DO ACTIVE FUND MANAGERS OUTPERFORM THEIR PEERS?

A Study of Active Management & Performance in the Swedish Mutual Fund Market

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Abstract

Primarily, the purpose of this paper is to examine the relationship between active management and fund performance in the Swedish mutual fund market, 2010-2021. Two measures of active management are used: Active Share and Tracking Error. The study is conducted by collecting data from Nasdaq and Morningstar on holdings and returns for Swedish equity mutual funds and five benchmark indexes. We have examined the relationship between active management and fund performance, measured as benchmark-adjusted return (alpha), primarily by using linear- and quantile regressions. The findings consistently imply a positive relationship between Active Share and fund performance, while the findings on Tracking Error are more ambiguous. Further, the findings suggest that the relationship between active management and fund performance is negative among low-performing funds, but positive among median- and high-performing funds. In addition, the findings suggest that the mean Tracking Error and Active Share has steadily increased over time in the period examined.

Keywords

Active Share, Tracking Error, Benchmark-Adjusted Return, Alpha, Benchmark Index

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1. Introduction

A mutual fund is a professionally managed pool of investments that primarily invests in financial securities such as stocks, bonds, and short-term debt. Mutual funds have become an increasingly popular investment alternative in Sweden. In 2020, almost 70 percent of the Swedish population had any part of their savings or investments in a fund (The Swedish Investment Fund Association, 2020). People invest in mutual funds due to their professional management, diversification, affordability, and liquidity (US Securities and Exchange Commission, 2022). However, a debate has arisen regarding the justification of fund fees, and whether actively managed funds outperform or underperform their benchmark indexes (Sanchez, 2020).

The relative performance of actively managed funds is a topic extensively debated and researched in recent years (Sanchez, 2020). Most research on the topic suggests that active fund managers on average underperform their benchmark indexes net of fees, which has raised the question of whether the fees charged by active funds are justifiable (Wermers, 2003). The issue of whether fund fees are justifiable received great attention in Sweden in 2014, when a Swedish fund company was alleged to have charged substantial fund fees, despite not being particularly active (Sveriges Aktiesparares Riksförbund, 2014).

Fewer studies have examined the degree of active management within actively managed funds and its relationship with fund performance. However, this relationship has been examined in previous research, where a comprehensive study covering the period 1980-2003 in the United States found a strong relationship between active management and benchmark-adjusted fund performance (Cremers and Petajisto, 2009).

Our paper investigates the relationship between active management and benchmark-adjusted performance for Swedish equity mutual funds, in the period 2010-2021. This is carried out by replicating, with extensions and modifications, the study *How Active is Your Fund Manager? A New Measure That Predicts Performance*, published by Cremers and Petajisto (2009).

Primarily, we contribute to the findings of Cremers and Petajisto (2009) by applying a new geographical and temporal scope; the Swedish mutual fund market in 2010-2021. Further, we contribute with respect to methodology by using quantile regressions to examine if Active Share and Tracking Error affect high-, median-, and low-performing funds differently. Moreover, two country-specific analyses are carried out by examining if the funds' Tracking Error has increased on average since it became a legal requirement for Swedish mutual funds to disclose this measure in their annual reports (Finansinspektionen, 2019), and examining if the funds' Active Share has increased on average since the Swedish fund association sharpened their guidelines regarding fund reporting, recommending funds to disclose their Active Share (The Swedish Investment Fund Association, 2015).

Hence, the aim of this paper is to examine the following research questions:

- *Can active management predict mutual fund performance in the Swedish market?*
- *Is the relationship between active management and fund performance consistent among high-, median-, and low-performing funds?*
- *Has the mean Tracking Error been affected by Swedish law enforcement?*
- *Has the mean Active Share been affected by the Swedish Fund Association's recommendation?*

Consistent with Cremers and Petajisto (2009), this paper examines the relationship between active management and fund performance. This is examined by using data on Swedish equity mutual funds, covering the years 2010-2021. Two measures are applied to determine the level of active management; 1. Active Share, invented by Cremer & Petajisto (2009), which captures the deviations in portfolio holdings (weights) from a fund and its benchmark index, and 2. Tracking Error (active risk), which represents to what extent a fund's return deviates from the return of its benchmark index. In this study, the Active Share measure is used as a proxy for a fund´s level of stock selection, while the Tracking Error is used as a proxy for a fund´s level of factor timing (Cremers & Petajisto, 2009).

We investigate to what extent these measures can predict fund performance, measured as benchmark-adjusted return (alpha), among Swedish equity mutual funds, both gross and net of fees.

To examine the research questions, data on fund holdings and fund return (gross- and net of fees) have been collected from Morningstar Direct. The sample consists of Swedish equity mutual funds, investing at least 75 percent of their total assets in equities, and at least 75 percent of their equity assets in Swedish equities. Furthermore, data on benchmark indexes, their weights and returns, are obtained from Nasdaq. Five Swedish equity indexes have been selected: one Large-Cap-, two All-Share-, one Mid-Cap, and one Small-Cap index. All the data on holdings are reported quarterly, while the data on returns consist of daily and quarterly returns.

The study begins by conducting a baseline regression, regressing Net- and Gross Alpha against Active Share and Tracking Error. The findings suggest that there is a significant positive relationship between a funds' level of Active Share and its benchmark-adjusted return, gross and net. For the Tracking Error measure, the findings are more ambiguous. While a slight negative relationship is obtained between Tracking Error and benchmark-adjusted gross return, a slightly positive relationship is obtained between Tracking Error and benchmark-adjusted net return. However, none of these results are significant, and thus no clear conclusions can be drawn regarding the Tracking Error measure.

Further, the baseline regression is extended by conducting a quantile regression, dividing the dependent variable (benchmark-adjusted return) into quantiles at 25%, 50%, and 75%. The results suggest that both Active Share and Tracking Error effects high-performing funds more extensively (positively) than median- and low-performing funds – both regarding gross- and net returns.

Moreover, when dividing the two measures of active management into quartiles, funds within the highest quartile with respect to the Active Share measure has a benchmark-adjusted annual return of 1.32 percentage points (gross) and 1.26 percentage points (net) higher than that of the least active quartile. Thus, the findings regarding Active Share support the results obtained by Cremers & Petajisto (2009).

The hitherto mentioned regressions are complemented by adding control (proxy) variables to the regression model, including Fund Size, Fund Fee, and Fund Manager Persistence. Although none of these variables significantly explains deviations in benchmark-adjusted returns, they explain variations in Active Share and Tracking Error, but in opposite directions. Fund Fee is positively (negatively) correlated with Active Share (Tracking Error), while Fund Size is negatively (positively) correlated with Active Share (Tracking Error).

Lastly, a Welch two-sided t-test is conducted to determine the mean difference before and after the law change on disclosing Tracking Error (Q1 2020) and the change in Active Share after the recommendation on disclosing Active Share from the Swedish Fund Association (Q3

2015). Regarding the new legislation's effect on Tracking Error, the funds' Tracking Error increased significantly when the new legislation came into effect. It can be argued to what extent the law enforcement regarding the disclosure of Tracking Error is appropriate to serve the purpose of justifying fund fees. While the Tracking Error measures active risk, a higher Tracking Error may not imply a high effort by the manager per se, nor a higher expected return as compensation for the additional risk inflicted on the investor.

Given the purpose of the law enforcement, Active Share may be a more appropriate measure of active management as it indicates the level of stock selection, which arguably requires greater managerial effort than factor timing, thus justifying higher fees charged (Cremers, K. J. M., Ferreira, M. A., Matos, P., and Starks, L. T., 2015). Furthermore, as our and Cremer and Petajisto's study (2009) suggest that Active Share (but not Tracking Error) has a statistically significant positive relationship with the benchmark-adjusted gross return, it may be more reasonable for funds to justify their fees to investors with their level of Active Share rather than their Tracking Error.

The average Active Share in the sample is significantly higher after the recommendation for funds to disclose Active Share came into effect in May 2015. However, the average Active Share may have increased due to other factors than the recommendation, as the average Active Share increased quite steadily in the overall period covered (2010-2021), and not solely after the recommendation came into effect.

2. Literature Review

Historically, the mutual fund literature has primarily focused on fund performance. Wermers (2000) examined the returns for mutual funds in relation to their benchmark indexes but did not investigate the reason for the deviations, nor incorporated the degree of active management. Wermers (2003) investigated the topic further by applying Tracking Error as a measure of active management and examining its relationship to benchmark-adjusted fund performance. However, fund holdings were not considered, and the only benchmark index applied for obtaining Tracking Error was the S&P 500 index.

Cremers and Patajisto (2009) invented the Active Share measure and examined its connection to fund performance, making their paper the closest to ours. The paper tests how active management is related to characteristics such as fund size, expenses, and fund turnover as well as benchmark-adjusted return. Their sample covered the American mutual fund market from 1980 to 2003 and found that Active Share significantly predicts benchmark-adjusted fund performance; funds in the highest Active Share-quintile substantially outperformed their benchmark indexes, gross- and net of fees, while the funds in the lowest Active Share-quintile underperformed to their benchmark indexes. Further, their study found, if anything, a negative relationship between a fund's Tracking Error and its benchmark-adjusted return. However, the results on Tracking Error were not significant.

Cremers and Pareek (2015) presented an extension of Cremers and Petajisto (2009), applying the same measures of active management, but added another key variable: fund holding duration (how frequently the fund manager trades). Again, the paper covered the U.S. market, and the sample included all-equity U.S. retail funds and aggregate institutional investor portfolios. Adding fund holding duration could be an appropriate extension to the findings in this paper on the Swedish market for further researchers.

Lastly, Cremers et al. (2015) investigated variations in closet indexing and active management across countries in the global fund market, Sweden included. However, the authors focused on determining explanatory factors between national discrepancies in active management associated with countries' regulatory and financial market environments, not explicitly on the relationship to benchmark-adjusted return.

In our study, we carry through a replication on the study of Cremers and Petajisto (2009) on active management and fund performance, where we contribute by applying a new geographical scope and time frame. We regard the geographical scope (the Swedish market) and the time covered (2010-2021) in our study as highly relevant since the Swedish government in 2014 appointed an inquiry regarding legal requirements for Swedish funds to disclose their activity level (SOU 2016-45).

The background for the inquiry was that the Swedish Association of Equity Investors ("Sveriges Aktiesparares Riksförbund") claimed that a Swedish mutual fund company had a too low activity level to justify the annual fees charged, and the purpose of the inquiry was to enable investors to determine whether a funds fee corresponded to its activity level. Both Active Share and Tracking Error were originally proposed as measures of activity level for the new legislation. The inquiry eventually resulted in a law change that was voted through the Swedish parliament in 2019 and came into effect the on 1st of January 2020. The new law requires all Swedish mutual funds to disclose information on their fund's activity level, measured as active risk, i.e. Tracking Error (Finansinspektionen, 2019).

Our study extends the paper of Cremers and Petajisto by examining if the funds' Tracking Error has increased on average since the law change came into effect, and if the funds' Active Share increased on average after the Swedish Fund Associations sharpened their guidelines for funds by recommending them to disclose their Active Share.

In addition to these country-specific extensions, we have performed methodical extensions. First, we add an additional measure regarding how active management is related to fund outperformance; using quantile regressions where the data is divided into quantiles with respect to alpha. Hence, we examine if the Active Share and Tracking Error exhibit a similar relationship to benchmark-adjusted return among low, median- and high-performing funds. Finally, we extend Cremers and Petajisto's (2009) paper by investigating possible determinants of Tracking Error, in addition to the determinants of Active Share that were examined in their study.

3. Methodology

3.1. Definitions of active management and fund performance

3.1.1. Tracking Error

The Tracking Error measures the time series standard deviation (volatility) in the difference between the return of the fund and the return of its benchmark index (excess return), defined by Grinold and Kahn (1999) as:

$$\text{Tracking Error} = Stdev\left[R_{fund,t} - R_{index,t}\right]$$

Where $R_{fund,t}$ and $R_{index,t}$ refers to the return at time t for the fund and the index.

3.1.2 Active Share

The Active Share measures the differences in holdings for a fund and its benchmark index in each time period, defined by Cremer and Petajisto (2009) as:

$$\text{Active Share} = \frac{1}{2} \sum_{i=1}^{N} \left| w_{fund,i} - w_{index,i} \right|,$$

Where $w_{fund,i}$ and $w_{index,i}$ are the portfolio weights of asset i in the fund an in the index, and the sum is taken over the universe of all assets.

Given this measure, a mutual fund that does not invest on margin or has short positions will always have an Active Share between 0 and 100%, where 0% implies identical holdings with the benchmark index, and 100% implies zero overlapping in holdings with the benchmark index.

3.1.3. Alpha

The benchmark-adjusted return (alpha) for the fund is computed as the difference between the fund's return and the return of its benchmark index in a given period, defined as:

$$\text{Alpha} = R_{Fund,t} - R_{Index,t}$$

Where $R_{Fund,t}$ and $R_{Index,t}$ refers to the returns at time t for the fund and the index. This definition is applied for both Gross- and Net Alpha. In this paper, Alpha is consistently computed based on annualized returns for the funds and indexes.

3.1.4 Summary Statistics Gross Returns

Table A, Summary Statistics Gross Returns

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Active Share (%)	5.00	43.55	56.62	56.64	73.37	94.42
Tracking Error	0.004	0.063	0.086	0.118	0.142	1.991
Alpha	-0.979	-0.048	0.0172	0.023	0.092	1.130
No. of observations	4181					

Summary statistics for Gross Alpha, Active Share, and Tracking Error are shown. All three variables are computed as described earlier in Section 3.1. The gross return sample consist of 4181 data points for each variable. The Active Share is displayed in percentage points while the Gross Alpha and Tracking Error are annualized and expressed in proportions.

As displayed in table A), the mean Gross Alpha is 2.34 percent, while the median Gross Alpha 1.72 percent. This suggests the Gross Alpha sample consists of some extreme outliers, which we account for by applying a quantile regression in Section 5 that is less sensitive to outliers. Active Share ranges from 5 to 94 percent, with a median and mean of 56.6 percent. The mean Tracking Error is 11.8 percent. We locate some extreme values in the sample.

3.1.5 Summary Statistics Net Returns

Table B, Summary Statistics Net Returns

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Active Share (%)	5.00	43.73	57.12	57.01	73.90	95.92
Tracking Error (yearly)	0.003	0.065	0.087	0.117	0.143	0.905
Net Alpha (yearly)	-1.013	-0.060	0.004	0.009	0.076	1.089
No. of observations	4299					

Summary statistics for Net Alpha, Active Share, and Tracking Error. The sample consists of 4299 observations for each variable. The Active Share is displayed in percentage points while the Net Alpha and Tracking Error are annualized and expressed in proportions.

The mean Net Alpha is 0.85 % and the median Net Alpha is 0.4%. The median and mean Active Share are marginally higher in the net return sample compared to the gross return sample. Similarly, the Tracking Error data is highly similar to the gross return data, except for slightly fewer extreme outliers.

3.2 Definition of Control Variables (Proxies)

3.2.1 Fund Size and Fund Fee

The Fund Size is defined as the fund's total assets under management. The Fund Size as of April 2022 is used as a proxy for the Fund Size in the period 2017-2021. The Fund Fee is the actual fees deducted in the last year. The Fund Fee as of April 2022 is used as a proxy for the Fund Fee in the period 2017-2021. Instead of exact historical data, proxies are applied (i.e. applying data from 2022 on the prior 5 years) because we did not manage to find reliable, corresponding historical data for these two measures.

3.2.2 Fund Manager Persistence

As part of our extension, we have added another variable for our regression analysis that captures the persistence of the fund manager, i.e. to what extent the same person remains as manager for the fund over time. To measure the persistence of the fund manager, we have invented a variable that both captures how long the current manager has managed the fund in relative terms, i.e. in relation to how long the fund has existed, and also how many years, in absolute terms, the current manager has managed the fund. The proxy is then obtained by multiplying these relative and absolute measures, defined as:

Fund manager persistence = $(Y_{manager} - Y_{fund}) \times Y_{fund} \times Y_{manager}$,

Where $Y_{manager}$ is the number of years the current manager has managed the fund and Y_{fund} is the number of years since the funds' start date. In our dataset, the end date for both these measures is 2022-04-26.

If the fund currently has more than one fund manager, $Y_{manager}$ refers to the manager that has managed the fund the longest. Although manager tenure was used as an explanatory

variable by Cremer & Petajisto (2009), we seek to nuance this variable by incorporating the relative dimension of the manager persistence into our proxy.

3.2.3 Summary Statistics Control Variables

Table C: Summary Statistics Control Variables

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Fund Size (M SEK)	9.39	1,350.29	3,965.41	9,079.15	12,671.55	50,449.73
Fund Fee (%, Annual)	0	0.900	1.360	1.203	1.530	2.020
Fund Manager Persistence	0	0.230	3.350	5.764	9.570	29.250
No. of observations	1426					

Summary statistics for the control variables. All three variables are computed as described previously in Section 3.2. The sample consists of 1426 observations for each variable.

The Fund Size data ranges from 9.39 to 50,499 million SEK under management, with a mean of 9,079 million SEK. The annual fund fee is ranging from 0 percent to 2.02 percent, with a mean of 1.2 percent. The Fund Manager Persistence measure is ranging from 0 to 29.3, with a mean of 1.2.

3.3 Computations

The computation of each fund's Active Share has been conducted by comparing the fund's holdings to that of the five benchmark indexes at each quarter-end, where the fund is assigned the lowest Active Share with respect to the five benchmark indexes (i.e. where the holdings differ the least). The benchmark index that the fund has the lowest Active Share to in each quarter is also the index that the computation of the fund´s benchmark-adjusted return is based on in the following quarter. To illustrate the methodology, this can be exemplified by a fund that has the following Active Share measures on 2010-03-31 (at the inception of the second quarter 2010):

- OMXS30GI: 30%
- OMXAFGX: 40%
- OMXSBGI: 50%
- OMXSSCGI: 60%
- OMXSMCGI: 70%

The fund is then assigned an Active Share of 30% since that is the lowest with respect to the benchmark indexes. Further, the fund is assigned OMXS30GI as a benchmark index for that quarter (Q2 2010) since the fund's portfolio holdings are most similar to those of the OMXS30GI-index at the inception of the quarter. Hence, due to changes in portfolio holdings, a fund may be assigned different benchmark indexes in different periods. The benchmark-adjusted return (alpha) for the fund is computed as the difference between the fund's annualized return and the annualized return of its assigned benchmark index (OMXS30GI in our example) in that given quarter.

The computations of each fund's Tracking Error are based on differences in daily returns of the fund and its assigned benchmark index (the benchmark index is obtained from the calculations of Active Share) over the examined quarter, which is then annualized by multiplying the obtained

(sample-based) volatility in daily returns with the square root of 252, stemmed from the convention that a year consists of approximately 252 trading days (Nasdaq Nordics, 2022).

Thus, the Active Share for each fund is based on the holdings at the inception of the examined period, and the Tracking Error for each fund is based on the daily returns within the examined period. These variables are then regressed against the fund´s Alpha for the period.

Using the data obtained on Active Share, Tracking Error, and Alpha, a time series analysis is then conducted, where each quarter represents one time period.
To illustrate this further, in terms of these three variables, a data point for Fund X in the second quarter of 2010 (Q2 2010) refers to:

1. The Active Share of Fund X at 2010-03-31.
2. The Tracking Error of Fund X for the period 2010-03-31 to 2010-06-30.
3. The Alpha of Fund X for the period 2010-03-31 to 2010-06-30

By designing the timeliness this way, the intent is to design the Active Share measure as forward-looking, and thus if it can predict benchmark-adjusted fund performance in the upcoming period. As the Tracking Error is based on daily returns and refers to a certain time period (a quarter) rather than a specific point in time, we perceived it as suitable to match the period of the Tracking Error to that of the Alpha.

4. Data description

4.1 Data on Holdings and Fund Characteristics

To compute Active Share for each fund, data have been collected on the portfolio composition of the funds and the benchmark indexes.

The portfolio holdings for the funds are extracted from the database Morningstar Direct, available through the Swedish House of Finance. Morningstar Direct is a global investment analysis platform, uniting all of Morningstar's data and institutional research. The sample for this study covers two Morningstar categories: The first category is *Sweden Equity*, consisting of Swedish mutual funds that invest at least 75% of their total assets in equities, and at least 75% of their equity assets in Swedish equity. The second category is *Sweden Small/Mid-Cap Equity*, consisting of Swedish mutual funds that invest at least 75% of their total assets in equities, and invest at least 75% of the equity assets in Swedish equity. The funds in second category differs from those in the first category with respect to the size of the companies they invest in. These categories do not include explicit sector or industry-specific funds. Based on these two categories, the funds are then scaled down to fit the purpose of this study, which is further described in the sample selection part.

For the benchmark indexes, data have been extracted directly from Nasdaq, using the category *Nasdaq Nordic Classic only*. From Nasdaq's database, five Swedish equity benchmark indexes have been selected: OMXS30GI (OMX Stockholm 30_GI), OMXAFGX (OMX Affarsvarldens Generalindex), OMXSBGI (OMX Stockholm Benchmark_GI), OMXSMCGI (OMX_Stockholm_Mid_Cap_GI), and OMXSSCGI (OMX_Stockholm_Small_Cap_GI).

The data on portfolio- and index weights consists of the portfolio composition at each quarter-end from 2009-12-31 to 2021-12-31, thus 48 quarters in total.

Additional data on fund characteristics, including Fund Size, Manager Tenure, and Fund Fees, have been obtained from Morningstar's database.

4.2 Data on Returns

To calculate each fund´s Tracking Error, the daily gross returns for each fund and its benchmark index are used. To compute benchmark-adjusted returns (alpha), we use quarterly returns for the indexes, quarterly gross, and net returns for the funds respectively, which are then annualized (EAR) using the following formula:

$$\text{Annualized return} = (1 + R_q)^{\frac{1}{n}} - 1$$

where R_q is the return in the quarter examined and n = number of years in a quarter (1/4).

Quarterly returns for the funds, both gross and net returns, are obtained from the database Morningstar Direct. *Gross Return* is the return of each fund before the deduction of any fees, commissions, or other expenses. *Total Return* represents net returns. Morningstar's definition of Total Returns does account for the expense ratio, including management, administrative, 12b-1 fees, and other costs that are taken out of assets, but does not adjust for sales charges (front-end loads, deferred loads, and redemption fees). This is a proper measurement of net return as it gives a clearer picture of performance. Daily returns for the funds are obtained from Morningstar Direct.
Quarterly and daily returns for the benchmark indexes are obtained from Nasdaq. All the indexes belong to the Gross Index (GI) category, which includes dividends.

4.3 Sample Selection

From the original data sample, consisting of Swedish equity funds that invest at least 75% of total assets in equities, and invest at least 75% of their equity assets in Swedish equities, the following data refinement has been done to obtain as stringent dataset as possible to base the results on:

Only funds that have reported their holdings for at least two continuous quarters in the period examined (Q1 2010-Q4 2021) are included in the sample. We did not find a reliable way to estimate the holdings and returns for funds that are no longer in operation, and thus only funds that have reported holdings and returns are included in each period, which may cause a survivorship bias in our sample, as failed funds get excluded from the dataset once they cease to exist.

Funds that are traded in other currencies than SEK are excluded from the sample. The underlying logic of excluding these funds stems from the impact of exchange rates on return. A fund traded in EUR may perform well (bad) over a period only due to currency appreciation (depreciation) in EUR relative to SEK, and thus outperform or underperform in relation to their benchmark index solely due to currency effects. However, many of the funds excluded due to their foreign currency have an otherwise identical "twin" traded in SEK that is included in the sample, with identical holdings, only differing in the currency they are traded in.

Further, in line with Cramer and Petajisto (2009), exchange-traded funds (ETFs) are excluded from the sample, as we have understood it, due to liquidity reasons. Because ETFs are

traded on the market throughout the day, price fluctuations may not have a 100% correlation with the return on the underlying assets.

Explicit index funds are also excluded from the sample since this study examines the impact of active management on benchmark-adjusted return (alpha) to investigate if active fund managers have skill in stock selection (Active Share) or factor timing (Tracking Error). Thus, we regard it as irrelevant to include explicitly passive funds with the stated target to track their benchmark index as closely as possible with respect to holdings and returns.

Funds with weights that exceed 100% (that use leverage, such as hedge funds) are also excluded from the sample since the Active Share measure assumes a portfolio weight of 100% to obtain proper comparisons.

Duplicates are removed from the sample, as they have identical data on holdings, returns, as well as the same fund managers, these funds are regarded as the same (one) fund in our study.

Finally, as we want to focus on Swedish all-equity funds, we have excluded funds with less than 80% of their holdings in Swedish equity (on average) over the period examined. The logic is that a substantial proportion of holdings in other securities and/or geographical markets than the Swedish stock market may lead to an overestimated Active Share and Tracking Error in relation to the benchmark indexes, stemming not from active fund management per se. However, few funds were excluded for this reason since all funds were obtained from the Sweden Equity Morningstar categories.

After this data refinement has been carried out, the sample of funds is scaled down to 180 funds in total, where the main cut is due to the absence of data on holdings and returns for the examined period, currency differences, and duplicates. Even when scaled down, the dataset is still solid as it covers 48 periods (quarters) of holdings and returns, including 4180 and 4295 data points in the main regressions.

4.4 Selection of Benchmark Indexes

To obtain meaningful and proper comparisons of holdings and returns, five different Swedish equity indexes (all including dividends) have been selected as proxies for benchmark indexes. The benchmark indexes cover the following index categories: All-Shares, Large Cap, Mid Cap, and Small Cap.

The reason for using these proxies instead of the fund´s self-proclaimed benchmark indexes is primarily that we did not manage to find enough reliable data on holdings on the self-proclaimed benchmark indexes, and even if we would, the funds have many different indexes, and it would not have been feasible (in this study) to manage the data and make computations for all these indexes. Further, funds may intentionally choose benchmark indexes that are in favor (biased) for their benchmark-adjusted returns.

Since the five benchmark indexes are used as proxies rather than exact matches, some limitations have been identified.

The funds with Small-and Mid-Cap-holdings in some instances seem to lack a suitable comparison among the five indexes selected, possibly causing their Active Share to be overstated. Pure index funds are defined by Cremers & Petajisto (2009) as funds with an Active Share below 20%. When we computed the Active Share for Large-Cap and All-Shares funds that are explicit index funds, the Active Share was consistently low (between 5 and 15%), suggesting that they have a proper match among the applied benchmark indexes as the values were

consistently below 20%. However, for explicit index funds within the Mid- and Small-Cap segment, the Active Share obtained was on certain occasions unreasonably high (above 50%), suggesting that the fund was not matched with a proper benchmark index. Taking this possible shortcoming into consideration, the study is supplemented by performing an in-depth analysis where the funds in the Small- and Mid-Cap segment are excluded.

Another identified limitation is the unreasonably high average annualized alpha obtained (2.34% gross and 0.88% net) compared to previous studies on the performance of actively managed funds, as well as compared to our expectations (Wermers, 2000). Despite examining potential flaws in our dataset, we have not managed to determine any specific reason or error that may have caused an overestimation of the average alpha obtained, but we consider it probable that some of the funds (not only the Small- and Mid-Cap-oriented) are not matched with a proper benchmark index. Hence, these funds' returns are not matched with the returns of their proper benchmark index. For example, none of the selected benchmark indexes are explicitly sustainability oriented, despite several funds exhibiting this feature.

5. Empirical Results

5.1 Fund Performance and Active Management, Gross Returns

Table 1a) displays the results from the OLS regression:

$$Gross\ Alpha_i = \beta_0 + \beta_1 Active\ Share_i + \beta_2 Tracking\ Error_i + \varepsilon_i$$

The sample consists of quarterly returns for each fund and its benchmark index, from January 1st, 2010, to December 31st, 2021. The Gross Alpha is based on the (equal-weighted) returns for all funds in the sample every quarter. A fund is included in the sample in a given quarter if it has reported its holdings (has an Active Share in that quarter) and has reported daily returns (has a Tracking Error for that quarter). In total, the sample consists of 4180 data points for each variable over the 48 quarters observed. We run this regression to answer our first research question: *Can active management predict mutual fund performance in the Swedish market?*

Table 1a), OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
Intercept	-0.0012	0.0077	-0.153	0.878	-0.0162	0.0139
Active Share	0.0005	0.0001	3.588	0.001 ***	0.0002	0.0006
Tracking Error	-0.0076	0.0235	-0.324	0.746	-0.0536	0.0384
No. of observations	4180					
R^2	0.003					
F-statistic	6.444 (2 and 4178 df)					
p-value	0.0006					

Significance codes: 0 '***'. Gross equal weighted alphas for all-equity Swedish mutual funds, 2010-2021, are regressed against Active Share and Tracking Error. Active Share is defined as the percentage of a fund's holdings that differ from the fund's benchmark index. Tracking Error is defined as the annualized standard deviation of the fund's daily deviation in return from its benchmark index. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

As reported in the table, the regression does succeed in showing a statistically significant relationship between Active Share and Gross Alpha. Active Share's beta reveals that for each additional unit increase in Active Share, Gross Alpha increases by 0.05 percentage points on average, conditional upon the other regressor (Tracking Error). This result is in line with the results of Cremers and Petajisto (2009).

In contrast, Tracking Error is not positively related to Gross Alpha. The regression results show, if anything, a negative relationship between Tracking Error and Gross Alpha, but no significant results are obtained. This finding is also in line with the findings of Cremers and Petajisto (2009).

However, the explanatory value is low, below one percent. Although a low obtained R square is not surprising due to the difficulty in explaining mutual fund performance, we expected that these measures on the degree of active management would explain fund performance to a (at least slightly) greater extent.

Table 1b) shows the results from the Quantile Regression:

$$Quintile\ Reg(Y_i = \beta_0 + \beta_1 X1_i + \beta_2 X2_i + \varepsilon_i) \quad at\ tau\ 0.25, 0.5, and\ 0.75$$

where Y = Gross Alpha, X1 = Active Share, and X2 = Tracking Error. Tau is the different quantiles used in the regressions.

This regression is conducted to examine the research question: *Is the relationship between active management and fund performance consistent among high-, median-, and low-performing funds?*

The dependent variable, Gross Alpha, is divided into quantiles (percentiles), using R studio's quantile regression function. Quantiles are used to describe the distribution of the dependent variable. The quantile regression models the relationship between independent variables and the conditional quantiles of the dependent variable, rather than just the conditional mean that the ordinary OLS regression does. In Table 1b) the results for the 25th, 50th, and 75th quantiles of Gross Alpha are displayed. As the quantiles refers to the relative fund performance, measured as Gross Alpha, we label these quantiles as *low-performing funds* (25th Quantile), *median-performing funds* (50th Quantile) and *high-performing funds* (75th Quantile)

In Table 1c), an Anova test is conducted for coefficient differences between the selected quantiles (a joint test of equality of slopes between the quantiles). This test is conducted to evaluate if there is any significant difference in the slope of the quantiles, i.e. if the independent variables (Tracking Error and Active Share) has the same relationship to the dependent variable (Gross Alpha) across the distribution of Gross Alpha.

Table 1b), quantile regression (Y = Gross Alpha, X1 = Active Share, and X2 = Tracking Error).

Variables	Coefficient	Std. err.	t-value	Pr(>|t|)	95% conf. interval	
X1 0.25	-0.0008	0.000	-11.273	0.000 ***	-0.0009	-0.0007 +
X2 0.25	-0.0732	0.027	-2.761	0.006	-0.1249	-0.0189
X1 0.5	0.0004	0.000	5.060	0.000 ***	0.0003	0.0006
X2 0.5	0.0427	0.027	1.559	0.119	-0.0121	0.0976
X1 0.75	0.0016	0.000	13.841	0.000 ***	0.0014	0.0019 +
X2 0.75	0.1510	0.039	3.841	0.000 ***	0.0724	0.2296 +

Significance codes: 0 '***' in the regression. 0.05 '+' means significantly different from the OLS coefficient result in Table 1a). Gross equal weighted alphas for all-equity Swedish mutual funds, 2010-2021, are divided into quantiles (25th,

50th, and 75th) and regressed against Active Share and Tracking Error to evaluate differences along the distribution of Gross Alpha. The sample consists of 4180 data points in total. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed as proportions (i.e. one unit of Tracking Error is 100 percentage points).

In Table 1b) the results for each quantile are displayed. Two types of significance are important for quantile regression coefficients; quantile coefficient can be significantly different from zero (marked with *); quantile coefficients can be significantly different from the OLS coefficients (marked with +), showing different effects along with the distribution of the dependent variable.

As displayed in table 1b), the Active Share's quantile coefficients are significantly different from zero, as in the original OLS model illustrated in Table 1. However, the coefficient for the low-performing funds is negative, meaning that one additional unit of Active Share is associated with a decrease in Gross Alpha at this performance level. On the other hand, the coefficient for the high-performing funds is greater than the Active Share coefficient in the OLS regression. One additional unit (percentage point) of Active Share is predicted to decrease the Gross Alpha by 0.08 percentage points for low-performing funds, increase Gross Alpha by 0.04 percentage points for median-performing funds, and increase Gross Alpha by 0.16 percentage points for high-performing funds. Thus, the marginal effect of adding an additional unit of Active Share is greater for high-performing than median-performing funds. This can be interpreted as the results of differences in stock selection skill across fund managers, in that relative underperformance is associated with deficient stock selection (unskilled fund managers), while outperformance is associated with proper stock selection (skilled managers).

Table 1b) shows that the low- and the high- performing funds' Active Share coefficient is significantly different than the OLS coefficient, since the Active Share coefficient in the OLS regression is not included within their 95 percent confidence intervals. This implies different effects along the distribution of Gross Alpha and justifies the use of a quantile regression test. Further, an important feature of the quantile model is that it is not as sensitive to extreme values (outliers) as the results are only affected when a data point moves across the quantile limit.

Moreover, the same pattern holds for Tracking Error. Among low-performing funds, one additional unit of Tracking Error is predicted to decrease the Gross Alpha. However, for median- and high-performing funds, an additional unit of Tracking Error is predicted to increase the Gross Alpha, and the marginal effect is greatest for high-performing funds. Interestingly, within the 75th quantile, the positive relationship between Tracking Error and Gross Alpha is statistically significant, which is completely in contrast with our OLS regression findings in Table 1a.

Table 1c) depicts the results from the Anova regression:

$$anova(quantreg25, quantreg50, quantreg75)\ for\ Gross\ Returns$$

The quantile regressions for the 25th, 50th, and 75th quantile is the same as depicted in Table 1b).

Table 1c) Anova joint test of equality of oslopes

Variables	df	Resid df	F-value	Pr(>F)
X1 and X2	4	12539	129.97	<2.2e-16 ***

Significance codes: 0 '***'. The table shows the results for the Anova joint test of equality of slopes, testing Active Share and Tracking Error's coefficients in the 25th, 50th, and 75th quantile of Gross Alpha.

Table 1c) compares the coefficients for both Active Share and Tracking Error from the 75th, 50th, and 25th quantiles, and there is a significant difference in the coefficients. The results show that we can reject the null hypothesis that the slopes are equal in the three quantile samples. Hence, we can show that Gross Alpha is differently affected by an additional unit of Active Share and Tracking Error across the highest and lowest quantile.

Table 1d) shows the average Gross Alpha (equal weighted) for each quartile of Active Share (Panel A) in the sample and the Gross Alpha (equal-weighted) for each quartile of Tracking Error (Panel B), followed by t-statistics in parenthesis based on White's standard errors.

Table 1d), Panel A: Active Share Quartiles; Panel B: Tracking Error Quartiles

Panel A: Active Share Quartiles

Active Share Quartile	Alpha	All
4	3.08% (0.41)	1053
3	3.01% (2.10)	1034
2	2.00 % (3.51)	1021
1	1.76% (1.31)	1047
All	2.34%	4155

Panel B: Tracking Error Quartiles

Tracking Error Quartile	Alpha	All
4	2.64% (0.048)	1059
3	2.00% (0.134)	1038
2	2.21% (0.134)	1032
1	2.52% (0.018)	1046
All	2.33%	4175

Table 1d) describes the mean gross equal-weighted alpha for all Swedish mutual funds, 2010-2021, in each quartile of Active Share (Panel A) and Tracking Error (Panel B). t-statistics based on White's standard errors in parenthesis. A detailed explanation for the minor differences in the number of quartile observations is conducted in the Appendix (Table 1d).

To further investigate how the degree of active management affects Gross Alpha, we divide the data into quartiles with respect to both Active Share and Tracking Error. In Table 1d Panel A) we the different Active Share quartiles are shown. The equal-weighted benchmark-adjusted return is 2.34 percent for the period examined. The results indicate visible differences in performance between quartile one and two compared to quartile three and four, a difference that is statistically significant. Being in the two highest Active Share quartiles generates a higher Gross Alpha on average. This result is in line with the findings presented by Cremers and Petajisto (2019). However, they found a more robust difference between the third and fourth quartile.

Tracking Error exhibits a vaguer relationship with alpha. The first quartile has a higher average Gross Alpha than quartiles two and three. Nonetheless, the fourth quartile has a higher average benchmark-adjusted return compared to the three others. However, no significant results are obtained on Tracking Error. Similar results were found by Cremers and Petajisto (2009) but measured differently. They divided Active Share and Tracking Error into quintiles and found that considerably elevated levels of Tracking Error were associated with higher alpha.

The average Gross Alpha of 2.34% is a bit higher than reasonable, as mutual funds tend to outperform (gross) their benchmark indexes with slightly less (Werners, 2000). In Cremer and Petajisto (2009), the average Gross Alpha was 0.98%. Thus, the average Gross Alpha of 2.34% in our study could be slightly overstated, possibly due to the limited number of benchmark indexes applied, causing the funds' returns not to be matched with a proper benchmark index occasionally. For example, one study on the European mutual fund market indicates that

sustainability-oriented (ESG) equity funds have yielded 1.2 percentage points higher annual return on average than non-ESG funds in 2016-2020, but none of the benchmark indexes applied in our study are ESG-oriented, thus failing to cover this feature (European Fund and Asset Management Association, 2021).

5.2 Fund Performance and Active Management, Net Returns

Table 2a) displays the results from the OLS regression:

$$Net\ Alpha_i = \beta_0 + \beta_1 Active\ Share_i + \beta_2 Tracking\ Error_i + \varepsilon_i$$

The procedure of obtaining Active Share and Tracking Error, as well as determining whether a fund is included or not, is equivalent to that of table 1a). The Net Alpha is based on (equal-weighted) annualized net returns for all funds in the sample on a quarterly basis, and the sample covers the time from January 1st, 2010, to December 31st, 2021. The sample consists of 4295 data points for each variable in total from all the 48 quarters observed. This regression is carried out to answer the following research question: *Can active management predict mutual fund performance in the Swedish market?*

Table 2a) OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-0.015	0.008	-1.961	0.050 *	-0.0298	-1.66e-06
Active Share	0.0004	0.0001	3.329	0.0009 ***	0.0002	6.4e-04
Tracking Error	0.0057	0.027	0.216	0.216	-0.0465	5.8e-02
No. of observations	4295					
R^2	0.027					
F-statistic	5.73 (2 and 4293 df)					
p-value	0.0033					

Significance codes: 0 '***', 0.05 '*'. Net equal weighted alphas for all-equity Swedish mutual funds, 2010-2021, are regressed against Active Share and Tracking Error. Active Share and Tracking Error are computed as before. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

The results from this regression, on Net Alpha, support the results obtained on Gross Alpha regarding the relationship between Active Share and benchmark-adjusted fund performance. As displayed in the table, the regression does succeed in showing a statistically significant relationship between Active Share and Net Alpha. Active Share's beta implies that for each additional unit increase in Active Share, Net Alpha increases by 0.04 percentage points on average, conditional upon the other regressor (Tracking Error).

In contrast to the regression on Gross Alpha, this regression on Net Alpha implies a positive relationship between Tracking Error and Net Alpha. However, these results are not significant. This finding is consistent with Cremers and Petajisto's (2009) in that that no conclusions can be drawn whether Tracking Error's is correlated with alpha or not.

The explanatory value from this regression is quite low (2.7%), though slightly higher than that of the Gross Alpha. Again, a low R square is not particularly surprising, as many other

factors not covered in this regression plausibly affect the benchmark-adjusted performance for mutual funds.

Table 2b) displays the results from the Quantile Regression, based on net returns:

$$Quintile\ Reg(Y_i = \beta_0 + \beta_1 X1_i + \beta_2 X2_i + \varepsilon_i) \quad at\ tau\ 0.25, 0.5, and\ 0.75$$

where Y = Net Alpha, X1 = Active Share, and X2 = Tracking Error. Tau is the different quantiles used in the regressions.

This regression is conducted to answer the research question: *Is the relationship between active management and fund performance consistent among high-, median-, and low-performing funds?*

To evaluate the distribution in Net Alpha, data is divided into quantiles using R studio's quantile regression tool. In Table 1b), the results for the 25th, 50th, and 75th quantiles of Net Alpha are shown. As the quantiles refers to the relative performance, measured as Net Alpha, we label these quantiles as *low-performing funds* (25th Quantile), *median-performing funds* (50th Quantile) and *high-performing funds* (75th Quantile).

Table 2b), quantile regression (Y = Net Alpha, X1 = Active Share, and X2 = Tracking Error).

Variables	Coefficient	Std. err.	t-value	Pr(>|t|)	95% conf. interval	
X1 0.25	-0.0008	0.000	-8.637	0.000 ***	-0.0010	-0.0006 +
X2 0.25	-0.0683	0.032	-2.104	0.035	-0.1333	-0.0034 +
X1 0.5	0.0004	0.000	4.455	0.000 ***	0.0002	0.0006
X2 0.5	0.0705	0.032	2.335	0.020	0.0101	0.1308 +
X1 0.75	0.0016	0.000	14.599	0.000 ***	0.0014	0.0018 +
X2 0.75	0.1602	0.040	4.063	0.000 ***	0.0813	0.2390 +

Significance codes: 0 '***' in the regression. 0.05 '+' means significantly different from the OLS coefficient result in Table 2a). Net equal weighted alphas for all-equity Swedish mutual funds, 2010-2021, are divided into quantiles (25th, 50th, and 75th quantiles) and regressed against Active Share and Tracking Error to evaluate differences along the distribution of Net Alpha. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Table 2b) models the results for each quantile. Again, two types of significance are important for quantile regression coefficients; significantly different from zero (marked with *) and significantly different from the OLS coefficients (marked with +).

Consistent with the findings in Table 1b), Active Share's quantile coefficients are significant for all three quantiles examined. Moreover, the distribution seems remarkably similar to the results found in 1b). For low-performing funds, an additional unit of Active Share is predicted to decrease Net Alpha. The coefficient is significantly different from the OLS coefficient in 2a) since the Active Share coefficient in that regression is not included in the confidence interval above. For median-performing funds, the coefficient is equal to Active Share's OLS coefficient, and an additional unit of Active Share increases Net Alpha by 0.04 percentage points at this performance level.

Again, the most distinctive results are those for high-performing funds. Each additional unit (percentage point) of Active Share is predicted to increase Net Alpha by 0.16 percentage

points at this performance level. The marginal effect of adding an additional unit of Active Share is distinctly higher for high-performing funds than for median-performing funds.
All Tracking Error quantile coefficients are significantly different from the OLS Tracking Error coefficient, indicating non-linear distribution. Again, for low-performing funds, an additional unit of Tracking Error is predicted to decrease Net Alpha. However, for median- and high-performing funds, the marginal effect of adding a unit of Tracking Error is positive. In particular for the high-performing funds, where each additional unit in Tracking Error increases annual Net Alpha by 16%. Note that the Tracking Error is expressed in terms of proportions, meaning that a one-unit increase refers to an increase of Tracking Error by 100%, which is incredibly much for this measure, and may explain how the coefficient is incredibly high. Given the same slope (0.16) at the high-performance quantile, if Tracking Error were expressed in percentage terms, one additional unit of Tracking Error would predict an increase in Net Alpha of 0.16 instead of 16 percentage points.

Similar to the findings on Quantiles for Gross Alpha, these findings on Net Alpha may indicate the importance of fund manager skill. Low-performing funds may be the result of deficient stock selection and factor timing (unskilled managers), while high-performing funds may be the result of adequate stock selection and factor timing (skilled managers).

Table 2c) depicts the results from the Anova regression:

$$anova(quantreg25, quantreg50, quantreg75)\ for\ Net\ Returns$$

We conduct an Anova test for coefficient differences between the $75^{th,}$ 50^{th}, and 25^{th} quantiles (a joint test of equality of slopes between the quantiles). The quantile regressions for the 25^{th}, 50^{th}, and 75^{th} quantiles are the same as depicted in Table 1b).

Table 2c) Anova joint test of equality of slopes

Variables	df	Resid df	F-value	Pr(>F)
X1 and X2	4	12886	227.11	<2.2e-16 ***

Significance codes: 0 '***'. The table shows the results for the Anova joint test of equality of slopes, testing Active Share and Tracking Error's coefficients in the 25^{th}, 50^{th}, and 75^{th} quantiles of Net Alpha.

Consistent with the findings regarding gross benchmark-adjusted return, Table 2c) displays that there is a significant difference in the coefficients between the low-, median-, and the high-performing funds.

Table 2d) shows the average Net Alpha (equal-weighted) for each quartile of Active Share (Panel A) in our sample and the Net Alpha (equal-weighted) for each quartile of Tracking Error (Panel B), followed by t-statistics in parenthesis based on White's standard errors.

Table 2d), Panel A: Active Share Quartiles; Panel B: Tracking Error Quartiles

Panel A: Active Share Quartiles

Active Share Quartile	Alpha	All
4	1.41% (0.19)	1137
3	1.48% (0.00)	1111
2	0.54% (0.00)	1095
1	0.15% (0.00)	1125
All	0.88%	4468

Panel B: Tracking Error Quartiles

Tracking Error Quartile	Alpha	All
4	1.67% (0.05)	1097
3	0.12% (0.147)	1067
2	0.78% (0.05)	1056
1	0.68% (0.00)	1081
All	0.85%	4301

Table 2d) shows the mean net equal-weighted alpha for all Swedish mutual funds, 2010-2021, for each quartile of Active Share (Panel A) and Tracking Error (Panel B). t-statistics based on White's standard errors are shown in parenthesis. A detailed explanation for the minor differences in quartile observations is conducted in the Appendix (Table 2d).

To examine if a higher degree of active management generates a higher alpha, the data have been divided into quartiles with respect to Active Share (Panel A) and Tracking Error (Panel B).

As displayed in Panel A, the third and fourth quartiles with respect to Active Share exhibit a substantially higher Net Alpha on average than that of the first and second quartiles, where the greatest difference is to be found between the second and third quartiles. However, the relationship is not entirely linear over all quartiles, as the fourth quartile has a slightly lower Net Alpha on average than that of the third.

For Panel B, the relationship between the Tracking Error quartile and Net Alpha appears more ambiguous, as the third quartile clearly has the lowest Net Alpha on average among the quartiles. However, the forth quartile with respect to Tracking Error has the highest Net Alpha on Average.

As with the Gross Alpha, the average Net Alphas of 0.85% and 0.88% are slightly higher than expected since mutual funds tend to slightly underperform (rather than outperform) their benchmark index net of fees (Wermers, 2003). Cremer & Petajisto (2009) obtained an average Net Alpha of –0.43%, i.e. a slight underperformance to their benchmark index net of fees. The average Net Alpha in our dataset could thus, for similar reasons as mentioned in the section 5.1, be slightly overstated.

5.3 In-depth analysis, Fund Performance and Active Management, Excluding Small- and Mid-Cap funds

Due to the (plausible) insufficient allocation of benchmark indexes for Small- and Mid-Cap funds in our study, we run a regression exclusively for funds whose benchmark indexes are All-Shares or Large-Cap, excluding funds matched to the Small- and Mid-Cap indexes. The sample period still runs from the first quarter of 2010 to the fourth quarter of 2021. We run this regression to answer the first research question more comprehensively: *Can active management predict mutual fund performance in the Swedish market?*

Table 3a) reports results from the OLS regression:

$$GrossAlpha_{LCap_i} = \beta_0 + \beta_1 ActiveShare_{LCap_i} + \beta_2 TrackingError_{LCap_i} + \varepsilon_i$$

Table 3b) reports results from the OLS regression:

$$NetAlpha_{LCap_i} = \beta_0 + \beta_1 ActiveShare_{LCap_i} + \beta_2 TrackingError_{LCap_i} + \varepsilon_i$$

Table 3a) OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-0.0416	0.008	-4.997	6.12e-07 ***	-0.0580	-0.0253
Active Share	0.0013	0.0001	8.644	<2.e-16 ***	0.0009	0.0015
Tracking Error	0.0661	0.031	2.158	0.031 *	0.0060	0.126
No. of observations	3244					
R^2	0.024					
F-statistic	40.57 (2 and 4178 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.05 '*'. Gross equal weighted alphas for all-equity Swedish mutual funds, 2010-2021, are regressed against Active Share and Tracking Error. Small- and Mid-Cap fund are excluded from the sample. Active Share and Tracking Error is computed as before. The total number of observations in this regression is 3244. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Table 3b) OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-0.062	0.008	-7.595	3.98e-14 ***	-0.078	-0.046
Active Share	0.001	0.0001	9.568	<2.2e-16 ***	0.0011	0.0016
Tracking Error	0.087	0.031	2.795	0.005 **	0.026	0.147
No. of observations	3325					
R^2	0.030					
F-statistic	51.44 (2 and 3323 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.01 '**'. Net equal weighted alphas for all-equity Swedish mutual funds, 2010-2021, are regressed against Active Share and Tracking Error. Small- and Mid-Cap fund are excluded from the sample. Active Share and Tracking Error is computed as before. The total number of observations in this regression is 3325. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Excluding Small- and Mid-Cap funds provided us with several insights. Active Share's beta is still positive at the strongest significance level, both in Table 3a) and 3b. Moreover, it is slightly higher than the betas obtained in Table 1a and 2a (including Mid- and Small-Cap funds). A fund manager's decision to deviate in holdings from the funds benchmark index seems to generate a higher Gross- and Net Alpha on average.

Further, Tracking Error in Table 3a) is positively related to Gross Alpha (at the five percent significance level) while it was negatively correlated in Table 1a, but not significantly. In Table 3b) the beta is even higher, significant at the 1 percent level. This finding may suggest that fund managers for Large-Cap and All-Shares funds exhibit a skill in factor timing.

5.4 Adding Control (Proxy) Variables to the Model

5.4.1 Fund Performance and Active Management + Control Variables

The regression model is extended by adding the following three additional explanatory variables: Fund Size, Fund Fee, and Fund Manager Persistence.

In order to properly adapt these approximated variables to the data set, we use data from January 1st, 2017, until December 31st, 2021, i.e. five years back in time instead of 12. As the approximation for e.g., Fund Size is based on fund data from 2022, the approximation gets less accurate the further back in time it is applied, and thus it would not be reasonable to apply it in the entire period of the sample (2010-2021). Again, Gross Alpha and Net Alpha are equal-weighted and for each quarter, only funds with a computed Active Share Tracking Error are included in the regression. The regression on gross return consists of 1426 observations in total for each variable and the regression on net return consists of 1411 observations in total for each variable, with data from 20 quarters in total timewise.

Table 4a) displays the results from the regression:

$$Gross\ Alpha_i = \beta_0 + \beta_1 Active\ Share_i + \beta_2 Tracking\ Error_i + \beta_3 Fund\ Size_i + \beta_4 Fund\ Fee_i + \beta_5 Fund\ Manager\ Persistence_i + \varepsilon_i$$

Table 4b) displays the results from the regression:

$$Net\ Alpha_i = \beta_0 + \beta_1 Active\ Share_i + \beta_2 Tracking\ Error_i + \beta_3 Fund\ Size_i + \beta_4 Fund\ Fee_i + \beta_5 Fund\ Manager\ Persistence_i + \varepsilon_i$$

Table 4a) OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-7.23e-03	2.26e-02	-0.320	0.749	-5.156	3.710
Active Share	1.30e-03	3.68e-04	3.520	0.0001 ***	5.737	2.018
Tracking Error	-1.28e-02	5.14e-03	-2.480	0.013 *	-2.283	-2.666
Fund Size	-4.91e-08	4.73e-07	-0.104	0.917	-9.776	8.794
Fund Fee	-4.91e-04	1.215e-02	0.040	0.967	-2.433	2.335
Fund Manager Persistence	1.32e-04	7.80e-04	0.169	0.866	-1.340	1.661
No. of observations	1426					
R^2	0.012					
F-statistic	3.244 (5 and 1417 DF)					
p-value	0.006					

Significance codes: 0 '***', 0.05 '*'. Gross equal weighted alphas for all-equity Swedish mutual funds, 2017-2021, are regressed against Active Share, Tracking Error, Fund Size, Fund Fee, and Fund Manager Persistence. Fund Size is

computed as million SEK under management Q1 2022. Fund Fee is computed as the actual fee (in percentage of invested capital) charged by the fund the last year (2021). Fund Manager Persistence is an approximation capturing how long the Fund Manager has managed the fund in relative and absolute terms. Active Share and Tracking Error is computed as before. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Table 4b) OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-1.71e-02	2.25e-02	-0.758	0.448	-6.196	2.510
Active Share	1.28e-03	3.65e-04	3.512	0.0001 ***	7.754	2.198
Tracking Error	-1.25e-02	4.57e-02	-2.730	0.006 **	-3.344	-1.174
Fund Size	-8.57e-07	4.73e-07	-0.181	0.856	-9.489	9.013
Fund Fee	-1.62e-03	1.21e-02	-1.342	0.180	-2.784	1.979
Fund Manager Persistence	1.412e-0.4	7.82e-04	0.181	0.857	-1.294	1.727
No. of observations	1411					
R^2	0.011					
F-statistic	3.007 (5 and 1405 df)					
p-value	0.010					

Significance codes: 0 '***', 0.01 '**'. Net equal weighted alphas for all-equity Swedish mutual funds, 2017-2021, are regressed against Active Share, Tracking Error, Fund Size, Fund Fee, and Fund Manager Persistence. All five variables are computed, and measured, as before. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Again, Active Share is positively correlated with Gross- and Net Alpha at the strongest significance level. The obtained Tracking Error coefficients differ from the previous regressions, being negatively correlated with both Gross- (in line with the result in Table 1a) and Net Alpha (contrary to the findings in Table 2a). However, the negative relationships are now statistically significant at the 5, contra 1 percent significance level. Hence, the level of factor timing (measured by Tracking Error) decreased the benchmark-adjusted return on average, gross and net of fees, in 2017-2021.

None of our control variables explains variations in Gross or Net Alpha at any significance level. Increases in million SEK under management, as well as increases in annual fees, seem to lower the benchmark-adjusted return on average, conditional upon the other regressors. Contrary, each additional unit of the Fund Manager Persistence variable seems to increase both Gross- and Net Alpha. However, as the results are not significant, no conclusions can be drawn from the regression. These results are quite in line with those of Cremers & Petajisto (2009), as they found a slightly negative relationship between Fund Size and performance, and a slightly positive connection between Manager Tenure (a variable similar to Fund Manager Persistence) and fund performance, though not significant.

5.4.2 Determinants of Active Share

Further, we want to evaluate which factors could explain deviations in Active Share. Can the Tracking Error together with our three control variables – Fund Size, Fund Fee, and Fund Manager Persistence – explain the observed differences in Active Share? The four variables are computed as before. We use the net return data set from Table 4b), consisting of 1411 data points, from January 2017 to December 2021.

Table 4c) models the result from the regression:

$$Active\ Share_i = \beta_0 + \beta_1 Fund\ Size_i + \beta_2 Fund\ Fee_i + \beta_3 Fund\ Manager\ Persistence_i + \beta_4 Tracking\ Error_i + \varepsilon_i$$

Table 4c) OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	4.08e+01	1.27e+00	36.30	<2e-16 ***	38.434	4.32e+01
Fund Size	-7.57e-05	3.45e-05	-2.194	0.028 *	-0.001	-8.01e+01
Fund Fee	1.29+01	8.14e-01	15.881	<2e-16 ***	11.334	1.45e-06
Fund Manager Persistence	2.26e-01	5.67e-02	4.623	0.000 ***	0.150	3.73e+01
Tracking Error	4.97e+01	3.07e+00	16.216	<2e-16 ***	43.685	5.57e+01
No. of observations	1411					
R^2	0.3001					
F-statistic	150.5 (4 and 1404 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.05 '*'. Active Share for all-equity Swedish mutual funds, 2017-2021, are regressed against Fund Size, Fund Fee, Fund Manager Persistence, and Tracking Error, in order to explain deviations in Active Share. All variables are computed, and measured, as before. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Firstly, the Fund Size's beta is negative, meaning that additional capital (measured in million SEK) under management is associated with a lower Active Share. The result is significant at the 5 percent significance level. The negative relationship between Fund Size and Active Share have been demonstrated in previous studies, by Beck and Green (2004), and Cremers and Petajisto (2009).

Secondly, Fund Fee is positively correlated with Active Share at the strongest significance level, which partly contradicts Cremers and Petajisto's findings (2009). Their results indicated that active funds charge similar fees regardless of their Active Share. One explanation can be that they computed each funds expense ratio as operating expenses including 12b-1 fees but excluded transaction fees, while our approximation of annual fund fee for the period covered (2017-2021) included all fees investors were charged by the fund in the most recent year, as of April 2022. Another reason that we, in contrast to Cremers & Petajisto (2009), found a positive relationship between Fund Fee and Active Share may be due to sharpened requirements for funds to disclose their holdings and other fund characteristics in recent years (Proposition 2018/19:62, 2019). As investors obtain more comprehensive information on the holdings (and in the Swedish setting, activity level) of the funds, it may be reflected in fund fees to a greater extent, as funds with a higher activity level may find it easier to justify higher fees than the less active funds.

Thirdly, a statistically significant positive relationship between Fund Manager Persistence and Active Share is observed. Thus, a fund that retains the same manager over a long period seem to (on average) take on more active positions with respect to holdings.

Lastly, Tracking Error is positively correlated with Active Share at the strongest significance level. The more bets on factor timing a fund manager carry out, the higher Active Share, on average, is expected. This is consistent with Cremers and Petajisto's (2009) results.

The four variables can explain 30 percent of the deviation in Active Share (R square). We regard this as a solid explanatory value. Observing a fund's size, fee, Tracking Error, and for how long the current manager has been in charge, could, on average, give an investor a hint of how high the fund's Active Share is.

5.4.3 Determinants of Tracking Error

In this section, the determinants of Tracking Error are investigated. The explanatory variables are Fund Size, Fund Fee, Fund Manager Persistence, and Active Share.

Table 4d) models the result from the regression:

$$Tracking\ Error_i = \beta_0 + \beta_1 Fund\ Size_i + \beta_2 Fund\ Fee_i + \beta_3 Fund\ Manager\ Persistence_i + \beta_4 Active\ Share_i + \varepsilon_i$$

Table 4d) OLS regression (linear regression, t-test)

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-7.23e-03	1.07e-02	-0.679	0.497	-2.81e-02	1.36e-02
Fund Size	2.66e-07	2.26e-07	1.176	0.240	-1.78e-07	7.10e-07
Fund Fee	-1.58e-02	5.18e-03	-2.721	0.007 **	-2.72e-02	-4.41e-03
Fund Manager	-8.56e-04	3.69e-04	-2.319	0.021 *	-1.58e-03.	-1.32e-04
Persistence	2.46e-04	1.62e-04	15.219	<2e-16 ***	2.14e03	2.77e-03
Active Share						
No. of observations	1423					
R^2	0.148					
F-statistic	61.58 (4 and 1418 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.01 '**', 0.05 '*'. Tracking Error for all-equity Swedish mutual funds, 2017-2021, are regressed against Fund Size, Fund Fee, Fund Manager Persistence, and Active Share, in order to explain deviations in Tracking Error. All variables are computed, and measured, as before. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points). The gross return data set from Table 4a) is used, consisting of 1423 data points, from January 2017 to December 2021.

As displayed in Table 4d), Active Share is positively correlated with Tracking Error at the strongest significance level, which is in line with the findings in Table 4c). A one unit increase in Active Share is associated with a higher Tracking Error on average, conditional upon the other regressors – and vice versa.

Further conspicuous findings are obtained. The three control variables' betas are completely opposite to those in Table 4c). Fund Size seems to increase the degree of Tracking Error, but this result is not significant. An additional percentage point in annual fund fees seems to lower the degree of Tracking Error in the sample, at the 1 percent significance level. An additional unit of Fund Manager Persistence seems to decrease a fund's degree of Tracking Error, at the 5 percent significance level.

5.5 Change in Active Share and Tracking Error after the Law Enforcement and Recommendation

5.5.1 Change in Tracking Error After the Law Enforcement in 2020

Figure 1 shows how the median Tracking Error evolved over time in our sample.

Figure 1: Tracking Error Over Time

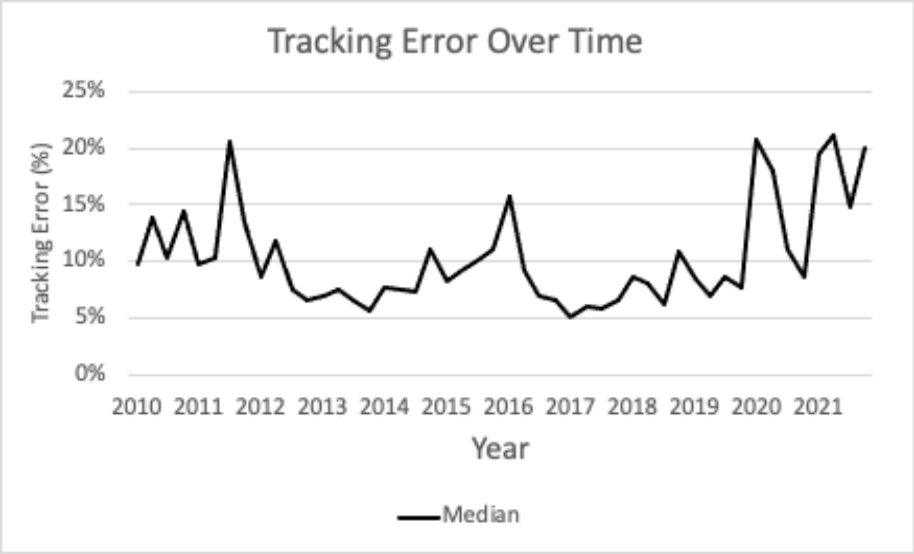


Figure 1 displays the evolution over time in the Tracking Error-median for all funds in our dataset, 2010-2021, on a quarterly basis. As seen, the Tracking Error-median is quite volatile over time, within the interval 5.09–21.18%. We use the gross dataset, shown in Table A, consisting of 4181 data points.

On January 1st, 2020, the new legislation on Tracking Error came into effect, requiring all Swedish mutual funds to disclose the Tracking Error of their fund. Hence, we intend to evaluate if this requirement has had any impact on the Tracking Error observed in our sample. Since the sample only consists of Swedish funds exclusively, we could not conduct a difference-in-difference test as the sample lacks a proper control group, in this case funds that were not subject for the law change. Instead, a Welch t-test regression is conducted, testing the null hypothesis that the mean of the two-samples (before and after Q1 2020) was equal. This regression is conducted in order to answer the research question: *Has the mean Tracking Error been affected by Swedish law enforcement?*

Table 5a) depicts the results from the following Welch two-sided t-test regression:

$$t.test(Tracking\ Error\ Before\ 2020,\ Tracking\ Error\ After\ 2020,\ mu = 0,\ alternative = two-sided,\ conf.\ interval = 0.99)$$

Table 5a) Welch two-sided t-test regression

Data	Mean Tracking Error Before 2020	Mean Tracking Error After 2020	t-value	p-value	99% conf. interval	
Tracking Error Before 2020; Tracking Error After 2020	0.107	0.1902	-15.326	<2.2e-16	-0.0965	-0.0668

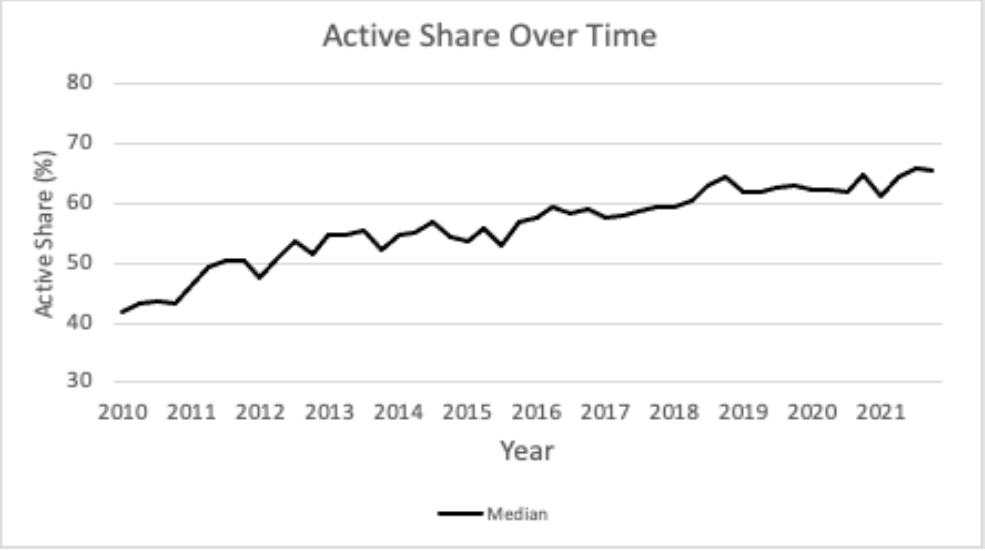
Degrees of freedom = 572.68. Number of observations: Tracking Error before 2020 = 3796 & Tracking Error After 2020 = 506. The table shows the differences in mean for Tracking Error before and after the law enforcement in January 2020.

As displayed in table 5a), the mean annualized Tracking Error was significantly higher after the law enforcement than before, increasing from 10.7% prior to the legislation to 19.02% after. The increase is significant with a p-value below 1%. However, the observed increase could be due to many other factors than the law enforcement, as we have not been able to test the causality due to the lack of control groups.

5.5.2 Change in Active Share after the New Recommendation in 2015

Figure 2 graphs how the median Active Share evolved over time in our sample.

Figure 2: Active Share Over Time

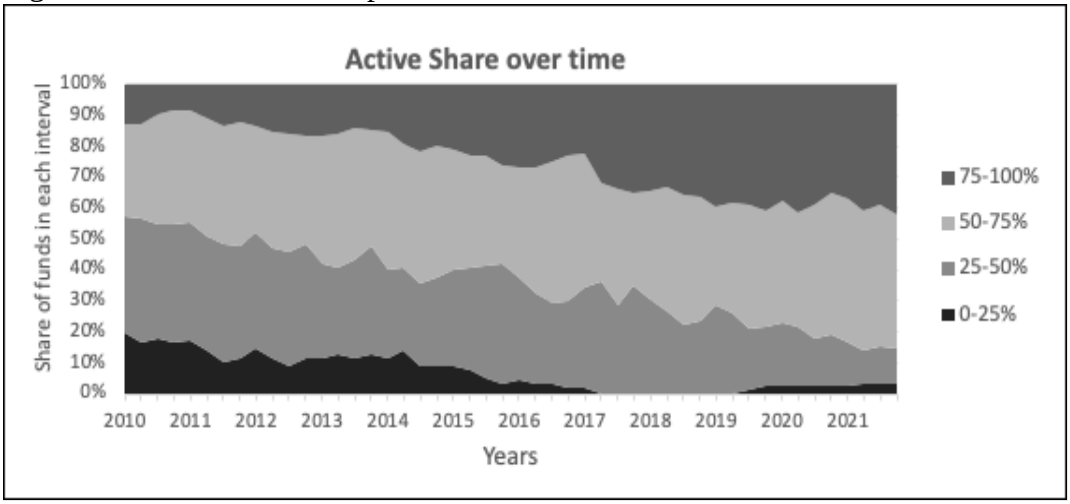


The figure describes the evolution of Active Share over sample over the period 2010-2021. The sample consists of the gross data set, shown in Table A, consisting of 4181 data points.

In Figure 2, the evolution of the Active Share-median for the funds is displayed, based on quarterly data. A continuous increase in the median of Active Share can be seen, from a median

of 41.8% at the inception of the period (2010-01-01) to a median of 65.7% at the end of the period (2021-09-30).

Figure 3: Active Share in-depth Over Time



The table illustrates the evolution of Active Share over time, 2010-2021 more in-depth. The funds are divided into intervals with respect to their Active Share. Each interval covers 25 percentage points in Active Share, ranging from the funds with the lowest Active Share (0–25%) to the ones with highest Active Share (75-100%).

As Figure 3 indicates, the funds have undergone a major shift with respect to Active Share, becoming more active over time. In particular, the percentage of funds with an Active Share greater 75 percent have increased dramatically, from 12.9% at the inception (2010-01-01) to 42.1% at the end of the period (2021-09-30). As explicit index funds are not included our dataset, it is perfectly reasonable that the percentage of funds with an Active Share less 25% becomes almost non-existent.

In May 2015, the Swedish Fund Association sharpened their guidelines to their members, encouraging them to display their Active Share more transparently to their investors. To examine if this recommendation affected the proportion of Active Share in the sample, we conducted a Welch t-test regression, testing the null hypothesis that the mean of the two samples (before and after Q3 2020) was equal. This regression is conducted to answer the research question: *Has the mean Active Share been affected by the Swedish Fund Association's recommendation?*

Table 5b) depicts the results from the following Welch two-sided t-test regression:

$$t.test(Active\ Share\ Before\ Q3\ 2015,\ Active\ Share\ After\ Q3\ 2015,\ mu = 0,\ alternative = two - sided,\ conf.interval = 0.99\ )$$

Table 5b) Welch two-sided t-test regression

Data	Mean Active Share Before Q3 2015	Mean Active Share After Q3 2015	t-value	p-value	99% conf. interval

Active Share (%) Before Q3 2015; Active Share (%) After Q3 2015	51.661	62.629	-19.111	<2.2e-16	-12.446	-9.489

Degrees of freedom = 4289.5. Number of observations: Active Share Before Q3 2015 = 2162 & Tracking Error After Q3 2015 = 2306. The table shows the differences in mean for Active Error before and after the Swedish Fund Association's recommendation in May 2015.

As depicted in the table, the Active Share is significantly higher after the recommendation than before, increasing from 51.7% to 63.6% on average. The increase is significant with a p-value below 1%. However, as with the increase in Tracking Error following the law enforcement, the observed increase in this regression could be due to many other factors than the recommendation to disclose Active Share, as we have not been able to test the causality due to the lack of control groups.

6. Conclusions

In this paper, we have examined the relationship between active management and benchmark-adjusted return in the Swedish equity mutual fund market from January 1st, 2010, to December 31st, 2021. This has been done by replicating the methods in Cremers and Petajisto (2009), with some modifications and extensions.

Active management is measured in two dimensions: Tracking Error and Active Share. Our findings suggest that there is a positive relationship between Active Share and benchmark-adjusted fund performance, with respect to both Gross and Net Alpha. Fund managers that deviate from their benchmark index to a greater extent with respect to holdings obtain a higher benchmark-adjusted return on average.

The relationship between Tracking Error and fund performance is more ambiguous. Depending on type of fund return (gross or net) and the time frame examined, Tracking Error occasionally exhibit a positive relationship with Alpha, other times a negative relationship is found. The significance levels on Tracking Error differed and were often absent.

Further, we divided the observations into quantiles with respect to Gross- and Net Alpha to investigate if the relationship between active management and benchmark-adjusted fund performance was consistent among low-, median-, and high-performing funds. Rather than being consistent among the performance levels, the relationship differed substantially. For low-performing funds, a higher degree of Active Share and Tracking Error is associated with a lower benchmark-adjusted return. In contrast, the relationship is positive among median- and high-performing funds. Moreover, among the highest performing funds, this marginal outperformance becomes even greater by adding additional units of Active Share and Tracking Error.

In the attempt to investigate determinants of Active Share and Tracking Error, our findings suggest that Fund Fees and Fund Manager Persistence are positively correlated with Active Share, and the relationships are significant. However, the relationship between Fund Size and Active Share seems to be the reverse. Funds managing larger amounts of capital seem to be associated with lower Active Share.

Contrary, our findings suggest that Fund Fees and Fund Manager Persistence are associated with a lower degree of Tracking Error, while the reverse relationship holds for Fund Size and Tracking Error. However, these results were less significant than the determinants for Active Share.

Additionally, we identify substantial changes in mean values for both Active Share and Tracking Error over time. After the law change in January 2020, forcing fund companies to disclose each fund's Tracking Error, the mean Tracking Error in the sample distinctly increased. Likewise, after the Swedish Fund Association's recommendation to Swedish fund companies – to disclose their Active Share – came into effect in May 2015, the mean Active Share increased in the sample.

To sum up the findings, the empirical results obtained imply that Active Share succeeds in predicting fund performance, while Tracking does not. The relationship between active management and fund performance are not consistent among low-, median-, and high-performing funds. Both Tracking Error and Active Share have steadily increased over the sample period, and a substantial increase was observed after the law enforcement in 2020 (Tracking Error) and after the Swedish Fund Association changed their recommendations in 2015 (Active Share).

For further research on this topic, we encourage to examine the Swedish market more comprehensively by applying additional benchmark indexes, for Small- and Mid-Cap-oriented funds in particular, as this was the main shortcoming identified in our study. In addition, future research could contribute by examining the relationship between active management and fund performance over longer time periods. Lastly, adding fund holding duration as a variable could be an appropriate extension to the findings in this paper on the Swedish market.

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APPENDIX

Summary Statistics Gross Returns, Net Returns, and Control Variables. Alpha is defined as the portfolio return minus its benchmark index return gross (net) fund returns do not include (exclude) any fees or transaction costs. Active share is defined as the percentage of a fund's portfolio holdings that differs from its benchmark index. Tracking Error is computed as the annualized standard deviation of a fund's daily return in excess of its benchmark index return. Fund Size is computed as million SEK under management Q1 2022. Fund Fee is computed as the actual fee (in percentage of invested capital) charged by the fund the last year (2021). Fund Manager Persistence is an approximation capturing how long the Fund Manager has managed the fund in relative and absolute terms. Alpha and the measures of active management are computed as before.

Table A: Summary Statistics Gross Returns

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Active Share (%)	5.00	43.55	56.62	56.64	73.37	94.42
Tracking Error	0.004	0.063	0.086	0.118	0.142	1.991
Alpha	-0.979	-0.048	0.0172	0.023	0.092	1.130
No. of observations	4181					

Table B: Summary Statistics Net Returns

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Active Share (%)	5.00	43.73	57.12	57.01	73.90	95.92
Tracking Error	0.003	0.065	0.087	0.117	0.143	0.905
Net Alpha	-1.013	-0.060	0.004	0.009	0.076	1.089
No. of observations	4299					

Table C: Summary Statistics Control Variables

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Fund Size (M SEK)	9.39	1,350.29	3,965.41	9,079.15	12,671.55	50,449.73
Fund Fee (%, Annual)	0	0.900	1.360	1.203	1.530	2.020
Fund Manager Persistence	0	0.230	3.350	5.764	9.570	29.250
No. of observations	1426					

Table 1a. Regression results for **gross-equal weighted Alphas** for all equity mutual Swedish funds 2010-2021. Panel A-D shows our regression results, gross-return alpha is our dependent variable, Active Share and Tracking Error our independent ones. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Panel A: OLS results, Gross Alpha dependent variable

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
Intercept	-0.0012	0.0077	-0.153	0.878	-0.0162	0.0139
Active Share	0.0005	0.0001	3.588	0.001 ***	0.0002	0.0006
Tracking Error	-0.0076	0.0235	-0.324	0.746	-0.0536	0.0384
No. of observations	4180					
R^2	0.003					
F-statistic	6.444 (2 and 4178 df)					
p-value	0.0006					

Significance codes: 0 '***'

Panel B: Anova Variance Analysis

Variables	df	Sum Sq	Mean Sq	F value	Pr(>F)
Active Share	1	0.314	0.314	12.7835	0.0003 ***
Tracking Error	1	0.003	0.003	0.105	0.746
Residual	4178	102.68	0.025		
Root MSE	0.0006				

Significance codes: 0 '***'

Panel C: Robustness Test using White's Standard Errors (1 = HC0, 2 = HC1)

	Estimates		Std. err.		t-value		Pr(>F)	
Variables	1	2	1	2	1	2	1	2
(Intercept)	-0.001	-0.001	0.007	0.007	-0.163	-0.163	0.870	0.870
Active Share	0.004	0.004	0.000 1	0.0001	3.617	3.616	3.4e-05 ***	3.0e-0.5 ***
Tracking Error	-0.008	-0.008	0.034	0.034	-0.222	-0.221	0.824	0.825

Significance codes: 0 '***'

Panel D: Cluster Standard Errors (cluster by Quarter only)

Variables	Coefficient	Cluster std. err.	t-value	Pr>| t |
(Intercept)	-0.0012	0.01579	-0.075	0.941
Active Share	0.0004	0.0003	1.527	0.127
Tracking Error	-0.0076	0.0501	-0.152	0.879
Residual std. err.	0.1568 (4178 df)			
F-stat full model (p-value)	6.444 (0.0016) [2 and 4178 df]			
F-stat proj. model (p-value)	1.166 (0.3204) [2 and 47 df]			

Table 1b: Quaintile regressions using R studio's function. **Gross-return alpha** is our dependent variable, out two measurements for active management our independent ones. The three variables are computed as before. Gross-alpha is our dependent variable, Active Share and Tracking Error our independent. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Panel A: Quantile regressions Y = Gross Alpha, X1 = Active Share, X2 = Tracking Error

Variables	Coefficient	Std. err.	t-value	Pr(>|t|)	95% conf. interval	
X1 0.25	-0.0008	0.000	-11.273	0.000 ***	-0.0009	-0.0007 +
X2 0.25	-0.0732	0.027	-2.761	0.006	-0.1249	-0.0189
X1 0.5	0.0004	0.000	5.060	0.000 ***	0.0003	0.0006
X2 0.5	0.0427	0.027	1.559	0.119	-0.0121	0.0976
X1 0.75	0.0016	0.000	13.841	0.000 ***	0.0014	0.0019 +
X2 0.75	0.1510	0.039	3.841	0.000 ***	0.0724	0.2296 +

Significance codes: 0 '***' in the regression. 0.05 '+' means significantly different from the OLS coefficient result in Table 1a)

Table 1c: Anova Joint Test of Equality of Slopes for the 25th, 50th, and 75th quantiles (Anova test for coefficient differences)

Variables	df	Resid df	F-value	Pr(>F)
X1 and X2	4	12539	129.97	<2.2e-16 ***

Significance codes: 0 '***'

Table 1d: Gross-equal weighted alphas for all-equity Swedish funds 2010-2021.
Panel A shows the mean **Gross Alpha for each Active Share quartile**. Panel B shows the mean **Gross Alpha for each Tracking Error** quartile. The measures of active management are computed as before. The table shows annualized returns, followed by t-statistics in parentheses, based on White's standard errors. The number of observations in each quartile differs slightly because the funds are divided into quartiles for each of the 48 quarters examined. If the total number of observations is not divisible by four, as is often the case, the number of observations in each quartile will not be identical for that quarter. As an example, if a quarter has 93 observations in total, there will be 23 observations in three of the quartiles and 24 observations in one of the quartiles. The order of the "extra" observation(s) distributed in each quarter is consistent, in the following order: fourth quartile, first quartile, third quartile, second quartile.

Panel A: Active Share Quartiles

Active Share Quartile	Alpha	All
4	3.08% (0.41)	1053
3	3.01% (2.10)	1034
2	2.00 % (3.51)	1021
1	1.76% (1.31)	1047
All	2.34%	4155

Panel B: Tracking Error Quartiles

Tracking Error Quartile	Alpha	All
4	3.20% (0.84)	1053
3	1.49% (0.45)	1040
2	1.90% (1.49)	1021
1	2.10% (0.42)	1047
All	2.34%	4155

Table 2a: Regression results for **net-equal weighted Alphas** for all-equity Swedish funds 2010-2021. Alpha and the measures of active management are computed as before. Panel A-D shows our regression results, gross-return alpha is our dependent variable, Active Share and Tracking Error our independent ones. In Panel D, quarter is used as the cluster. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Panel A: OLS, Net Alpha dependent variable

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-0.015	0.008	-1.961	0.050 *	-0.0298	-1.66e-06
Active Share	0.0004	0.0001	3.329	0.0009 ***	0.0002	6.4e-04
Tracking Error	0.0057	0.027	0.216	0.216	-0.0465	5.8e-02
No. of observations	4295					
R^2	0.027					
F-statistic	5.73 (2 and 4293 df)					
p-value	0.0033					

Significance codes: 0 '***', 0.05 '*'

Panel B: Anova Variance Analysis

Variables	df	Sum Sq	Mean Sq	F value	Pr(>F)
Active Share	1	0.271	0.271	11.413	0.0007 ***
Tracking Error	1	0.001	0.001	0.047	0.829
Residual	4293	101.797	0.0237		
Root MSE	0.0006				

Significance codes: 0 '***'

Panel C: Robustness Test using White's Standard Errors (1 = HC0, 2 = HC1)

	Estimates		Std. err.		t-value		Pr(>F)	
Variables	1	2	1	2	1	2	1	2
(Intercept)	-0.015	-0.015	0.007	0.007	-1.997	-1.007	0.046 *	0.046 *
Active Share	0.0004	0.004	0.0001	0.0001	3.410	3.409	0.0007 ***	0.0007 ***
Tracking Error	0.006	0.006	0.037	0.037	0.157	0.157	0.875	0.875

Significance codes: 0 '***', 0.05 '*'

Panel D: Cluster Standard Errors (cluster by Quarter only)

Variables	Coefficient	Cluster std. err.	t-value	Pr>| t |
(Intercept)	-0.0148	0.0170	-0.876	0.381
Active Share	0.0004	0.0003	1.354	0.176
Tracking Error	-0.0057	0.05779	-0.100	0.921
Residual std. err.	0.154 (5293 df)			
F-stat full model (p-value)	5.73 (0.003) [2 and 4293 df]			
F-stat proj. model (p-value)	0.930 (0.402) [2 and 47 df]			

Table 2b: Quantile regressions using R studio's function. **Net-return alpha** is our dependent variable, our two measurements for active management our independent ones. The three variables are computed as before. To interpret the coefficients properly, note that the Active Share data used is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Quantile regression Y = alpha, X1 = Active Share, X2 = Tracking Error

Variables	Coefficient	Std. err.	t-value	Pr(>|t|)	95% conf. interval	
X1 0.25	-0.0008	0.000	-8.637	0.000 ***	-0.0010	-0.0006 +
X2 0.25	-0.0683	0.032	-2.104	0.0354	-0.1333	-0.0034 +
X1 0.5	0.0004	0.000	4.455	0.000 ***	0.0002	0.0006
X2 0.5	0.0705	0.0318	2.335	0.020	0.0101	0.1308 +
X1 0.75	0.0016	0.000	14.599	0.000 ***	0.0014	0.0018 +
X2 0.75	0.1602	0.040	4.0634	0.000 ***	0.0813	0.2390 +

Significance codes: 0 '***' in the regression. 0.05 '+' means significantly different from the OLS coefficient result in Table 1a)

Table 2c: Anova Joint Test of Equality of Slopes 0.75, 0.5, and 0.25 quantiles (Anova test for coefficient differences)

Variables	df	Resid Df	F-value	Pr(>F)
X{0.25 0.5 0.75}	4	12886	277.11	<2.2e-16 ***

Significance codes: 0 '***'

Table 2d: Net-equal weighted alphas for all-equity Swedish funds 2010-2021.
Panel A shows the **mean Net Alpha for each Active Share quartile**. Panel B shows the **mean Net Alpha for each Tracking Error quartile**. The measures of active management are computed as before. The table shows annualized returns, followed by t-statistics in parentheses, based on White's standard errors.

Panel A: Active Share Quartiles

Active Share Quartile	Alpha	All
4	1.41% (0.19)	1137
3	1.48% (2.72)	1111
2	0.43% (4.29)	1095
1	0.15% (1.31)	1125
All	0.88%	4472

Panel B: Tracking Error Quartiles

Tracking Error Quartile	Alpha	All
4	1.67% (-0.68)	1097
3	0.12% (-1.81)	1067
2	0.78% (26.14)	1056
1	0.86% (26.12)	1081
All	0.85%	4301

Table 3a: Regression results for **gross-equal weighted Alphas** for all-equity Swedish funds 2010-2021. **Small-Cap & Mid-Cap Funds are excluded** from this sample, which can be seen in our summary statistics. Alpha and the measures of active management are computed as before. Panel A-D shows our regression results, gross-return alpha is our dependent variable, Active Share and Tracking Error our independent ones. To interpret the data properly, note that the Active Share is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Gross Alpha and Tracking Error are expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Summary Statistics Gross-Return, Small-Cap Funds Excluded

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Active Share (%)	5.00	38.71	50.68	50.35	61.79	94.42
Tracking Error	0.004	0.065	0.087	0.113	0.140	1.204
Alpha	-0.789	-0.041	0.018	0.029	0.087	1.130
No. of observations	3245					

Panel A: OLS results, Alpha dependent variable – SmallCap Funds Excluded

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-0.0416	0.008	-4.997	6.12e-07 ***	-0.0580	-0.0253
Active Share	0.0013	0.0001	8.644	<2.e-16 ***	0.0009	0.0015
Tracking Error	0.0661	0.031	2.158	0.031 *	0.0060	0.126
No. of observations	3244					
R^2	0.024					
F-statistic	40.57 (2 and 4178 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.05 '*'

Panel B: Anova Variance Analysis

Variables	df	Sum Sq	Mean Sq	F value	Pr(>F)
Active Share	1	1.550	1.550	76.488	<2.e-16 ***
Tracking Error	1	0.094	0.094	4.656	0.031 *
Residual	3242	65.694	0.020		
Root MSE	0.0004				

Significance codes: 0 '***', 0.05 '*'

Panel C: Robustness Test using White's Standard Errors (1 = HC0, 2 = HC1)

	Estimates		Std. err.		t-value		Pr(>F)	
Variables	1	2	1	2	1	2	1	2
(Intercept)	-0.042	-0.041	0.008	0.008	-4.801	-4.799	1.6e-06 ***	1.7e-06 ***
Active Share	0.001	0.001	0.0001	0.0002	7.813	7.810	7.5e-15 ***	7.7e-15 ***
Tracking Error	0.066	0.066	0.038	0.038	1.762	1.761	0.078	0.078

Significance codes: 0 '***'

Table 3b: Regression results for **net-equal weighted Alphas** for all-equity Swedish funds 2010-2021. **Small- and Mid-Cap Funds are excluded** from this sample, which can be seen in our summary statistics. Alpha and the measures of active management are computed as before. Panel A-D shows our regression results, gross-return alpha is our dependent variable, Active Share and Tracking Error our independent ones. To interpret the data properly, note that the Active Share is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Net Alpha and Tracking Error are expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Summary Statistics Net Alphas, SmallCap Funds Excluded

Variables	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Active Share (%)	5.00	39.05	50.90	50.68	62.47	95.02
Tracking Error	0.004	0.066	0.089	0.114	0.142	0.811
Net Alpha	-0.787	-0.053	0.005	0.016	0.074	1.089
No. of observations	3326					

Panel A: OLS, Net Alpha Small Cap Excluded

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-0.062	0.008	-7.595	3.98e-14 ***	-0.078	-0.046
Active Share	0.001	0.0001	9.568	<2.2e-16 ***	0.0011	0.0016
Tracking Error	0.087	0.031	2.795	0.005 **	0.026	0.147
No. of observations	3325					
R^2	0.030					
F-statistic	51.44 (2 and 3323 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.01 '**'

Panel B: Anova Variance Analysis

Variables	df	Sum Sq	Mean Sq	F value	Pr(>F)
Active Share	1	1.867	1.867	95.064	<2.2e-16 ***
Tracking Error	1	0.153	0.152	7.814	0.005 **
Residual	3323	65.249	0.019		
Root MSE	0.0004				

Significance codes: 0 '***', 0.01 '**'

Panel C: Robustness Test using White's Standard Errors (1 = HC0, 2 = HC1)

	Estimates		Std. err.		t-value		Pr(>F)	
Variables	1	2	1	2	1	2	1	2
(Intercept)	-0.062	-0.062	0.009	0.008	-7.105	-7.101	1.5e-12 ***	1.5e-12 ***
Active Share	0.001	0.001	0.0001	0.0001	8.720	8.716	<2.2e-16 ***	2.2e-16 ***
Tracking Error	0.087	0.087	0.040	0.040	2.175	2.174	0.030 *	0.030 *

Significance codes: 0 '***', 0.05 '*'

Table 4a: Regression results for **gross-equal weighted Alphas** for Swedish all-equity mutual funds 2017-2021 (Q1 2017-Q4 2021). We add new control variables, **Fund Size, Fund Fee, and Fund Manager Persistence.** Fund Size is computed as million SEK under management Q1 2022. Fund Fee is computed as the actual fee (in percentage of invested capital) charged by the fund the last year (2021). Fund Manager Persistence is an approximation capturing how long the Fund Manager has managed the fund in relative and absolute terms. Alpha and the measures of active management are computed as before. To interpret the coefficients properly, note that the Active Share is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Panel A: OLS results, Gross Alpha dependent variable

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-7.23e-03	2.26e-02	-0.320	0.749	-5.156	3.710
Active Share	1.30e-03	3.68e-04	3.520	0.0001 ***	5.737	2.018
Tracking Error	-1.28e-02	5.14e-03	-2.480	0.013 *	-2.283	-2.666
Fund Size	-4.91e-08	4.73e-07	-0.104	0.917	-9.776	8.794
Fund Fee	-4.91e-04	1.215e-02	0.040	0.967	-2.433	2.335
Fund Manager Persistence	1.32e-04	7.80e-04	0.169	0.866	-1.340	1.661
No. of observations	1423					
R^2	0.012					
F-statistic	3.244 (5 and 1417 DF)					
p-value	0.006					

Significance codes: 0 '***', 0.05 '*'

Table 4b: Regression results for **net-equal weighted Alphas** for Swedish all-equity mutual funds 2017-2021 (Q1 2017-Q4 2021). The control variables as well as net-alpha and the active management measures are computed as before. To interpret the coefficients properly, note that the Active Share is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Panel B: OLS results, Net Alpha dependent variable

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-1.71e-02	2.25e-02	-0.758	0.448	-6.196	2.510
Active Share	1.28e-03	3.65e-04	3.512	0.0001 ***	7.754	2.198
Tracking Error	-1.25e-02	4.57e-02	-2.730	0.006 **	-3.344	-1.174
Fund Size	-8.57e-07	4.73e-07	-0.181	0.856	-9.489	9.013
Fund Fee	-1.62e-03	1.21e-02	-1.342	0.180	-2.784	1.979
Fund Manager Persistence	1.412e-0.4	7.82e-04	0.181	0.857	-1.294	1.727
No. of observations	1423					
R^2	0.011					
F-statistic	3.007 (5 and 1417 df)					
p-value	0.010					

Significance codes: 0 '***', 0.01 '**'

Table 4c: Determinants of Active Share for all-equity mutual funds 2017-2021 (Q1 2017-Q4 2021). Panel A-C show how each control variable **explains the deviation in Active Share**. The additional control variables are computed as before. Active Share and Tracking are computed as before. To interpret the coefficients properly, note that the Active Share is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Panel A: OLS results, dependent variable Active Share

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	4.08e+01	1.27e+00	36.30	<2e-16 ***	38.434	4.32e+01
Fund Size	-7.57e-05	3.45e-05	-2.194	0.028 *	-0.001	-8.01e+01
Fund Fee	1.29+01	8.14e-01	15.881	<2e-16 ***	11.334	1.45e-06
FundManagerPersistence	2.26e-01	5.67e-02	4.623	0.000 ***	0.150	3.73e+01
Tracking Error	4.97e+01	3.07e+00	16.216	<2e-16 ***	43.685	5.57e+01
No. of observations	1411					
R^2	0.3001					
F-statistic	150.5 (4 and 1404 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.01 '**'

Panel B: Anova Variance Analysis

Variables	df	Sum Sq	Mean Sq	F value	Pr(>F)
Fund Size	1	4250	4250	21.097	0.000 ***
Fund Fee	1	52012	52012	258.166	<2.2e-16 **
Fund Manager Persistence	1	4306	4306	21.373	0.000 ***
Tracking Error	1	60716	60716	301.369	<2.2e-16 ***
Residual	1404	282862	201		
Root MSE	14.177				

Significance codes: 0 '***', 0.01 '**'

Panel C: Robustness Test White Standard Errors

Variables	Coefficient	Std. err.	t-value	Pr>| t |
(Intercept)	4.0e+0.1	1.14e+00	34.832	<2.2e-16 ***
Fund Size	-1.0e-0.4	3.38-05	-3.290	0.001 **
Fund Fee	1.3e+0.1	7.76e-01	17.300	<2.2e-16 ***
Fund Manager Persistence	2.4e-0.1	4.98e-02	4.846	0.000 ***
Tracking Error	5.7e+0.1	3.45e+00	16.539	<2.2e-16 ***

Significance codes: 0 '***', 0.01 '**'

Table 4d: Determinants of Tracking for all-equity mutual funds 2017-2021 (Q1 2017-Q4 2021). Panel A-C show how each control variable **explains the deviation in Tracking**. The additional control variables are computed as before. Active Share and Tracking Error are computed as before. To interpret the coefficients properly, note that the Active Share is expressed in percentage points (i.e. one unit of Active Share is one percentage point), while Tracking Error is expressed in proportions (i.e. one unit of Tracking Error is 100 percentage points).

Panel A: OLS regression, Tracking Error dependent variable

Variables	Coefficient	Std. err.	t-value	Pr>| t |	95% conf. interval	
(Intercept)	-7.23e-03	1.07e-02	-0.679	0.497 ***	-2.81e-02	1.36e-02
Fund Size	2.66e-07	2.26e-07	1.176	0.240	-1.78e-07	7.10e-07
Fund Fee	-1.58e-02	5.18e-03	-2.721	0.007 **	-2.72e-02	-4.41e-03
FundManagerPersistence	-8.56e-04	3.69e-04	-2.319	0.021 *	-1.58e-03.	-1.32e-04
Active Share	2.46e-04	1.62e-04	15.219	<2e-16 ***	2.14e03	2.77e-03
No. of observations	1423					
R^2	0.148					
F-statistic	61.58 (4 and 1418 df)					
p-value	<2.2e-16					

Significance codes: 0 '***', 0.01 '**', 0.05 '*'

Panel B: Anova Variance Analysis

Variables	df	Sum Sq	Mean Sq	F value	Pr(>F)
Fund Size	1	0.008	0.000	0.096	0.754
Fund Fee	1	0.120	0.120	13.936	0.000 ***
Fund Manager Persistence	1	0.006	0.006	0.693	0.405
Tracking Error	1	1.9886	1.996	231.611	<2.2e-16 ***
Residual	1418	12.219	0.009		
Root MSE	0.095				

Significance codes: 0 '***'

Panel C: Robustness Test White Standard Errors

Variables	Coefficient	Std. err.	t-value	Pr>| t |
(Intercept)	-7.2e-03	1.0e-02	-0.709	0.479
Fund Size	2.7e-07	2.1e-07	1.256	0.208
Fund Fee	-1.6e-02	5.9e-03	-2.682	0.007 **
Fund Manager Persistence	-8.6e-04	3.5e-04	-2.424	0.015 *
Tracking Error	2.5e-03	1.9e-04	13.159	<2.2e-16 ***

Significance codes: 0 '***', 0.01 '**', 0.05 '*'

Table 5a: Tracking Error before vs After law enforcement (January 2020)

Welch Two-sided t-test

Data	Mean Tracking Error Before 2020	Mean Tracking Error After 2020	t-value	p-value	99% conf. interval	
Tracking Error Before 2020; Tracking Error After 2020	0.107	0.1902	-15.326	<2.2e-16	-0.0965	-0.0668

Degrees of freedom: 572.68. Number of observations: Tracking Error before 2020 = 3796 & Tracking Error After 2020 = 506

Table 5b: Active Share before vs After Recommendation Change (May 2015)

Welch Two-sided t-test

Data	Mean Active Share Before Q3 2015	Mean Active Share After Q3 2015	t-value	p-value	99% conf. interval	
Active Share (%) Before Q3 2015; Active Share (%) After Q3 2015	51.661	62.629	-19.111	<2.2e-16	-12.446	-9.489

Degrees of freedom = 4289.5. Number of observations: Active Share Before Q3 2015 = 2162 & Tracking Error After Q3 2015 = 2306

Figure 1: Tracking Error development over the sample period

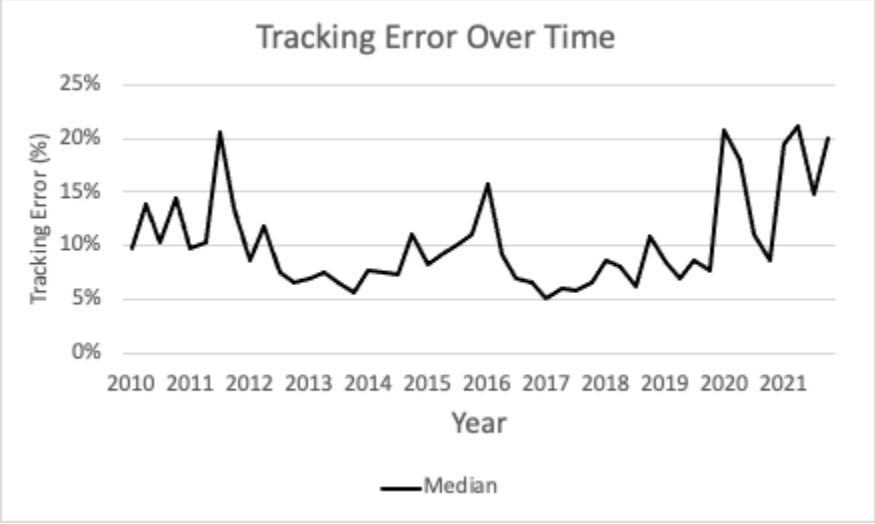

Figure 2: Active Share development over the sample period

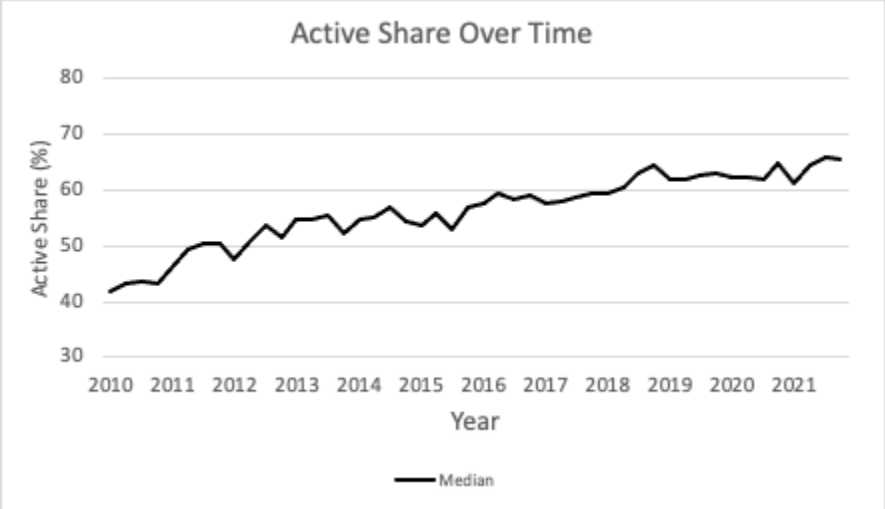

Figure 3: Active Share in-depth development over the sample period