OSLO METROPOLITAN UNIVERSITY

FACULTY OF SOCIAL SCIENCES

MASTER'S THESIS

SCALE AND SKILL IN MUTUAL FUND MANAGEMENT: EVIDENCE FROM NORWAY

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Abstract

A sample free of survivorship bias is used to identify effects of scale on mutual fund performance in the Norwegian market. Using several risk-adjusted performance benchmarks, I find mixed evidence that both large and small funds underperform the middle sized funds in the period 2005-2018. Controlling for relevant factors in panel data regressions find that on average, performance worsens with an increase in size while giving support to initial findings of nonlinearity. The relationship is most robust after 2013 and seems to be affected by competition in the market as well as fund inflows. No empirical evidence is found supporting the liquidity hypothesis.

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1 Introduction

The Norwegian Mutual Fund industry has been growing at remarkable rates since the financial crisis of 2008 due to low interest rates, new pension regulations and increased availability and knowledge (VFF, 2018). This raises the question of how stakeholders adapt to the increases in scale and should be of special concern for investors trying to pick the best performing mutual funds. This study provides the first evidence to my knowledge of how the size of a Norwegian mutual fund's asset base affects future performance through several risk-adjusting measures.

Active mutual funds are found to underperform passive strategies after costs (Jensen, 1968) (Carhart, 1997) (Fama and French, 2010). Still, investors choose to trust managers in allocating their assets. This paradox has puzzled students of finance for years, bringing mainly two questions: why do active funds underperform their benchmarks and why do investors still choose them? This thesis aims to increase understanding by answering the following questions:

1. Does the size of a fund's asset base affect risk-adjusted performance among Norwegian active mutual funds investing in Norwegian equities?

2. Are there any factors affecting the relationship between size and performance?

Many authors have contributed to the research regarding manager performance, providing some consensus on the role of fund size. Studies on funds in the US mainly show that fund performance worsens with size due to increased trading costs from liquidity issues and price movement (Chen et al., 2004) (Perold and Salomon, 1991) (Pástor, Stambaugh, and Taylor, 2014). Indro et al. (1999) complicate the picture as they find that the relationship is nonlinear; performance increases with size up to a certain point as more resources lead to more information and better commission rates until exceeding its optimal size. When too big, performance worsens as funds experience higher transaction costs, more attention, and administrative stress.

A cross-sectional study compared findings in the US with 26 other countries from 1997 to 2007 (Ferreira, Keswani, and Miguel, 2012). They find the negative relationship to be valid in the US only as effects of scaling for non-US funds are positive. As loadings on the non-US funds are aggregated, they do not comment on the coefficients for every country separately. Studies have been done on the performance of Norwegian mutual funds, although to my knowledge, none are looking specifically at the relationship between fund size and performance.

Berk and Green (2004) construct a model to explain these empirical findings. They assume that there is competitive provision of capital by investors to mutual funds, that managers have significant skill that comes to the surface from studying past returns, and that their abilities suffer from decreasing returns to scale. Funds then attract new money up until the point where expected alpha after costs is zero. The model seems to be consistent with some empirical findings, even though Fama and French (2010) argued that it was based on false assumptions as they find that in equilibrium, investors have negative alpha after costs.

Motivated by these findings, I attempt to investigate if results found in the US can be extended to the Norwegian market. This is of importance as managers and investors in smaller markets are basing their decisions on assumptions that might only be true in the US, a market of unmatched size. At the end of 2018, domestic companies listed in Norway had a market cap of about USD 267 billion, while companies in the US had a market cap of about USD 30 trillion. The Oslo Stock Exchange had around 240 listed stocks, and the NYSE and Nasdaq traded around 8000 stocks in total[1]. As fewer stocks make it harder to diversify, I expect liquidity problems to be a bigger problem in Norway, possibly stating a stronger negative relationship between size and performance.

Factors such as the size of the mutual fund industry and the concentration of its competition are also expected to affect performance. With more (less) money chasing mispriced assets, a higher (lower) price pressure is to be expected, although it might also bring positive incentives to perform. It might also be that the size of the fund's owning company plays a role as bigger families have more resources and organizational possibilities.

Using a survivorship-bias-free dataset from two different sources I study 49 mutual funds investing in Norwegian equities from January 2005 to December 2018. Using monthly data, I start by dividing funds into three groups based on their assets under management for every month in the sample. Allowing for funds to change group through time, which they do on average every 25th month, makes for a more realistic comparison of group performance. Initially, groups are compared using three different risk-adjusted performance measures. While Sharpe Ratio shows no significant difference in performance, small and large funds both underperform medium funds in terms of Information Ratio. The same results emerge when studying alpha values from Fama and French' three-factor model although not as significant when adding a fourth momentum factor to the regression.

[1]The World Bank. (2019, May 01). The World Bank: Data. Retrieved from The World Bank: https://data.worldbank.org/indicator/CM.MKT.LDOM.NO

Cross-sectional analysis in a panel data framework is utilized to investigate whether performance depends on lagged fund size, also when controlling for relevant factors. Performance is risk-adjusted by three performance benchmarks, accounting for the possibility that funds load differently on different strategies. Lagged fund characteristics are included and controlled for as they may correlate with size and drive performance. Three dependent variables are then regressed on a set of independent variables including size, age, expense ratio, family size, industry size, competition level, fund strategy, manager history, and fund flows. Two different estimation methods are utilized. A pooled regression uses OLS technique on all the data together while a fixed effects model allows for different intercepts for the variables. The pooled model makes for an omitted-variable bias as skill, which is unobservable, might affect both size and performance. The fixed effects model makes for a new regression-to-the-mean bias, probably affecting coefficients in the opposite direction. Presenting results from both methods give a more nuanced picture.

All six models indicate that performance is negatively correlated with an increase in size. A ten percent increase in assets erodes performance by 5 bps annually according to the pooled models while fixed effects estimates between 20 and 35 bps annually. The notion of nonlinearity found in the group analysis is strengthened as the results are more significant when excluding the smallest funds and weaker when excluding the biggest funds. Dividing the sample into periods unveils that the negative correlation has been strongest after 2013, present but not as strong in the period containing the financial crisis of 08 and weakest in the period from 2009 to 2013. I find little evidence of why the negative relationship seems to exist, which is open for further study.

I find a positive correlation between fund inflow and performance as return on new cash flow is better than the average return. This finding might indicate that investors are more rational than we think and can predict future performance or that new money helps managers alter exposure and increase their best positions. Further, I find mixed evidence of a negative correlation between the size of the industry and performance. This confirms studies in the US showing that when more money is chasing good deals, performance suffers (Pástor, Stambaugh and Taylor, 2014).

Further, I find that an increase in density of the competition (decrease in Herfindahl-Hirschman Index) leads to improved performance when models are applied to the period after 2013. In contrast to findings related to the size of the industry, this indicates that tougher competition seems to bring positive incentives for managers and positively affecting performance. I find no evidence of liquidity issues as no coefficients concerning fund strategy (small-cap funds) are statistically significant.

Financial intermediaries are introducing success fees which makes identification of drivers behind the performance of increased importance both for managers and investors. This paper contributes in this aspect by identifying factors that should be considered by all participants. Implications in the Norwegian market might be more funds competing while trying to keep size to certain levels. This will probably be good for investors as agency costs are reduced although non-symmetric risk still exists.

The paper proceeds as follows. Section 2 presents existing literature on the topic, Section 3 describes the data and the construction of variables, Section 4 analyses group performance while Section 5 discusses the panel data methodology. Section 6 presents the results and Section 7 concludes.

2 Theory

One of the first attempts to explain expected returns with regard to risk is the Capital Asset Pricing Model (Treynor 61-62, Sharpe 64 and Lintner 65). The model assumes that investors have homogenous expectations and are trying to maximize returns for a given variance or to minimize the variance for a given return.

The expected return for an asset less the risk-free rate will be the expected return for the market less the risk-free rate adjusted by the correlation between the market and the asset and the risk of the market, given by β. CAPM is then given by:

$$E[r_i] - r_f = \beta_i(E[r_m] - r_f) \quad (1)$$

The only risk factor in the model is the variance of the market, so the abnormal returns found by eliminating the market risk will be from the mispricing of assets in the market or other risk factors that funds are exposed to.

Building on Ross' factor model from 1976 (Ross, 1976), Fama and French (1993) suggested two additional risk factors in a regression framework where in addition to the market risk premium, the model includes the size factor SMB (Small Minus Big) and the value factor HML (High Minus Low)[2] as well as the intercept term alpha (α).

[2]SMB mimics the risk factor in stock returns related to size. It is calculated as the difference between the returns on small- and big-stock portfolios with the same weighted average book-to-market equity. HML is the risk factor in stock returns related to book-to-market equity. It is calculated by subtracting returns of stocks with a low book-to-market ratio from stocks with a high book-to-market ratio with about the same size (Fama and French, 1993).

Studying the alpha will be of interest in this thesis as it represents a funds' performance in excess of the expected return estimated by the regression and its risk factors. The model was extended further when Carhart (1997) introduced a momentum factor to adjust for an assets tendency to continue rising if it is going up and continue declining if it is going down. Fama and French (2015) adds to the asset pricing universe by introducing a five-factor model. Two factors are added, namely profitability and investment. The first is the difference between returns on portfolios of stocks with good and weak profitability, and the latter is the difference between returns on portfolios of stocks of conservative and aggressive investment firms. The five-factor model is found to improve predictability from the three-factor model although it does bring some problems. The extended model fails to fully capture the low average returns of small stocks, and the investment factor is shown to be redundant in Europe and Japan (Fama and French, 2017).

2.1 Empirical Studies

There have been multiple studies trying to apply the models to empirical data. Jensen was among the first to evaluate manager skill with an absolute measure of performance by adjusting for risk. Using the CAPM in regressions, he estimated alpha values for mutual funds from 1945 – 1964. Positive and significant alpha values would imply that fund managers beat the market, but Jensen finds little to no evidence that actively managed funds outperform their passive benchmarks (Jensen, 1968).

In later years, Carhart (1997) supports Jensen's findings of uninformed mutual fund managers. Fama and French (2010) also find that few funds produce benchmark-adjusted expected returns that cover their costs, even though there were funds with nonzero true alpha in the extreme tails of the estimates (Fama and French, 2010). Kosowski, Timmermann, Wermers, and White (2006) took a closer look at the extreme performing funds. By using bootstrap approaches to control for nonzero alphas expected by chance they find that the large positive alphas of the top ten percent performing US funds are extremely unlikely to be due to luck only. Alphas also seem to persist through time, indicating that some fund managers do have superior skills.

Studies on Norwegian mutual funds show that the mixed results in the US can be generalized to smaller markets. Using several risk-adjusted performance measures, Gjerde and Sættem (1991) find that managers did show market timing skill although their ability to pick stocks was limited from 1982-1990. This is supported by Sørensen (2009), who expands the period to 1982-2008 and finds no evidence of abnormal performance after adjusting for risk in the Fama-French three-factor model. Using daily data from 2000-2010, Gallefoss et al. (2015) provide further perspectives when finding that top and bottom performers cannot be explained solely by luck and that the mutual fund industry as a whole underperforms the benchmark by about the fund fees.

Finding evidence of skill is a challenge as performance comes as a result of many factors and skill cannot be observed in its own. Institutional conditions contain some of the factors and make the basis for this thesis. Studies have been looking at characteristics such as fund strategy, finding that funds focusing on growth stocks have been performing better than funds focusing on value stocks (Jegadeesh, Chen and Wermers, 2000) and (Kosowski et al., 2006).

2.2 Fund Size

The size of the fund itself has also been considered a contributing factor of risk-adjusted performance. Especially with the massive growth of assets in the money management industry, the question of economies of scale should be of special concern for investors and managers. Some previous studies argue that a large asset base erodes performance as a result of increased trading costs due to liquidity constraints and price movement (Perold and Salomon, 1991). They argue that returns decline while wealth created increases up to a point where the cost of additional trading exceeds the opportunity cost of not trading.

The negative relationship between size and performance is supported by Chen et al. (2004) who find that fund returns decline with lagged fund size after accounting for risk through various performance benchmarks constructed through market-adjusted returns, CAPM and the Fama-French three-factor model. They use the log-transformed fund's assets under management (AUM) as a proxy for size and utilize a regression framework to control for fund characteristics such as fund age, strategy, expense ratio, flow of assets, and the size of the fund family. This lets them point the finger at liquidity problems being one of the reasons for the negative relationship as it is strongest among funds investing in small and illiquid stocks. The decreasing returns to scale also depend upon how the fund is organized within its owner companies' family of funds as return does not deteriorate with the size of the family it belongs to.

Pollet and Wilson (2008) complement Chen et al. (2004) when finding evidence that funds investing in the small-cap sector benefit more from diversification after controlling for fund- and fund family size in a panel data specification. The study looks at how fund characteristics such as diversification (proxied by the number of stocks in the portfolio) and scaling (the average log ownership share in stocks held) affect the flow of money into the fund. Large-cap funds seem to diversify slower in response to growth in AUM. The same study also finds that fund families rather than individual funds suffer from growth in that funds with many siblings diversify slower.

Pástor, Stambaugh, and Taylor (2014) look at pooled regressions, fixed effects models and a recursive demeaning procedure to see how performance (benchmark-adjusted return) is affected by the size of the industry (sum of AUM of all funds in the sample) and size of the fund's AUM at time *t*-1. They find that the ability to beat its benchmark decline with an increase both in industry and fund size. As more money chases good deals - prices move, making it harder to find and enter wanted positions, especially when bigger trades have to be done.

To which degree scaling funds are suffering due to liquidity issues does depend on how they invest new money. Funds could choose to invest in more information by hiring more people who could expand the investment universe by analyzing new stocks. Instead, they seem to increase their bets on existing positions (Pollet and Wilson, 2008). In contrast to smaller funds which can put all its money in its best ideas, a lack of liquidity forces larger funds to choose between investing in not as good ideas or taking larger than optimal positions in existing bets.

Although these results suggest that smaller is better the picture is probably a bit more complicated. Indro et al. (1999) find that risk-adjusted performance through CAPM and price multiples increase with increases in the size of AUM up to a certain point as more resources lead to more information and better commission rates. When funds exceed their optimal size, the relationship turns negative due to several reasons. First, transaction costs will increase as large trades increase bid-ask spreads and makes prices harder to predict. Second, bigger firms are subject to more attention and suffer administrative stress with having to hire more people and reorganize. Indro et al. (1999) conclude that 20 percent of funds in their dataset are smaller than break-even costs and that the biggest 10 percent of funds are overinvesting in information. Further, they find that growth funds are more affected by the limited opportunity sets that come with increased size than funds with a value or blend strategy.

In order to explain these patterns and why investors keep paying management fees when funds underperform their benchmarks, Berk and Green (2004) derive a model that combines three elements:

1. There is competitive provision of capital by investors to mutual funds
2. There is differential ability to generate high average returns across managers but

decreasing returns to scale in deploying these abilities

3. There is learning about managerial ability from past returns

The model assumes that funds have a given positive alpha before costs and that costs are a convex function of the funds' assets. Investors will rationally think that good performance is a sign of skill and funds will attract money up until the point where expected alpha after costs is zero. All investors have a zero expected excess return in equilibrium. When funds grow, volatility decreases as funds that have done well invest bigger portions of their new capital in passive strategies. Funds that have done worse, on the other hand, increases risk in an attempt to turn things around. This is consistent with Chevalier and Ellison (1997) who find that mutual funds did alter their risk exposure at the end of the year in the period 1982-1992 to maximize the inflows to the fund. This risk-adjustment has proved to depend in parts on compensation structures and to be more common for funds whose managers have longer tenures (Chen and Pennacchi, 2009).

Berk and Green argue that the model makes room for high levels of skill among fund managers and that it is consistent with empirical findings from the past. Fama and French (2010) on the other hand, deny that the model is consistent with their findings. They describe it as an attractive theory, but that the assumption of positive alpha is false. Fama and French (2010) find that in equilibrium accounting, investors have zero alpha before costs and negative alpha after costs.

All studies discussed in this chapter utilize data on mutual funds operating in the US. A cross-sectional study compares these findings to 26 other countries spanning from 1997-2007 (Ferreira, Keswani, and Miguel, 2012). Using an extensive list of fund characteristics and similar regression models to Chen et al. (2004), they find that the diminishing return to scale is not universally true for other markets. Non-US funds show a positive correlation between size and performance, also controlling for country-specific factors. As loadings on the non-US funds are aggregated, they do not comment on the coefficients for every country separately, making it hard to see which countries are driving the results. They find that the Norwegian mutual fund industry is about five percent of the US in terms of number of funds and less than one percent in terms of total net assets.

Although studies have been published on the performance of Norwegian mutual funds, I have not found any empirical research on the relationship between size and performance in the Norwegian market. This paper seeks to complement findings from the US markets and to examine whether the same results can be applied in Norway.

3 Data

To examine the effect of fund size on performance, data was used from the Thomson Reuter Lipper database, Thomson Reuter Datastream, and Morningstar. The study looks at monthly observations for 49 actively managed mutual funds with a Norwegian equity focus and spans the period from January 2005 to December 2018.

The asset universe is restricted to active mutual funds registered for sale in Norway with Lipper Database classification of Equity Norway. These are funds with a primary focus on the Norwegian market and at least 80 percent of their assets invested in Norwegian equities, leaving some room for cash holdings. This excludes bond funds and other non-equity funds as well as index funds. All funds follow the European Union UCITS directives for investor protection which states that fund's need to hold at least 16 different equities to ensure diversification. The 5/10/40 rule says that a maximum of 10 percent of a fund's net asset may be invested in a single asset and that investments of more than 5 percent with a single issuer may not make up more than 40 percent of the whole portfolio (European Parliament, 2014). A complete list of funds in the sample can be found in the appendix (A.1).

Survivorship bias is avoided by including liquidated and merged funds for the periods for which they were active. This could only be done by using multiple databases as inactive funds did not have information about Total Net Assets (TNA) in the Lipper database. Utilizing an additional source also made it possible to compare data in the two databases which gives added certainty to the quality of the data. No significant differences were found neither in TNA or Net Asset Value (NAV) between the databases. Morningstar also provides additional relevant aspects to the dataset such as manager history and a Morningstar fund category which helps to classify the strategy of the fund. The sample starts in 2005 as this is the earliest reported monthly observations of TNA.

A fund may enter the dataset several times as the database reports different share classes for the same fund. Assuming that managers take decisions for the fund in its entirety and cares less about the sizes of each class, classes of a fund are merged into one representative. TNA is summarized and one of the classes' NAV is chosen to represent the fund, effectively making sure that each fund is represented only once. NAV is reported after costs and might, therefore, vary for different classes as institutional investors usually pay less than private investors. As every fund does not have institutional classes, the most expensive class is chosen to have comparable returns across funds. As a new class is introduced a significant increase in the merged fund's TNA usually appears as it is launched with rather big investors. This might be a weakness in the data but should overall make for random errors as it should not significantly affect performance the next month.

3.1 Risk Free Rate

In the estimation of fund's factor loadings and calculation of Sharpe Ratio, returns in excess of the risk-free rate is used. As a proxy for the risk-free return monthly averages of the nominal Norwegian Interbank Offered Rate (NIBOR) is used. This is a commonly used proxy in Norwegian markets and is gathered from Norges Banks' webpages for the period before 2013 (Norges Bank, 2019) and from Oslo Stock Exchange for the period after 2013 (Oslo Børs, 1991). As both sources link to each other for their respective periods, it is assumed that the data is calculated equally and can be combined to span the whole period.

3.2 Fund Groups

To get a better understanding of the data and to see how funds of various sizes perform in different periods, funds are divided into three groups for every month they appear in the dataset. Funds can move between groups through time but at any given month the active funds at that time are divided in the 0.33 and 0.66 percentiles which make for three equally big groups every month.

As the total number of funds varies, so does the group sizes. There is a minimum of 10 funds in each group, maximum of 15 and an average of 12.7 funds. Funds change group on average every 25th month, which makes room for alterations through time and lets the funds contribute to the group they belong to at the time. Summary statistics for group sizes are presented in Table 1 where values of AUM is inflated to NOK as of 31.12.2018 using monthly data on the Norwegian Consumer Price Index (SSB, 2019). Groups do overlap in terms of minimum and maximum values since they are taken at different points in time and that the mutual fund industry has experienced significant growth in the period. Of special interest might be the Variation column, calculated as standard deviation of AUM as a percentage of mean AUM. The Small and Large groups experience significantly higher variation than the Medium group, showing that there are some extreme values of fund size at tails on both sides.

Table 1
Descriptive Statistics

The table shows descriptive statistics in NOK for the funds in the sample. Funds are divided into groups for every month of the dataset. Average values for fund size is calculated for each group. Variation is the average group standard deviation in percent of mean. The sample is from January 2005 to December 2018.

Group	Min	Max	Mean	Variation
Small	1 251 182	902 833 567	207 929 747	84 %
Medium	256 519 329	3 684 691 000	880 964 019	49 %
Large	606 643 202	27 531 329 010	4 904 563 335	83 %

3.3 Dependent Variables

The dependent variables in the analysis are net fund returns adjusted for risk using three different approaches: a three-factor model, a four-factor model, and a benchmark-adjusted return variable. The Fama-French five-factor model will not be used as it does not apply as well to smaller stocks (which accounts for a big part of the Norwegian market) and that one of the factors (investment) are shown to be redundant in Europe and Japan (Fama and French, 2017). A summary of the calculation of variables can be seen in Table 2. Some variables will be used in the preliminary assessment of fund performance, and all will be used in the panel data models.

3.3.1 Three Factor Model

The first approach uses the Fama and French three-factor model to adjust for risk (Fama and French, 1993). Regressions are done on all funds in the sample in order to estimate loadings on three factors; the market risk premium (market return in excess of the risk free rate), a size factor - small minus big (SMB), and a value factor - high minus low (HML) as well as the regression intercept - alpha (α). The values of the factors are constructed and made public by Bernt Arne Ødegaard with data from the Oslo Stock Exchange Data Service (Ødegaard, 2018). The SMB factor is meant to mimic the risk factor in stock returns related to size. It is calculated as the difference, each month, between the returns on small- and big-stock portfolios with the same weighted average book-to-market equity (Fama and French, 1993). By constructing portfolios with about the same book-to-market equity, the focus will be solely on the size factor and exclude risk stemming from book-to-market loadings.

The risk factor in stock returns related to book-to-market equity is mimicked in the HML factor. It is calculated by subtracting the monthly returns of stocks with a low book-to-market ratio from stocks with a high book-to-market ratio with about the same size. By constructing portfolios of stocks with about the same size, the difference calculated should be largely free of the size factor in returns.The SMB and HML factors together with the market risk premium are regressed on the fund return:

$$r_{i,t} - r_{ft} = \alpha_i + \beta_{iM}(r_{m,t} - r_{ft}) + \beta_{iSMB} r_{SMBt} + \beta_{iHML} r_{HMLt} + \epsilon_{it} \quad (2)$$

where r_{it} is the portfolio return at month t and r_{ft} is the risk free rate. α_i is the intercept term which represents the performance not explained by the other factors and $(r_{mt} - r_{f,t})$, SMB and HML is the excessive market return, size factor, and book-to-market factors, respectively.Regressions are calculated from available NAV-data starting in 2004 as twelve months rolling averages to account for changes in risk exposure through time. Factor loadings from the regressions are multiplied with real factor returns every given month and express estimated return. Deducting this from the actual return gives the risk-adjusted three-factor excessive return and the dependent variable for model 1 and 4, *EXCRET3F*.

Table 2
Calculation of Variables

The table shows the calculation of variables used in group performance analysis and panel data regressions. *EXCRET3*, *EXCRET4* and *EXCRETM* are the dependent variables, *FundSize, Age, ExpRatio, FamilySize, IndustrySize, HHI, Mutual Fund Index, Small Cap Index, Manager History* and *Flow* are the independent variables.

Variable	Calculation
EXCRET3	Fund return - (Estimated returns from 12 months rolling window of Three Factor Model)
EXCRET4	Fund return - (Estimated returns from 12 months rolling window of Four Factor Model)
EXCRETM	Fund return - Benchmark return
FundSize	Log of size of fund at time t-1
Age	Log of age of fund
ExpRatio	Total Expense Ratio
FamilySize	Log of size of fund family at time t-1
IndustrySize	Log of size of fund industry at time t-1
HHI	HHI = $\sum_{i=1}^{N} s_i^2$ where s_i = fund i's market share. N = nr of funds
Mutual Fund Index	Dummy; 1 if TR Mutual Fund Index given as benchmark index
Small Cap Index	Dummy; 1 if TR Small Cap Index given as benchmark index
Manager History	Dummy; 1 if change in management team at month t-1
Flow	Flow= $\frac{TNA_t - (TNA_{t-1} * R_t)}{TNA_{t-1}}$

3.3.2 Four Factor Model

The second dependent variable extends the model with the Carhart momentum factor to account for a momentum effect in stocks (Carhart, 1997). The variable gathered from Ødegaard's website is calculated by subtracting the equal-weighted average of a portfolio of the lowest performing stocks from the equal-weighted average of the top performing firms, lagged one month (Ødegaard, 2018). Adding the variable extends the model to:

$$r_{it} - r_{ft} = \alpha_i + \beta_{iM}(r_{mt} - r_{ft}) + \beta_{i,SMB} r_{SMBt} + \beta_{i,HML} r_{HMLt} + \beta_{i,MOM} r_{MOMt} + \epsilon_{it} \quad (3)$$

where MOM is the Carhart-momentum factor. The variable is calculated as a twelve-month rolling average which reduces the number of observations used in the panel data regression as some funds are launched after 2004. Factor loadings are multiplied with real factor returns every month and gives the estimated monthly return. Subtracting this from funds actual returns gives the variable *EXCRET4F*.

Table 3
Factor Loadings

The table reports average factor loadings for the three fund groups. α is the constant derived from the regressions, $R_m - R_f$ is the market return in excess of the risk-free rate, SMB is the size factor (Small Minus Big), HML is the book-to-market factor (High Minus Low), and MOM is the momentum factor. Panel A shows loadings for the Three Factor Model and Panel B for the Four Factor Model. Factors are calculated as averages in the period of January 2005 to December 2018.

Panel A: Three Factor Model							
Group	Alpha	Rm-Rf	SMB	HML	MOM	R2	adj. R2
Small	-0.0003	0.918	0.115	0.003		0.835	0.827
Medium	0.0005	0.992	0.167	0.016		0.908	0.905
Large	-0.0002	0.966	0.114	-0.001		0.954	0.953
Panel B: Four Factor Model							
Group	Alpha	Rm-Rf	SMB	HML	MOM	R2	adj. R2
Small	-0.0002	0.899	0.106	-0.007	-0.028	0.834	0.825
Medium	0.0004	0.962	0.153	0.004	-0.006	0.913	0.910
Large	0.0000	0.949	0.110	-0.007	-0.026	0.954	0.953

The average risk factor loadings from the two models are presented in Table 3. The three-factor model produces marginally bigger differences in alpha values between the groups than the four-factor model. Market return in excess of the risk-free rate is the strongest factor for all groups in both models, describing most of the variation in fund return. It is strongest for the medium-sized funds, hinting that smaller and bigger funds have less systematic risk. SMB and HML account for less of the variation in fund return. Including the MOM factor only marginally reduce loadings on the other factors.

Including the momentum variable in the four-factor model does not seem to improve r-squared as only marginal changes can be seen. Adjusted r-squared considers the increase in predictors and does not change much either. Both models seem to explain most of the variation for large funds, providing r-squared of about 95 percent, while small and medium funds have values of r-squared of about 83 and 91 percent, respectively.

3.3.3 Benchmark Adjusted Return

The third dependent variable (*EXCRETM*) is a benchmark-adjusted return, where the fund monthly net return is subtracted the return on the fund's benchmark designated by the Thomson Reuters Lipper database. Three benchmarks are given, namely OSE Mutual Fund TR, OSE Benchmark TR, and OSE Small Cap Index TR.

Pástor, Stambaugh, and Taylor (2014) argue that this is a better adjustment for risk than the Factor Models as they are constructed by long-short portfolios which would be expensive to set up for a fund manager. The three-factor model has been argued to produce biased assessments of fund performance as it also assigns large nonzero alphas to passive benchmarks (Cremers, Petajisto and Zitzewitz, 2013). Using a benchmark-adjusted return as a proxy for performance assumes that the fund's benchmark beta is equal to one, which can be considered reasonable as the average mutual fund beta ($R_m - R_f$) is close to one, as can be seen in Table 3. In this paper, all three dependent variables will be reported and commented on to get a more holistic picture and to compare the results they produce.

3.4 Independent Variables

Fund size is the independent variable of interest to answer the main thesis question. It equals the funds' assets under management (AUM) at the end of month *t-1*. To avoid problems concerning scaling, a log-transformation is done, creating the variable *FundSize*. This packs observations together and reduces problems with outliers in terms of big and small funds. Non-transformed variables can be found in Appendix A.2

Control variables are included to account for the possibility that they might correlate with fund size as well as affecting fund performance. All independent variables are from time *t-1* to model how last month's values have affected this month's performance. *FundAge* is the number of years since the funds' launch date, averaging 15.4 years in the dataset, with the oldest fund being active for 48 years (Appendix A.2). Since funds vary from 0 to 48 years, a log-transformation is done to get a smoother density of observations. Total expense ratio is included as the variable *ExpRatio*. Ratios in the sample differ between 0,75 percent and 2,52 percent with a mean of 1,62 percent.

FamSize is the log of the sum of AUM for all funds in the same family excluding the fund's own AUM at time *t-1*. Family is defined as the group of funds owned by the company ultimately owning the fund, even via daughter companies. Numbers are compared with the VFF database to make sure they are valid (VFF, 2018). From Appendix A.2 we find that the average family has had an AUM of about NOK 38 billion during the period with a standard deviation of about NOK 56 billion. By summarizing all funds listed for sale in Norway with any Lipper classification at time *t-1* and doing a log-transformation, the variable *IndustrySize* is constructed for every month.

As a measure of the degree of competition, the Herfindahl-Hirschman Index (*HHI*) is calculated. It is defined as the sum of the squares of every funds' market share. The market share is calculated as the funds AUM divided by the total AUM of all funds in the sample. The *HHI* ranges from 0 to 1 where high values indicate less competition as the concentration of market share is higher and lower values indicate high competition. The index varies between 0.068 and 0.107 in the period, generally implying that the industry is unconcentrated and fairly competitive. A plot of the *HHI* over time can be found in the Appendix A.3. A competitive industry might make good deals harder to find, but at the same time, it might be a strong incentive for managers to work harder and could increase performance.

The dataset also reports benchmarks which can be used to proxy for a fund's strategy as it shows which index they compare against. The variable *Mutual Fund Index* takes the value of 1 if the fund's reported benchmark index is SE Mutual Fund TR and 0 if not. The variable *Small Cap Index* takes the value of 1 if the reported benchmark is OSE Small Cap Index TR and 0 if not. If both variables are 0, the fund is given OSE Benchmark TR as its benchmark. Including these dummies is done to adjust for the possibility that different strategies make for different fund sizes and to find evidence of the liquidity hypothesis described in (Chen et al., 2004).

Manager History is included in the model with a dummy where the variable reflects when a change has been made in the management team. If one or several of a funds' managers either leaves or enters the fund, the variable gets the value 1 for that month and the value of 0 in months where no change is made. The last variable included is *Flow* which is the flow of assets in or out of the fund during the last month. Funds in the sample have an average net fund inflow of 1.9 percent per month which makes for an average flow of 22.8 percent per year. Calculation summary can be seen in Table 2.

An attempt was made for including a variable for fund turnover to control for the liquidity of the fund's assets. Funds that hold less liquid portfolios have been shown to have a stronger inverse relationship between size and performance (Yan, 2008). Unfortunately, the dataset reported too inconsistently with too many missing data points which resulted in the factor being excluded from the model. Cash holdings were also excluded due to missing data, which could have been of interest in the model as holding significant cash reserves might be a mediator for the size-performance relationship.

One weakness in the data is that we are comparing fund returns net of costs to performance of benchmarks before costs. This gives slightly unbalanced results as performance is understated when compared to passive approaches.

There are many factors affecting fund performance which are not included in this paper. Models are specified to describe the relationship between size and performance, not to include all factors affecting fund returns. I seek to explain variance in alpha accounted for by variation in size, which is expected to be of limited magnitude. I have tried to include variables that are relevant to the relationship under study and excluded other variables, even though they might explain parts of the variation in alpha. Movements in the market and fund's risk exposure are accounted for in the dependent variables and lagged fund and market characteristics in the independent variables. Goodness-of-fit measures such as r-squared are therefore expected to be rather low, and the magnitudes of the coefficients will be of main interest.

3.4.1 Summary Statistics

Summary statistics for the variables are presented in Table 4. A correlation matrix for the variables can be found in the Appendix A.4. *FamilySize* and *FundSize* are positively correlated (0.505) which might indicate that bigger families have better means to attract investors or that bigger funds make for bigger families. *Age* is also positively correlated with *FundSize*, which seems intuitive as funds that have existed longer has had more time to grow. Our variable of interest in the research question, *FundSize* seem to be strongest correlated with other variables, which might make for some problems concerning multicollinearity.

The Variation Inflation Factor (VIF) is calculated to test how much of the variance of the estimated regression coefficients is inflated due to covariance with other variables. The formula is given by:

$$VIF_i = \frac{1}{1 - R_1^2} \tag{4}$$

Results can be seen in Table 4. All values lie in the interval 1 - 1.6, implying moderate collinearity which should not impose a significant problem for the estimates in the panel data models.

Table 4
Summary Statistics

The table reports summary statistics for calculated variables. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI* is the Herfindahl-Hirschmann index, a measure of the concentration of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if the reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 in months where a change was made in the management team. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018.

Statistic	N	Mean	St. Dev.	Min	Max	VIF
FundSize	6 194	8.812	0.672	6.700	10.439	1.488
Age	6 194	1.115	0.300	0.000	1.681	1.364
ExpRatio	6 194	0.016	0.004	0.002	0.025	1.102
FamilySize	6 194	10.089	0.917	0.000	11.564	1.602
IndustrySize	6 194	11.709	0.267	11.025	12.124	1.171
HHI	6 194	0.082	0.009	0.068	0.107	1.073
Mutual Fund Index	6 194	0.160	0.367	0	1	1.188
Small Cap Index	6 194	0.073	0.260	0	1	1.124
Manager History	6 194	0.019	0.135	0	1	1.004
Flow	6 194	0.010	0.166	−0.966	9.516	1.009

4 Group Performance

With funds being divided into groups for every month in the period it is now possible to compare the performance of the groups. Equally-weighted averages of returns net of costs for each group can be seen in Figure 1. Average group statistics can be seen in Panel A of Table 5. Medium-sized groups seem to have outperformed Small and Large, especially since the financial crisis. Starting at 100, the Medium group ended up at 275 at the start of 2019, while Small and Medium ended up at 241 and 233. The average monthly return is highest for Medium-sized funds, but at the same time so is the standard deviation of returns. To get a fair picture of the performance and thoroughly answer the thesis question: if size affects performance, we must account for the risk taken by the fund managers. This is done in three ways, first with two commonly used performance-risk measures, then with two factor models and lastly with a panel data regression.

Figure 1
Group Returns

The figure shows equally-weighted returns net of costs for three groups based on AUM. The black line shows Small funds, the grey line Medium funds and the blue line Large funds in the period 2005 to 2018, all starting at 100.

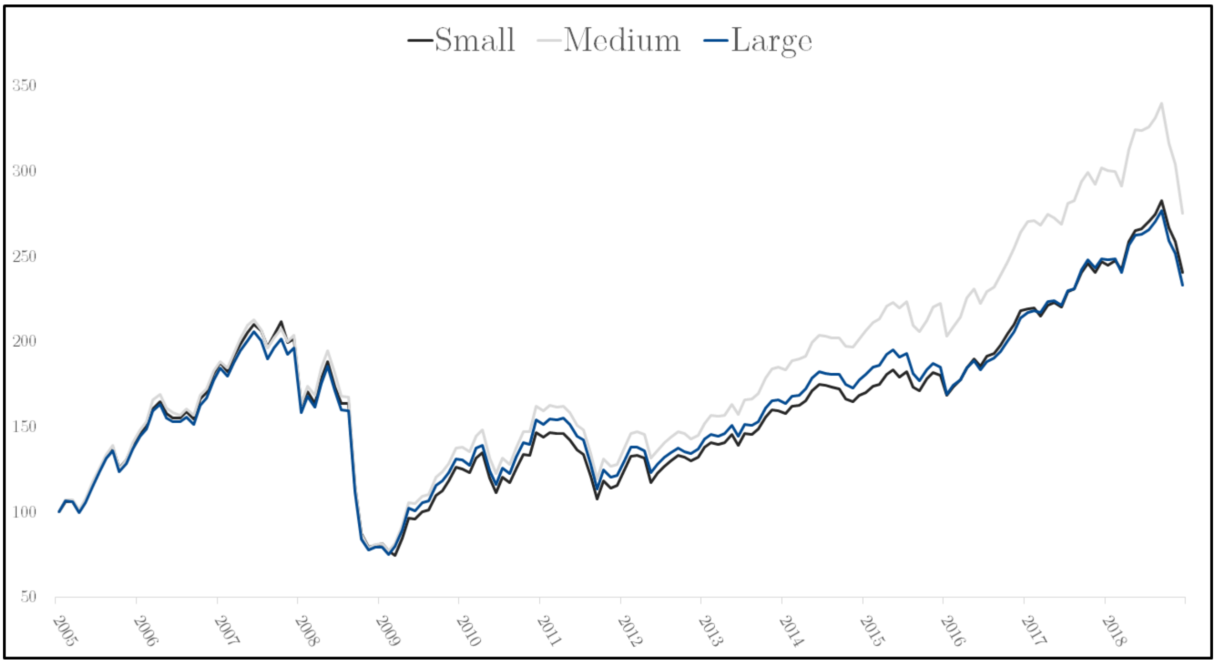


Table 5
Group Performance

The table reports performance statistics for three fund size groups. Panel A reports mean statistics and standard deviation for the equally-weighted returns. 2019 is the value at the beginning of 2019. Panel B shows mean values, standard deviation and t-statistics from two-sample t-tests assuming equal variance for Sharpe Ratio calculated as a twelve-month rolling average from 2005 to 2018. Panel C shows statistics for Information Ratio calculated as a twelve-month rolling average from 2005 to 2018. Panel D shows alpha values from a three-factor model calculated with twelve months rolling windows from 2004 to 2018 and Panel E shows alpha statistics from a four-factor model calculated with twelve months rolling windows from 2004 to 2018.

Panel A: Equally-weighted Returns

Group	Min	Max	Mean	Std. Dev	2019
Small	74	283	0.70 %	5.61 %	241
Medium	77	340	0.79 %	5.74 %	275
Large	75	277	0.68 %	5.62 %	233

Panel B: Sharpe Ratio

			t-statistics	
Group	Mean SR	Std.dev	Diff from Small	Diff from Medium
Small	0.980	2.280		
Medium	1.216	2.531	0.867	
Large	1.114	2.561	0.489	0.354

Panel C: Information Ratio

			t-statistics	
Group	Mean IR	Std.dev	Diff from Small	Diff from Medium
Small	-0.099	0.590		
Medium	0.259	0.644	5.129	
Large	0.029	0.644	1.645	2.869

Panel D: Three-Factor Model

			t-statistics	
Group	Mean	Std.dev	Diff from Small	Diff from Medium
Small	-0.0003	0.003		
Medium	0.0005	0.003	2.221	
Large	-0.0002	0.003	0.229	2.209

Panel E: Four-Factor Model

			t-statistics	
Group	Mean	Std.dev	Diff from Small	Diff from Medium
Small	-0.0003	0.004		
Medium	0.0002	0.004	1.181	
Large	-0.0001	0.003	0.543	0.774

4.1 Sharpe Ratio

Sharpe Ratio (SR) is a performance measure introduced by William F. Sharpe in 1966 (Sharpe, 1966). It is commonly used to state the reward-to-variability or return-to-risk for mutual funds. The following formula gives the ratio:

$$SharpeRatio = \frac{R_p - R_f}{\sigma_p} \tag{5}$$

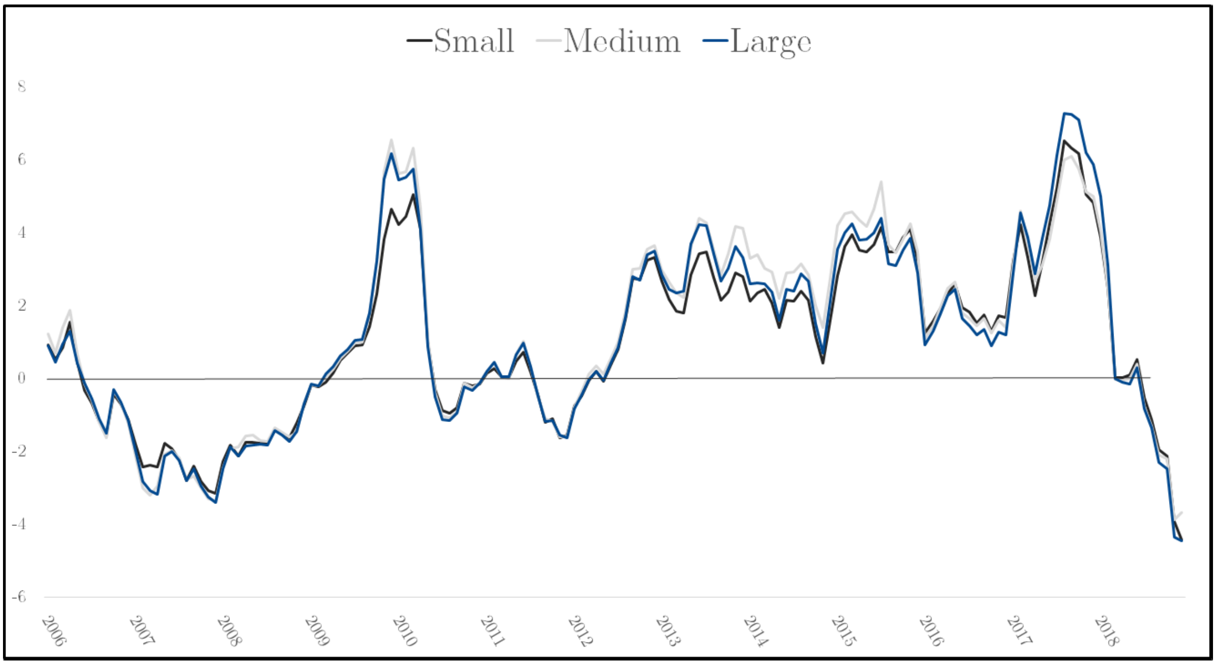
Where R_p is the return of the portfolio, R_f is the risk-free rate and σ_p is the standard deviation of the portfolios excess return. Subtracting the risk-free rate allows us to isolate returns made from risk-taking activities. An annualized rolling SR is calculated for every fund to allow for changes through time. Average values for the groups are calculated every month. The result is plotted in Figure 2. It is hard to see if there is a substantial difference between the groups, although it might seem as if Small is lower at some points, especially where the SR reaches high levels. This notion is confirmed when looking at the mean values in Table 5. Small has a SR-average at 0.980, while Medium and Large have 1.216 and 1.114 respectively. The standard deviation for Small is a bit lower than Medium and Large, implying that smaller funds are more stable than bigger funds.

By studying the histogram and the Q-Q plot of the data in appendix B.1 the density can be described as close to a normal distribution, although the top seems to be too low. This is confirmed when doing a Shapiro-Wilk test for normality (Shapiro and Wilk, 1965), results can be seen in appendix B.2. The test gives a p-value of 0.0826 which is above the critical value of 0.05, and the h_0 of a normal distribution cannot be rejected.

This makes it possible to test if the differences between the groups are significant using two-sample Student's t-tests which assumes a normal distribution (Markowski and Markowski, 1990). The results can be seen in Table 5. None of the t-values are above the critical value of 1.645 for a significance level $\alpha = 0.05$, which let us answer the first thesis question: there are no significant differences in mean SR between the fund groups. In other words, the size of the mutual fund's asset base does not affect performance in terms of Sharpe Ratio.

Figure 2
Sharpe Ratio

The figure shows equally-weighted averages of Sharpe Ratio for three groups based on AUM. Ratios are calculated as twelve-month rolling averages. The black line shows Small funds, the grey line Medium funds and the blue line Large funds in the period 2006 to 2018.



4.2 Information Ratio

The Information Ratio (IR), or appraisal ratio, was introduced by Jack Treynor and Fischer Black in 1973 (Treynor and Black, 1973). Whereas the SR states the return in excess of the risk-free rate, the IR measures the return in excess of a relevant benchmark index:

$$InformationRatio = \frac{R_p - R_{mi}}{TrackingError} \tag{6}$$

R_p is the return of the portfolio, R_{mi} is the return of a fund's benchmark index given by the Thomson Reuter Lipper database. Tracking Error is the standard deviation of the difference between the portfolio and benchmark returns which represents the consistency of a fund's performance. Tracking Error is given by the formula:

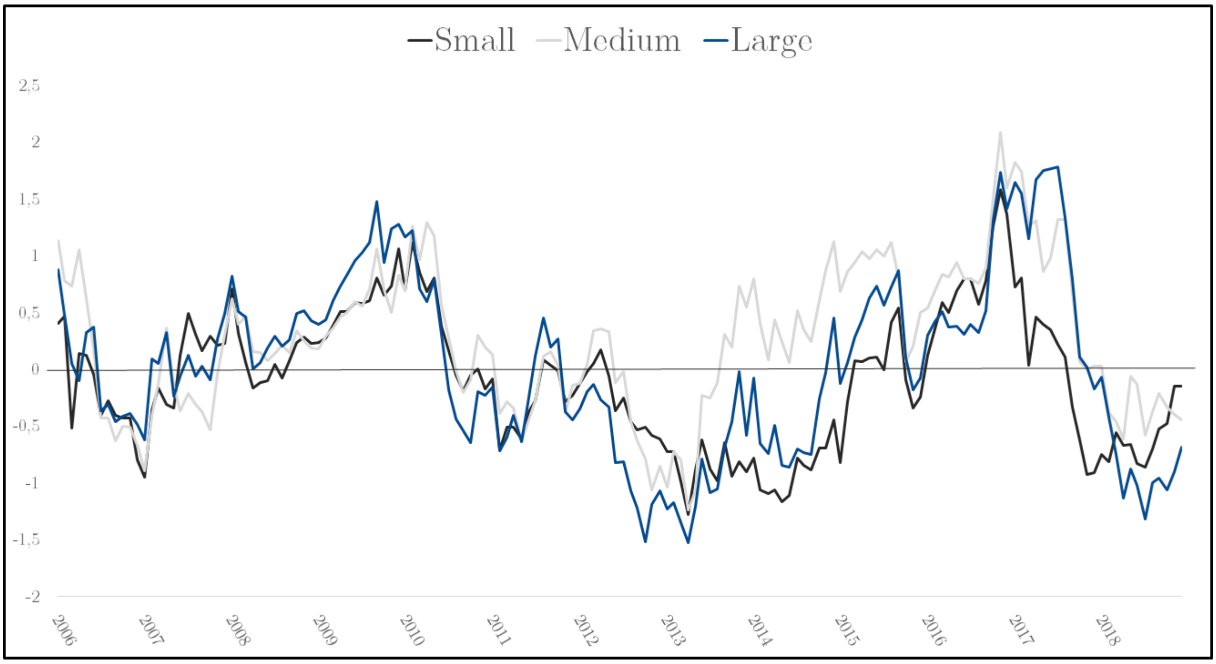
$$TrackingError = \sqrt{\frac{\sum(R_p - R_{mi})^2}{N-1}} \tag{7}$$

Information ratio is also calculated with twelve months rolling window. By studying Figure 3, some differences emerge. It seems as if Large funds outperformed the other groups in the years following the financial crisis in 2008 up until 2010. Even bigger differences can be seen in the period between 2013 and 2017 where funds in the Medium group did far better than the other groups, with Large outperforming Small. By looking at the mean values in Table 5, the pattern from the later years seems to be making the biggest difference as Medium sized funds had an average annualized rolling IR of 0.259 in the whole period while Small and Large had -0.099 and 0.029 respectively.

Plots and normality tests done on the ratios can be seen in the appendix B.1 and B.2 and are indicating a normal distribution, allowing for t-tests to quantify the differences. Two-Sample t-tests are done between pairs of groups assuming equal variances of IR. The t-statistic of the test between Small and Medium are 5.129, above the critical value of 1.645 for a significance level $\alpha = 0.05$, indicating that the Medium group has done significantly better than Small. This is also the case for Medium and Large, where the t-statistic is 2.869, stating that Medium also has performed significantly better than Large. The t-statistic on the test done between Small and Large is 1.645 which is at the critical value, making it hard to say if there is a difference in performance between the smaller and larger funds on average. In contrast to findings using the Sharpe Ratio, the fund's asset base does affect performance in terms of Information Ratio, contributing with new answers to the thesis question. Medium sized funds outperform both Small and Large funds on average.

Figure 3
Information Ratio

The figure shows equally-weighted averages of Information Ratio for three groups based on AUM. The ratio is calculated as a twelve-month moving average. The black line shows Small funds, the grey line Medium funds and the blue line Large funds in the period 2006 to 2018.



4.3 Factor Models

The Fama-French three-factor model and the extended Carhart four-factor model uses the factors market risk, size, book-to-market, and a momentum factor to explain a fund's performance. These models are estimated for all funds in the thesis, and the fund loadings between groups can be seen in Table 3.

Using the extended model, we find that Medium sized funds have a higher mean alpha than both Small and Large. It is worth mentioning that only 5 out of 49 of the alphas in the sample had a low enough p-value to discard H_0 of alpha = 0 at a 5 percent significance level. Three of the funds with a p-value under 0.05 belonged to the group of Small funds, while two belonged to Medium. Two of the significant alphas among the small funds were negative while the rest of the significant alphas across groups were positive. By looking at adjusted R^2 a goodness-of-fit measure of the model can be obtained. The model explains most of the variation in performance for the bigger funds (0.953) and less for the smaller funds (0.835).

As variations over time are of interest, the Factor Models are calculated with rolling twelve months averages for every fund. Group averages are then calculated allowing for funds to change group belongings through time. From the histograms and Q-Q plots in Appendix B.1, there seems to be a negative skewness in the Three Factor Model, while the Four Factor seems to be closer to a normal distribution. A Shapiro-Wilk test for normality (Shapiro and Wilk, 1965) gives a p-value of 0.2567 and 0.2478 for the Three and Four Factor Model (Appendix B.2). These are both above the critical value of 0.05, indicating a normal distribution.

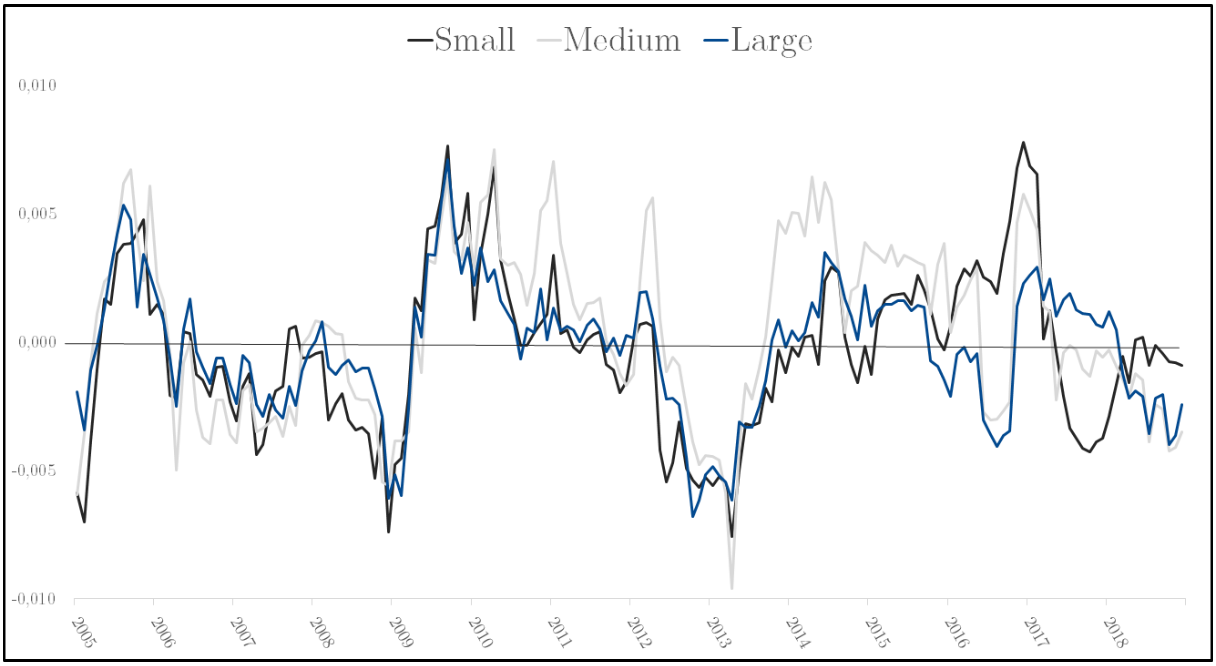
The plotted alpha values can be seen in Figure 4. Medium sized funds seem to outperform the other groups between 2009-2012 and 2013-2016 in both models. Table 5 shows that on average, Medium sized funds outperform Small and Large funds in both models. Since the data is normally distributed, t-tests can be completed to test if the differences are significant. In the Three Factor Model, Medium is significantly different from both Small and Large as the t-statistics 2.221 and 2.209 both are above the critical value of 1.645 for a significance level $\alpha = 0.05$.

Differences are not as clear in the Four Factor Model where t-values are 1.181 and 0.774. In neither of the models are the Small funds significantly different from the Large funds. Again, there is a mixed answer to the first thesis question. The size of the fund's asset base does affect performance in terms of alpha values in a three-factor model. As was the case for IR, Medium sized funds outperform both Small and Large funds. These results are not significant in the four-factor model, implying that there is no connection between fund size and performance.

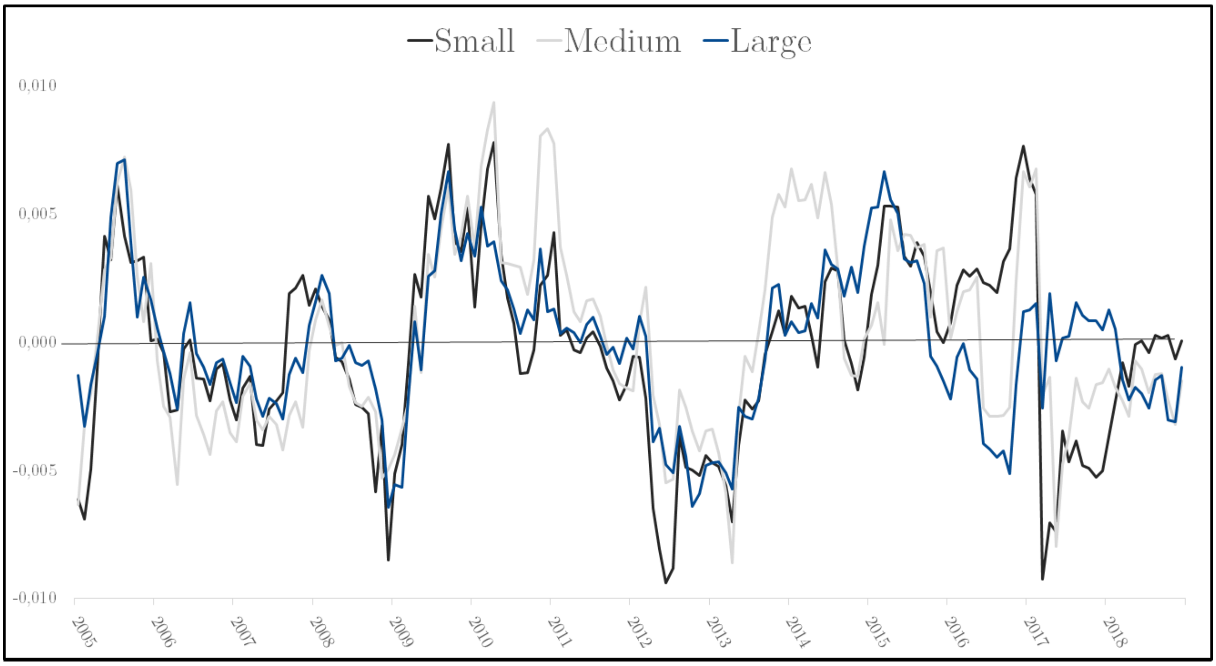
Another interesting feature of fund alpha appears when comparing active to closed funds. Differences can be seen in Appendix C.1. Here, all funds are included even though they are missing data on assets under management. A total of 57 funds are split into 40 active and 17 merged or liquidated. Active funds have an average alpha of 0.0007 through the period while closed funds have a mean of -0.0013 and the cumulative averages on 0.0001. This gives a hint that closed funds have performed worse than active funds which would have led to a survivorship bias if delisted funds would not have been included in the study.

Figure 4
Factor Models

Figure (a) shows equally-weighted averages of alpha values calculated through a three-factor model for three groups based on AUM. Figure (b) shows equally-weighted averages of alpha values calculated through a four-factor model for three groups based on AUM. Both regressions are done on rolling twelve months windows. The black line shows Small funds, the grey line Medium funds and the blue line Large funds in the period 2005 to 2018.



(a) Three Factor Model



(b) Four Factor Model

5 Panel Data Regression

The dataset is constructed as an unbalanced panel data which contains cross-sectional data on each fund as well as time-varying data. This makes it possible to address a broader range of issues than would be possible with pure time series or cross-sectional data alone and makes it possible to examine how variables and their relationships change over time. Relevant control variables are included in the model to isolate the effect of fund size on performance. The panel data setup is described with the following equation:

$$y_{it} = \alpha + \beta x_{it} + u_{it} \tag{8}$$

where y_{it} is the dependent variable for fund i at time t. α is the intercept term, β is a set of parameters to be estimated on the explanatory variables, and x_{it} is a set of observations on the explanatory variables. The easiest way to deal with panel data is to estimate a pooled regression, which involves estimating a single equation on all the data together. The ordinary least squares (OLS) consists of five core assumptions (Greene, 2002):

1. Linearity in the parameters
2. $\mathrm{E}(u_t) = 0$ — Exogeneity of the independent variables
3. Var $(u_t) = \sigma^2 < \infty$ — Homoscedasticity
4. Cov $(u_i, u_j) = 0$ — No multicollinearity
5. $u_t \sim \mathrm{N}(0\,, \sigma^2)$ — Normal distribution of error term.

The relationship under investigation is a challenge to estimate since size is not randomly decided. While pooling the data assumes that the average values of the variables and the relationships between them are constant over time and across all the cross-sectional units, the skill of the fund manager impacts both the dependent variable performance and the independent variable size. Larger funds have better means to attract better managers who again attract more investors to the fund. As skill is unobservable, estimating a pooled OLS panel regression will then make room for an omitted-variable bias with the same size as the effect of skill on performance times the slope of skill on fund size (Pástor, Stambaugh, and Taylor, 2014). If skilled managers manage bigger funds, disadvantages with scaling might be hidden.

5.1 Fixed Effects Model

Introducing a fixed effects panel regression will remove the omitted-variable bias but introduce another one (Chen et al., 2004). In a fixed effect model the disturbance term in equation (8), u_{it}, is decomposed into an individual specific effect μ_i, which includes all the variables that affect y_{it} cross-sectionally but do not vary over time, and v_{it} which captures everything that is left unexplained about $y_i t$ (Brooks, 2008). A fixed effects model uses dummy variables to allow for different intercepts for the variables. In other words, identification in a fund-fixed effect model stems from variation over time within a fund, not from variation across funds. This gives the model:

$$y_{it} = \alpha + \beta x_{it} + \mu_i + v_{it} \tag{9}$$

Subtracting the time-mean of each entity away from the values of the variable (within transformation) is done to avoid the necessity to estimate dummy variables for every k parameter. The model can now be written as:

$$y_{it} - \overline{y}_i = \beta(x_{it} - \overline{x}_i) + u_{it} - \overline{u}_i \tag{10}$$

Chen et al. (2004) argue that this model makes for a new regression-to-the-mean bias. A fund which experiences a period of lucky performance will experience an increase in fund size. When performance regresses to the mean, a spurious conclusion will be made stating that an increase in fund size is associated with a decrease in fund returns. This is a negative bias which will lead to a more negative relationship between size and performance than it is.

A clear disadvantage of using a fixed effect model is that it excludes variables that might affect y_{it} but do not vary over time. For this dataset that means that the fund's benchmark index will be excluded as it is assumed to be the same through time. Expense ratio will also be excluded due to the same reason.

5.2 Random Effects Model

A version of the fixed effect model is the random effects model. The random effects model is usually preferred when the funds in the sample have been randomly selected from the population, while a fixed effect model is used when the sample can be thought of as being the entire population (Brooks, 2008). The random effect model might not be the best fit in this case as the funds can be thought of as the entire population given the screening criterions. Even though Norwegian Funds are a part of the global population of mutual funds, the data used in the thesis is not randomly selected.

5.3 Specification Testing

It might seem as if the choice is between a pooled model and a fixed model, and therefore a choice between two biases. To see which of the regressions fits the data best a series of tests are made to see if the goodness-of-fit for a pooled regression is improved by introducing a fixed or random effects model.

To test for fixed effects in the data, an F-test is conducted. The null hypothesis is that all dummy parameters except for one are zero (Park, 2011). The alternative hypothesis is therefore that at least one dummy parameter is not zero and a fixed effects model is preferred. Results can be seen in Appendix B.3. The tests are indicating that there are some significant fixed effects in model 3, with *EXCRETM* as the dependent variable, although not for model 1 and 2, with *EXCRET3F* and *EXCRET4F* respectively.

Even though a fixed effect approach removes the omitted-variable bias from manager skill, tests show that assumptions for the OLS is not breached and pooled regressions can be performed. This makes it possible to include non-time-varying variables which let us control for seemingly important factors. At the same time, there is some evidence of fixed effects which might improve the models.

As both estimators produce biased coefficients in opposite directions presenting both should give a more holistic picture and let us identify the causal relationship stated in the thesis question. The pooled regression should give more conservative coefficients than the fixed effect approach.

5.4 Model Specification

By computing pooled regressions and fixed effects models on the panel data we get six models with three different dependent variables regressed on lagged fund characteristics. The utilized regression specifications are:

$$EXCRET_{xit} = \mu + \varphi FundSize_{it-1} + \gamma X_{it-1} + \epsilon_{it} \tag{11}$$

Where $EXCRET_{xit}$ is the return of fund i in month t risk-adjusted by three various performance benchmarks. μ is a constant (OLS), $FundSize_{it-1}$ is the log of fund i's AUM at month *t-1*, and X_{it-1} is relevant control variables in month *t-1*. ϵ_{it} is the error term uncorrelated with all other independent variables and φ is the main coefficient of interest as it captures the relationship between fund size and performance, controlling for the other variables.

6 Results

I find mixed evidence of performance erosion due to growth in the fund's asset base. Estimation results for the panel data regressions are presented in Table 6. Coefficients on *FundSize* is negative for all six models implying that on average, increases in size negatively affects performance. This finding provides another answer to the thesis question and is in line with the findings of Chen et al. (2004) who find the same to be true in the US. They further argue that the negative relationship is partly due to liquidity constraints and price movements faced by bigger funds when trading.

For the pooled OLS models (1, 2 and 3) t-statistics for *FundSize* ranges from -1.730 to -3.205, with model 3 being statistically significant at the 0.01 significance level and model 1 and 2 being only marginally statistically significant (α = 0.1 level).

Even though statistically significant the coefficients are economically small. As *FundSize* is log-transformed, a ten percent increase in AUM will reduce expected monthly risk-adjusted return by 0.001 * log(1.1) = 0.004 percent (5 bps annually) for all three models, controlled for the other variables in the models. Keep in mind that the pooled OLS is expected to produce biased results. If skill and size are positively correlated, the economic significance of changes in fund size is understated. Better managers attract more money and are probably hired to manage bigger funds. The disadvantages associated with bigger funds might, therefore, be hidden by the better-skilled managers as skill is not observed in this study.

The fixed effects models produce expectedly stronger negative results due to the regression-to-the-mean bias. T-values range from -4.490 to -6.831 making all coefficients statistically significant at the 0.01 significance level. Coefficients are stronger, with -0.005, -0.004 and -0.007 for model 4, 5 and 6 respectively. With a ten percent increase in funds AUM, monthly performance is expected to decrease by 2.1 bps, 1.7 bps and 2.9 bps, controlled for the other variables in the models. This equals 25 bps, 20 bps and 35 bps annually which is of some economic significance, though still modest.

As the two estimation techniques probably give biases in separate directions, the bias-free coefficients can be assumed to be somewhere in between. This is in line with findings from US funds where size erodes performance (Chen and Pennacchi, 2009) (Pástor, Stambaugh, and Taylor, 2014) (Yan, 2008), but in contrast to the results of Ferreira, Keswani, and Miguel (2012) who find that the negative relationship does not exist outside the US.

Table 6
Panel Data Models

The table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if the reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if a change is made in managers. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018. **Table 6 continues on the next page.**

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
FundSize	-0.001^{*}	-0.001^{*}	-0.001^{***}	-0.005^{***}	-0.004^{***}	-0.007^{***}
	(-1.950)	(-1.730)	(-3.205)	(-5.706)	(-4.490)	(-6.831)
Age	0.00004	-0.0003	0.00001	0.006^{**}	0.005^{*}	0.004
	(0.053)	(-0.400)	(0.006)	(2.033)	(1.768)	(1.325)
ExpRatio	0.049	0.074	0.010			
	(0.995)	(1.600)	(0.175)			
FamilySize	0.0002	0.0002	0.0003	-0.0004	-0.0004	0.0003
	(0.919)	(0.816)	(0.871)	(-0.841)	(-0.777)	(0.547)
IndustrySize	-0.003^{***}	-0.003^{***}	-0.001	-0.001	-0.002^{*}	0.001
	(-3.492)	(-4.149)	(-0.832)	(-1.004)	(-1.698)	(0.303)
HHI	0.013	-0.013	0.046^{*}	0.015	-0.010	0.032
	(0.563)	(-0.609)	(1.723)	(0.617)	(-0.438)	(1.150)
Observations	6 194	6 194	6 194	6 194	6 194	6 194
R^2	0.007	0.008	0.005	0.011	0.009	0.011
Adjusted R^2	0.006	0.006	0.004	0.002	0.001	0.002
F Statistic	4.447^{***}	5.013^{***}	3.181^{***}	9.832^{***}	8.307^{***}	9.732^{***}

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 6 continued: The table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is return in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
Mutual Fund Index	0.001	0.001	−0.001			
	(0.995)	(0.960)	(−0.851)			
Small Cap Index	0.001	0.0001	−0.001			
	(0.569)	(0.073)	(−0.852)			
Manager History	0.001	0.001	0.001	0.001	0.001	0.002
	(0.929)	(0.990)	(0.870)	(0.823)	(0.911)	(0.971)
Flow	0.005***	0.005***	0.004***	0.005***	0.004***	0.004**
	(4.144)	(4.003)	(3.120)	(3.702)	(3.641)	(2.523)
Constant	0.037***	0.043***	0.016			
	(3.693)	(4.534)	(1.391)			
Observations	6 194	6 194	6 194	6 194	6 194	6 194
R^2	0.007	0.008	0.005	0.011	0.009	0.011
Adjusted R^2	0.006	0.006	0.004	0.002	0.001	0.002
F Statistic	4.447***	5.013***	3.181***	9.832***	8.307***	9.732***

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

With most of the variation in fund returns being accounted for in the dependent variables, the models are trying to explain the variation in alpha, the variation of return in excess of performance benchmarks. Many factors are expected to affect a fund's performance but are not included in the models as they are hard to observe or irrelevant for the relationship studied in this paper. This makes for a rather low r-squared. The fixed effects models 4 and 6 seem to be fitting the data best with r-squared = 0.011, even though adjusted r-square is lower (0.002). Pooled OLS regression gives the highest adjusted r-squared of 0.004 - 0.006. The focus is on the relationships between the variables to answer the thesis questions. All f-statistics are significant at the 0.01 level which tells us that the specified models provide a better fit than an intercept-only model, making it possible to conclude from the coefficients.

6.1 Other Findings

The most consistently statistically significant variable is *Flow*. T-values range from 2.523 to 4.144 with the coefficient in model 6 being the only one that is not statistically significant at the 0.01 level (significant at the 0.05 level). All coefficients are positive, indicating that funds that have experienced a positive cash flow in month *t-1* perform better than funds with outflows. This finding shows that the return on new cash flow is better than the average return for investors which give support to the "smart money hypothesis" of Gruber (1996) who argue that investors can predict future performance. Another explanation for the positive relationship is that managers invest new capital in their best ideas and that liquid funds are valuable to alter exposure.

Coefficients range from 0.004 to 0.005, indicating that a ten percent increase in fund inflows will result in a 4-5 bps increase in fund performance, holding all other variables constant. This might seem small, but keep in mind that funds have experienced an average annual inflow of 22.8 percent in the sample period. To answer the second thesis question: fund flows might affect the relationship between size and performance. A bigger asset base erodes performance, but at the same time, inflows provide managers the possibility to change exposure. This might be good for performance in the short run but bad over time as liquidity problems will be more prominent later on.

Chen et al. (2004) find evidence of liquidity issues as the negative relationship of size is strongest for funds investing in small-cap stocks. If the same were true in the Norwegian market, we would expect the Small Cap Index variable to produce negative coefficients. I find no evidence that this is true since two out of three coefficients are positive and none being statistically significant. Answering the second thesis question, fund benchmark does not seem to affect the relationship between size and performance.

Another interesting variable is *IndustrySize* which five out of six models give negative coefficients. There are however large variations in t-statistics, ranging from 0.303 to -4.149. While Model 1 and 2 estimates statistically significant coefficients at the 0.01 level, model 5 estimates it to be significant only at the 0.1 level, and the remaining models give no statistical significance. Even though hard to conclude, there are signs that increases in the mutual fund industry erode fund performance, possibly indicating that growth leads to fiercer competition. The size of the industry might affect the relationship between fund size and performance, which partly supports findings of Pástor, Stambaugh, and Taylor (2014). Remaining coefficients are hard to interpret as so few provide sufficient t-statistics.

6.2 Nonlinearity

Performance metrics used to identify differences among size groups in chapter 4 indicated that medium-sized funds outperformed both small and large funds. This indicates a nonlinearity implying that a regression model might not be the best fit for the data. This notion is evaluated further by doing the same panel data regressions on subsamples of the data. To be more specific, the same models are applied twice, first by excluding the smallest funds throughout the whole period, then by excluding the biggest funds.

Appendix C.2 presents the results for the first subsample, excluding the smallest funds. *FundSize* is now statistically significant at the 0.01 level for all models but model 1, which is significant at the 0.05 level. Improved significance confirms our notion that there is decreasing performance to scale for the bigger funds in our sample. Looking closer at the strength of the coefficients, we find that model 3 and 6 which both has *EXCRETM* as the dependent variable show stronger economic significance while the other models are unchanged or show weaker effects. Notice also that all R^2 values increase by about the double, implying that the models fit better for these funds than they do for the entire sample.

If the relationship between size and performance is as concave as analyses of fund performance show, we could expect the coefficients for *FundSize* to become positive when excluding the large funds. Appendix C.3 shows that this is not entirely the case. Model 2 and 3 now produce insignificant coefficients. Model 4, 5 and 6 are still negative and statistically significant at the 0.01 level, while model 1 is negative and statistically significant at the 0.05 level.

Goodness-of-fit measures are again reduced showing that the models explain less of the changes in the dependent variables than the models including the larger funds. It might still be true that there is a nonlinear relationship, but that the positive relationships among smaller funds are weaker and valid only for the very small funds, being outweighed by the negative relationships among the medium-sized funds. Dividing the funds into smaller groups could have given a clearer picture. This has not been done as the sample contains too few funds which would have made the groups too small.

6.3 Periods

Plots of historical fund performance (Figure 1 - 4) hinted that the relationship between size and performance has changed through time. To account for this, the regression framework is applied to three different periods. Period 1 spans from January 2005 to August 2009, period 2 from September 2009 to April 2014, and period 3 from May 2014 to December 2018, which gives a total of 56 months per period (almost five years).

Regression results can be seen in appendix C.4-6, showing some patterns. Period 1 and 2 seem to produce similar results, with *FundSize* coefficients being statistically significant only for models using fund fixed effects (4, 5 and 6). Model fit seems to be rather poor, especially for pooled OLS models where f-statistics are not significant at all in period 2.

Specifications seem to be better in period 3 where all f-statistics are statistically significant at either 0.05 or 0.01 level. *FundSize* is negative in all models, with t-statistics ranging from 2.519 to 5.786. Model 2 shows a coefficient statistically significant at the 0.05 level and the other models at the 0.01 level. The magnitude of the coefficients are still rather modest, but the relationship has been stronger in the later years, confirming what was found when studying group performance in terms of Information ratio and alpha values (Figure 3 and 4).

Some interesting evidence on the role of competition can be found in period 3. All models show negative coefficients for *IndustrySize*, giving hints that a bigger industry makes it harder to produce positive alphas, controlled for other variables. Model 3 and 6 is statistically significant at the 0.01 level, model 1 at the 0.05 level, while the other three models do not find the coefficients significant. More competition in terms of a bigger market erodes performance.

At the same time, *HHI* also shows negative coefficients. Model 3 and 6 shows significant coefficients at the 0.01 level, model 1 and 4 at the 0.05 level and model 2 and 5 show no statistical significance. As higher index values indicate a decrease in competition, a negative coefficient implies that a decrease in competition reduces fund performance. An explanation for this might be that the incentive to perform is lower with lower competition which erodes performance. Answering the second thesis question, the degree of competition might affect the relationship between size and performance in some periods by providing managers a need to perform.

In summation, I find some evidence that a bigger industry will imply worse performance, while a more competitive industry will imply better performance. These results are in line with findings from the US markets. Pástor, Stambaugh, and Taylor (2014) find a negative relationship between the size of the active mutual fund industry and fund performance and Feldman, Saxena, and Xu (2018) find evidence that a decrease in the mutual fund industry concentration gives a decrease in net alpha.

7 Conclusions and Policy Implications

This paper empirically analyses the relationship between performance and size on Norwegian active mutual funds and contributes with increased understanding of several drivers behind the performance. Several methods are used to shed light on the relationship. I find mixed evidence, mainly indicating that there is a negative relationship between lagged fund size and performance. The negative relationship seems to be nonlinear as bigger funds suffer more from increases than medium and smaller sized funds. Some evidence also points towards a positive relationship for the smallest funds, indicating that funds might be too small to justify an active strategy. This compliments earlier studies as it finds that relationships found in the US are valid also in smaller markets with smaller participants. Further studies have to be done to see if it is a universal truth or if Norway is a special case of small markets.

Answering the first thesis question "Does the size of a fund's asset base affect risk-adjusted performance among Norwegian active mutual funds investing in Norwegian equities?" is done using several adjustments for risk. Firstly, dividing funds into size tertiles for every month reveals significant differences when analyzing information ratio and estimated alpha from multi-factor models. Both small and large funds underperform against the medium-sized funds, implying that size does affect the performance. This finding is not consistent as no significant differences are found using the Sharpe ratio.

Secondly, a panel data model is proposed to control for other variables assumingly affecting the risk-adjusted performance. Two estimators are considered, each expected to produce biases in opposite directions. Presenting both gives a more nuanced answer to the thesis question. Six regression models provide mixed evidence that growth in the size of a fund's asset base erodes performance. All models produce negative coefficients although of varying significance. Overall, economic significance seems to be small but present.

The suspicion of nonlinearity is strengthened after applying the regression models to subsamples of the data. Regressions done after excluding the smallest funds show more significant coefficients, implying that the negative relationship is more robust for bigger funds. Applying the models on three different periods show that the relationship between size and performance has changed through time, with the last five years showing better fit to the data and higher significance of coefficients.

Including control variables also provide answers to the second thesis question: "Are there any factors affecting the relationship between size and performance?" A positive correlation between fund inflow and performance is found for all panel data models. This relationship indicates that return on new cash flow is better than the average return, either showing that investors to some extent predict future performance or that liquid funds are valuable for the managers as they can make alterations in exposure.

I find mixed evidence in the whole sample of a negative correlation between the size of the mutual fund industry and fund performance. More money competing for good deals give a more efficient market, making it harder for managers to outperform their passive benchmarks. I also find significant negative relations between competition density (HHI) and fund performance in the latest period, indicating that a more competitive industry improves performance. No evidence of liquidity issues is found as no coefficients concerning fund strategy (small-cap funds) are statistically significant.

I have not found evidence of reasons for the negative relationship between size and performance, but existing literature shows that liquidity and price movement play important roles in the US market (Chen et al., 2004). The smallest funds seem to be too small to justify the cost of an active strategy, while the biggest funds overinvest in information and suffer higher transaction costs (Indro et al., 1999). As bigger blocks of trades must be done, managers move prices and take longer time to complete changes in exposure, which negatively hurts performance. Further studies will have to be done to investigate if the same reasons apply to the Norwegian market.

With the money management industry constantly evolving, companies take new approaches to attract customers. One of the biggest participants in the Norwegian market, DNB, recently changed their fee structure by reducing the fixed fee and introducing a performance fee (DNB, 2019). For the company, this means that their fund's performance plays a bigger role for their profits than before, and size becomes more of an issue. Previously, a bigger fund would have produced higher income, but now this is only true if the magnitude of size outweighs the loss of performance.

If performance-based rewards are a trend being followed by other companies, findings in this paper implicate that we might start to see managers putting limits to the size of their funds. If performance became the direct source for income, managers would have to carefully consider factors affecting that performance, fund size being one of them. Companies might open several funds and hire more people in the search for new investments, which proves to mediate the relationship between size and performance (Chen et al., 2004). Also, having strategies such as keeping cash reserves and investing in more liquid assets to cope with liquidity issues might become a bigger focus for managers.

Funds introducing performance-based fee structures align the interest of the managers and investors, although the risk structure is still asymmetric. A stronger incentive to produce positive alphas might make for better performance, but it might also make for alterations in risk. Especially if the basis for the success fee is reset every year, an underperforming fund might take undesirable risk at the end of the year in a last attempt to end up on the positive side, with the downside being mostly on the investor side. Regulators should make sure success fees are applied with a watermark solution where the principal investment sets the basis for the success fee and further reduce agency costs. Allowing for more funds to enter the market might also be good for the investor as a lower density of competition is good for performance.

Understanding the effects of scale on fund performance is of importance to investors both to pick the best funds and knowing when to invest or withdraw. By being aware of how economies of scale may affect their agency relationship to managers, investors can choose compensation contracts (fee structures) that will best serve them. Independent intermediaries should analyze how funds are exposed to liquidity risk and problems concerning scale to provide investors with the knowledge needed to make informative decisions.

I control for various variables that might covary with fund size and performance, but potentially important factors are excluded due to lack of data or observability. These factors could affect the relationship and should be explored further. It might be that performance benchmarks are inadequate proxies for fund strategy or that cash holdings could make up for some of the disadvantages that extreme variations of size may bring. Nevertheless, investors should pay close attention to the size of the fund's asset base and how fund managers are planning to cope with price and liquidity issues.

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A Summary Statistics

A.1 Sample factor loadings

The table reports average factor loadings for all funds in the sample. N is the number of NAV observations used in the calculation. Factor loadings are calculated through Four Factor Models where α is the constant, $R_m - R_f$ is the market return in excess of the risk-free rate, SMB is the size factor (small minus big), HML is the book-to-market factor (high minus low), and MOM is the momentum factor. R^2 is the explanation power of the model and the adjusted R^2 takes the number of variables into account. **The table continues on the next page.**

Fund	N	α	$R_m - R_f$	SMB	HML	MOM	R^2	adj R^2
Alfred Berg Aktiv	210	-0.0006	1.01	0.16	-0.06	0.08	0.94	0.94
Alfred Berg Gambak	210	-0.0001	1.02	0.24	-0.13	0.13	0.85	0.84
Alfred Berg Humanfond	210	0.0003	0.91	-0.03	-0.05	0.02	0.95	0.95
Alfred Berg Norge [Classic]	210	0.0009	0.96	0.05	-0.01	0.09	0.95	0.95
Arctic Norwegian Equities I	97	-0.0007	0.90	0.08	0.00	0.14	0.90	0.89
Arctic Norwegian Equities II A	52	0.0016	0.88	0.06	-0.04	0.09	0.83	0.81
C WorldWide Norge	210	0.0007	0.95	-0.02	-0.05	0.06	0.97	0.97
Danske Invest Norge I	210	0.0012	0.93	0.04	0.01	-0.01	0.97	0.97
Danske Invest Norge Vekst	210	-0.0002	0.91	0.17	0.01	-0.01	0.88	0.88
Delphi Norge	210	0.0001	1.05	0.28	-0.07	-0.04	0.89	0.89
DNB Norge	210	-0.0002	0.94	0.00	0.00	0.02	0.98	0.98
DNB Norge Selektiv (I)	210	0.0007	0.97	0.02	-0.03	-0.03	0.95	0.95
DNB SMB	210	0.0006	1.10	0.49	-0.05	-0.10	0.83	0.83
Eika Norge	183	0.0006	1.00	0.20	0.03	-0.06	0.93	0.93
Eika Spar	210	0.0016	0.80	0.01	-0.07	0.03	0.92	0.92
FIRST Generator S	99	0.0028	1.28	0.25	0.09	-0.04	0.77	0.76
Fondsfinans Norge	192	0.0029	0.96	0.11	-0.01	-0.05	0.92	0.92
FORTE Norge	93	0.0003	0.99	0.08	0.03	-0.01	0.69	0.68
FORTE Tronder	72	0.0074	0.63	-0.01	0.04	-0.04	0.32	0.28
Holberg Norge	210	0.0005	0.93	0.27	-0.02	-0.02	0.89	0.89
KLP AksjeNorge	210	0.0010	0.97	0.04	0.00	0.00	0.96	0.96
Landkreditt Utbytte A	70	-0.0020	0.80	0.19	0.15	0.14	0.52	0.49
Nordea 1 - Norwegian Equity	210	-0.0020	1.00	0.09	0.00	0.01	0.96	0.96
Nordea Avkastning	210	0.0000	0.99	0.05	-0.02	-0.01	0.98	0.98

Table A.1 continued. The table reports average factor loadings for all funds in the sample. N is the number of NAV observations used in the calculation. Factor loadings are calculated through Four Factor Models where α is the constant, $R_m - R_f$ is the market return in excess of the risk-free rate, SMB is the size factor (small minus big), HML is the book-to-market factor (high minus low), and MOM is the momentum factor. R^2 is the explanation power of the model and the adjusted R^2 takes the number of variables into account.

Fund	N	α	$R_m - R_f$	SMB	HML	MOM	R^2	adj R^2
Nordea Kapital	210	0.0007	0.98	0.04	-0.02	-0.01	0.98	0.98
Nordea Norge Pluss	92	0.0017	1.03	0.13	0.04	-0.01	0.92	0.92
Nordea Norge Verdi	210	0.0019	0.88	0.16	0.05	-0.09	0.92	0.92
ODIN Norge C	210	-0.0019	0.97	0.34	0.08	0.00	0.88	0.88
Pareto Aksje Norge A	207	0.0016	0.88	0.22	0.07	0.03	0.85	0.85
Pareto Investment Fund A	210	-0.0004	1.01	0.08	-0.08	0.04	0.94	0.94
PLUSS Aksje	210	0.0007	0.88	-0.01	-0.03	0.00	0.95	0.95
PLUSS Markedsverdi	210	0.0013	0.91	-0.04	-0.01	0.01	0.98	0.98
Sbanken Framgang Sammen	35	-0.0022	1.05	0.01	0.08	0.06	0.93	0.92
SEB 1 Norway Focus C (NOK)	33	0.0011	0.89	0.21	0.16	0.03	0.70	0.66
Storebrand Norge	210	0.0000	1.00	0.05	-0.02	0.03	0.98	0.98
Storebrand Norge Pluss	20	0.0083	0.44	0.11	0.24	-0.10	0.97	0.96
Storebrand Optima Norge A	210	-0.0007	0.96	0.02	0.03	-0.02	0.92	0.92
Storebrand Vekst	210	0.0015	0.92	0.16	-0.25	-0.11	0.82	0.82
Storebrand Verdi A	210	0.0004	0.92	-0.03	0.15	0.12	0.94	0.94
Vibrand Norden	210	-0.0009	0.99	0.06	-0.05	0.02	0.93	0.93
Alfred Berg Norge Etisk	145	-0.0010	0.99	0.05	-0.08	0.00	0.98	0.98
Delphi Vekst	90	-0.0034	1.04	0.13	0.03	0.00	0.83	0.82
DNB Norge (Avanse II)	113	-0.0010	1.03	0.03	-0.01	-0.07	0.99	0.99
Landkreditt Norge	120	0.0011	0.88	0.13	0.06	-0.08	0.90	0.90
NB Aksjefond	148	-0.0024	0.97	0.13	-0.01	-0.05	0.96	0.96
Nordea SMB	163	-0.0053	1.01	0.51	-0.01	-0.05	0.83	0.83
Nordea Vekst	163	-0.0015	0.98	0.06	-0.04	-0.01	0.97	0.96
Storebrand Norge Institusjon	38	0.0001	0.90	-0.04	0.02	0.00	0.97	0.96
Terra Norge	148	-0.0006	0.98	0.08	-0.05	0.00	0.96	0.96

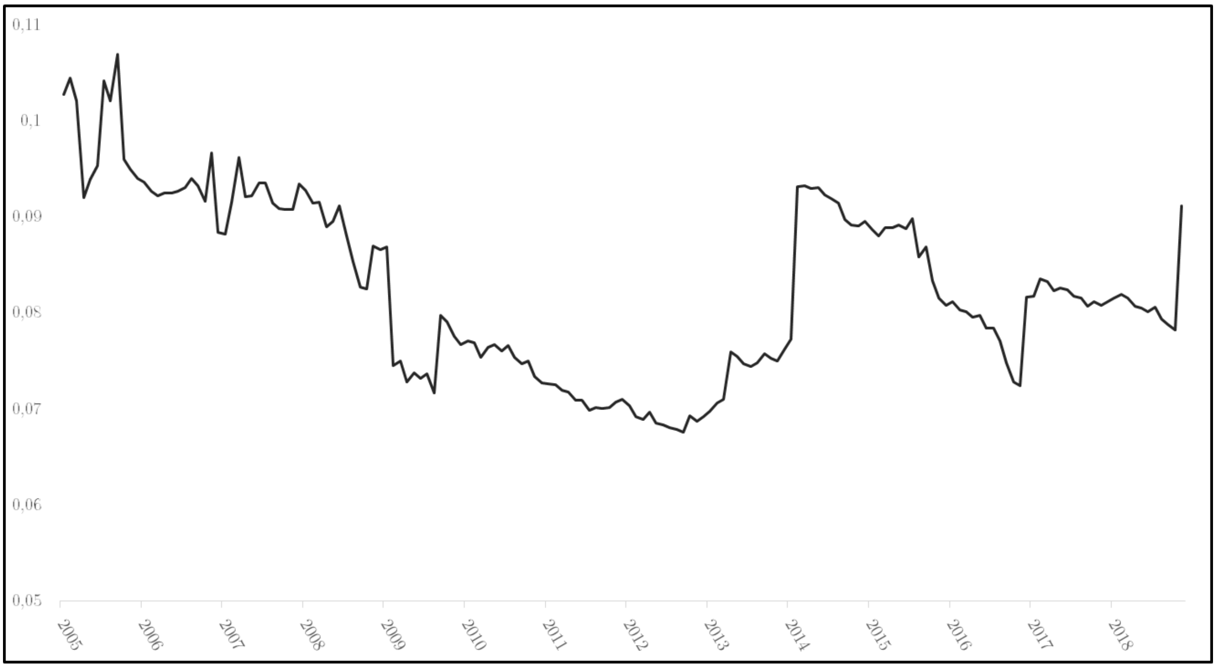
A.2 Summary of Non-Transformed Variables

The table reports summary statistics for non-transformed variables. *FundSize* is the funds AUM. *Age* is the funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the sum of the AUM of the owning family. *IndustrySize* is the sum of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018

Statistic	N	Mean	St. Dev.	Min	Max
FundSize	6 194	1 770 677 056	2 883 355 975	5 015 000	27 456 106 800
Age	6 194	15.642	8.295	0	48
ExpRatio	6 194	0.016	0.004	0.002	0.025
FamilySize	6 194	37 835 494 943	56 302 815 343	0.000	366 206 499 900
IndustrySize	6 194	620 535 171 619	358 619 271 398	161 272 722 141	1 329 551 537 396
HHI	6 194	0.082	0.009	0.068	0.107
Mutual Fund Index	6 194	0.160	0.367	0	1
Small Cap Index	6 194	0.073	0.260	0	1
Manager History	6 194	0.019	0.135	0	1
Flow	6 194	0.010	0.166	−0.966	9.516

A.3 Herfindahl-Hirschman Index

The figure shows changes in the Herfindahl-Hirschman Index (HHI) from 2005 - 2018. The index is a measure of market share concentration and ranges from 0 to 1. High (low) values imply lower (higher) degree of competition.



A.4 Correlation Matrix

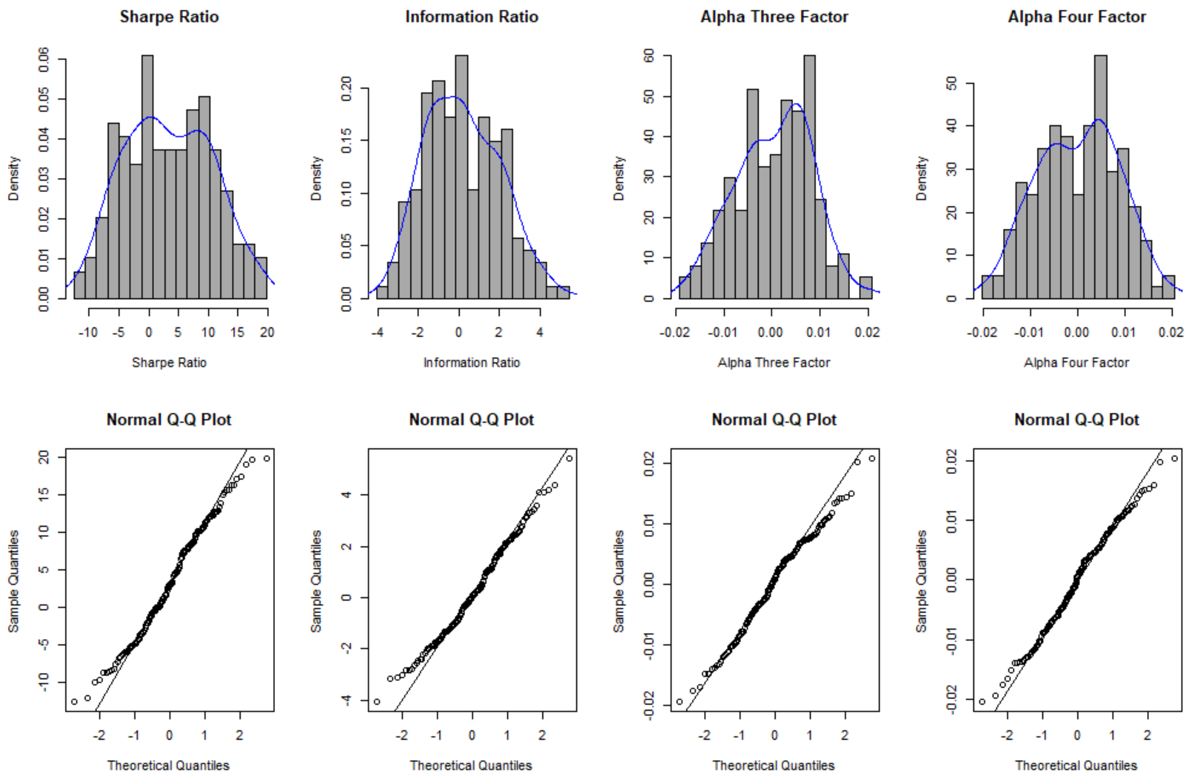
The table shows the correlation matrix for the independent variables *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are variables stating a funds benchmark. *Manager History* is a variable accounting for changes in manager team. *Flow* is a measure of monthly fund flow. Variable names are substituted by numbers in the column titles. Sample period from January 2005 to December 2018

	1	2	3	4	5	6	7	8	9	10
FundSize	1									
Age	0.421	1								
ExpRatio	0.111	0.058	1							
FamilySize	0.505	0.386	0.092	1						
IndustrySize	0.218	0.150	-0.013	0.244	1					
HHI	-0.053	-0.120	-0.002	-0.035	-0.243	1				
Mutual Fund	0.152	0.057	0.174	0.256	-0.020	0.026	1			
Small Cap	-0.046	-0.011	0.183	0.102	-0.053	0.022	-0.122	1		
Manager History	-0.003	0	0.009	-0.031	-0.023	0.014	0.041	0.003	1	
Flow	-0.075	-0.102	-0.003	-0.042	-0.010	-0.013	-0.010	-0.014	-0.010	1

B Specification Tests

B.1 Histograms and Q-Q plots for Normality

The figure shows plots of normality when studying the distribution of Sharpe Ratio, Information Ratio and alpha values from regressions of a three and four factor framework. The top plots show histograms and blue density lines. The bottom figures show Q-Q plots.



B.2 Shapiro-Wilk test for Normality

The table report results from the Shapiro-Wilk test of normality for the distribution of Sharpe Ratio, Information Ratio and alpha values from regressions of a three and four-factor framework. The null hypothesis is that the population is normally distributed.

Shapiro-Wilk Normality	W	p-value
Sharpe Ratio	0.985	0.083
Information Ratio	0.987	0.174
Three Factor Model	0.989	0.257
Four Factor Model	0.989	0.248

B.3 Model Specification Tests

The table report results from model specification testing. The Lagrange-Multiplier test (LM test) compare random models to pooled OLS models. The null hypothesis is that there are no significant differences across units and a pooled model is preferred. The F-test compares fixed effects to a pooled OLS model. The null hypothesis is that there are no fixed effects in the model. Test statistics and p-values are reported.

Model	LM test	p-value	F-test	p-value
1	-2.245	0.988	1.022	0.432
2	-1.909	0.972	0.880	0.704
3	0.491	0.312	1.799	0.001

C Performance Subsamples

C.1 Four Factor alpha - Active vs Closed Funds

The table shows summary statistics and factor loadings for funds divided into active and closed funds. Factor loadings are calculated through four-factor models where α is the constant, $R_m - R_f$ is the market return in excess of the risk-free rate, SMB is the size factor (small minus big), HML is the book-to-market factor (high minus low), and MOM is the momentum factor. R^2 is the explanation power of the model and the adjusted R^2 takes the number of variables into account.

Panel A: Active Funds								
	N	*Alpha*	*Rm-Rf*	*SMB*	*HML*	*MOM*	R^2	*adj* R^2
Mean	160.9	**0.0007**	0.94	0.11	0.00	0.01	0.89	0.88
Standard Error	10.1	0.000	0.02	0.02	0.01	0.01	0.02	0.02
Median	198	0.001	0.96	0.08	-0.01	0.00	0.93	0.92
Standard Deviation	64.11	0.002	0.13	0.12	0.09	0.06	0.13	0.14
Sample Variance	4110.16	0.000	0.02	0.01	0.01	0.00	0.02	0.02
Kurtosis	0.15	5.944	6.71	1.43	2.33	-0.03	9.17	8.77
Skewness	-1.36	1.963	-1.50	1.16	0.18	0.25	-2.81	-2.78
Range	190	0.011	0.84	0.53	0.50	0.25	0.66	0.71
Minimum	8	-0.002	0.44	-0.04	-0.25	-0.11	0.32	0.27
Maximum	198	0.008	1.28	0.49	0.24	0.14	0.98	0.98
Count	40	40	40	40	40	40	40	40
Panel B: Closed Funds								
	N	*Alpha*	*Rm-Rf*	*SMB*	*HML*	*MOM*	R^2	*adj* R^2
Mean	117.1	**-0.0013**	0.97	0.09	-0.01	-0.03	0.92	0.91
Standard Error	14.1	0.000	0.01	0.04	0.01	0.02	0.01	0.02
Median	145.0	-0.001	0.99	0.07	-0.01	-0.04	0.95	0.94
Standard Deviation	58.2	0.002	0.06	0.16	0.04	0.06	0.06	0.07
Sample Variance	3388.0	0.000	0.00	0.03	0.00	0.00	0.00	0.00
Kurtosis	-1.4	0.213	1.14	2.30	0.24	-0.52	0.92	0.85
Skewness	-0.4	-1.008	-1.23	0.82	0.55	0.29	-1.28	-1.28
Range	164	0.006	0.21	0.74	0.17	0.22	0.22	0.22
Minimum	31	-0.005	0.82	-0.23	-0.08	-0.12	0.77	0.76
Maximum	195	0.001	1.03	0.51	0.09	0.10	0.98	0.98
Count	17	17	17	17	17	17	17	17

C.2 Panel Data Subsamples - Excluding Small Funds

Excluding small funds, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018. **The table continues on the next page.**

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
FundSize	-0.001^{**}	-0.001^{***}	-0.004^{***}	-0.004^{***}	-0.003^{***}	-0.010^{***}
	(−2.421)	(−2.807)	(−5.679)	(−4.365)	(−3.404)	(−7.323)
Age	0.001	0.0002	0.001	0.002	0.0003	−0.003
	(0.739)	(0.315)	(1.216)	(0.506)	(0.090)	(−0.691)
ExpRatio	−0.032	−0.019	−0.085			
	(−0.649)	(−0.422)	(−1.223)			
FamilySize	0.001	0.001	0.001^{**}	0.002	0.002	0.006^{***}
	(1.554)	(1.611)	(2.497)	(1.468)	(1.213)	(2.824)
IndustrySize	-0.004^{***}	-0.004^{***}	−0.0003	-0.004^{*}	-0.004^{**}	0.002
	(−4.640)	(−5.605)	(−0.217)	(−1.706)	(−2.103)	(0.551)
HHI	−0.010	-0.040^{**}	0.058^{*}	−0.003	-0.037^{*}	0.060^{*}
	(−0.460)	(−1.973)	(1.856)	(−0.122)	(−1.695)	(1.814)
Observations	4 200	4 200	4 200	4 200	4 200	4 200
R^2	0.013	0.016	0.013	0.015	0.015	0.018
Adjusted R^2	0.010	0.013	0.010	0.004	0.005	0.007
F Statistic	5.350^{***}	6.741^{***}	5.421^{***}	8.761^{***}	9.265^{***}	10.662^{***}

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

Table C.2 continued. Excluding small funds, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018. **The table continues on the next page.**

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
Mutual Fund Index	0.001	0.001	0.0001			
	(0.966)	(1.071)	(0.120)			
Small Cap Index	0.001	0.001	0.002			
	(0.909)	(1.007)	(1.453)			
Manager History	0.0002	0.0001	0.001	0.00003	0.0001	0.001
	(0.109)	(0.103)	(0.524)	(0.019)	(0.069)	(0.365)
Flow	0.008***	0.006***	0.010***	0.007***	0.006***	0.009***
	(3.686)	(3.110)	(3.315)	(3.429)	(2.949)	(2.938)
Constant	0.053***	0.062***	0.023*			
	(5.498)	(6.991)	(1.713)			
Observations	4 200	4 200	4 200	4 200	4 200	4 200
R^2	0.013	0.016	0.013	0.015	0.015	0.018
Adjusted R^2	0.010	0.013	0.010	0.004	0.005	0.007
F Statistic	5.350***	6.741***	5.421***	8.761***	9.265***	10.662***

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

C.3 Panel Data Subsamples - Excluding Large Funds

Excluding large funds, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018. **The table continues on the next page.**

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
FundSize	-0.001^{**}	-0.001	-0.001	-0.007^{***}	-0.005^{***}	-0.009^{***}
	(-2.102)	(-1.584)	(-1.387)	(-5.431)	(-4.218)	(-5.948)
Age	0.0001	-0.0002	-0.0002	0.009^{**}	0.007^{*}	0.009^{**}
	(0.087)	(-0.181)	(-0.209)	(2.402)	(1.948)	(2.274)
ExpRatio	0.114^{*}	0.138^{**}	-0.005			
	(1.698)	(2.173)	(-0.063)			
FamilySize	0.0001	0.0001	0.0001	-0.001	-0.0004	0.00001
	(0.323)	(0.305)	(0.344)	(-0.926)	(-0.837)	(0.017)
IndustrySize	-0.002	-0.002^{**}	-0.001	-0.001	-0.002	-0.001
	(-1.522)	(-2.008)	(-0.500)	(-0.590)	(-0.917)	(-0.487)
HHI	0.034	-0.0003	0.032	0.044	0.008	0.028
	(1.043)	(-0.011)	(0.925)	(1.250)	(0.237)	(0.748)
Observations	4 153	4 153	4 153	4 153	4 153	4 153
R^2	0.007	0.007	0.003	0.012	0.009	0.011
Adjusted R^2	0.005	0.005	0.001	-0.0003	-0.004	-0.001
F Statistic	2.956^{***}	3.106^{***}	1.305	7.082^{***}	5.131^{***}	6.773^{***}

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

Table C.3 continued. Excluding large funds, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. Sample period from January 2005 to December 2018.

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
Mutual Fund Index	−0.001	−0.001	−0.00002			
	(−0.663)	(−0.930)	(−0.024)			
Small Cap Index	−0.002	-0.003^{**}	−0.001			
	(−1.612)	(−2.178)	(−0.486)			
Manager History	0.003	0.003	0.002	0.003	0.003	0.003
	(1.423)	(1.430)	(0.973)	(1.345)	(1.322)	(1.045)
Flow	0.005^{***}	0.004^{***}	0.004^{**}	0.004^{***}	0.004^{***}	0.003^{*}
	(3.067)	(2.999)	(2.434)	(2.670)	(2.669)	(1.818)
Constant	0.028^{**}	0.033^{**}	0.013			
	(2.073)	(2.572)	(0.878)			
Observations	4 153	4 153	4 153	4 153	4 153	4 153
R^2	0.007	0.007	0.003	0.012	0.009	0.011
Adjusted R^2	0.005	0.005	0.001	−0.0003	−0.004	−0.001
F Statistic	2.956^{***}	3.106^{***}	1.305	7.082^{***}	5.131^{***}	6.773^{***}

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

C.4 Panel Data Subsamples - Period 1

Using data from January 2005 to August 2009, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. **The table continues on the next page.**

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
FundSize	−0.001	−0.001	−0.001	−0.014***	−0.010***	−0.011***
	(−0.771)	(−0.707)	(−0.783)	(−4.298)	(−3.362)	(−3.567)
Age	−0.0002	−0.001	−0.004*	0.042***	0.025**	0.020
	(−0.092)	(−0.527)	(−1.852)	(3.251)	(2.020)	(1.556)
ExpRatio	0.237	0.261*	−0.122			
	(1.645)	(1.884)	(−0.880)			
FamilySize	0.001	0.001	0.001	0.008*	0.007	0.003
	(0.741)	(0.843)	(0.597)	(1.698)	(1.559)	(0.667)
IndustrySize	0.005	0.004	−0.009	−0.004	−0.004	−0.006
	(0.816)	(0.748)	(−1.564)	(−0.567)	(−0.539)	(−0.880)
HHI	−0.019	−0.024	−0.315***	0.242**	0.139	−0.134
	(−0.264)	(−0.347)	(−4.536)	(2.321)	(1.383)	(−1.327)
Observations	1 793	1 793	1 793	1 793	1 793	1 793
R^2	0.009	0.010	0.018	0.017	0.013	0.018
Adjusted R^2	0.004	0.004	0.013	−0.007	−0.012	−0.007
F Statistic	1.631*	1.808*	3.326***	4.432***	3.193***	4.476***
Note:						*p<0.1; **p<0.05; ***p<0.01

Table C.4 Continued. Using data from January 2005 to August 2009, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow.

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
Mutual Fund Index	0.0003	0.0005	0.002			
	(0.210)	(0.341)	(1.160)			
Small Cap Index	0.001	0.002	0.0002			
	(0.518)	(0.708)	(0.088)			
Manager History	0.002	0.002	0.003	0.002	0.001	0.004
	(0.637)	(0.521)	(0.969)	(0.453)	(0.256)	(1.020)
Flow	0.007***	0.007***	0.002	0.005**	0.006***	0.001
	(3.151)	(3.206)	(1.139)	(2.524)	(2.666)	(0.564)
Constant	−0.052	−0.047	0.135**			
	(−0.787)	(−0.729)	(2.118)			
Observations	1 793	1 793	1 793	1 793	1 793	1 793
R^2	0.009	0.010	0.018	0.017	0.013	0.018
Adjusted R^2	0.004	0.004	0.013	−0.007	−0.012	−0.007
F Statistic	1.631*	1.808*	3.326***	4.432***	3.193***	4.476***

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

C.5 Panel Data Subsamples - Period 2

Using data from September 2009 to April 2014, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. *EXCRET3F* is returns in excess of estimated return through a three-factor model. *EXCRET4* extends estimation with a momentum factor. *EXCRETM* is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. **The table continues on the next page.**

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
FundSize	−0.0004	−0.0004	−0.0004	−0.007***	−0.006***	−0.005*
	(−0.931)	(−0.904)	(−0.774)	(−3.535)	(−3.150)	(−1.921)
Age	0.001	0.0004	0.002*	0.007	0.010	0.012
	(0.797)	(0.419)	(1.774)	(0.989)	(1.539)	(1.386)
ExpRatio	−0.051	−0.017	−0.013			
	(−0.885)	(−0.321)	(−0.176)			
FamilySize	−0.0002	−0.0001	−0.0003	−0.001	−0.001	−0.0003
	(−0.725)	(−0.243)	(−0.816)	(−1.290)	(−1.435)	(−0.511)
IndustrySize	0.004	0.005**	−0.003	0.005	0.004	−0.007
	(1.550)	(1.993)	(−0.954)	(1.128)	(1.029)	(−1.336)
HHI	0.003	−0.072	0.100	0.018	−0.052	0.109
	(0.057)	(−1.504)	(1.487)	(0.341)	(−1.074)	(1.619)
Observations	2 252	2 252	2 252	2 252	2 252	2 252
R^2	0.004	0.004	0.005	0.010	0.010	0.005
Adjusted R^2	−0.001	−0.001	0.001	−0.013	−0.013	−0.018
F Statistic	0.788	0.857	1.190	3.042***	3.161***	1.541
Note:						*p<0.1; **p<0.05; ***p<0.01

Table C.5 Continued. Using data from September 2009 to April 2014, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. *EXCRET3F* is returns in excess of estimated return through a three-factor model. *EXCRET4* extends estimation with a momentum factor. *EXCRETM* is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow.

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
Mutual Fund Index	−0.001	0.0001	−0.001			
	(−0.669)	(0.214)	(−1.490)			
Small Cap Index	0.00001	0.0004	−0.001			
	(0.010)	(0.377)	(−0.565)			
Manager History	−0.002	−0.002	0.0002	−0.002	−0.002	0.001
	(−1.028)	(−1.063)	(0.098)	(−0.979)	(−1.019)	(0.352)
Flow	0.003	0.002	0.005	0.002	0.001	0.003
	(1.112)	(0.716)	(1.483)	(0.813)	(0.571)	(0.985)
Constant	−0.039	−0.043	0.033			
	(−1.317)	(−1.604)	(0.884)			
Observations	2 252	2 252	2 252	2 252	2 252	2 252
R^2	0.004	0.004	0.005	0.010	0.010	0.005
Adjusted R^2	−0.001	−0.001	0.001	−0.013	−0.013	−0.018
F Statistic	0.788	0.857	1.190	3.042***	3.161***	1.541

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

C.6 Panel Data Subsamples - Period 3

Using data from May 2014 to December 2018, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow. **The table continues on the next page.**

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
FundSize	-0.001^{***}	-0.001^{**}	-0.002^{***}	-0.008^{***}	-0.005^{***}	-0.014^{***}
	(-2.669)	(-2.519)	(-3.013)	(-4.412)	(-2.975)	(-5.786)
Age	-0.0001	0.00005	0.0001	0.011^{**}	0.013^{**}	0.021^{***}
	(-0.149)	(0.052)	(0.052)	(1.980)	(2.474)	(2.822)
ExpRatio	0.042	0.071	0.059			
	(0.650)	(1.206)	(0.670)			
FamilySize	0.001	0.0002	0.001^{*}	0.004	0.002	0.002
	(1.458)	(0.463)	(1.843)	(0.890)	(0.568)	(0.322)
IndustrySize	-0.011^{**}	-0.002	-0.050^{***}	-0.010	-0.007	-0.045^{***}
	(-2.067)	(-0.510)	(-6.950)	(-1.260)	(-0.897)	(-4.179)
HHI	-0.176^{**}	-0.105	-0.533^{***}	-0.157^{**}	-0.089	-0.468^{***}
	(-2.498)	(-1.626)	(-5.522)	(-2.179)	(-1.334)	(-4.814)
Observations	2 149	2 149	2 149	2 149	2 149	2 149
R^2	0.011	0.009	0.032	0.016	0.010	0.045
Adjusted R^2	0.006	0.005	0.028	-0.008	-0.013	0.022
F Statistic	2.290^{**}	2.028^{**}	7.109^{***}	4.824^{***}	3.094^{***}	14.112^{***}
Note:						*p<0.1; **p<0.05; ***p<0.01

Table C.6 Continued. Using data from May 2014 to December 2018, the table reports regression results using two estimators, pooled OLS and Fixed Effects. Each model uses three different dependent variables. $EXCRET3F$ is returns in excess of estimated return through a three-factor model. $EXCRET4$ extends estimation with a momentum factor. $EXCRETM$ is returns in excess of benchmark return. *FundSize* is the logarithm of funds AUM. *Age* is the logarithm of funds age. *ExpRatio* is the annual expense ratio. *FamilySize* is the logarithm of the AUM of the owning family. *IndustrySize* is the logarithm of the AUM of all funds listed for sale in Norway. *HHI]* is the Herfindahl-Hirschmann index, a measure of competition. *Mutual Fund Index* and *Small Cap Index* are dummy variables taking 1 if reported benchmark is Mutual Fund TR or Small Cap Index TR. *Manager History* is a dummy taking the value 1 if change in manager team. *Flow* is a measure of monthly fund flow.

	Pooled OLS			*Fixed Effects*		
	EXCRET3F	EXCRET4F	EXCRETM	EXCRET3F	EXCRET4F	EXCRETM
	(1)	(2)	(3)	(4)	(5)	(6)
	(−2.498)	(−1.626)	(−5.522)	(−2.179)	(−1.334)	(−4.814)
Mutual Fund Index	−0.001	−0.001	−0.001			
	(−1.012)	(−0.742)	(−0.775)			
Small Cap Index	−0.002	−0.001	−0.001			
	(−1.118)	(−0.521)	(−0.722)			
Manager History	0.005**	0.005***	0.001	0.005**	0.006***	0.003
	(2.272)	(2.776)	(0.303)	(2.434)	(2.983)	(0.850)
Flow	0.001	−0.0001	0.005	−0.001	−0.001	0.001
	(0.320)	(−0.035)	(1.526)	(−0.378)	(−0.513)	(0.449)
Constant	0.153**	0.047	0.660***			
	(2.281)	(0.769)	(7.178)			
Observations	2 149	2 149	2 149	2 149	2 149	2 149
R^2	0.011	0.009	0.032	0.016	0.010	0.045
Adjusted R^2	0.006	0.005	0.028	−0.008	−0.013	0.022
F Statistic	2.290**	2.028**	7.109***	4.824***	3.094***	14.112***

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