	(0.813)	(0.000)
3 months	**-0.0040**	**-0.0011**	0.0000	0.0012	**0.0029**
	(0.001)	(0.050)	(1.000)	(0.081)	(0.000)
6 months	**-0.0030**	-0.0005	0.0000	0.0011	**0.0021**
	(0.006)	(0.359)	(0.968)	(0.060)	(0.006)
12 months	**-0.0023**	-0.0007	-0.0002	0.0001	0.0008
	(0.020)	(0.214)	(0.579)	(0.835)	(0.255)
	Sweden: 3-factor alpha				
	Quintile portfolio				
Holding period	Bottom 20 %	2	3	4	Top 20 %
1 month	**-0.0038**	**-0.0027**	**-0.0015**	0.0001	**0.0025**
	(0.000)	(0.000)	(0.027)	(0.919)	(0.007)
3 months	**-0.0042**	**-0.0029**	**-0.0022**	**-0.0012**	0.0007
	(0.000)	(0.000)	(0.000)	(0.046)	(0.307)
6 months	**-0.0044**	**-0.0028**	**-0.0024**	**-0.0018**	-0.0005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.383)
12 months	**-0.0040**	**-0.0027**	**-0.0023**	**-0.0019**	**-0.0011**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.028)

Regression-based evidence of persistence is presented in Table 14, where the performance measure (estimate of alpha) is regressed on its lagged values in Fama & MacBeth regressions. Results are given for all factor models for periods from 1 months up 2 two years. The regressor and regressand variable periods are symmetrical, which for example means that the 18 month average performance is regressed on the previous lagged 18 months. The regression equation (Equation 28) includes both an intercept and a slope coefficient. However, the former of these two are generally not statistically significant and is thus of no interest to this study. The estimated slope coefficient, $\hat{\gamma}_1$, has a more intuitive meaning and is interpreted as the fraction of performance carried over from one period to the next. As is evident from the general trend in Table 14, almost all estimates are statistically different from zero, which means that the previous period's return has some predictive power for the next. However, the statistical significance of the estimate is of lesser importance for this method. Instead, the magnitude of the slope coefficient is more closely scrutinized as this carries greater economic significance. If the estimated slope coefficient is greater than 0.5, there exists (on a theoretical level) an exploitable trading strategy of buying (or short selling) mutual funds based on the preceding period's performance. If the coefficient is lower than 0.5, then the odds are stacked against the investor and the given strategy becomes less attractive.

While the method that generated the results of Table 14 is able to aid to identify performance persistence in each market, it does not distinguish between positive and negative persistence. It is possible that the persistence found in the Nordic and especially the Swedish market is driven mainly by the sub-par performance of the worst mutual funds. On the other hand, Denmark which generally has positive risk-adjusted returns is perhaps more likely to be characterized by positive persistence. The results in Table 13 is better suited for investigating the sign of persistence while those in Table 14 tell more about the market in general.

As for the actual results in this table, it can be reported that the preferred model for Denmark, which is the capital asset pricing model, finds evidence of significant persistence for one and a half years. Moreover, the estimated coefficient is in the region of 0.5, which as discussed earlier in this section is advantageous to investors. Unreported auxiliary statistical tests on this estimated coefficient finds that γ_1 is for Denmark statistically greater than 0.5 for up to three months.

The results for Finland, Norway and Sweden, based on the model selected by the information criterion, are largely similar. About 75 % of risk-adjusted performance is carried over to next month which serves as strong evidence for short-term persistence. When this time period is extended to three months, 60-70 % of performance persists. Statistical tests confirm that this is significantly different from 50 % for Finnish and Norwegian mutual funds. However, for the Swedish funds the hypothesis that true three months persistence factor is 0.5 can no longer be rejected. In general, the strength of the estimated coefficient is for these three countries related to the age and size of the stock market with Sweden dominating the lower end.

What is remarkable is the high level of market persistence in these countries. If the random walk model for securities, which states that an assets performance is truly random, would hold for this market then there would be no predictive power in past returns and the slope coefficient estimates would be insignificant. The findings in this section indicate otherwise although the magnitude of the predictive power fades drastically after three months.

To summarize the findings of this chapter, there is generally little evidence of managerial outperformance and only weak evidence of performance persistence. The Danish mutual funds are seemingly the best according to the regression performed on the equally-weighted portfolios. However, this result is likely to be obtained due to the misspecified form of the probability density function as the bootstrapping methods finds little or no evidence of outperformance. On the other hand, the Swedish underperformance from the regression is confirmed by the bootstrap as the majority of the funds are not even able to recover the extra costs charged.

Table 14 Fama-Macbeth regressions on past performance

This table presents the results for the slope coefficient (γ_1) from the following regression equation: $perf_t = \gamma_0 + \gamma_1 perf_{t-1} + \varepsilon$. The 1, 3, 6, 12, 18 and 24 month time periods utilized in the subscript t is shown in the column header of each column. The factor model utilized is disclosed in the first column of each row (1: CAPM, 3: Fama&French, 4: Carhart). The dependent variable is estimated alpha intercepts obtained from a Kalman filter and is not adjusted for error-in-variable effects. The t-statistic is presented in parenthesis and is adjusted for autocorrelation and heteroscedasticity. One (*) and two (**) stars indicates 5 % and 1 % statistical significance, respectively, measured against a two-sided test with the null hypothesis of $h_0: \gamma_1 = 0$.

	Denmark					
	Period t (months)					
Factors	1	3	6	12	18	24
1	0.7023** (23.38)	0.7486** (31.13)	0.5329** (8.14)	0.4848** (6.72)	0.5018** (7.76)	-0.1532 (-4.46)
3	0.6985** (30.26)	0.7034** (51.00)	0.4911** (13.04)	0.2765** (4.80)	0.3045** (5.54)	-0.1267 (-3.48)
4	0.7339** (42.95)	0.7167** (37.52)	0.6063** (20.21)	0.2999** (5.71)	0.2465** (7.53)	-0.1020 (-2.45)
	Finland					
	Period t (months)					
Factors	1	3	6	12	18	24
1	0.7741** (17.55)	0.7004** (40.46)	0.3307** (5.34)	0.2841** (30.65)	0.2602** (21.71)	0.0518 (2.96)
3	0.7563** (17.98)	0.7071** (42.27)	0.4588** (13.51)	0.3518** (29.44)	0.2191** (9.89)	0.2492** (16.05)
4	0.7760** (21.69)	0.7298** (32.70)	0.5256** (15.84)	0.4451** (23.41)	0.3676** (21.99)	0.3273** (23.83)
	Norway					
	Period t (months)					
Factors	1	3	6	12	18	24
1	0.7833** (41.62)	0.6507** (66.70)	0.5660** (32.05)	0.2310** (8.80)	0.2335** (7.59)	-0.0887 (-5.65)
3	0.7800** (44.82)	0.6515** (46.15)	0.5100** (42.63)	0.2625** (7.05)	0.2403** (11.44)	0.0962** (11.80)
4	0.8086** (83.91)	0.6752** (92.92)	0.5013** (44.25)	0.2064** (12.86)	0.1749** (5.88)	0.0971** (10.42)
	Sweden					
	Period t (months)					
Factors	1	3	6	12	18	24
1	0.7357** (18.79)	0.6135** (15.81)	0.3338** (16.67)	0.3267** (7.69)	0.1905** (7.58)	0.2637** (11.25)
3	0.7261** (18.66)	0.5948** (12.38)	0.3799** (13.31)	0.3570** (8.77)	0.2340** (11.69)	0.1907** (10.86)
4	0.7713** (39.05)	0.6650** (29.40)	0.4989** (33.80)	0.4511** (8.93)	0.4149** (29.93)	0.3263** (20.93)

7 DISCUSSION

This chapter summarizes the findings reported in this study and the economic impact of these results is commented on. The first section covers the accuracy and unbiasedness of the factor returns as it is important to first assess the correctness of the benchmarks before focus can be shifted towards the main results. It also contains a brief discussion of the ability of the utilized factor models to describe the sources of returns in the context of Nordic mutual funds. The section following this, identifies the other potential sources of problems with methodology and data that has been overlooked in this study, while the last section discusses the main results.

7.1 Factor returns

Concerns were raised in the data chapter (Section 5.1) about the reliability of the older firm characteristics data (utilized for constructing 3- and 4-factor returns) from Datastream due to missing observations and other similar quality issues. However, the results obtained in this study has been repeated with alternative factor returns whenever possible, courtesy of the 3rd party data available for Sweden and Norway. These sets of alternative results have not altered the conclusions drawn from the original results which makes it possible to state with high confidence that any bias in the factor returns is small enough to be ignored. This is only confirmed for the Swedish and Norwegian dataset, but since the data sources are similarly obtained and the calculation methods are identical across all four countries, it can be generalized to hold throughout the sample.

The four factor model, which incorporates a factor capturing the momentum effect of stock returns, is generally found to be unable to raise the explanatory power of the model compared to the 3-factor model (measured with adjusted R^2) and is likewise not chosen by the BIC. Additionally, the momentum factor coefficient estimate is found to be nonsignificant when the model is regressed against equally-weighted portfolios and the average momentum coefficient across all funds is close to zero. There are two possible explanations for the failure of the 4-factor model: the momentum anomaly might not be prominent in the Nordic countries or the methodology for calculating this factor return is suboptimal. As a remark to the latter, there exists another widely-adopted approach for measuring momentum, which is the WML (winners minus losers). This differs from the MOM factor in the sense that it is created from a portfolio sorted on market capitalization and previous performance as opposed to just the latter.

In addition to these issues, the construction of the SMB, HML and MOM factors is dependent on the investors' ability to engage in short selling. This is however off-limits for the majority of the mutual fund managers due to regulations. Therefore, these additional factors do not accurately represent the universe of investable securities, unlike the market return factor (MKT), which in this study is explicitly selected with mutual funds in mind. The impact of this minor flaw of the 3- and 4-factor model is likely to be very small. The market factor is the main driver for explaining the sources of fund returns (the R^2 measure). The additional factors mainly aid in controlling for size, value or momentum exposure which are the easy sources of returns not attributed to managerial skill. In addition, the R^2 and adjusted R^2 measures are in all cases very high (at least over 0.85; see Table 7), which means that the utilization of these factors is justified.

Recently, the five factor model was introduced (Fama & French 2015), which is able to capture more of the unexplained variation in market returns. However, it is unlikely that this model would have been chosen as the best model by the BIC due to the high number of factors, and it is therefore not considered in this study. Additionally, the data required for the five factor model, such as historical investments and profitability based on numbers from annual reports, is missing for the majority of the stocks in the earlier period of the sample. This would likely introduce a noticeable bias in these extended factors. Additionally, it is deemed important to keep the model coefficients to a minimum as this ensures greater probability of finding the local maximum in the Kalman filter model.

7.2 Other issues

In general, the underlying assumption of the statistical methods has not been violated or alternatively, has been corrected for. The non-normality of mutual fund's alpha estimates has been rectified by the bootstrapped distribution which is a more efficient estimate than the normal- or student's t-distributions. The heteroscedastic and autocorrelated behaviour of financial time series has been accounted for with the Newey & West (1987) standard errors, wherever applicable. Essentially this means that the results obtained are more robust and less prone to statistical bias. However, there is one case for which no workaround exist.

The measurement model of the Kalman filter assumes that the model errors (in essence, the errors from a factor model) are drawn from a normal distribution. As previously stated in this study, the cross-sectional alpha estimates are not normal. While the probability density function of the dynamic time-series alpha estimates are not known, it can reasonably be assumed that these exhibit similar non-normality traits. It is therefore possible that a minor bias is introduced to the Kalman filter estimates of the dynamic factor coefficients. The severity of this is unknown, but it is unlikely to cause any major deviations to the conclusions drawn in this thesis.

7.3 Results

The results based on the bootstrapped probability distribution of alpha estimates (or t-statistics of alpha estimates) clearly indicate that there is no evidence of positive risk-adjusted performance among any of the mutual funds in the Nordic countries. These results are obtained with an investment opportunity set that generally reflects that which is available for mutual fund managers. When this is repeated with the more established value-weighted all share market indexes, the evidence of abnormal performance is even weaker. The implications of this is that there is no added value in active portfolio management, net of costs, either because the markets are too efficient or because the extra value gained is offset by the extra cost incurred. For the Finnish market this is not a strictly negative issue, as there is likewise no evidence of significant risk-adjusted underperformance. The investors in this market can freely choose among funds as the active managers will, on an after-cost basis, yield a return statistically comparable to a passive index fund. This is useful knowledge as the number of index funds is low and most of these track the general market index. Additional utility is gained for investors as they benefit from the opportunity to invest in an active fund that tracks a different index, for example small-cap stocks.

Similar conclusions can be drawn for the Danish and Norwegian market, but it must be noted that there is a real chance of selecting an underperforming manager, since the performance of the bottom decile of funds is shown to be significantly bad. However, the selection of the right fund to invest in is alleviated, as it is also shown that performance will persists for up to one year. This makes it possible to identify the underperforming funds and therefore avoid the bad managers. There is also an option to allocate capital to the current winner funds and enjoy the benefits of abnormal performance for up to one year, after which the returns revert to the mean.

In Sweden the situation is significantly more severe, as the majority of the mutual funds will not even regain the extra fees charged for active management and instead consistently underperform. The value invested in these funds is being actively destroyed by the managers and the investor is better off by allocating the capital to low-cost passive index funds. It is most likely not a deliberate strategy of these managers to destroy the value of investors, but the high degree of national and international competition for attractive investment opportunities makes the market highly price-efficient. The implication of this is that capital expended on acquiring information is lost as the costs overshadow the gains.

There is an additional trend in the data which further limits the opportunity of investors to select good actively-managed funds in the future. This trend is that market efficiency is seemingly correlated with the size of the stock market. The Danish and Finnish market, which provide less evidence of significant underperformers, are roughly the same size (measured by the average number of daily trades; Nasdaq Inc. 2016). The Norwegian market, whose average estimated alpha and level of persistence is lower and has a larger fraction of underperforming funds, is by the same metric a slightly larger market (Oslo Børs 2016). The Swedish market, which is more than twice the size of the rest is also clearly the most underperforming market. It would be naïve to assume that markets will progress towards less efficiency in the future, so it is likely that the fraction of underperforming mutual funds will be even greater in the upcoming years. There is also an indication of a weak downwards trend among the estimated dynamic alpha coefficients, which was presented in Figure 3. It is also clear from the international studies that actively-managed funds are not justified in charging extra fees which raises the question why these exist and are still popular.

Finally, this study helps to solve the puzzle which was pointed out in Section 3.2 concerning the performance of Danish mutual funds. The studies by Christensen (2003, 2005 & 2013) find that these funds are underperforming the market while the international studies by Ferreira et al (2012) and Vidal-García et al. (2016) rank Denmark among the best countries based on mutual fund performance. This thesis shows that, based on the equally-weighted portfolio, Danish mutual funds have a positive and significant estimated alpha. On the other hand, evidence of outperformance is not found when the non-normality of alpha distribution is taken into account. The stance taken by this thesis is therefore in the middle-ground of these other studies; Danish mutual funds are on average neither bad nor exceptionally good.

8 CONCLUSIONS

This thesis investigated the performance and the performance persistence of mutual funds in the Nordic countries. The metric for measuring performance, which is the alpha intercept estimate obtained from regressions of fund returns against factor returns, is shown to be non-normally distributed for 35 – 45 % of the individual funds. In order to get a better approximation of the distribution of the alpha estimates, the bootstrapping methods are implemented. The results obtained from these show only very weak evidence of positive abnormal performance. The Fama & French method, which is stricter and is able to capture more of the hidden relationships in the data, presents even less evidence. On the other hand, the results indicate that the performance of some mutual funds are significantly bad. Up to 80 % of the Swedish market it characterized by underperformance and in the Danish and Norwegian markets this figure is limited to 10-20 % of the worst funds. For the Finnish market, no evidence of significant and negative abnormal performance is found.

Strong evidence of persistence is found for all countries for periods up to three months and weaker evidence is found for up to 18 months. This is found among both the outperforming and the underperforming funds, but in Sweden these results are most likely driven by the underperformers. This thesis also finds initial evidence of a correlation between performance and stock market size. The largest market, Sweden, has the highest fraction of negative risk-adjusted returns while the smaller markets of Finland and Denmark significantly less so. It is speculated that the Nordic stock markets will progress towards higher levels of market efficiency, which will make mutual fund outperformance even rarer in the future. The individual investors of these markets are therefore better off by investing their capital in passive index funds, as it is shown that active management provides no extra value.

9 ABBREVIATIONS

Act	Actual
AR	Autoregressive
BIC	Bayesian information criterion
CAPM	Capital asset pricing model
CIBOR	Copenhagen interbank offered rate
dec	Decile
EURIBOR	Euro interbank offered rate
HELIBOR	Helsinki interbank offered rate
HML	High minus low
MKT	Excess market return
MOM	Momentum
NAV	Net asset value
NIBOR	Norway interbank offered rate
OMXCCAPHI	OMX Copenhagen capped growth index
OMXHCAPGI	OMX Helsinki capped growth index
OLS	Ordinary least squares
OSEFX	Oslo stock exchange mutual fund index
PDF	Probability density function
Sim	Simulated
SIXPRX	SIX Portfolio return index
SMB	Small minus big
STIBOR	Stockholm interbank offered rate
t-stat	t-statistic
UCITS	Undertakings for the collective investment of transferable securities

SVENSK SAMMANFATTNING

Investeringar i fonder är idag ett utbrett fenomen i de nordiska länderna i och med att dessa erbjuder kunden möjligheten att enkelt placera kapital i en bred aktieportfölj för vilken investeringsbeslut tas av en insatt tredje part. Fonder som investeringsobjekt har existerat i Norden sedan de först introducerades i Danmark år 1956 (Bechmann & Rangsvid 2007). Två år senare dök den första fonden upp på den svenska marknaden (Pettterson, Helgesson & Hård af Segerstad 2009) följt av Norge år 1982 (Gjerde & Sættem 1991) och till sist Finland år 1987 (Korkeamäki & Smythe 2004). Merparten av fonderna är idag aktivt förvaltade, vilket innebär att de genom en aktiv investeringsstrategi eftersträvar att producera en avkastning som överstiger referensindexet.

Huruvida fondernas förvaltare lyckats med detta är en forskningsfråga som har fått mycket uppmärksamhet inom den finansiella forskningen under de senaste 50 åren. Generellt har tidigare studier inom detta ämne funnit att majoriteten av de aktivt förvaltade fonderna inte har åstadkommit ett resultat som varit nämnvärt bättre än passivt förvaltade fonder. På senare tid har dock nya statistiska metoder utvecklats, med vilkas hjälp fonders prestation kan utvärderas mer precist. Detta motiverar att ämnet tas upp för granskning på nytt. Traditionellt har fondförvaltarens förmåga att skapa mervärde för kunderna utvärderats genom att analysera förtecknet samt den statistiska signifikansen av alfakoefficienten som erhålls från en faktormodell. Som illustrativt exempel används här kapitalmarknadsmodellen (CAPM; capital asset pricing model), där termen för den riskfria räntan är flyttad över till ekvationens vänstra sida:

$$R_{i,t} - r_{f,t} = \alpha_i + \beta_{i,1}\left(R_{m,t} - r_{f,t}\right) + \varepsilon_{i,t}. \qquad (1)$$

I denna ekvation är $R_{i,t}$ fond i:s avkastning för tid t, $r_{f,t}$ är den riskfria räntan, $R_{m,t}$ är marknadens avkastning och α_i samt $\beta_{,1}$ är regressionskoefficienter. Ifall ekvation 1 antas kunna fullständigt beskriva tvärsnittet av fonders avkastning på marknaden så borde konstanten α_i inte vara statistiskt oskiljbar från noll. Om denna däremot skiljer sig från noll så är detta bevis för att fondförvaltaren innehar förmågan att skapa mervärde åt kunden (alternativt förstöra värde ifall den estimerade koefficienten är signifikant och negativ).

Ett problem uppstår dock när signifikansen av den estimerade variabeln undersöks, i och med att en stor del av fondernas alfa-estimat inte är normalfördelade (Kosowski et al.

2006) vilket leder till att slutsatserna blir felaktiga ifall detta inte beaktas. För att undvika detta problem applicerar denna studie Kosowski et al. (2006) samt Fama & Frenchs (2010) statistiska bootstrap-teknik vars syfte är att estimera den underliggande sannolikhetsfördelningen med hjälp av tvärsnittet av alla fonder på marknaden. Det andra huvudtemat i denna studie är hur länge en fonds över- eller underprestation kan förväntas fortgå, givet att denna kan identifieras överhuvudtaget. Detta utförs genom att fondernas dynamiska faktorkoefficienter estimeras med hjälp av ett Kalman-filter.

Syfte

Syftet med denna studie är att undersöka ifall det finns bevis för överprestation bland de nordiska fonderna samt hur uthållig denna förväntas vara.

Avgränsningar

Studien avgränsar sig till de nordiska länderna från vilka Island har exkluderats på grund av bristfälliga data. Tidsperioden är 1997-2016 och frekvensen för observationer av fonders avkastning begränsas till månatlig avkastning.

Kontribution

Studien bidrar genom att de två bootstrap-teknikerna appliceras på data från finska och danska fonder, vilket inte gjorts tidigare. För de norska och svenska fonderna är kontributionen snarast att skapa mer bevis för eventuell över- eller underprestation i och med att tidsperioden, frekvensen och eventuellt datakällorna skiljer sig något från de tre studier som tidigare har applicerat samma metoder. Dessutom jämförs ländernas resultat med varandra vilket kan ge mer information om marknadernas dynamik. Utöver detta bidrar denna studie genom att uthålligheten av fondprestationer undersöks med hjälp av Kalman-filtret, något som inte utförts på nordiska fonder tidigare.

FONDER

En fond är ett investeringsobjekt som består av ett samlat kapital av en bred bas investerare som delegerat ansvaret för portföljen till en fondförvaltare. Fonder kan indelas i öppna, stängda samt hedgefonder, varav det första alternativet är den mest förekommande som dessutom utgör majoriteten av samplet i denna studie. Dessa skiljer sig från de övriga formerna genom att investeraren kan ta ut sitt kapital ur fonden på daglig basis. Detta är en mekanism som har införts bland annat för att minska på de agentkostnader som uppstår när ansvaret för kapitalet överförs till en tredje part.

För fonder utgör dessa en reell, dock inte trivialt mätbar, kostnad eftersom fondförvaltarens och fondbolagets intressen i viss mån avviker från investerarens. Förvaltaren vill i första hand maximera sin ersättning som denna erhåller för sin insats, men förvaltaren är också mån om sin arbetsplats. Fondbolaget vill å sin sida maximera inkomsten från de diverse avgifter som åläggs investerare, något som enklast görs genom att maximera mängden kapital i fonden. Till en stor del är dessa faktorer beroende av varandra, men historiskt har fonder ibland använt sig av knep för att maximera sin vinst på investerarnas bekostad.

Förutom agentkostnader finns det andra bekymmer som belastar investerare när valet av fond är aktuellt. Hypotesen om den effektiva marknaden (Fama 1970) påstår att alla värdepapper på en börs är korrekt prissatta enligt den risknivå som existerar och att extraordinära resultat således är omöjliga. I fall denna hypotes är sann innebär det att fondförvaltare som kräver en högre avgift för att erbjuda aktivt förvaltande i praktiken endast förstör sina kunders kapital i och med att det inte är möjligt att slå marknaden. I praktiken är denna hypotes i sin fulla form inte helt sann i och med att det bevisligen är möjligt att uppnå onormala resultat, men rent generellt eftersträvar marknaden en jämnvikt i prissättning av värdepapper vilket försvårar aktivt förvaltande.

Berk & Green (2004) utvecklar på basis av tidigare forskning en modell som eftersträvar att beskriva dynamiken av en fond och dess kapitalflöden. I denna modell antas fondernas kostnader stiga proportionellt mot storleken av dess kapitalbas. Enskilda investerare utvärderar olika fonders prestation och väljer att investera i de som bevisligen är bra. Detta leder till att fonder som överpresterar upplever ett stort inflöde av kapital, vilket i sin tur leder till högre kostnader. Efter ett tag uppstår en jämnvikt där den onormala avkastningen kompenseras av ökade utgifter vilket leder till att fonder upphör att överprestera. Denna modell förklarar varför uthålligheten av prestation bland fonder inte anses vara långlivad, vilket tidigare studier påvisat.

TIDIGARE STUDIER

Som tidigare nämndes under rubriken *kontribution* finns det tre studier som använder sig av antingen Kosowski-metoden (Kosowski et al. 2006) eller Fama & Frenchs metod (Fama & French 2010) för att erhålla ett bättre estimat av sannolikhetsfördelningen av alfa. Dessa är Flam & Vestmans studie från 2014 för svenska fonder samt studierna av Sørensen (2009) och Gallefoss et al. (2015) för den norska marknaden. Resultaten från dessa studier indikerar att fonder generellt sett inte skapar mervärde för kunderna, men det finns svaga bevis för att ett fåtal av de bästa fonderna har en positiv inverkan. Däremot är sannolikheten större att fondförvaltare förstör värde i och med att andelen underpresterande fonder är märkbart större. Utöver dessa tre studier existerar det givetvis andra publicerade forskningar inom detta område, men slutsatserna från dessa kan ifrågasättas i och med att de inte beaktar den invecklade sannolikhetsfördelningen bakom estimaten. Till dessa kan räknas Christensens studier från 2003, 2005 samt 2013 om den danska fondmarknaden, vilka uppvisar ytterst svaga bevis för överprestation. Angående den finska marknaden kan Westerholm & Kuuskoskis studie från 2003 nämnas, som undersöker fondprestation genom att jämföra deras avkastning mot privatpersoners värdepappersportföljer. I denna studie klassificeras privatpersoner i ”små”, ”medelstora” samt ”stora” investerare, av vilka endast gruppen ”stora” klarade av att uppnå en avkastning som överskred de professionella fondförvaltarnas resultat.

Slutsatsen av denna litteraturöversikt är att bevisen för överprestation *är* svaga och att underprestation är ett mer förekommande fenomen. Angående uthålligheten av prestation återfinns bevis för att denna kan existera på kort sikt, dvs. 1 till 3 månader, medan längre uthållighet är mindre förekommande.

DATA

Rådata för fondernas historiska avkastning är hämtad från de nationsspecifika institutioner som specialiserar sig på insamling av dessa uppgifter. Data för danska fonder är erhållna av Investeringsfondsbranchen (IFB) och omfattar den något förkortade tidsperioden 01.2000–03.2016. Endast det finska och norska datasetet innehar alla data för den tidsperiod som nämndes i avgränsningen. Suomen Sijoitustutkimus samt Børsprosjektet på Norska Handelshögskolan är de institutioner som levererat dessa. De svenska fondernas avkastningar är erhållna från Fondbolagens förening och omfattar tidsperioden 05.1999–02.2016.

De rådata som har erhållits gallras ner tills endast fonder som investerar majoriteten (över 75 %) av kapitalet i inhemska aktier kvarstår. De återstående fonderna representerar antingen den kompletta marknaden för denna kategorisering (Finland, Danmark) eller en överlägsen stor majoritet (Norge, Sverige) vilket leder till att slutsatserna av denna studie kan generaliseras till att hålla för hela marknaden. Tabell 3 i avhandlingen presenterar deskriptiv statistik om det slutgiltiga samplet som används i denna studie. Avkastningarna har blivit konverterade till månatliga avkastningar samt är angivna i netto-basis (avkastningen minus fondens kostnader och provision).

Som jämförelseindex för marknadernas avkastning används de index som bäst beaktar det utbud av aktier som fonder enligt regelverk får investera i. Dessa regler förhindrar bland annat enskilda fonder att investera mer än 10 % av fondens kapital i enskilda värdepapper, vilket gör att de normala aktiebörsindexen inte är helt rättvisa referensindex. I praktiken används OMXCCAPGI, OMXHCAPGI, OSEFX samt SIXPRX som jämförelseindex i och med att dessa är konstruerade med fondernas regelverk i åtanke. Som representant för den riskfria räntan används de lokala 1-månaders internbankräntorna: CIBOR, EURIBOR, NIBOR samt STIBOR. I och med att avkastningsdata är inkluderade för de finländska fonderna före eurons införande används 3-månaders HELIBOR-räntan, som är uträknad med den finska marken, för tidsperioden 1997-1999.

De faktormodeller som används i denna studie är kapitalmarknadsmodellen (CAPM), 3-faktormodellen av Fama & French (1993) samt 4-faktormodellen av Carhart (1997). De två senare baserar sig på CAPM, men innehåller utöver marknadsavkastningen variabler som kontrollerar för storleks-, värde- samt momentumavvikelser för aktieavkastningar. Syftet med dessa utvidgade modeller är att kontrollera att fondförvaltarens avkastning inte till stor del härstammar från enkla strategier som baserar sig på utnyttjande av dessa erkända avvikelser. Dessutom leder inkluderandet av extra och relevanta faktorer till att alfa-estimatet blir mer precist. I och med att data för 3- och 4-faktormodellerna inte existerar för alla nordiska länderna eller omfattar hela tidsperioden som används i denna avhandling konstrueras dessa specifikt för denna studie med hjälp av de metoder som beskrivs i originalartiklarna. Data för detta, såsom P/B-kvoten och storleksmått, är inhämtade från databasen Thomson Reuter Datastream. Jämförelser mellan de faktoravkastningar som skapats i denna studie och de som sedan tidigare existerar för Norge och Sverige visar att skillnaden mellan dessa inte är stor, vilket är bevis för att dessa har konstruerats korrekt.

METODIK

De två metoderna som innehar det huvudsakliga fokuset i denna studie är bootstrap-metoderna samt Kalman-filtret. En bootstrap är i statistiska sammanhang en metod som går ut på att slumpade värden plockas ut från originaldata, varefter ett nytt resultat räknas ut baserat på det nya datasetet. Genom att repetera detta tillräckligt många gånger erhålls en estimering av hur utfallen av den slumpartade variabeln uppför sig. Vid utvärdering av fonders prestation inleds denna metod av att alfakoefficienterna för varje fond estimeras med hjälp av linjär regression baserat på en faktormodell (CAPM-modellen i ekvation 1 är ett exempel på detta), varefter residualerna och de estimerade koefficienterna från varje regression sparas. Därefter rangordnas fonderna i samplet från bäst till sämst baserat på estimatet av alfa. Själva bootstrap-metoden utförs genom att en ny vektor av residualer skapas genom att en slumpmässig lottning av värden (med ersättning) dras från de sparade residualerna. Dessa placeras sedan in i faktormodellen, som modifieras med kriteriet att alfa-koefficienten per definition är noll, varefter en ny simulerad tidsserie av fondavkastningar erhålls. Därefter estimeras faktormodellen på nytt med denna simulerade tidsserie av avkastningar och en simulerad alfakoefficient för varje fond i samplet fås. Dessa rangordnas från bäst till sämst varefter den ovan beskrivna processen upprepas 10 000 gånger.

Resultatet av denna process är att varje fond tilldelas en egen serie av slumpmässiga variationer av alfa som beskriver sannolikheten att detta estimat uppnås genom ren tur. Eftersom simuleringen genomförs med alla fonder samtidigt innebär det att den slutgiltiga sannolikhetsfördelningen kan bestå av värden som rent tekniskt är kopplade till helt andra fonder. Denna metod är den som utvecklades av Kosowski et al. (2006), men versionen av Fama & French (2010) är mycket lik denna. Skillnaden består av att Kosowski-metoden endast drar slumpmässiga tal från de sparade residualerna medan Fama & French-metoden drar från residualerna och faktoravkastningarna samtidigt. Den senare metoden har den fördelen att den fångar upp mer av de osynliga underliggande sambanden som kan existera mellan fonders avkastning. Dock används bägge metoder i denna studie samtidigt, men Fama & French-metodens resultat anses vara mera pålitliga.

Kalman filtret är en av de mest effektiva metoderna för att estimera dynamiska faktorkoefficienter. I och med att denna teknik är relativt invecklad kommer den inte att förklaras närmare i denna sammanfattning. Huvudsaken är dock att genom att köra observationerna för fondernas avkastning genom Kalman-filtret och en faktormodell erhålls en tidsserie av alfaestimat som kan användas till att undersöka uthålligheten av riskjusterad prestation. Detta genomförs i denna studie på tre olika vis: den första är att sortera in fonder i fem olika portföljer baserat på storleken av det estimerade alfat för en viss tidsperiod. En motsvarande sortering utförs i följande tidsperiod varefter antalet fonder som behållit sin initiala rang räknas. Den andra metoden använder sig av de fem portföljer som nu skapats för att kontrollera portföljens riskjusterade avkastning i en kommande utvärderingsperiod. Den sista är en regressionsbaserad teknik som motsvarar tekniken utvecklad av Fama & MachBeth (1973). Regressionen har den nuvarande avkastningen som beroende variabel och den tidigare, med perioder från 1 månad till 2 år, som oberoende variabel. Styrkan och den statistiska signifikansen av den erhållna riktningskoefficienten används för att undersöka uthålligheten av prestationen.

RESULTAT

Resultaten för de nordiska fondernas prestation följer i hög grad den trend som uppmärksammats i internationella studier, vilket är att bevisen för överprestation är ytterst svaga. Inledningsvis genomfördes en normal linjär regression med de tre faktormodellerna för en portfölj bestående av medeltalet för varje lands fondavkastningar. Den estimerade extra årliga avkastningen (alfa) är 2,18 %, 2,06 %, 0,00 % samt -2,49 % för Danmark, Finland, Norge respektive Sverige. Dock är endast det danska och svenska estimatet statistiskt skiljbart från noll, men denna metod beaktar som tidigare nämnts inte det faktum att dessa estimat inte är normalfördelade. Däremot ger dessa en initial överblick över de resultat som skall komma, vilka visar att de danska och finska fonderna är generellt nollpresterande medan en överlägsen majoritet av de svenska fonderna underpresterar. Detta syns i tabellen nedan som visar utfallet av simuleringen för de två bästa, sämsta samt 20 % bästa och sämsta fonderna. Tabellen är en komprimerad version av tabell 9–12 i den egentliga avhandlingen, men baserar sig endast på de mest relevanta resultaten, vilka är trefaktor-alfat vars statistiska sannolikhetsfördelning genererats med Fama & French-metoden. De danska resultaten representeras dock av CAPM-modellen i och med att denna är mest relevant för denna marknad baserat på informationskriteriet BIC (Bayesian information criteria).

Resultat av bootstrap-analysen för de nordiska fonderna

	Sämst	nästsämst	0-10 %	10-20 %	80-90 %	90-100 %	nästbäst	bäst
Danmark	-2.760	-1.471	-1.525	-0.177	2.584	3.680	4.249	5.101
%(sim>act)	**(0.992)**	(0.943)	**(0.956)**	(0.816)	(0.472)	(0.385)	(0.252)	(0.222)
Finland	-2.450	-2.078	-1.880	-0.766	2.390	3.166	3.088	4.754
%(sim>act)	(0.285)	(0.396)	(0.557)	(0.708)	(0.283)	(0.249)	(0.341)	(0.073)
Norge	-3.584	-2.848	-2.317	-1.440	1.381	2.572	3.330	3.461
%(sim>act)	(0.929)	(0.937)	(0.916)	**(0.958)**	(0.579)	(0.393)	(0.301)	(0.417)
Sverige	-6.577	-6.343	-5.302	-3.640	-0.053	1.091	1.806	2.645
%(sim>act)	**(0.996)**	**(0.999)**	**(0.999)**	**(1.000)**	**(0.999)**	(0.988)	(0.977)	(0.894)

I denna tabell rangordnas fonderna baserat på deras t-värde istället för alfa-estimatet på grund av att den tidigare tar estimatets varians i beräkning, vilket leder till ett mer precist resultat. För de fonder som endast har ett fåtal observationer i samplet kan alfakoefficienten på grund av statistisk osäkerhet anta onormalt stora värden. Värdet %(sim>act) är andelen simulerade utfall för t-värdet av alfa som överskrider det initialt estimerade talet och kan tolkas som ett traditionellt p-värde. Ifall det initiala t-värdet är positivt och har ett %(sim>act) tal mindre än 0,05 är detta en indikation på att ifrågavarande fond har uppnått sitt överlägsna resultat genom genuina färdigheter. I och med att den simulerade sannolikhetsfördelningen har erhållits genom att alfakoefficienten per konstruktion är noll, beskriver denna sannolikheten att de rangordnade fonderna har erhållit sina alfa-estimat (eller t-värde för alfa) genom ren tur. Ifall fondens estimat är negativt och %(sim>act) värdet är högre än 0,95 innebär det att de typiska simuleringsutfallen får ett högre t-alfa genom ren tur. Detta i sin tur innebär att fonden är genuint dåligt i och med att de erhållit ett resultat som inte kan bortförklaras med slumpmässiga yttre faktorer. För att förenkla tolkningen av tabellen ovan har signifikanta värden utmärkts med **halvfet** text.

En närmare granskning av denna tabell visar att de danska fonderna inte överpresterar, men däremot finns det bevis för signifikant dåliga resultat bland de lägsta 10 % av rangordnade fonder. För Finlands del ger resultaten en annan bild av marknaden i och med att det inte finns bevis för varken över- eller underprestation, vilket antyder att valet av fond inte har så stor betydelse. Den norska fondmarknaden uppvisar liknande karaktärsdrag som den danska genom att den näst sämsta tiondelen är statistiskt signifikant. Däremot är de två sämsta fonderna inte signifikant dåliga, även om p-värdet för dessa med knapp marginal undviker 5 % -gränsen.

Den överlägset största värdepappersmarknaden Sverige uppvisar markant dåliga resultat för sina fonder i och med att upp till 90 % av dessa underpresterar på ett vis som inte kan påvisas vara oturligt. Detta är ett resultat som tidigare antyds i andra svenska och internationella studier. Orsaken till detta dystra resultat kan härledas till den svenska marknadens storlek och internationalitet. Den stora mängden professionella aktieanalytiker som aktivt följer med denna marknad leder till att aktierna till stor del är korrekt prissatta och att eventuella lukrativa situationer snabbt försvinner på grund av konkurrens. Liknande resultat påvisades av Fama & Frenchs (2010) studie om den amerikanska fondmarknaden. De övriga nordiska länderna klarar sig aningen bättre i och med att de har mindre konkurrens och är således till en mindre grad effektiva marknader.

Resultaten för prestationernas uthållighet redovisas i den egentliga avhandlingen i figur 5 samt i tabell 13 och 14. Figuren visar hur fonderna i snitt rangordnas från en utvärderingsperiod till en annan. Av dessa framgår det tydligt att de 20 % bästa och sämsta fonderna har en stor sannolikhet att behålla sin plats till nästa tidsperiod. Detta är allra tydligast för ett till sexmånadsperioder, och efter tolv månader försvinner denna trend åtminstone för Finland och Norge. I tabell 12 utvärderas de rangordnande fondernas riskjusterade avkastning för de kommande månaderna. Ur denna kan man utläsa att de 40 % bästa finska samt danska fonderna överpresterar marknaden signifikant ända upp till ett år från utvärderingstillfället. För Norge begränsas detta till den bästa femtedelen av fonderna och endast de kommande sex månaderna. Dessutom underpresterar den sämsta femtedelen under det kommande året, vilket följer mönstret från internationella studier att vinnande fonder fortsätter att vinna och förlorande fonder fortsätter att förlora, åtminstone på kort sikt. Detta mönster passar dock inte in på de svenska fonderna i och med att hela 80 % av dessa fortsätter underprestera under det kommande året. Speciellt intressant är den vinnande kvintilen, vars första månads avkastning är positiv och signifikant, men som efter ett år blir negativ och signifikant. Detta är ytterligare bevis på att den svenska marknaden består av hård konkurrens och att fonder som investerar resurser på att försöka slå denna egentligen slösar bort sina kunders kapital.

Slutligen tillför tabell 13 regressionsbaserade bevis för uthållighet där den estimerade koefficienten används för att förutspå kommande resultat. Nästan alla resultat är signifikanta, vilket sker i och med att noll hypotesen är att den estimerade koefficienten är noll. Det som däremot är mer viktigt är ifall det rapporterade estimatet är högre än 50 %, vilket indikerar att över hälften av prestandan överförs från en tidsperiod till en annan. Detta kan anses vara bevis för stark uthållighet, medan estimat mindre än 0,5 är bevis för en svagare variant. Resultaten är i generella termer rätt liknande, men bevis för uthållighet är svagare för Sverige och Norge gentemot Finland och Danmark. Nackdelen med denna metod är att det inte är möjligt att separera positiv prestation från negativ prestation, men de tidigare resultaten i denna avhandling kan användas för att skapa en uppfattning om vilket av dessa två alternativ som är dominerande för vardera marknad.

AVSLUTNING

Denna studie undersökte fonders prestation med hjälp av en ny statistisk teknik som bättre estimerar fördelningen av alfakoefficienten som används för att utvärdera prestation. Resultaten påvisar att fonderna på den finska marknaden varken är bra eller dåliga. För Norge och Danmark återfinns bevis för underprestation bland de sämsta fonderna, något som även gäller för Sverige men på denna marknad är underprestationen nästan utbredd till hela samplet. För individuella investerare i Finland antyder dessa resultat att valet av investeringsobjekt inte är ett kritiskt beslut i och med att prestationerna är statistiskt liknande bland alla fonder. För norska och danska investerare gäller det att undvika de sämsta fonderna, vilka är möjliga att identifiera eftersom underprestationen på dessa marknader håller i sig under längre tidsperioder. Däremot bör den svenska marknaden undvikas eftersom det extra kapital som investeras med hopp om att slå marknaden går förlorat på grund av hård konkurrens. Passiva indexfonder vars avgifter är små är ett bättre alternativ eftersom underprestationen således minimeras. Detta är dock något som även kan generaliseras till att gälla för de övriga nordiska länderna i och med att det bevisligen inte finns tillräckligt goda skäl att investera i aktiv förvaltning. Dessutom kan man anta att dessa länder i takt med globaliseringen går mot en mer effektiv marknad som i framtiden leder till att fonderna börjar underprestera i en allt större omfattning.

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APPENDIX 1 ESTIMATED 4-FACTOR COEFFICIENTS

Table 15 Sample mutual funds and estimated four factor coefficients

This table contains the complete list of all mutual funds in the sample accompanied by the estimated four factor coefficients (listed in columns 2-6). The stars (*), (**) indicates a significant estimate at 1 % and 5 % level, respectively. The null hypothesis is that the estimated coefficient is equal to zero and is measured with a two-sided test. The t-statistic is calculated with Newey & West (1987) heteroscedasticity and autocorrelation consistent standard errors. The interpretation of these coefficients and their significance must be performed with care as the diagnostic tests in Table 7 (Section 7.1) rejects the normality of errors assumption for almost half of the funds in this sample.

Denmark

Mutual fund	α	β_1 (MKT)	β_2 (SMB)	β_3 (HML)	β_4 (MOM)	R^2
Absalon Invest Danske Aktier	0.000	0.98**	0.01	-0.02	0.02	0.98
Absalon Invest Danske Indeks	0.003	1.02**	-0.14	-0.12*	-0.03	0.96
Alfred Berg Invest Danske Aktier	-0.000	1.01**	0.00	-0.08	0.03	0.93
BankInvest Danske Aktier	-0.002	1.05**	0.11**	0.00	0.00	0.94
BankInvest OMXC20 Aktier	-0.006	0.96**	-0.19**	-0.11**	0.08	0.93
BankInvest OMXC20 Aktier II	-0.005	1.02**	-0.12	-0.11	0.03	0.91
BankInvest Pension Danske Aktier	-0.002	1.08**	0.11**	0.02	0.01	0.95
BankInvest Pension Danske Small Cap Aktier	0.009	1.03**	0.48**	0.24**	-0.12	0.73
BankInvest Danmark	0.001	0.98**	0.21**	0.14**	0.00	0.83
BIL Danmark Danske Small Cap aktier	0.002	1.06**	0.38**	0.22**	0.02	0.78
Dexia Invest Fokus Danske Aktier	-0.000	1.01**	0.11	0.05	-0.01	0.94
BLS Invest Danske Aktier	0.011	0.86**	-0.09	-0.09	-0.07	0.83
Carnegie WorldWide/Danske Aktier	0.000	1.02**	-0.08	-0.07*	0.02	0.91
Danske Invest Danmark	-0.001	1.04**	-0.02	-0.03	0.02	0.97
Danske Invest Danmark - Akkumulerende	-0.000	1.03**	-0.05	-0.04**	0.02	0.97
Danske Invest Danmark Fokus	0.002	1.05**	0.05	0.02	0.02	0.90
Danske Invest Danmark Indeks	-0.000	1.03**	-0.03	-0.02	0.02	0.98
Danske Invest Danmark Indeks Small Cap	0.001	1.02**	0.23**	0.09	0.01	0.76
Danske Invest Engros Danske Aktier	0.000	1.02**	-0.03	-0.01	0.01	0.96
Danske Invest Select Danske Aktier E	-0.004	1.05**	-0.01	-0.02	0.06	0.96
EgnsINVEST Danmark	-0.001	1.02**	-0.07*	-0.03	0.02	0.97
Fundamental Invest, Stock Pick	0.002	1.27**	0.39**	0.25**	0.08	0.71
Fundamental Invest, Stock Pick II Akkumulerende	-0.012	1.24**	0.14	0.10	0.26**	0.81
Handelsinvest Danmark	-0.001	1.02**	-0.01	-0.01	0.03*	0.97
Gudme Raaschou Danske Aktier	0.008*	0.99**	-0.05	-0.04	-0.04	0.95
Jyske Invest Danske Aktier	0.000	1.06**	-0.02	-0.04**	0.00	0.98
LPI Akt Danmark (Ak. Forv, OMXCCAPGI)	0.005	0.99**	-0.07	-0.05	-0.03	0.97
LPI Akt Danmark (Indeksp.følje, OMXC20)	-0.004	0.98**	-0.17**	-0.10*	0.05	0.96
Lån & Spar Invest Danmark	0.000	1.01**	-0.05	-0.07**	0.01	0.96
Lån & Spar Rationel Invest Danske Aktier Pension	-0.002	1.05**	0.01	-0.03	0.03	0.96
Maj Invest Danske Aktier	0.004	0.98**	-0.07	-0.05	-0.03	0.97
Nordea Invest Portefølje Danmark	0.001	1.01**	0.02	-0.00	0.00	0.99
Nordea Inv Danske Aktier	0.002	0.99**	-0.09	-0.05	-0.01	0.98
Nordea Invest Danmark	0.001	1.02**	-0.04	-0.06**	0.01	0.97
Nordea Invest Danske aktier fokus	-0.001	1.12**	0.04	0.01	0.05	0.94
Nykredit Invest Danske aktier	-0.002	1.02**	0.01	-0.01	0.04	0.97
Nykredit Invest Danske aktier Akk.	-0.001	0.97**	-0.05	-0.04*	0.02	0.98
Placeringsfore. Nykredit Inv. Danske Fokusaktier	0.006	0.95**	0.03	-0.03	-0.04	0.86
PFA Invest Dansk aktier	0.002	1.03**	-0.01	-0.02	0.00	0.96
SEBinvest Danske Aktier	0.002	1.00**	0.00	-0.01	0.02	0.95
SEBinvest Danske Aktier Akkumulerende	0.003	0.96**	-0.04	-0.03	-0.00	0.97

Sparinvest Danske Aktier	-0.002	0.97**	-0.08*	-0.06*	0.03	0.93
Sparinvest INDEX OMX C20 Capped	0.002	1.07**	-0.08**	-0.05**	-0.04	0.98
Sydinvest Danmark A DKK	0.000	1.00**	-0.05*	-0.03*	0.01	0.98
Access Small Cap A/S	0.001	0.73*	0.19	0.05	0.15	0.58
Placeringsfore. Nykredit Inv. Danske Fokusaktier	0.002	1.02**	-0.09	-0.08	0.06	0.95
BLS Invest Danske Aktier	0.011	0.86**	-0.09	-0.09	-0.07	0.83
Finland						
Aktia Capital	0.001	0.92**	0.19**	0.07**	0.02	0.91
Alfred Berg Finland HPI *	0.007**	0.96**	-0.07	0.02	-0.03	1.00
Alfred Berg Portfolio B	0.006	1.16**	0.10*	-0.13**	-0.00	0.97
Alfred Berg Small Cap Finland	-0.003	1.21**	0.45**	-0.16**	0.07	0.84
Alfred Berg Suomi Fokus B	0.004	1.05**	0.09*	-0.09**	-0.03	0.95
Arvo Finland Value	0.001	0.97**	0.17**	0.25**	-0.00	0.89
Conventum Finland Value	0.009	0.52**	0.10	0.02	0.02	0.45
Conventum Osake	-0.002	1.06**	0.23**	-0.13**	0.02	0.94
Danske Invest Suomen Parhaat K	-0.004	1.07**	0.14	0.05	0.09*	0.96
Danske Invest Suomen Pienyhtiöt K	0.000	1.14**	0.41**	-0.14**	0.02	0.82
Danske Invest Suomi Osake	0.001	1.04**	0.08**	-0.08**	0.00	0.94
Danske Invest Suomi Osinko K	-0.003	1.02**	0.09**	0.02	0.05	0.94
Danske Invest Suomi Yhteisöosake	-0.000	1.08**	0.08**	-0.09**	0.05	0.94
eQ Suomi 1 K	0.002	1.01**	0.01	-0.01	-0.02	0.97
eQ Suomi Pienyhtiöt	-0.004	0.89**	0.46**	0.03	0.04	0.88
eQ Suomiliiga	-0.003	1.05**	0.36**	-0.09*	0.05	0.90
Evli Suomi Pienyhtiöt B	0.005**	1.01**	0.13**	-0.10**	-0.05	0.94
Evli Finland Small Tech	-0.010	1.12**	0.37*	-0.14	-0.14	0.76
Evli Suomi Select B	-0.003	1.05**	0.13**	-0.12**	0.07	0.93
FIM Fenno	-0.005	1.20**	0.28**	-0.17**	0.19	0.85
Fondita Equity Spice	0.005	1.04**	0.14**	-0.08**	-0.02	0.89
Fourton Fokus Suomi	0.007	1.10**	0.35**	0.21**	-0.16	0.84
Front Suomi A1	0.001	1.03**	0.12	-0.02	-0.06	0.94
Handelsbanken Suomi	0.001	1.02**	0.06**	0.00	-0.00	0.97
Handelsbanken Suomi (A1 EUR)	-0.001	0.93**	0.08	0.03	0.03	0.97
LähiTapiola Suomi	-0.002	0.95**	0.19**	0.02	0.03	0.94
Mandatum Nordic IT Small Firm	-0.003	1.59**	0.88**	-0.36**	0.10	0.85
Mandatum Osake	0.003	1.05**	0.24**	-0.04	0.05	0.93
Nordea 1 - Finnish Equity Fund	0.014*	1.10**	0.04	0.03	-0.05	0.98
Nordea Fennia Plus	0.001	1.02**	0.11*	-0.13**	0.03	0.92
Nordea Private Banking Focus Suomi A K	-0.002	1.12**	0.08	-0.08	-0.04	0.94
Nordea Private Banking Focus Suomi I K	-0.002	1.12**	0.08	-0.08	-0.04	0.94
Nordea Pro Suomi B kasvu	-0.002	1.03**	0.06	0.03	-0.01	0.98
Nordea Pro Suomi I K	0.002	1.00**	0.00	-0.02	-0.01	0.97
Nordea Suomi	0.002	1.02**	0.04	-0.02	-0.03	0.96
Nordea Suomi 130/30	0.002	1.17**	0.12*	-0.00	-0.04	0.90
Nordea Suomi Indeksirahasto	0.003*	1.02**	-0.04	-0.01	-0.02	0.98
Nordea Suomi Indeksirahasto I	0.004**	1.02**	-0.05	-0.02	-0.03	0.98
Nordea Suomi Small Cap	0.004	1.18**	0.34**	-0.06	-0.11	0.88
ODIN Finland C	-0.003	1.00**	0.32**	0.24**	0.07	0.85
OP-Delta	-0.001	1.02**	0.01	-0.05	0.05	0.94
OP-Focus	0.002	0.99**	-0.05	-0.04	0.01	0.95
OP-Suomi Arvo	-0.002	0.97**	0.12*	0.22**	0.04	0.93
OP-Suomi Indeksi	0.003	1.12**	-0.10	-0.08**	0.00	0.95
OP-Suomi Pienyhtiöt	-0.001	1.20**	0.49**	-0.25**	-0.02	0.84
Pohjola Finland Kasvu	-0.005	1.14**	0.39**	-0.19*	0.18*	0.89

POP Suomi	-0.003	1.01**	0.16**	-0.04	0.05	0.93
Sampo Sektorit (Suomi)	-0.000	1.05**	0.29**	-0.23**	0.16*	0.90
SEB Finland Small Cap B	-0.010	1.15**	0.47**	-0.11**	0.16	0.84
SEB Finlandia B	-0.004	1.06**	0.05	-0.05	0.09*	0.93
Seligson & Co OMX Helsinki 25 pörssinoteerattu rahasto	0.004**	1.02**	-0.08**	0.01	-0.03*	0.98
Seligson & Co Phoebus	-0.002	0.79**	0.20**	0.02	0.07	0.79
Seligson & Co Suomi Indeksirahasto A	0.004*	1.07**	-0.08**	-0.06*	-0.02	0.95
Säästöpankki Kotimaa	-0.002	0.93**	0.11**	0.13**	0.05	0.95
Säästöpankki Pienyhtiöt	0.006	1.03**	0.27	-0.11	0.00	0.83
Taaleritehdas Arvo Markka Osake	0.001	1.13**	0.30**	0.16**	-0.06	0.92
Taaleritehdas Mikro Markka Osake Kasvu	-0.001	1.05**	0.99**	-0.01	-0.02	0.71
Trevise Osakerahasto	0.002	0.96**	0.24*	-0.07	0.09	0.90
UB HR Suomi A	0.002	0.91**	0.07	0.13	-0.05	0.97
UB HR Suomi K	0.001	0.98**	-0.03	0.08**	0.02	0.96
VISIO Finland 140/40	-0.005	1.20**	0.23	0.16	0.26	0.88
XACT OMXH25	0.003	1.00**	0.03	0.05	-0.02	0.98
Ålandsbanken Finland Value	-0.001	0.98**	0.04	0.04	-0.01	0.94
Norway						
ABIF Norge ++	-0.002	0.96**	0.05	-0.06*	0.04*	0.98
ABN AMRO Aktiv	-0.006	1.03**	0.25**	-0.12**	0.05*	0.91
ABN AMRO Indeks	0.000	0.92**	-0.08**	0.03	0.00	0.97
ABN AMRO Indeks +	-0.001	0.92**	-0.04*	-0.04	0.02	0.99
ABN AMRO Kapital	-0.003	0.99**	0.32**	-0.09*	0.03	0.89
ABN AMRO Norge	-0.002*	0.93**	0.07**	-0.01	0.03**	0.98
Alfred Berg Gambak	-0.003	1.02**	0.39**	-0.19**	0.05	0.87
Alfred Berg Humanfond	-0.003	0.89**	0.07*	-0.06	0.02	0.95
Alfred Berg Indeks Classic	0.002	1.02**	-0.01	0.01	-0.02	0.98
Alfred Berg Norge Etisk	-0.002	0.99**	0.03	0.00	0.02	0.98
Alfred Berg Norge Inst	0.001	0.85**	0.06	0.01	0.04*	0.94
Arctic Norwegian Equities Class A	-0.005	0.81**	0.11	-0.07	0.05	0.81
Arctic Norwegian Equities Class B	-0.007	0.90**	0.07	-0.07	0.06**	0.86
Arctic Norwegian Equities Class D	-0.003	0.83**	0.09	-0.06	0.05*	0.86
Arctic Norwegian Equities Class I	-0.007	0.90**	0.08	-0.07	0.06**	0.86
Avanse Norge (I)	-0.000	0.96**	0.02	0.02	-0.01	0.99
Avanse Norge (II)	-0.001	0.95**	0.02	0.01	-0.00	0.98
Avanse OBX Indeks	0.001	0.94**	-0.07*	0.02	-0.01	0.97
Banco Norge	-0.002	0.98**	0.04	-0.09	0.02	0.96
Carnegie Aksje Norge	-0.002	0.97**	0.05*	-0.05	0.04*	0.95
Carnegie Norge Indeks	0.000	0.93**	-0.09**	-0.00	0.00	0.97
Danske Fund Norge Aksj. Inst 1	0.001	0.92**	-0.00	0.00	0.02	0.97
Danske Fund Norge Aksj. Inst 2	-0.002	0.91**	0.00	0.02	0.05*	0.97
Danske Fund Norge I	-0.000	0.96**	0.01	-0.01	0.01	0.94
Danske Fund Norge II	0.000	0.95**	0.00	-0.01	0.01	0.94
Danske Fund Norge Vekst	-0.000	0.95**	0.34**	-0.20*	0.01	0.83
Delphi Norge	0.001	1.07**	0.30**	-0.15**	0.01	0.89
Delphi Vekst	0.002	0.99**	0.34**	-0.22**	-0.01	0.87
DnB NOR Norge (III)	-0.001	0.92**	-0.01	-0.01	0.01	0.98
DnB NOR Norge (IV)	0.000	0.93**	-0.03	-0.02	0.01	0.98
DnB NOR Norge Indeks	-0.000	0.93**	-0.05	-0.01	0.01	0.98
DnB NOR Norge Selektiv (I)	0.001	0.97**	0.03	-0.01	-0.01	0.94
DnB NOR Norge Selektiv (II)	0.001	0.91**	-0.05*	-0.02	0.01	0.97
DnB NOR Norge Selektiv (III)	-0.001	0.94**	0.05	-0.05*	0.01	0.96
DnB NOR SMB	0.005	1.04**	0.49**	0.00	-0.04	0.86

DNB Norge Indeks	-0.000	0.94**	-0.03	-0.01	0.00	0.98
DnB Real-Vekst	-0.002	0.96**	0.06*	0.03	-0.00	0.98
First Generator	0.008	1.13**	0.10	0.20**	-0.05	0.84
Fondsfinans Aktiv II	-0.002	0.89**	0.06	0.04	-0.00	0.92
Fondsfinans Spar	0.002	0.93**	0.06	0.02	0.00	0.92
FORTE Norge	0.004	0.88**	-0.09	0.01	-0.05	0.76
FORTE Trønder	0.024**	0.51**	0.04	-0.02	-0.13*	0.52
Globus Aktiv	0.003	1.20**	0.36**	-0.07	-0.11**	0.89
Globus Norge	0.005	1.14**	0.36**	-0.06	-0.13**	0.89
Globus Norge II	-0.001	1.21**	0.37**	-0.07	-0.10**	0.89
Handelsbanken Norge	-0.004*	1.01**	0.10**	-0.00	0.04*	0.96
Holberg Norge	-0.003	0.91**	0.26**	-0.01	0.03	0.90
Kaupthing Norge	-0.002	1.03**	0.16**	-0.24**	0.03	0.90
KLP Aksjeinvest	-0.003	0.91**	0.04	0.00	0.00	0.95
KLP AksjeNorge	0.001	0.96**	0.04*	0.00	0.00	0.96
KLP AksjeNorge Indeks	-0.000	0.92**	-0.05*	-0.05*	0.01	0.99
KLP AksjeNorge Indeks II	0.000	0.90**	-0.03	-0.05*	-0.00	0.98
Landkreditt Norge	-0.004	0.89**	0.17**	0.05	0.04	0.90
Landkreditt Utbytte	0.012**	0.50**	0.01	-0.05	-0.04	0.61
NB-Aksjefond	-0.001	0.93**	0.10**	0.03	-0.01	0.96
NB-Plussfond	0.002	0.92**	0.22**	0.02	-0.03	0.91
Nordea Avkastning	-0.001	0.96**	0.07**	0.01	-0.00	0.98
Nordea Kapital	-0.001	0.97**	0.08**	-0.02	0.01	0.98
Nordea Kapital II	-0.001	1.01**	0.08**	-0.02	0.00	0.98
Nordea Kapital III	-0.001	1.00**	0.06**	-0.01	-0.01	0.98
Nordea Norge Pluss	0.002	0.99**	0.06	0.02	-0.01	0.93
Nordea Norge Verdi	0.004	0.86**	0.13**	-0.02	-0.03	0.92
Nordea SMB	0.002	0.92**	0.49**	-0.02	-0.06	0.84
Nordea SMB II	0.005	0.86**	0.42*	-0.14	-0.12	0.78
Nordea Vekst	-0.003	0.97**	0.11**	-0.02	0.01	0.96
Nordnet Superfondet Norge	0.001	1.01**	-0.01	0.08	-0.01	0.97
ODIN Norge	-0.004	0.95**	0.29**	0.09	0.03	0.86
ODIN Norge II	-0.005	0.81**	0.29**	0.08	0.04	0.86
Omega Investment Fund B	-0.002	0.65**	0.17*	-0.00	0.09**	0.73
Omega Investment Fund C	-0.001	0.65**	0.17*	-0.00	0.09**	0.73
Orkla Finans 30	-0.001	0.98**	0.12**	-0.02	-0.00	0.93
Orkla Finans Inv. Fund	-0.002	0.99**	0.08*	-0.00	0.00	0.95
Orkla Finans Investment Fund	-0.002	0.97**	0.10**	-0.01	0.02	0.94
Pareto Aksje Norge	0.002	0.82**	0.10	0.10	0.00	0.85
Pareto Aktiv	-0.001	0.81**	0.12*	0.04	0.00	0.84
Pareto Verdi	0.005	0.79**	0.14*	0.08	-0.06	0.87
PLUSS Aksje (Fondsforval)	0.001	0.92**	0.02	-0.02	0.01	0.93
PLUSS Index (Fondsforvaltn)	0.001	0.92**	-0.10**	-0.00	0.00	0.97
PLUSS Markedsverdi (Fondsforv)	0.000	0.92**	-0.02	0.03	0.01	0.98
Postbanken Aksjevekst	-0.003	0.96**	0.13**	-0.10**	0.01	0.93
Postbanken Norge	-0.002	0.93**	-0.02	-0.01	0.01	0.98
RF Aksjefond	-0.002	0.93**	0.04	0.01	0.00	0.96
RF-Plussfond	-0.007	1.07**	0.22**	-0.08	0.02	0.95
Sk. Delphi Norge	0.004	1.05**	0.40**	-0.23**	-0.01	0.84
Sk. Delphi Vekst	-0.005	0.96**	0.25**	-0.03	-0.01	0.79
Sk. DnB Norge	-0.003	0.95**	0.02	-0.01	0.04	0.94
Sk. DnB Norge_gml	-0.003	0.88**	0.22*	0.13*	-0.01	0.86
Sk. ODIN Norge	-0.002	0.99**	0.38**	0.19**	-0.01	0.81
Sk. Skandia Horisont	0.014	0.75**	-0.34**	-0.11	-0.16**	0.96
Skandia Horisont	0.005	0.97**	0.22**	-0.04	-0.05	0.92

Skandia Indeks Norge	-0.001	0.94**	-0.04	0.03	-0.01	0.97
Skandia SMB Norge	0.002	1.02**	0.51**	-0.03	-0.13	0.87
Storebrand Aksje Innland	-0.002	0.83**	0.01	-0.05**	0.02	0.97
Storebrand Indeks - Norge	0.006	0.90**	-0.00	0.05	-0.03	0.93
Storebrand Norge	-0.003*	0.98**	0.07**	-0.01	0.03*	0.98
Storebrand Norge A	-0.001	1.00**	-0.03	0.01	-0.00	0.98
Storebrand Norge H	-0.000	0.96**	0.05	-0.01	-0.02	0.95
Storebrand Norge I	0.000	0.87**	0.07**	-0.04	-0.00	0.95
Storebrand Norge Institusjon	-0.003	0.94**	0.07	0.01	0.02	0.97
Storebrand Optima Norge A	0.001	0.87**	0.10**	-0.06*	-0.01	0.93
Storebrand Vekst	0.000	1.02**	0.44**	-0.38**	0.00	0.86
Storebrand Verdi	-0.002	0.89**	-0.05	0.08	0.03	0.92
Terra Norge	0.000	0.98**	0.12**	-0.13**	0.00	0.95
WarrenWicklund Norge	0.001	0.86**	0.16**	0.07*	0.01	0.95
XACT OBX	0.000	0.93**	-0.10**	-0.05	0.00	0.98
Sweden						
Aktie-Ansvar Sverige	-0.003*	0.80**	0.03	-0.02	0.02	0.95
Aktiespararna Topp Sverige	-0.002	0.84**	-0.08**	-0.21**	0.00	0.96
Alfred Berg Småbolagsfond	-0.017**	1.08**	0.53**	0.08	0.15*	0.86
Alfred Berg Sverige Plus A	0.001	0.86**	-0.03	-0.18**	-0.05*	0.93
AMF Aktiefond Småbolag	-0.007*	1.04**	0.35**	0.05	0.06	0.90
AMF Aktiefond Sverige	-0.003	0.87**	0.02	-0.03	0.03	0.94
Atlant Fonder Edge	-0.013	0.57**	0.05	0.09	0.17	0.40
Atlant Fonder Explora	-0.003	0.19**	0.01	-0.07	0.04	0.36
Avanza ZERO	-0.001	0.88**	-0.10**	-0.07*	-0.01	0.96
Banco Etisk Sverige Pension	0.001	0.97**	-0.03	-0.14**	-0.04	0.97
Banco Sverige Pension	0.001	0.98**	-0.04	-0.17*	-0.03	0.97
Bancos Etiska Sverige	-0.002	0.98**	-0.03	-0.18**	-0.01	0.96
Carnegie Safety 90 Sverige	-0.009	0.37**	0.10*	-0.02	0.08	0.52
Carnegie Swedish Large Cap	-0.002	1.04**	0.01	-0.10	-0.01	0.94
Carnegie Swedish Small Cap	-0.012*	1.12**	0.37**	-0.00	0.15*	0.86
Carnegie Småbolagsfond	-0.008	0.90**	0.32**	0.17	0.16	0.74
Carnegie Svea Aktiefond	-0.003	0.85**	-0.00	-0.08	0.00	0.94
Carnegie Swedish Equity Fund A	-0.004	0.83**	0.05	0.08	-0.01	0.82
Carnegie Swedish Equity Fund B	-0.004	0.83**	0.05	0.08	-0.01	0.82
Carnegie Sverige	-0.003	0.79**	0.02	-0.05	0.03	0.93
Catella Allocation Sweden R	-0.005	0.54**	0.01	-0.15	0.02	0.88
Catella Fokus	-0.001	0.83**	-0.03	0.10	-0.02	0.86
Catella Reavinstfond	-0.005	1.01**	0.10**	-0.16**	0.02	0.95
Catella Småbolagsfond	-0.003	0.79**	0.16**	-0.09**	0.03	0.90
Catella Sverige Index A	-0.001	0.85**	-0.03**	-0.04**	-0.01	0.99
Catella Sverige Index B	-0.002	0.99**	-0.01	-0.01	0.01	1.00
Cicero Focus A	0.007	0.89**	-0.14**	-0.18*	-0.08*	0.85
Cicero MÖ Sverige	-0.011**	0.93**	0.13**	-0.06	0.06*	0.87
Cicero SRI Sverige	0.001	0.84**	0.03	-0.07**	-0.03	0.95
Cliens Sverige A	-0.009**	0.68**	0.11	0.12	0.10*	0.77
Cliens Sverige B	-0.009**	0.69**	0.11	0.12	0.10*	0.77
Cliens Sverige C	-0.009**	0.69**	0.11	0.12	0.10*	0.77
Cliens Sverige Fokus A	0.006	0.81**	-0.10	0.08	-0.02	0.83
Coeli Sverige	-0.007	0.93**	0.37**	-0.37**	-0.05	0.78
Coeli Select Sverige	0.005	0.99**	0.03	0.12	-0.04	0.74
Danske Invest SRI Sverige	0.000	0.90**	0.02	-0.03	-0.03	0.97
Danske Invest Sverige	-0.005**	0.91**	0.04*	0.01	0.03	0.95
Danske Invest Sverige Beta	-0.001	0.99**	-0.07**	-0.01	-0.01	0.99

Danske Invest Sverige Fokus	0.009	0.88**	0.06	0.15*	-0.14*	0.81
Didner & Gerge Aktiefond Sv.	0.001	0.97**	0.03	-0.04	0.00	0.91
DNB Fonder Sweden	-0.004	0.97**	0.02	0.01	0.01	0.95
Enter Sverige	-0.004**	0.89**	0.04	-0.06**	0.02	0.95
Enter Sverige Pro	-0.003*	0.91**	0.03	-0.10**	0.02	0.96
Evli Aktieindexfond Sverige	-0.002	0.78**	-0.09**	-0.22**	0.01	0.95
Evli Sverige Aktieindex	0.001	0.98**	-0.08*	-0.05	-0.06	0.97
Evli Sverige Select	-0.008	0.96**	-0.00	-0.07	0.12	0.94
Evli Sverige Småbolag	-0.007	1.10**	0.38**	-0.03	0.09	0.88
Evli Sverigefond	-0.001	0.92**	-0.05	-0.08*	-0.03	0.96
Folksams Aktiefond Sverige	-0.002*	0.85**	-0.04**	-0.05**	0.00	0.98
Folksam LO Sverige	-0.002	0.90**	-0.04**	-0.04**	-0.00	0.98
Folksam LO Västfonden	-0.001	0.89**	-0.03*	-0.03*	-0.00	0.98
Eldsjäl Sverigefond	-0.000	0.87**	-0.02	-0.12**	-0.02	0.96
Granit Fonder Småbolag	-0.001	1.06**	0.23**	0.04	0.00	0.84
Granit Fonder Sverige 130/30	0.000	0.95**	-0.05	-0.02	-0.04	0.89
Gustavia FonderGustavia Sverige	0.002	0.96**	0.23**	0.07	-0.04	0.89
Handelsbanken Mega Sverige Index	-0.001	0.85**	0.00	-0.09**	-0.01	0.98
Handelsbanken SSF Sweden	-0.003	0.99**	0.05	-0.02	-0.02	0.92
Handelsbanken Svenska Småbolag	-0.005*	0.93**	0.35**	-0.01	0.04	0.88
Handelsbanken Sverige Selektiv	-0.005	0.93**	0.03	-0.16**	0.03	0.89
Handelsbanken Sverige Selektiv (A1)	-0.004	0.93**	0.05	-0.17**	0.04	0.89
Handelsbanken Sverige Selektiv (A9)	-0.014*	0.92**	-0.01	-0.18*	0.33**	0.96
Handelsbanken Sverige Selektiv (B1)	-0.005	0.91**	0.02	-0.17**	0.02	0.86
Handelsbanken Sverigefond	-0.002	0.87**	-0.02	-0.08**	-0.01	0.97
Humle Kapitalförvaltningsfond	0.001	0.87**	-0.01	0.02	-0.05	0.95
Humle Småbolagsfond	-0.003	1.07**	0.46**	0.18*	0.01	0.89
IKC Sverige Flexibel	0.002	0.60**	0.13*	0.01	-0.02	0.58
Lannebo Sverige	-0.000	0.90**	0.04	0.00	-0.01	0.92
Lannebo Sverige Plus	0.004	1.16**	-0.00	-0.26**	-0.06	0.92
Lannebo Utdelningsfond	-0.004	0.95**	-0.00	0.08	0.04	0.83
Länsförsäkringar Mega Sverige	-0.003	0.86**	-0.08**	-0.08**	0.02	0.97
Länsförsäkringar Småbolag Sverige	-0.005	1.09**	0.60**	-0.07	0.01	0.88
Länsförsäkringar Sverige Aktiv	-0.002	0.85**	-0.06**	-0.10**	-0.00	0.96
Länsförsäkringar Sverige Index	-0.003	0.94**	-0.04*	-0.05*	0.00	0.98
Monyx Fund SICAV Svenska Aktier	-0.003	0.95**	-0.03	-0.06	-0.00	0.91
CFS Balanserad Movestic	-0.003	0.34**	0.03	0.09	0.01	0.74
CFS Sv/Världen Movestic	-0.003	0.55**	0.02	0.10	0.01	0.92
CFS Världen Movestic	-0.004	0.43**	0.07	0.16	0.03	0.63
Navigera Dynamica 80 Sverige	0.006	0.69**	-0.06	0.15	-0.12	0.80
Nordea Sicav Swedish Equity Fund (SEK)	0.000	0.97**	-0.07*	0.02	-0.04	0.97
Nordea Indexfond Sverige icke-utd	-0.001	1.01**	-0.03	-0.05*	-0.02	0.98
Nordea Inst Aktief Sverige icke-utd	-0.003	1.01**	-0.01	-0.03	0.00	0.94
Nordea Private Banking Sverige Plus	-0.006	1.24**	0.09	-0.04	0.00	0.92
Nordea Selekta Sverige	-0.002	0.98**	-0.02	-0.17**	-0.01	0.95
Nordea Småbolagsfond Sverige	-0.013**	0.98**	0.31**	0.10	0.16**	0.86
Nordea Sweden Fund	-0.002	1.04**	-0.01	-0.03	-0.02	0.97
Nordea Swedish Ideas Equity Fund	0.001	1.02**	0.18	-0.09	-0.09	0.88
Nordea Swedish Stars icke-utd	-0.000	0.88**	-0.05*	-0.06**	-0.02	0.95
Nordea Sverigefond	-0.001	0.88**	-0.02	-0.07**	-0.03	0.96
Nordic Equities Kapförv. Nordic Equities Sweden	-0.007	1.05**	-0.02	-0.02	0.03	0.93
Norron SICAV Active	0.005	1.01**	0.07	0.01	-0.03	0.90
ODIN Sverige	-0.004	0.97**	0.32**	0.28**	0.05	0.83
ODIN Sverige II	-0.013	0.94**	0.20**	-0.05	0.14	0.78
PriorNilsson Sverige Aktiv A	0.002	0.87**	-0.06	0.09	0.01	0.89

Royal Skandia Swedish Eqty	-0.004	0.91**	0.04	0.04	-0.00	0.89
Scientia Fund Management Inside Sweden	-0.010	0.93**	0.15*	-0.01	0.09	0.90
SEB Hållbarhetsfond Sverige Lu	0.001	0.93**	-0.06**	-0.05**	-0.04**	0.98
SEB PB Svensk Aktieportfölj	-0.003*	0.89**	-0.03	-0.08**	-0.00	0.98
SEB Special Clients Sverige	-0.005	1.02**	0.02	-0.07	0.00	0.91
SEB Swedish Ethical Beta Fund	0.001	1.01**	-0.07*	-0.05	-0.06	1.00
SEB Swedish Focus Fund C SEK	-0.012*	0.89**	0.05	-0.02	0.09	0.98
SEB Swedish Focus Fund SEK	-0.002	1.01**	-0.06	-0.06	-0.00	0.93
SEB Swedish Value Fund	-0.001	1.03**	0.01	0.05	-0.01	0.91
SEB Sverige Indexfond	-0.005	0.93**	-0.09*	0.01	0.05	0.98
SEB Sverige Småbolag	-0.004	0.87**	0.28**	-0.02	0.02	0.88
SEB Sverige Småbolag C/R	-0.002	0.94**	0.34**	-0.04	0.01	0.85
SEB Sverigefond	-0.004	0.83**	0.04	0.02	0.00	0.91
SEB Sverigefond C/R	-0.002	0.83**	0.00	-0.01	-0.02	0.89
SEB Sverigefond Småbolag P	-0.020**	0.82**	0.14	0.13	0.36**	0.89
Skandia Småbolag Sverige	-0.004	0.99**	0.38**	-0.02	0.02	0.87
Skandia Svea Aktiv	-0.010*	1.03**	0.02	-0.16*	0.03	0.94
Skandia Sverige	-0.003	0.86**	-0.02	-0.04*	0.00	0.97
Skandia Sverige Exponering	-0.001	1.00**	-0.07**	-0.06	-0.01	0.98
Skandia Swedish Equity Fund	-0.002	0.96**	0.12*	0.07	-0.04	0.86
Skandia Swedish Growth Fund	0.002	0.98**	-0.04	-0.02	-0.05	0.94
Solidar Fonder Sverige	-0.003	0.99**	-0.01	-0.02	0.02	0.91
Sparbanken Aktiefond Sverige	-0.002	0.97**	0.02	0.02	-0.02	0.95
Spiltan AF Investmentbolag	-0.004	1.13**	0.08	-0.06	0.06	0.92
Spiltan Aktiefond Dalarna	-0.005	0.92**	0.21**	0.06	0.03	0.90
Spiltan Aktiefond Småland	-0.004	0.96**	0.33**	0.11	0.06	0.89
Spiltan Aktiefond Stabil	-0.003	0.68**	0.17**	-0.02	0.04	0.81
Spiltan Aktiefond Sverige	-0.009*	0.97**	0.24**	0.01	0.08	0.85
SpotR OMXS30	0.001	0.98**	-0.10**	-0.02	-0.04*	0.98
SPP Aktiefond Sverige A	-0.003	0.87**	-0.09**	-0.20**	0.01	0.96
SPP Aktiefond Sverige Aktiv	-0.004*	0.88**	-0.02	-0.07**	0.02	0.96
SwedBank/Robur Banco Småbolag	-0.005	1.11**	0.60**	-0.21**	0.01	0.88
SwedBank/Robur Banco Svensk Miljö	-0.008*	0.90**	0.13**	-0.10**	0.05	0.94
SwedBank/Robur Banco Sverige	-0.004**	0.87**	-0.00	-0.13**	-0.01	0.97
SwedBank/Robur Carnegie Sverige	0.001	0.94**	-0.03	-0.17**	-0.02	0.97
SwedBank/Robur Ethica Miljö Sverige	-0.003	0.87**	0.05	0.02	-0.01	0.94
SwedBank/Robur Ethica Sverige	-0.000	0.89**	-0.05**	-0.13**	-0.04**	0.97
SwedBank/Robur Ethica Sverige MEGA	0.001	0.93**	-0.02	-0.04*	-0.04*	0.97
SwedBank/Robur Småbolagsfond Sverige	-0.003	0.97**	0.35**	-0.02	0.02	0.86
SwedBank/Robur Stella Småbolag	-0.002	1.03**	0.50**	-0.21**	-0.01	0.88
SwedBank/Robur Svensk Aktieportfölj	-0.001	1.05**	0.06	0.06	-0.02	0.93
SwedBank/Robur Sverigefond	-0.004**	0.90**	0.01	-0.01	0.01	0.98
SwedBank/Robur Sverigefond MEGA	-0.004**	0.88**	0.02	-0.01	0.03	0.98
Tanglin Tangent småbolagsfond	-0.011	1.44**	0.76**	0.00	0.08	0.81
Västra Hamnen Fonder Awake Swedish Equity Fund	-0.000	0.92**	0.37**	0.05	-0.05	0.89
Xact Sverige Index Criteria	-0.002	0.99**	0.03	-0.03	-0.01	0.98
Xact Sverige OMXSB Index	-0.001	1.04**	-0.05**	-0.08*	-0.02	0.98
Xact Sverigefond Index	-0.002*	0.80**	-0.02	-0.05**	0.00	0.98
Xact XACT OMXS30	0.002	0.85**	-0.11**	-0.14**	-0.04**	0.97
Ålandsbanken Swedish Eq	-0.003	1.23**	0.42**	-0.05	-0.05	0.80
Ålandsbanken Sweden OMXS30	-0.004*	0.82**	-0.09**	-0.21**	0.02	0.96
Ålandsbanken Swedish Growth	-0.003	1.08**	0.03	0.04	-0.00	0.94
Ålandsbanken Swedish Small Cap	-0.013*	0.99**	0.53**	-0.15**	0.06	0.85
Öhman Etisk Index Sverige	-0.000	0.92**	-0.06**	-0.02	-0.02	0.99
Öhman Etisk Index Sverige B	0.002	0.96**	-0.07**	-0.04	-0.05*	0.99

Öhman Index Sverige	-0.000	1.00**	-0.06**	-0.04*	-0.02*	0.99
Öhman Index Sverige B	0.002	0.95**	-0.06**	-0.03	-0.05**	1.00
Öhman Småbolagsfond A	-0.002	0.91**	0.32**	-0.02	-0.00	0.88
Öhman Småbolagsfond B	-0.006	0.94**	0.16**	0.05	0.14	0.88
Öhman Sweden Micro Cap	-0.002	0.89**	0.44**	0.03	0.01	0.85
Öhman Sverigefond	-0.002	0.85**	-0.01	-0.16**	0.01	0.97
Öhman Sverigefond 2 A	-0.003*	0.86**	-0.03	-0.05**	0.01	0.97
Öhman Sverigefond 2 B	-0.002	0.91**	-0.00	-0.00	-0.01	0.97
Öhman Sverige Koncis	-0.002	0.92**	0.00	-0.06*	-0.01	0.95
Öhman Sverige Koncis B	-0.000	0.90**	-0.04	-0.05	-0.04	0.95

APPENDIX 2 MATLAB CODE

Bootstrap methods

```
%This script requires the Newey-West package obtainable from:
%https://se.mathworks.com/matlabcentral/fileexchange/41275-newey-west-
standard-errors
%%% funds.xlsx is an excel spreadsheet of mutual fund returns
%%% factorRet.xlsx is an excel file of factor returns with columns:
%%% Rm, Rf, SMB, HML, MOM

[fundR,~,fund_raw] = xlsread('funds.xlsx');
[factorR,~,factor_raw] = xlsread('factorRet.xlsx');
[T, N] = size(fundR); % T is the number of months; N is the number of
funds
[~, K] = size(factorR); % K is the number of factor returns
K = K-1; % Risk-free interest rate is not a factor return

%%% First estimate using all funds saving coefficients and residuals
 for i = 1:N
    idx = find(isnan(fundR(:,i))==0); % Finds valid observations
    fund_i = fundR(idx,i);
    length_i = length(fund_i);
    Rm = factorR(idx,1);     rf = factorR(idx,2);
    MKT = Rm-rf;
    SMB = factorR(idx,3);
    HML = factorR(idx,4);
    MOM = factorR(idx,5);
    intercept = ones(length_i,1);
    excessR = fund_i-rf;

    % Factor returns are saved for the Kosowski method
    MKT_b{i} = MKT; SMB_b{i} = SMB; HML_b{i} = HML; MOM_b{i} = MOM;

    %Get intial alpha estimates and residuals
    [out,~,res] = regress(excessR,[intercept,MKT,SMB,HML,MOM]);
    SE = NeweyWest(res, [intercept,MKT,SMB,HML,MOM], -1,0);
    savedResiduals{i} = res;
    savedResidualsFF{i} = NaN(T,1); %% Saved with timestamp preserved-
    savedResidualsFF{i}(idx) = res; %% for Fama-French method
    savedCoef{i} = out;
    alpha(i) = out(1); % t-stat of alpha
    tstat(i) = out(1)/SE(1); %t-stat of alpha
 end
 alpha = sort(alpha); tstat = sort(tstat);

 %% Kosowski, Timmermann, Wermers & White (2006) method
 for b = 1:10000
    for i = 1:i
        % Generate the random sample of residuals from the available-
        % observations
        res_i = savedResiduals{i};
        lenr = length(res_i);
        T_b = randi([1,lenr],lenr,1);
        res_b = res_i(T_b);
        intercept_b = ones(lenr,1);
```

```
        % Calculate pseudo excess returns
        c = savedCoef;
        pseudoR = c{i}(2)*MKT_b{i}+c{i}(3)*SMB_b{i}+ ...
            c{i}(4)*HML_b{i}+c{i}(5)*MOM_b{i}+res_b;

        % Estimate alpha from bootstrapped returns
        [out_b,~,residuals_b] = regress(pseudoR, [intercept_b, ...
            MKT_b{i}, SMB_b{i}, HML_b{i}, MOM_b{i}]);
        SE_b = NeweyWest(residuals_b, [intercept_b, MKT_b{i}, ...
            SMB_b{i}, HML_b{i}, MOM_b{i}], -1, 0);

        alpha_b(b,i) = out_b(1);     %Save alpha and t-stat
        tstat_b(b,i) = out_b(1)/SE_b(1);
    end
    % Sort alphas and t-stats from best to worst
    alpha_b(b,:) = sort(alpha_b(b,:));
    tstat_b(b,:) = sort(tstat_b(b,:));
 end

%% Fama & French (2010) method
factorR2 = [factorR(:,1)-factorR(:,2), factorR(:,3:end)];
for b = 1:10000
    T_s = randi([1, T],T,1);    %Draws a random sample of factor
returns
    F = factorR2(T_s,:);  %Generate the set of resampled factor
returns

    for i = 1:N
       % Calculate pseudo returns
       pseudoR = F*savedCoef{i}(2:end) + savedResidualsFF{i};
       pseudoR = pseudoR(find(isnan(pseudoR)==0)); % Filter out NaNs
       intercept = ones(length(pseudoR),1);
       F_i = F(find(isnan(pseudoR)==0),:);
       if length(pseudoR) < 8
          continue; % Abort if not enough observed returns
       end

       % Estimate alpha from bootstrapped returns
       [out_b,~,residuals_b] = regress(pseudoR, [intercept, F_i]);
       SE_b = NeweyWest(residuals_b, [intercept, F_i], -1, 0);
       alpha_b(b,i) = out_b(1);          %Save alpha and t-stat
       tstat_b(b,i) = out_b(1)/SE_b(1);
    end
    % Sort alphas and t-stats from best to worst
    alpha_b(b,:) = sort(alpha_b(b,:));
    tstat_b(b,:) = sort(tstat_b(b,:));
end
```

Kalman filter

```
% yt is a (T x 1) vector of fund returns
% Ft is a (T x m) vector of factor returns and alpha column of ones
% init_param is a (1 x m+1) vector of initial guesses of
hyperparameters
% init_coeff is a (m x 1) vector of initial coefficients
% xOut is a global (T x m) vector of the estimated (dynamic)
coefficients
```

```
% POut is a global (T x m) vector of the error covariance

function [logLikelihood, param] = estimateKalmanFilter(y, Z,
init_param, init_coeff)

global T;
global m;
[T, m] = size(Z);

options = optimset('Display', 'off', 'FunValCheck', 'on', 'TolFun',...
    10^-10, 'TolX', 10^-10, 'TolCon', 10^-10, 'MaxFunEvals', 10000);
lowerBound = 1e-10;      %Lower bound for variance estimates
lb = ones(1,m+1)*lowerBound;

[x,fval] = fmincon(@KalmanFilter, init_param, ...
    [], [], [], [], lb, [], [], options, y, Z, init_coeff);
param = x;
logLikelihood = fval;



function logLikelihood = KalmanFilter(param, y, Z, init_coeff)
global xOut;
global POut;
global m;
global T;
R = param(1);
Q = diag(param(2:end));
Tt = eye(m);

xt = init_coeff;
xOut(1,:) = xt;
Pt = Q;
POut(1,:) = diag(Pt)';
logLikelihood = -(T/2)*log(2*pi);

for i = 2:T
    %Predict
    xt = Tt*xt;             %xt|t-1 State prediction
    Pt = Tt*Pt*Tt'+Q;       %Pt|t-1 Covariance prediction

    %Update
    Zt = Z(i,:);            %Factor returns at time = i
    yt = Zt*xt;             %Prediction for return at time = i
    it = y(i)-yt;           %Innovation residual
    Ft = Zt*Pt*Zt'+R;       %Innovation Covariance
    Kt = Pt*Zt'*inv(Ft);    %Kalman gain
    xt = xt+Kt*it;          %Update state
    Pt = Pt-Kt*Zt*Pt;       %Update covariance

    xOut(i,:) = xt;
    POut(i,:) = diag(Pt)';
    logLikelihood = logLikelihood - (1/2)*log(det(Ft)) - ...
        (1/2)*it'*inv(Ft)*it;
end
logLikelihood = -logLikelihood;
```

APPENDIX 3 THIRD PARTY FACTOR RETURNS

This appendix contains a comparison of the factor returns calculated specifically for the methods in this thesis and those calculated by other researchers. Table 16 discloses the correlation of these internal and external factors. Table 17 contains the alternative results of bootstrapped evidence for the Norwegian and Swedish market. These are obtained with the Fama & French (2010) method with the third party factor returns as the utilized benchmarks.

Table 16 Correlation with third party factor returns

This table presents the correlation of the factor returns calculated in this thesis to those calculated by Bernt Ødegaard (Norway) and Stefano Marmi (Sweden). The star (*) indicates that the factor return is calculated using the WML methodology, which makes it less comparable to the MOM factor utilized in this study.

	Rm	rf	MKT	SMB	HML	MOM
Norway	0.9694	0.9729	0.9114	0.6287	0.5522	0.5375
Sweden	0.9631	0.9947	0.9713	0.7816	0.7120	0.0927*

Table 17 Bootstrap results with alternative factor returns

This table contains bootstrapped evidence of mutual fund performance when the third party factor returns of Bernt Ødegaard (Norway) and Stefano Marmi (Sweden) are utilized. Panel A contains the results for Norwegian funds when the alternative Norwegian dataset is used as is. In Panel B, the same factors are used, but the market index is replaced with the more representative OSEFX index which takes the investment set of mutual funds into account. Panel C contains the results for the Swedish market and Panel D repeats this, but utilizes the SIXPRX index instead of Steano Marmi's own all-share index. The %(sim>act) value is generated with the Fama & French (2010) method and significant values are indicated with **bold** text. The t-statistic is based on estimated 3-factor alphas.

	Worst	2nd	3rd	1 dec	2 dec	3 dec	||	8 dec	9 dec	10 dec	3rd	2nd	Best
	Panel A: Ødegaard factors												
t-stat	-4.790	-4.610	-4.353	-3.888	-3.069	-2.515		-0.763	-0.093	2.479	4.034	4.150	4.305
%(sim>act) (F&F)	**0.986**	**0.998**	**0.999**	**0.996**	**1.000**	**1.000**		**1.000**	**0.998**	0.589	0.150	0.175	0.258
	Panel B: Ødegaard factors with OSEFX index												
t-stat	-3.869	-3.846	-3.465	-2.666	-1.566	-1.095		0.7526	1.278	2.7016	3.6911	3.7355	3.8056
%(sim>act) (F&F)	**0.959**	**0.996**	**0.995**	**0.965**	**0.979**	**0.963**		0.7561	0.6857	0.3882	0.1546	0.2097	0.337
	Panel C: Marmi factors												
t-stat	-4.781	-3.805	-3.653	-3.402	-2.678	-2.398		-0.436	0.223	0.848	1.260	1.332	1.773
%(sim>act) (F&F)	**0.994**	**0.996**	**0.999**	**0.996**	**0.999**	**0.999**		**0.994**	0.979	0.975	0.979	0.983	0.969
	Panel D: Marmi factors with SIXPRX index												
t-stat	-7.304	-6.103	-5.825	-5.433	-4.046	-3.197		-0.376	0.345	0.973	1.228	1.359	2.161
%(sim>act) (F&F)	**0.999**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**		**0.989**	0.962	0.960	0.980	0.981	0.920