Swedish Mutual Fund Performance and Persistence

Can past performance serve as an indicator for future returns?

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Abstract

This paper presents an overview of the Swedish mutual fund industry and investigates the prevalence of performance persistence using a sample of 139 funds during 2005 - 2020. The study is conducted using the Capital Asset Pricing Model for determining funds' alpha during a specific period, and analyses if an investment strategy based on past performance can consistently generate returns in excess of the market. In addition, we investigate whether funds with an ESG theme or funds investing exclusively in stocks with small market capitalisation outperform their counterparts. Finally, the performance persistence in ESG and small cap funds, respectively, is studied. Our overall results suggest that both positive and negative performance persistence exists in the Swedish mutual fund market, but only conclusively during an annual evaluation and holding period and with ambiguous inferences during a biannual periodisation depending on the market benchmark. Persistence does not seem to be more or less prevalent in ESG or small cap funds. Furthermore, our results imply that small cap funds outperform their counterparts while ESG funds fail to yield returns on par with funds lacking an ESG theme. Our results agree with most studies suggesting performance persistence exists on an annual evaluation basis.

Keywords:

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1 Introduction

Can actively managed mutual funds persistently deliver risk-adjusted excess returns to investors? A common saying among professionals that rejects this notion is that "past performance is no guarantee for future results". This implies a general consensus that persistence in performance among actively managed funds is rather a statistical anomaly than an industry standard. While informed professional fund managers may consistently outperform the market gross of fees, the common perception starting with Jensen (1969) is that fund investors rarely enjoy consistent and lasting alpha. However, later studies such as Grinblatt and Titman (1992), Elton, Gruber, Das, and Hlavka (1993), and Blake (1996) argue that funds can indeed persistently deliver excess performance to motivate their expenses. When Carhart (1997) provided evidence that mutual fund persistence on a one-year basis is primarily a product of expense ratios and stock momentum, the previous evidence of mutual fund persistence was weakened.

This paper examines if actively managed Swedish mutual funds that invest in Swedish equities can persistently create risk-adjusted excess return net of fees to their investors. Our approach employs the Capital Asset Pricing Model (CAPM) to find the required rate of return together with Jensen's alpha values for the actively managed funds during 2005-2020. Three portfolios are constructed with top performing, middle performing and bottom performing funds during a holding period with fund weighting correlated to the funds' deviation from the mean alpha. Each portfolio's return in the subsequent evaluation period is then evaluated against a passive market index to analyse if portfolios created based on past performance systematically outperform or underperform the market.

The Sustainable Finance Disclosure Regulation (SFDR), which went into effect on March 10, 2021, is the EU's most recent regulatory amendment from its 2030 Agenda for Sustainable Development, according to Regulation (EU) 2019/2088 (2019). Over the next ten years, the SFDR seeks to reorient €1 trillion into renewable investment alternatives (Jessop and Abnett 2021). The regulations aim to improve financial market participants and financial advisors' disclosure and transparency of sustainability information. This is ensured by the SFDR, which requires financial products and financial advisors to balance financial and sustainability risks, detail the product's sustainability impact, and provide general sustainability information (Regulation (EU) 2019/2088 (2019). The SFDR, according to a study by Asset Management firm Franklin Templeton (2021), is part of a paradigm shift that will significantly increase demand for ESG-denoted financial products. Previous research on whether investing in ESG mutual funds delivers higher returns than conventional mutual funds provide somewhat ambiguous conclusions. Gregory and Whittaker (2007) presented evidence that UK-domiciled ESG funds underperformed the market in absolute returns during the measurement period. Accounting for risk-adjusted returns, ESG funds did not underperform their counterparts and managed to deliver some annual performance persistence, albeit less than non-ESG funds. Climent and Soriano (2011) revealed that US ESG funds underperformed conventional funds during 1987-2009 but performed in parity during 2001-2009 specifically. Due to the slight ambiguity and increased demand for ESG mutual funds, this paper will also investigate the landscape of Swedish ESG mutual funds. We aim to evaluate whether actively managed Swedish equity mutual funds with an ESG thematisation perform better than their non-thematised counterparts and if previously described persistence analysis differ within these specific fund sub-samples.

Additionally, we will add to previous research by studying the performance and prevalence of persistence in actively managed Swedish mutual funds investing purely in equities with small market capitalisation. The rationale behind this extension relates to Banz (1981), who suggested that the risk-adjusted return for equities with a smaller market capitalisation is higher than that for equities with higher market capitalisation.

Our overall results suggest that performance persistence exists in the Swedish equity mutual fund market, but only during a 1-year evaluation and holding period and somewhat during a 2-year periodisation. Additionally, persistence in underperformance is prevalent during the 1-year period, and may accelerate or revert to zero when measuring over 2 years depending on the market proxy used. Furthermore, small cap funds tend to outperform non-small cap funds over the sample period and ESG-themed funds are outperformed by its counterparts. No significant difference is found in persistence when limiting the study to ESG or small cap funds.

The remainder of this paper is organised as follows. In section 2 we provide background about the previous literature relating to mutual fund performance and persistence. Information about the data will be provided in section 3. Section 4 describes the methodology used to analyse performance persistence. A presentation of our results is given in section 5. Section 6 concludes the paper.

2 Previous Literature

This section aims to present the findings of previous research studying persistence in performance of mutual funds. Section 2.1 introduces previous research on the subject in general, while sections 2.2 and 2.3 touch upon the previous studies of relative performance and persistence in small cap and ESG-themed funds.

2.1 Performance and Persistence

The performance of mutual funds and whether fund performance can be predicted by analysing past returns is well documented in finance literature since the 1960s. Sharpe (1966) and Jensen (1968) pioneered the subject of mutual fund performance, and laid a foundation that much of recent studies is based upon. Sharpe concluded that past performance is not a guarantee for future returns and suggested that a fund manager can construct an equity portfolio that can deliver returns in parity with the passive benchmark. However, with deducted fees, the returns fall short of the index. Jensen (1968) employed the Capital Asset Pricing Model (CAPM) and examined through regression analysis the funds' risk-adjusted excess returns - the Jensen's Alpha. The results revealed that the average alpha, both gross and net of fees, was negative. Accordingly, Jensen argued that mutual funds were unable to deliver returns that compensate for their level of systematic risk.

Analysing whether mutual funds can continually generate excess returns, Hendricks, Patel, and Zeckhauser (1993) employed Sharpe and Jensen's measures to analyse the returns of 96 mutual funds between 1974 and 1987. They formulated an investment strategy built on identifying previous "winners" and "losers". By picking funds with annual "hot hands", i.e. those with positive alphas in the previous year, the authors found that these funds continue to generate positive risk-adjusted returns net of fees for one to eight quarters. The mutual funds with "icy hands", i.e. those with negative alpha returns in the previous year, continued to underperform the market benchmark. The authors concluded that performance persistence was strongest during a one-year evaluation period. With shorter periods, noise and individual events eliminated the possible performance persistence from managerial skill. Over longer periods than one year, the "hot hands" investment strategy had diminishing importance in accordance with the efficient market hypothesis. Goetzmann and Ibbotson (1994) found similar results in monthly, annual and biannual performance persistence, with stronger evidence in the annual periodisation.

Using a non-parametric methodology, Brown and Goetzmann (1995) divided funds into four groups depending on their performance relative to the market index during the period 1976-1977. The results suggested that mutual fund performance persistence existed for one to three years. The authors also found evidence of reversal over time; funds that had previously outperformed the market tended to underperform in later periods. The authors concluded that persistence is not an effect of managerial skills in stock picking but rather a group phenomenon. Carhart (1997) extended previous research by analysing returns using the Four-Factor Model. The results suggested that annual persistence exists, albeit mainly as an effect of stock momentum. Additionally, Carhart claimed that the fund managers who managed to deliver excess return persistently did so by unintentionally including stocks with momentum, rather than employing a strategy built on this. This stands in contrast with Wermers

(1996), who reasons that short-term persistence is the effect of funds managing to incorporate a momentum strategy.

Previous research has also presented evidence that mutual funds can persistently deliver excess returns for more extended periods, up to ten years. Grinblatt and Titman (1992), Elton, Gruber, Das, and Hlavka (1993) and Elton, Gruber, and Blake (1996) presented similar conclusions that performance persistence exists on more extended periods with the cause being managerial talent and the possible access to superior information. Other research finds evidence of excess return persistence only in specific time periods. Malkiel (1995) found no evidence of persistence during the 1980s but during the 1960s. Thus, together with Berk and Green (2004), Malkiel concluded that the possible prevalence of performance persistence is likely the effect of the time period.

With many previous studies focusing on US mutual funds, Otten and Bams (2002) extended the previous research by studying a sample of 506 European mutual funds between 1991 and 1998. By employing Carhart's (1997) Four-Factor Model, Otten and Bams found evidence that European mutual funds managed to deliver excess returns persistently. The authors also found that funds with a high weight of small cap equities had a more significant tendency to deliver alpha net of fees persistently. Moreover, Otten and Bams found substantial evidence of persistence in UK-based mutual funds, albeit no evidence in German, French and Italian mutual funds.

Several papers examine the performance persistence in mutual funds in the Swedish market, with mixed results. Dahlquist et al. (2000) examined Sweden-based funds between 1993 and 1997, analysing the prevalence of performance persistence in different fund characteristics. The results indicated that large mutual funds underperformed smaller mutual funds. Significant evidence of persistent excess returns was found for money market funds but no other characteristic. Lindeen and Gros (2009) analysed 165 actively managed Swedish mutual funds between 1998 and 2008. The results indicated significant persistence during the time, but concentrated to underperforming mutual funds that continued to fall short of the market. Flam and Vestman (2014) studied 115 actively managed mutual funds between 1999 and 2009 and found practically no evidence of persistence in performance. When funds were grouped according to their previous returns, the return of the top and bottom performers converge to the mean after two or three years. Thus, the authors argued that there is no evidence of managerial skill or superior information influencing fund performance.

2.2 Performance and Persistence of Small Cap Mutual Funds

An investment strategy focusing on mutual funds with positions in equities with small capitalisation outperforms the market benchmark, Otten and Bams

(2002) argues. The authors found that small cap funds can add value to a more considerable degree than conventional mutual funds without an investment specialisation. Analysing the results using Fama and French's (1992) Three-Factor model and Carhart's (1997) Four-Factor model, the authors found that alphas net of fees were significantly higher for small cap equity funds than the mean of the sample and that small cap funds delivered significant over-performance in three out of four countries. Furthermore, Gorman (2003) argued that there exists some persistence in small cap mutual fund performance, as past "winners" continue to perform in the next year.

2.3 Performance and Persistence of ESG Mutual Funds

Gregory and Whittaker (2007) examined the performance and persistence of ESG funds between 1987 and 2002. The authors employed the Three- and Four-Factor Model to analyse the returns of the 32 ESG-themed funds and a corresponding control group of 160 non-ESG funds. The results indicated that both groups underperformed the market benchmark in absolute returns during the measurement period. However, none of the groups underperformed when accounting for their level of systematic risk. Additionally, the authors found evidence of persistence in both ESG and non-ESG funds on an annual basis. Some differences between the groups were presented, with the argument that performance persistence varies depending on the chosen performance metric.

3 Data

Sections 3.1 to 3.6 highlight and motivate the data used to evaluate the funds' performance and persistence and compare it to data used in previous research. Additionally, sections 3.7 and 3.8 aim to clarify the naming and disposition of each dependent and independent variable used in the analysis.

3.1 Swedish Mutual Funds

The fund sample collected from Morningstar consists of 139 diversified, open-ended mutual funds with Swedish equity exposure, as shown in table 1 in the Appendix.

The definition of a Swedish Equity Mutual Fund, and thus the criteria for funds used in this data set is:

1. The fund invests primarily in equities

2. The fund's geographical domicile is in Sweden

3. The fund's equity positions are listed on Swedish stock exchanges

4. The fund is actively managed with the goal of outperforming the market

3.1.1 Small Cap Funds

The examined Swedish small cap equity funds are funds where the fund management explicitly state that their main investment focus is equities of small market capitalisation. This information is gathered from each fund's fund information memorandum.

3.1.2 ESG Funds

According to Morningstar's definition, ESG-marked funds are funds using Environmental, Social, and Corporate Governance criteria when evaluating investments. When choosing investments, these funds can either pursue a theme that relates to creating positive and measurable social impact, a theme related to sustainability, or both. The ESG funds utilised in this paper are ESG-marked by Morningstar.

3.2 Time period

Fund performance is analysed during 16 years between January 1 2005 and December 31 2020. This stands in contrast to Hendricks, Patel and Zeckhauser (1993) who analyse fund returns for 14 years between 1974 and 1987.

3.3 Evaluation and Holding Period

The choices of evaluation and holding periods follow those applied by Hendricks, Patel, and Zeckhauser (1993), with some limitations. The authors collected quarterly fund returns and evaluated the 1 quarter, 1 year, 2 year, 3 year and 4 year performance persistence of these returns. This paper does not include a 3 and 4 year evaluation period as it requires a longer time period where the fund is active. Implementing this evaluation period would reduce the fund sample size and decrease the results' validity. Furthermore, this study only conducts analysis on matching holding and evaluation periods. Thus, quarterly persistence is defined as quarterly performance segmented by performance during the previous quarter. Annual persistence is defined as annual performance segmented by performance during the previous year. Biannual persistence is defined as biannual performance segmented by performance during the previous 2 years.

3.4 Market and Risk-Free Rate Proxy

The primary market proxy used is the SIXPRX index, with data gathered from Fondbolagens Förening. This index is used as it reflects many of the constraints relevant to the equity mutual funds selected for the performance data. SIXPRX is constructed to reflect the performance of companies on the Nasdaq Stockholm Stock Exchange, with a constriction in limited exposure to 10 percent of any single company according to EU UCITS investment rules for securities' funds. Furthermore, individual positions with more than 5 percent of total market capitalisation cannot exceed 40 percent of the index, and dividends are assumed to be reinvested in the index on the day after the dividend payments.

OMX Stockholm All-shares Gross Index (OMXSGI) is also used as a market proxy for fund performance evaluation in order to conduct the study more closely in line with Hendricks, Patel, and Zeckhauser (1993) which used the S&P 500. OMXSGI, with data gathered from Nasdaq, includes all shares listed on the OMX Nordic Exchange Stockholm, with all dividends reinvested. Contrary to the SIXPRX index, OMXSGI does not include exposure limits and has an exclusive aim of reflecting the current status and changes in the market. This index construction is more similar to the S&P 500 than that of SIXPRX. Important to note is that OMXSGI's base date is 28 December 2007, which is after the beginning of this study's sample period. Thus, the sample period is shorter when OMXSGI is used as a market proxy than when SIXPRX is used which may create some dissonance in the validity of the results.

As a proxy for the risk-free rate, the STIBOR Interbank Rate is used with data gathered from Sveriges Riksbank. When analysing persistence in quarterly fund performance, the 3M STIBOR rate at the time of the quarter's start is used. Similarly, the 6M STIBOR is compounded to yield an annual rate for each time period when analysing persistence on an annual basis, as well as a biannual risk-free rate when conducting the biannual analysis. The STIBOR rate is the calculated arithmetic mean of the rates major Swedish banks offer each other when borrowing and lending in SEK. This proxy calculation follows the method used by Hendricks, Patel, and Zeckhauser (1993).

3.5 Beta

The funds' Beta values are fixed 3-year Betas, calculated through a regression analysis of the fund returns and market returns. The Beta values are provided directly by Morningstar. Ideally, Betas would be calculated on a rolling basis for each quarter. However, fixed Betas are used for simplicity as in Hendricks, Patel, and Zeckhauser (1993). The Betas are calculated using OMXSGI as a market proxy. Ideally, the Beta values used in this analysis when SIXPRX is used as a market proxy should be based on SIXPRX as well. However, Morningstar Direct did not provide SIXPRX as an option for the Beta calculation.

3.6 Quarterly, Annual and Biannual Return

The funds' quarterly returns, extracted from Morningstar Direct, are the quarterly capital appreciation, including dividends. The returns are adjusted for administrative, management, and 12b-1 fees, which are deducted to attain the quarterly return. Sales charges and redemption fees are not accounted for. Quarterly returns are compounded to calculate annual and biannual returns.

3.7 Dependent Variables

Summary statistics of the independent and dependent variables are presented in Table 2 in the Appendix. This section aims to clarify the naming and disposition of each dependent variable.

3.7.1 Portfolios (Top, Middle, Bottom)

In the final regression, the dependent variables are the returns of the three portfolios during the given evaluation period on a rolling basis every quarter. The portfolio creation and portfolio return definition is presented in 4.4. Top portfolio variables will contain *Top*, middle portfolio variables will contain *Middle*, and Bottom portfolio variables will contain *Bottom*.

Note that N is the number of funds used to constitute the respective fund portfolio each quarter, and n is the number of quarters that the regression is made on (the number of portfolio returns that are evaluated against market returns).

3.7.2 Evaluation period (Q, Y, 2Y)

Each portfolio also has an assigned evaluation and holding period as defined in 3.3. *Q* stands for Quarter, *Y* stands for 1 Year and *2Y* stands for 2 Years. The sampling is conducted on a rolling basis each quarter for all periods.

3.7.3 Market Proxy (SIXPRX, OMX)

The portfolio returns based on SIXPRX as market proxy will simply be labelled *TopQ, MiddleY* etc. The portfolio returns based on OMXSGI as a market proxy will be labelled *TopQOMX, MiddleYOMX* etc.

3.7.4 Fund characteristic (ESG, Small Cap)

When conducting the analysis with a fund universe limited to those defined as in 3.1.1 and 3.1.2, the following notations are added to portfolio type as described in 3.7.1:

- *Small* (Small cap funds only)
- *NonSmall* (Small cap funds excluded)
- *ESG* (ESG funds only)
- *NonESG* (ESG funds excluded)

When conducting the simple performance analysis as defined in 4.6, *ESGY, NonESGY, SmallY, NonSmallY* are used as variable names.

3.8 Independent Variables

Summary statistics of the independent and dependent variables are presented in Table 2 in the Appendix. This section aims to clarify the naming and disposition of each independent variable.

3.8.1 Market Proxy (SIXPRX, OMX)

Market is the returns of the market proxy during the relevant holding period. When using the SIXPRX index as a market proxy, the independent variable is simply called *MarketQ, MarketY, Market2Y*. When OMXSGI is used as a market proxy, the independent variable is labeled *MarketQOMX, MarketYOMX, Market2YOMX* depending on the evaluation period.

4 Methodology

This section highlights the economic and statistical methods used to conduct the mutual fund performance analysis and obtain the final results. The section is divided into mathematical background on regression analysis to clarify the main statistical method of the paper, and subsequently the specific regression methods used to analyse the mutual fund performance and persistence.

Sections 4.1 to 4.4 are based on Montgomery, Peck, Vining and Geoffrey (2013).

4.1 Mathematical Background

Regression analysis is a widely applied method to examine the relationship of a set of independent variables and a dependent response variable. This analysis is based on a linear regression model, described by

$$y_i = \beta_0 + x_{1,i}\beta_1 + ... + x_{n,i}\beta_n + \epsilon_i$$

where y is the response variable, β_j are the regression coefficients, x_i are the observed values and ϵ_i is the error term. The model can be expressed in vector notation as

$$\mathbf{y} = \mathbf{X}\beta + \epsilon$$

where

$$\mathbf{y} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \quad \mathbf{X} = \begin{bmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1p} \\ 1 & x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & \ddots & & \\ 1 & x_{n1} & x_{n2} & \cdots & x_{np} \end{bmatrix} \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_n \end{bmatrix}; \epsilon = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_n \end{bmatrix}$$

The ordinary least squares method (OLS) is used to fit the model on a data set with n observations of the dependent variable and p independent variables.

This is equal to finding the parameter β which minimises the squared sum of the residuals, e_i. These residuals are the vertical distances from the data points y and the model's predicted values $\hat{y}$, or the regression line. Thus, the parameter $\hat{\beta}$ that minimises the squared sum is calculated by

$$\hat{\beta} = arg\min_{\beta}(y - X\beta)'(y - X\beta)$$

where $\hat{\beta}$ is the estimate of the true regression coefficient β.

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \hat{\beta}_2 x_2 + ... + \hat{\beta}_p x_p$$

4.2 Diagnostics and Handling of Outliers, Leverage and Influential Observations

A situation where a few extreme points excessively influence the fit is undesirable as the model is supposed to represent all observations. These abnormal observations shall thus be studied in detail and handled if necessary.

An observation with an abnormal x-value but a y-value in close proximity of the model regression line is called a leverage point. Such an observation will not affect the fit of the regression but the model summary statistics such as the R^2 as well as the standards errors of the coefficients. However, an observation with an unusual y-value will skew the regression line in its direction. This is called an influence point. An influence point's leverage can be determined form the hat matrix, $H = X(X'X)^{-1}X'$. The elements h_{ij} can be interpreted as the leverage exerted by the ith observation y_i on the jth fitted value $\hat{y_j}$. The greater the distance from the observation to the centroid, the greater the leverage that point has. If the hat diagonal exceeds $2p/n$, the point is remote enough to be considered a leverage point, given that $2p/n > |1|$. A widely used method for measuring said influence and the fit of the model is Cook's distance, described in 4.2.1.

4.2.1 Cook's Distance

American statistician R. Dennis Cook suggested a way of dealing with an observation's influence by a measure between the fitted coefficients $\hat{\beta}$ and fitted coefficients with the ith observation deleted, $\hat{\beta}_{(i)}$. This measure can be calculated by

$$D_i = \frac{r_i^2}{p}\frac{Var(\hat{y}_i)}{Var(e_i)} = \frac{r_i^2}{p}\frac{h_{ii}}{1-h_{ii}}$$

Generally, the threshold for an observation to be considered influential is $D_{(i)} > 4/n$.

4.3 Treatment of Influential Observations

The above-described detection of influence points is an important part of diagnosing the reliability of the model. The treatment of such influence points is harder and may be considered more of an art than a science. Generally, if an error was made while collecting the data and the influence point thus is not part of the intended population sample, then the point can be discarded completely. However, if the observation is deemed correct in its existence, then a removal cannot be justified, and it may be left in the model albeit having a large influence.

4.4 Persistence and Portfolio Creation

To measure fund performance persistence, the Capital Asset Pricing Model, as described in Sharpe (1964) and Lintner (1965), was used as follows:

$$ER_{ij1} = \alpha_{ij} + \beta_j ExM_i + e_{ij}$$

In the model, ER_{ij} corresponds to the excess return for the specific fund j and evaluation period i. α_{ij}, also known as Jensen's alpha, is the risk-adjusted return of the fund j during evaluation period i. β_j is the measure of volatility or systematic risk of a specific fund j towards the market as a whole, ExM_i is the market excess return for the evaluation period i and e_{ij} is the error term.

The regression is conducted in accordance with Hendricks, Patel, and Zeckhauser (1993). Each fund j's alpha is recorded for every relevant evaluation period i (quarterly, annually, and biannually). For each evaluation period, each fund's deviation from the arithmetic mean of all fund's alpha values is also recorded. Based on this data, three portfolios of funds are created where each fund's portfolio weight is linearly corresponding to its alpha deviation during the time frame. The top portfolio for a specific evaluation period contains all funds with an alpha deviation greater than 0.5 standard deviations from the mean alpha. The bottom portfolio contains all funds with an alpha deviation less than -0.5 standard deviations from the mean alpha, and the middle portfolio contains all funds in between.

The portfolios of top, middle, and bottom performers with corresponding fund weights relative to alpha deviation is then assessed during the next period (the holding period) with performance measured against market excess returns during the same period. When regressing portfolio returns for each time period subsequent to the period on which the weights are based against market excess returns, a positive intercept should indicate positive performance persistence and a negative intercept negative performance persistence. If said intercept has a p-value below 0.01, the observation is assumed to be of strong statistical significance. A p-value below 0.05 is considered to be of moderate statistical significance, whereas a p-value above 0.10 is assumed to be of no evidence.

Below are mathematical notations for the returns of each portfolio.

$$TopReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > 0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > 0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$MiddleReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -0.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -0.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$BottomReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < -0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < -0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

, where

$$\overline{\alpha_i} = \frac{\sum_{j=1}^{n} \alpha_{ij}}{n}$$

$$\alpha_{deviation,ij} = \alpha_{ij} - \overline{\alpha_i}$$

$$\sigma_i = Standard\ Deviation\ for\ \alpha_{deviation,ij}\ during\ time\ i$$

4.5 Persistence by Fund Characteristic

Persistence by fund characteristic is analysed by the method presented in 4.4, but with the fund sample size constricted to the characteristic analysed, i.e. ESG funds, non-ESG funds, small cap funds, and non-small cap funds.

4.6 Performance by Fund Characteristic

When evaluating if ESG funds have outperformed non-ESG funds and if small cap funds have outperformed non-small cap funds (excluding persistence), regressions were made on sub-samples of the dataset corresponding to the relevant aspect of the funds. When examining if ESG funds have outperformed funds without an ESG classification, a simple regression was made on the average return for the sample set of ESG funds against the average return of the sample set of non-ESG funds for each time period. Similarly, a regression on the sample set of small cap funds' average returns was made on the average returns of the sample set of non-small cap funds for each time period. If a positive intercept was achieved with statistical significance, over-performance by the subsets is assumed to have existed within the data set.

4.7 Biases

4.7.1 Survivorship bias

The majority of the funds that provide the data, exported from Morningstar, are still active, suggesting a survivorship bias within the dataset. As non-active funds are largely excluded, returns may be skewed upwards as low-performing funds are liquidated to a higher degree, creating a reversal effect that may dominate the persistence effect as suggested by Brown, Goetzmann, and Ibbotson (1992). Survivorship bias is, in this sense, a selection bias, leading to a fund sample that is not ideally randomised. Carpenter and Lynch (1999) elaborated more on this subject and found that a systematic disappearance of poor performers did affect the measure of performance persistence, both when true persistence exists and when it does not. Furthermore, the mere existence of attrition in poor performers alters the sample regardless of survivorship bias.

As the dataset provided by Morningstar did not include more closed funds that operated during the relevant time frame and finding such data that also corresponded with the measurement methodology of Morningstar was a fairly complex process, the decision was made to stick with the current data and accept the chance of an overstated bias.

4.7.2 Sample Size Bias

As mentioned in 4.7.1, the sample of funds is constricted mostly to funds actively managed by 2020 year-end. However, several funds have been established during the sample period and included within the sample period. Thus, the sample size of funds differs each quarter, with the intervals presented below.

	2005-01-01	2020-12-31
ESG Funds	21	35
Small Cap Funds	14	34
Non-ESG Funds	33	104
Non-Small Cap Funds	40	105
Total Funds	54	139

By studying recent research, an estimate of the “true” effect size of the population can be extracted, and subsequently a required sample size to capture said effect size.

Silva and Cortez (2016) studied the performance of green funds domiciled in the US and Europe, respectively. “Green” funds were those following a general environmental theme, according to the yoursri.com website. Since this study is conducted on funds investing in Swedish equities, the results of European funds in Silva and Cortez (2016) were used as a proxy for effect size. The article suggests an annualised effect size of -4.615% in performance of sustainable funds compared to an all-world index. It is important to note here that although the funds are European domiciled, they are not domiciled into the regions in which their equity investments are registered. This stands in contrast to this study, only covering funds taking positions in Swedish equities. The annualised standard deviation of the funds’ performance is 18%.

Fama and French (2012) examined, amongst other variables, the size premium of stocks in North America, Europe, Japan and the Asia Pacific. The paper presented different conclusions than Banz (1981) and Fama and French (1993) and found no evidence of stocks with lower market capitalisation having higher average returns than larger counterparts. Fama and French found an annualised effect size of 1.21% for global stocks and -0.72% for European stocks when comparing returns of the bottom 10% in market capitalisation against top the 90% in market capitalisation. The annualised standard deviation was 8.28% and 7.59%, respectively. Important to note is that Fama and French's study is conducted on small cap versus large cap stocks, and not funds investing in said equities. This will significantly increase the number of observations in comparison to this paper; however, it omits the presence of potential stock-picking skills within small cap or large cap funds, and the effect of diversification benefits within especially small cap funds.

With the implied population effect size and standard deviation, the sample size required to capture said effect size can be calculated according to the following formula and table presented in Kadam Bhalerao (2010).

$$n = \frac{2(Z_\alpha + Z_{1-\beta})^2\sigma^2}{\delta^2}$$

α-error	5%	1%	0.1%	Power	80%	85%	90%	95%
2-sided	1.96	2.5758	3.2905	Value	0.8416	1.0364	1.2816	1.6449
1-sided	1.65	2.33						

Setting the power of the study to 80%, the effect as two-sided and the accepted $\alpha -$ error as 0.05, the following values are yielded.

	Small – Large cap (EUR)	Small – Large cap (Global)	Sus. – non Sus. (EUR)
Implied Effect size δ	-0.72%	1.21%	-4.615%
S_d	8.28%	7.59%	18%
$Z\alpha$	1.96	1.96	1.96
$Z_{1-\beta}$	0.8416	0.8416	0.8416
Sample Size	2089	621	247

The required sample size to capture the implied effect size given the studied literature exceeds the total number of funds available according to the criteria presented in 3.1, and far exceeds the number of small cap and ESG funds. Especially large is the sample size required for the small cap fund extension with 2089 observation when referring to European stocks in Fama and French (2012). This is due to the almost non-existing size premium presented in the study, which suggests a much larger sample in order to detect such a small effect size. When referring to the Global set of stocks, the required sample is 621 observations as the implied effect size is larger. However, it far exceeds the available observations for this paper. Again, important to note is that the paper by Fama and French (2012) was conducted on individual stock returns and not fund returns with a diversified set of equity positions. The “true” effect size for fund returns may realistically differ from said value implied from the study conducted on stock returns which alters the ideal sample size. As for ESG funds, the implied true effect size through Silva and Cortez (2016) is larger which limits the required sample size to 247. This is also much larger than the available fund sample presented above. Important to note is that when the persistence analysis is conducted and the portfolio distinction made in line with 4.4, but with the fund universe constricted to ESG, non-ESG, small cap or non-small cap funds as presented in 5.4 and 5.5, the sample size is even smaller for each portfolio at any given time and the results’ robustness may suffer.

In order to analyse the implied effect size of the studied papers, it is important to discuss the sample size used in the respective study. Silva and Cortez (2016) used a sample of 95 “green” funds. Although larger than the sample available in this study, it is less than the implied required sample size to capture the effect size with a given power. This lesser sample size may inflate the implied effect size of -4.615%. In Fama and French (2012), the sample size of stocks was not reported in numbers, but included all publicly traded stocks in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom during a period of 245 months. This, along with a low standard deviation, witnesses a large sample size. Furthermore, since the implied effect size is very low, it is not deemed inflated by a lack of sample size. The potential issue here is instead the possibility of another true effect size for small cap funds versus general funds relative to small cap stocks versus non-small cap stocks.

Hendricks, Patel and Zeckhauser’s (1993) findings for positive performance persistence among previous winners on a yearly basis (2.6%) can be seen as an implied effect size for the persistence analysis. The effect size for positive persistence on a yearly basis is chosen due to it’s statistical significance in said study as well as in this study. However, Hendricks, Patel and Zeckhauser (1993) do not present the standard deviation in persistence excess returns relative to the market. If using this study’s standard deviation of 0.08 in said returns for the Top portfolio on a yearly basis as defined in 4.4, the required sample size for a 2-sided effect with 80% power and the accepted α-error as 0.05 is 152. This is above this study’s sample period of 56-61 quarters depending on the analysis’ evaluation and holding period. While the required sample size calculation is inhibited by the use of two different data sets in effect size and standard deviation, it provides a hint of small sample bias in the measurement period as well.

Furthermore, there may be some publishing bias in the studies used, as studies with no results are typically not published.

With potential biases in the implied effect sizes in mind, the sample size of funds according to the criteria outlined in 3.1 and the sample period as defined in 3.2 are both still low. This may lead to several biases in the statistical inference of this study. Firstly, a small sample size decreases the test's statistical power; thus, the probability of finding an effect when there is one to be found. A small sample size may therefore skew the results by increasing the chance of a type II error. Since the sample size is directly proportional to the Z-score and inversely to the margin of error, a reduced sample size leads to less conclusive results in general as the effect size is likely inflated (Button, Ioannidis, Mokrysz, et al. 2013).

5 Results

In this section, the primary findings of the study are presented. Furthermore, the robustness of the results is analysed through a gradual expansion of the decision rules for the portfolio creations, as well as an analysis of influential outliers and their significance to the regression output.

5.1 Mutual Fund Performance and Persistence

This section presents the results of the performance persistence analysis as defined in 4.4, divided into the different evaluation and holding periods.

5.1.1 Quarterly Performance Persistence

Table 3 shows the regression for quarterly returns for the three different portfolios using SIXPRX as a proxy for the market index. While all three portfolios have a positive intercept, none is statistically significant. The market coefficients are all close to unity with p-values below the 0.01 threshold. This implies that all fund portfolios follow the market closely during the quarterly time periods. The greater market coefficient for the top and bottom portfolios can be interpreted as an inclination towards persistence in volatility. All quarterly regressions have R^2 values above 94.1 per cent which implies a high explanatory value of the variation of the dependent variable (portfolio excess returns) by the independent variable (market excess returns).

Table 4 presents the results for quarterly persistence using OMXSGI as a market proxy. In line with the results using the SIXPRX proxy, no performance persistence exists during the quarterly measurement period. Although statistically insignificant, all portfolios show a positive and larger intercept than in table 3, implying a larger tendency towards persistence.

The lack of quarterly performance persistence might be explained by how the returns of the funds' equity positions may be heavily influenced by certain individual events, thus overshadowing the potential stock-picking skills of funds managers. Nevertheless, the results fall somewhat in line with the findings of Hendricks, Patel and Zeckhauser (1993), who find no statistically significant evidence for performance persistence in this setting.

5.1.2 Annual Performance Persistence

Table 5 with the results from the annual performance regression with SIXPRX as market index paints a different picture. The portfolio of top-performing funds consistently outperforms the market during subsequent years, with a positive intercept of 0.045 with a p-value below 0.01. For the middle portfolio, the results imply negative performance persistence with a statistically significant intercept of -0.024 at the 1% level. The bottom portfolio is persistently underperforming on an annual basis with a regression intercept of -0.061 statistically significant at the 1% level. All three regressions on an annual basis have R^2 values above 90 per cent, and the independent market variable can thus be said to have a high explanatory value of the dependent portfolio returns.

Table 6 presents the results when using OMXSGI as the market proxy, which are reasonably similar to those using SIXPRX. The top portfolio has a positive intercept of 0.048 with a p-value < 0.01, suggesting performance persistence on a yearly basis. The middle and bottom portfolio have statistically significant negative intercepts of -0.024 and -0.061, respectively, with p-values below 0.01. This implies that the middle and bottom portfolio persistently underperform the market index with a 1-year evaluation and holding period. Compared to the SIXPRX-based persistence evaluation, the regression intercept for the top portfolio is farther from 0, suggesting a more extensive performance persistence with OMXSGI used as a proxy for the market. Contrary to this, the middle and bottom portfolio have intercepts closer to 0 with OMXSGI, hence a more minor negative performance persistence than with SIXPRX.

These findings correspond with Hendricks, Patel and Zeckhauser (1993), Brown and Goetzmann (1995) and Carhart (1997), who find that a top-fund strategy with an annual evaluation as well as holding period generates significant excess returns. The negative performance persistence among bottom-performing funds also falls in line with Hendricks, Patel, and Zeckhauser (1993), who find that poorly performing funds in the recent year continue to underperform in the near term.

5.1.3 Biannual Performance Persistence

Table 7 shows the results with a biannual evaluation and holding period using SIXPRX as the market proxy. The results suggest that performance persistence is still existing, however, with less significance and only for top and bottom portfolios. The top portfolio has a positive intercept of 0.014 with a p-value < 0.05. The bottom portfolio has an intercept of -0.022 with a p-value < 0.1. The middle portfolio intercept does not differ significantly from zero. This implies some performance and underperformance persistence among the top and bottom funds over 2 years, but smaller and weaker than with an annual evaluation and holding period.

Table 8 stands in contrast to the findings in table 7. With OMXSGI as the market proxy, no statistically significant performance persistence exists in the top-performing fund. However, significant underperformance persistence seems to be prevalent in the middle portfolio, as suggested by the negative intercept of -0.079 with a p-value < 0.01. The bottom portfolio has an even lesser intercept of -0.144 with a p-value < 0.01. This implies that underperformance persistence exists in the middle and bottom portfolios on a 2-year basis and that these portfolios have a much higher tendency to continuously underperform than when using SIXPRX as market proxy. Furthermore, the top portfolio in table 8 also deviates from the findings in table 7, as no statistically significant performance persistence seems to exist.

These discrepancies could simply be due to a random occurrence, but also the effect of a plausible explanation rooted in the differences in the indices' compositions. Since the SIXPRX index enforces limitations in exposure levels to specific stocks, the persistence results may differ because certain individual stocks have driven the returns of the OMXSGI during the evaluation and holding periods in the 2-year study. Meanwhile, the sample funds may have failed to consistently overperform the market proxy apart from when the exposure to said stocks is limited in the index as is the case with SIXPRX.

The results regarding positive performance persistence fall somewhat in line with Hendricks, Patel and Zeckhauser (1993), who find persistence with a biannual evaluation and holding period, albeit on a lesser significance level than on an annual basis. Their conclusion is that persistence is gradually fading over time after one year. As Hendricks, Patel and Zeckhauser (1993) omit the study of negative performance persistence with a biannual evaluation and holding period, this study's results and especially the dissonance between the portfolios' intercepts with two different market proxies provides an interesting observation. The inference that positive persistence gradually fades over time might not be applicable for negative persistence; the OMXSGI results suggest an accelerated underperformance as the evaluation and holding periods are extended.

5.2 Robustness

This section aims to study if the results are purely mechanical or if there is robustness in the findings. The section presents an analysis of randomly created portfolios and a deep dive into the annual performance persistence results by gradually expanding the portfolio-creating decision rule in six phases. The decision rule is expanded by extending the alpha deviation intervals that determine the constituents of each portfolio.

5.2.1 Randomised Portfolios

Tables 9-11 show the results when the three portfolios were randomly created and analysed for performance persistence on a quarterly, annual and biannual basis. The randomised portfolio returns have no statistically significant alpha for any of the periods, apart from the middle portfolio during the biannual analysis, which most likely is random rather than a mechanical effect in the results. This suggests some robustness in the results.

5.2.2 Phase 1 Placebo Results

Table 12 presents the findings with the extended decision rules defined in the formulas below. Similar to the results with our initial decision rule shown in table 5 and 6, all three portfolios show statistically significant intercepts at the 0.01 level, suggesting performance persistence exists on an annual basis. Noteworthy is that all portfolio intercepts are closer to 0 than in table 5 and 6, implying a decreasing persistence.

Portfolio return definition with phase 1 decision rules applied:

$$TopReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > 0 \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > 0 \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$MiddleReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -0.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -0.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$BottomReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 0 \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 0 \\ 0 & \text{otherwise} \end{cases}} \right)$$

5.2.3 Phase 2 Placebo Results

Table 13 shows the findings with the extended decision rules presented below. In all three portfolios, statistically significant intercepts exist with p-values below 0.01, indicating that performance persistence still exists with this decision rule. The top and bottom regression intercepts are closer to 0 than in table 12, showing a diminishing persistence.

Portfolio return definition with phase 2 decision rules applied:

$$TopReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -0.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$MiddleReturn_i = \sum_{j=1}^{n}\left(ER_{j,i} * \frac{\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } \sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq \sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}{\sum_{j=1}^{n}\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } \sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq \sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}\right)$$

$$BottomReturn_i = \sum_{j=1}^{n}\left(ER_{j,i} * \frac{\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 0.5\sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}{\sum_{j=1}^{n}\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 0.5\sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}\right)$$

5.2.4 Phase 3 Placebo Results

Table 14 presents the findings of the portfolios with the expanded decision rules presented below. The top portfolio no longer shows a statistically significant intercept, implying that the positive performance persistence has diminished. However, the middle and bottom portfolio continue to show underperformance persistence as indicated by the negative intercepts at the 0.01 level.

Portfolio return definition with phase 3 decision rules applied:

$$TopReturn_i = \sum_{j=1}^{n}\left(ER_{j,i} * \frac{\begin{cases}\alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -\sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}{\sum_{j=1}^{n}\begin{cases}\alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -\sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}\right)$$

$$MiddleReturn_i = \sum_{j=1}^{n}\left(ER_{j,i} * \frac{\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } -1.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 1.5\sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}{\sum_{j=1}^{n}\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } -1.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 1.5\sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}\right)$$

$$BottomReturn_i = \sum_{j=1}^{n}\left(ER_{j,i} * \frac{\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < \sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}{\sum_{j=1}^{n}\begin{cases}|\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < \sigma_{i-1} \\ 0 & \text{otherwise}\end{cases}}\right)$$

5.2.5 Phase 4 Placebo Results

Table 15 presents the findings with further extensions to the decision rule, as presented below. The results further imply a diminishing persistence. As in phase 3, the top portfolio has no statistically significant intercept, suggesting no performance persistence exists. The middle and bottom portfolios deliver negative performance persistence below the 0.01 threshold with intercepts at -0.019 and -0.032. Compared to phase 3, the intercepts continue to progress closer to 0, further signalling a decreasing trend of persistence.

Portfolio return definition with phase 4 decision rules applied:

$$TopReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -1.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -1.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$MiddleReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -2\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 2\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -2\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 2\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$BottomReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 1.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 1.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

5.2.6 Phase 5 Placebo Results

Table 16 presents the findings with further extensions to the decision rule, as presented below. The results indicate that the trend of diminishing performance persistence continues as the decision rule is expanded, as all intercepts reverse closer to 0, albeit much slower for the bottom portfolio. The top portfolio has a statistically insignificant negative intercept of 0.006. The middle portfolio continues to deliver underperformance persistence at the 0.1 level, with an intercept of -0.013. The bottom portfolio has an intercept of -0.018 with a p-value < 0.01.

Portfolio return definition with phase 5 decision rules applied:

$$TopReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -2\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} \alpha_{deviation,j,i-1} & \text{if } \alpha_{deviation,j,i-1} > -2\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$MiddleReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -2.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 2.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } -2.5\sigma_{i-1} \leq \alpha_{deviation,j,i-1} \leq 2.5\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

$$BottomReturn_i = \sum_{j=1}^{n} \left(ER_{j,i} * \frac{\begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 2\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}}{\sum_{j=1}^{n} \begin{cases} |\alpha_{deviation,j,i-1}| & \text{if } \alpha_{deviation,j,i-1} < 2\sigma_{i-1} \\ 0 & \text{otherwise} \end{cases}} \right)$$

5.2.7 Phase 6 Placebo Results

Table 17 shows the findings where all three portfolios consist of all funds. With no statistical significance, all portfolios have a negative intercept of -0.009. This implies no performance persistence is found when all funds are included in the portfolios.

5.2.8 Robustness summary

When deep-diving into the robustness of the 1-year analysis to see when the performance persistence collapses, some interesting findings are made. The results collapse relatively late in both positive and negative persistence. The top portfolio's positive performance persistence disappears in phase 3, when the decision rule for constituting the top portfolio is relaxed from containing all funds with alpha deviations larger than -0.5σ during the preceding year, to that of -σ. This suggests that the negative persistence in the funds between those two thresholds is enough to erase the positive persistence in some of the funds constituting the previous top portfolios in phases 0 - 2. The negative performance persistence is prevalent much longer, with the bottom portfolio showing statistically significant underperformance in phase 5. This could partly be due to the overall underperformance of the fund sample set, as shown in phase 6. It could also be due to one or several outliers posting significant and consistent underperforming returns, thus driving down the alpha even when the decision rule is relaxed upward.

Overall, the results are not deemed mechanical in the sense that a randomised portfolio composition or portfolios containing all funds show no significant performance persistence. However, the results collapse quite late on both ends, witnessing some potential outliers driving the results rather than the majority of the sample.

5.3 Influential Points

Figures 1-9 show the Cook's distance for the respective regressions models according to the description in 4.1. As can be seen, several influential points may skew the model, most notably in BotQ and Bot2Y. However, after investigating each influential observation, the conclusion is that these are normal outliers that are measured correctly and should thus be included in the model.

5.4 Small Cap Funds

This section presents the results regarding small cap funds; the analysis on small cap funds performance relative to non-small cap funds, as well as the persistence study limited to small cap and non-small cap funds, respectively.

5.4.1 Small Cap Funds' Performance Relative to Non-Small Funds

In line with the findings of Banz (1981) and Otten and Bams (2002), table 18 presents the results implying that small cap funds tend to outperform non-small cap funds. The regression intercept of 0.043 at a p-value < 0.01 signals higher performance of the small cap funds on an annual measurement basis. However, this goes against the more recent study by Fama and French (2012), which finds no size premium in European stocks.

5.4.2 Small Cap Funds' Performance Persistence

Table 19 and 20 present the results for the annual performance persistence of small cap and non-small cap mutual funds. The top portfolios have positive intercepts for both groups, while the middle and bottom have negative intercepts, all at the 1% level. Considering there are only minor differences in the intercepts between the two groups and in the analysis of the whole sample presented in table 5, the prevalence of annual persistence in small cap funds is not greater than for non-small cap funds. Thus, both groups are equally likely to generate persistent excess return. However, as the fund sample size is significantly smaller when only including small cap funds as described in 4.7.2, the results' validity may suffer.

5.5 ESG Funds

This section presents the findings regarding ESG funds; the relative performance analysis against non-ESG funds as well as the persistence study limited to ESG and non-ESG funds, respectively.

5.5.1 ESG Funds' Performance Relative to Non-ESG Funds

ESG funds' performance relative to non-ESG funds is presented in table 21. There is a small but statistically significant underperformance in relation to funds not classified as ESG funds. The intercept is -0.010 and coefficient 0.991, both with p-values below 0.01. This suggests that ESG funds overall fail to perform on par with non-ESG funds. However, they may perform slightly better during bear markets. Important to note here is that fund fees might differ significantly, and a negative intercept in the regression does not necessarily mean underperformance of ESG themed positions. A valid hypothesis is that theme funds focusing on ESG investing charge higher fees than non-ESG funds, thus lowering returns after fees.

5.5.2 ESG Funds' Performance Persistence

The annual performance persistence of ESG and non-ESG funds is presented in table 22 and 23. For both groups, all three portfolios have statistically significant intercepts with p-values below 0.01. In line with the persistence study on the whole fund sample, the top portfolios show performance persistence while the middle and bottom portfolios show underperformance persistence. Albeit a slight difference, all portfolios' intercepts are closer to 0 for ESG funds than for the other group. This indicates that ESG funds have a smaller tendency continuously to outperform or underperform the market than non-ESG funds on a 1-year evaluation and holding period. However, the conclusion may be of limited significance due to the small sample size of ESG-funds.

6 Conclusion

This paper presents an overview of the persistence in performance of Swedish equity mutual funds. Analysing 137 mutual funds' returns between 2005-2020, we find evidence suggesting that previous "winners" continue to deliver alpha net of fees during subsequent periods. However, the results differ depending on the measured evaluation and holding period. While no persistence is found in funds' quarterly performance depending on the returns during the previous quarter, "hot hands" as well as "icy hands" are present on an annual basis. On a biannual basis, the results are mixed depending on the market proxy used. With an index adjusted for exposure limits present in mutual funds, performance persistence is existent albeit less pronounced than on an annual basis, while underperformance persistence also converges to the mean. When using a common gross market index, the positive performance persistence has diminished completely, whereas "icy hands" accelerates. These findings appear to be quite robust to the randomised analysis and the gradual phase-out of the portfolio decision rule, however less for underperformance persistence in the bottom portfolio, which a few outliers may drive.

In an extension, the fund sample is split into ESG and non-ESG funds, as well as small cap and non-small cap funds, to analyse if one characteristic had delivered greater return than the other during the sample period. Furthermore, the persistence analysis is conducted on sub-samples containing only ESG- or small cap-themed funds as well as their counterparts to analyse if previously suggested persistence is more pronounced in any of the fund sub-samples. The results suggest that funds focusing on small capitalisation stocks outperformed other funds during the sample period, and that ESG-themed funds were outperformed by non-ESG themed funds. Furthermore, the persistence in all sub-samples is practically equal, suggesting that performance persistence is not dependent on small cap or ESG categorisation.

This study presents a few novel findings. While many studies have analysed performance persistence in mutual funds, few have specialised in the Swedish market and included underperformance persistence as well and with the extension into ESG and small cap funds. The findings suggest that the results of specifically Hendricks, Patel and Zeckhauser (1993) hold even for a more recent sample period and set of Swedish mutual funds, with an investment strategy picking a portfolio of last years "winners" with weighting corresponding to alpha deviation delivering significant returns above the market. Furthermore, a set of small capitalisation funds may deliver greater performance to their investors than common mutual funds at the cost of higher volatility, with the contrary being true for ESG-themed funds.

In conclusion, our results suggest that some Swedish equity mutual fund managers might experience "hot hands", most notably on an annual evaluation and holding period, while others seem to underdeliver consistently. This effect appears unrelated to a fund thematisation towards small capitalisation stocks or Environmental Social and Governance. However, it is unclear if this performance persistence is due to managerial skill or another explanatory variable. While performance persistence still seems to exist on a biannual evaluation period basis, it gradually reverts to the mean, while underperformers seem to continue their trajectory depending on the market proxy used. It is possible that performance persistence finds a sweet spot on an annual measurement basis, as a middle ground between the short-term quarterly period influenced by individual events, and a more extended time period where performance eventually reverts to the mean in line with the efficient market hypothesis. Previous literature, most notably Carhart (1997), argues that fund persistence on an annual basis is primarily due to stock momentum. While momentum on a stock basis may be relevant, momentum in specific market sectors may be interesting to study in extended research since many funds in the sample have some specialisation.

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7.3 Data

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Morningstar Direct, contact: www.direct.morningstar.com

Nasdaq, contact: www.nasdaq.com

Sveriges Riksbank, contact: www.riksbank.se

8 Appendix

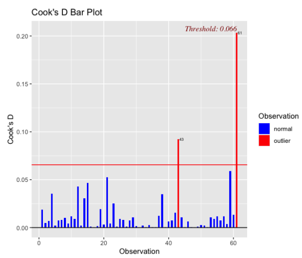

Figure 1: TopQ

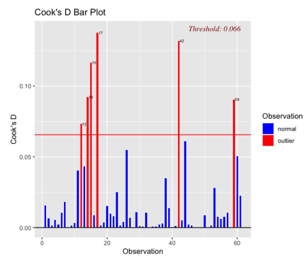

Figure 2: MidQ

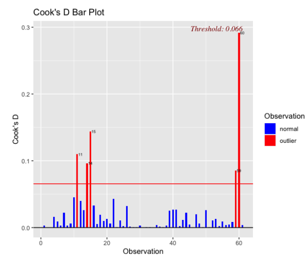

Figure 3: BotQ

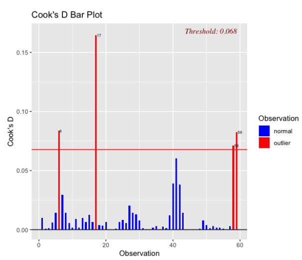

Figure 4: TopY

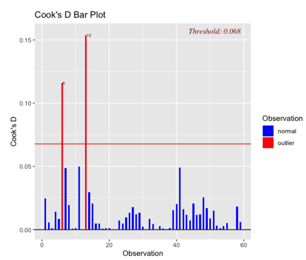

Figure 5: MidY

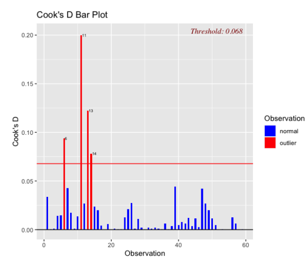

Figure 6: BotY

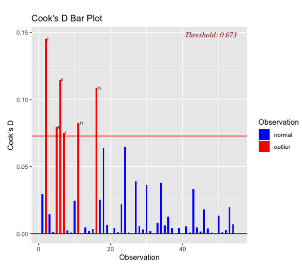

Figure 7: Top2Y

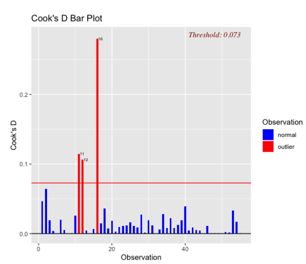

Figure 8: Mid2Y

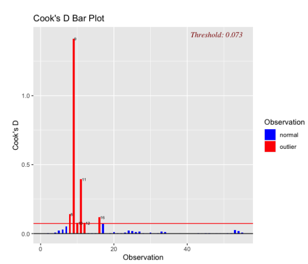

Figure 9: Bot2Y

Table 1: Summary Statistics, Swedish Equity Mutual Funds

Name	Mean return (Quarterly, Net of fees)	St. Dev.	Beta	Age (years)
Agenta Svenska Aktier	1.73%	9.65%	1.07	15
Aktie-Ansvar Sverige A	1.64%	9.53%	0.95	16
Aktiespararna Direktavkastning A	3.03%	8.24%	0.91	12
Aktiespararna Topp Sverige	1.35%	8.82%	1.01	16
AMF Aktiefond Småbolag	3.27%	12.10%	1.03	16
AMF Aktiefond Sverige	1.80%	9.56%	1.03	16
Avanza Zero	1.23%	9.01%	1.01	15
C WorldWide Sweden 1A	2.75%	8.80%	1.07	11
C WorldWide Sweden 5B	3.50%	11.96%	1.07	4
C Worldwide Sweden Small Cap 1A	4.50%	10.58%	0.98	11
C Worldwide Sweden Small Cap 5B	5.34%	9.92%	0.98	9
Carnegie Micro Cap	6.85%	15.38%	1.11	4
Carnegie Småbolagsfond A	4.54%	9.98%	1.01	9
Carnegie Spin-Off A	2.00%	9.74%	1.13	16
Carnegie Sverigefond A	1.94%	9.26%	1.09	16
Case All Star	2.71%	10.75%	0.93	3
Catella Småbolag	2.22%	10.27%	1.06	16
Catella Sverige Aktiv Hållbarhet	1.59%	10.03%	1.03	16
Catella Sverige Hållbart Beta A	1.79%	9.44%	0.98	16
CF Tillväxt Sverige A	4.48%	10.17%	1.08	5
Cliens Småbolag A	6.32%	11.65%	0.96	5
Cliens Sverige A	2.34%	9.83%	0.89	16
Cliens Sverige Fokus A	3.20%	8.31%	1.07	10
Didner & Gerge Aktiefond	2.22%	11.41%	1.16	16
Didner & Gerge Småbolag	5.22%	11.37%	1.05	12
DIX Sweden Restr SEK W	2.71%	7.89%	0.97	6
Enter Select A	1.87%	11.41%	1.05	16
Enter Select Pro	2.45%	10.83%	1.05	16
Enter Småbolagsfond A	6.91%	13.18%	1.04	6
Enter Sverige A	1.82%	10.48%	1.03	16
Enter Sverige Pro	2.16%	10.51%	1.03	16
Ethos Aktiefond	1.64%	9.98%	0.96	15
Evli Sweden Equity Index B	2.63%	7.25%	1.01	8
Evli Swedish Small Cap A	4.42%	12.51%	1.06	13
Folksam LO Sverige	1.82%	9.87%	1.08	16
Folksam LO Västfonden	1.99%	10.03%	1.08	16
Handelsbanken AstraZeneca Allemansfond	2.11%	8.52%	0.77	16
Handelsbanken Microcap Sverige (A4 SEK)	8.50%	14.08%	1.06	4
Handelsbanken Svenska Småbolag (A1 SEK)	3.31%	11.81%	1.09	16
Handelsbanken Svenska Småbolag (B1 SEK)	5.58%	10.24%	1.09	8
Handelsbanken Svenska Småbolag A1 EUR	3.33%	11.94%	1.15	16
Handelsbanken Sverige 100 Ind Cri A1 SEK	3.16%	7.29%	1.02	10
Handelsbanken Sverige Index Crit A1 SEK	1.70%	10.28%	1.01	16
Handelsbanken Sverige Index Crit B1 SEK	3.32%	8.21%	1.07	8
Handelsbanken Sverige Selektiv (A1 EUR)	1.99%	10.53%	1.09	16
Handelsbanken Sverige Selektiv (A1) SEK	1.98%	10.42%	1.03	16
Handelsbanken Sverige Selektiv (A9 EUR)	4.38%	9.93%	1.10	7
Handelsbanken Sverige Selektiv (A9) SEK	4.34%	9.56%	1.03	7
Handelsbanken Sverige Selektiv (B1) SEK	1.98%	10.41%	1.03	16
Handelsbanken Sverige Selektiv B1 EUR	2.00%	10.53%	1.09	16
Handelsbanken Sverige Tema (A1 SEK)	2.20%	10.17%	1.00	16
Humle Småbolagsfond	3.59%	13.60%	1.06	13
Indecap Guide Q30 A	4.56%	13.46%	0.99	3
Indecap Guide Sverige A	1.78%	9.90%	1.02	16
Lancelot Avalon A	5.77%	9.82%	0.80	8
Lannebo Småbolag	3.11%	11.10%	1.10	16
Lannebo Småbolag EUR	5.14%	12.56%	1.14	5
Lannebo Småbolag Select	2.90%	10.29%	1.02	16
Lannebo Sverige	1.74%	9.88%	1.13	16
Lannebo Sverige Hållbar A SEK	2.74%	9.17%	0.99	10
Lannebo Sverige Plus	3.85%	10.14%	1.15	12
Länsförsäkringar Småbolag Sverige A	3.44%	12.77%	1.02	16
Länsförsäkringar Sverige Aktiv A	1.74%	9.27%	1.01	16
Länsförsäkringar Sverige Indexnära	3.04%	8.58%	1.00	12
Nordea Alfa	1.19%	9.50%	1.17	16
Nordea Inst Aktie Sverige	1.50%	9.30%	0.99	16
Nordea Inst Aktief Sverige icke-utd	1.50%	9.31%	0.99	16
Nordea Institutionell Aktieförvaltn Acc	2.96%	9.43%	1.16	6
Nordea Institutionell Aktieförvaltn Inc	2.96%	9.44%	1.16	6

Name	Mean return (Quarterly, Net of fees)	St. Dev.	Beta	Age (years)
Nordea Olympiafond	1.26%	9.40%	1.13	16
Nordea Småbolagsfond Sverige	4.14%	10.01%	1.04	10
Nordea Sverige Passiv icke-utd	2.60%	9.19%	1.00	13
Nordea Sverige Passiv utd	2.60%	9.19%	1.00	13
Nordea Swedish Ideas Equity	3.01%	9.48%	1.18	7
Nordea Swedish Stars icke-utd	1.50%	9.86%	1.16	16
Nordea Swedish Stars utd	1.50%	9.86%	1.16	16
Nordic Equities Sweden	2.59%	8.62%	0.93	12
Nordnet Indexfond Sverige	3.28%	8.24%	0.97	12
Norron Active NRC SEK	2.70%	11.17%	1.01	3
Norron Active RC SEK	3.90%	8.38%	1.01	10
ODIN Sverige A	3.10%	11.59%	1.08	16
PLUS Mikrobolag Sverige Index	4.65%	14.19%	0.97	4
PLUS Småbolag Sverige Index	5.20%	12.86%	1.03	4
PriorNilsson Sverige Aktiv A	3.60%	7.26%	0.91	8
PriorNilsson Sverige Aktiv B	3.59%	7.26%	0.91	8
Quesada Sverige	1.04%	9.60%	1.08	16
SEB Hållbar Sverige Indexnära	3.19%	8.52%	0.99	12
SEB Hållbar Sverige Indexnära Inst	3.32%	8.25%	0.99	7
SEB Hållbar Sverige Indexnära utd	3.38%	7.66%	0.99	8
SEB Hållbarhetsfond Sverige Index	3.18%	9.65%	0.99	4
SEB Hållbarhetsfond Sverige Index utd	1.48%	9.58%	0.99	16
SEB Micro Cap	4.10%	11.89%	1.06	16
SEB Stiftelsefond Sverige	2.06%	10.60%	0.98	16
SEB Sustainability Fund Sweden C	1.76%	9.35%	0.99	16
SEB Sustainability Fund Sweden ID SEK	3.80%	8.83%	0.99	5
SEB Sverige Expanderad	1.50%	9.20%	0.99	16
SEB Sverige Expanderad HNW	3.49%	8.87%	0.99	6
SEB Sverige Expanderad Inst	3.58%	8.87%	0.99	5
SEB Sverige Expanderad utd	3.47%	8.87%	0.99	5
SEB Sverige Småbol C/R utd	6.01%	10.38%	1.04	8
SEB Sverige Småbolagsfond utd	5.54%	10.07%	1.05	8
SEB Sverigefond	1.58%	9.53%	1.00	16
SEB Sverigefond Småbolag	3.01%	11.54%	1.05	16
SEB Sverigefond Småbolag C/R	3.34%	11.94%	1.04	16
SEB Sverigefond Småbolag Inst	5.65%	10.83%	1.05	7
SEB Swedish Value Fund	1.56%	11.20%	1.12	14
SEB Swedish Value Fund utd	3.44%	9.70%	1.12	5
SEF – Kavaljer Quality Focus A SEK	3.82%	12.98%	1.15	5
SEF – Kavaljer Quality Focus I SEK	3.96%	12.97%	1.16	5
She Invest Sweden	2.34%	8.25%	0.77	6
Simplicity Småbolag Sverige A	4.76%	10.75%	0.89	4
Simplicity Sverige	3.36%	7.40%	0.66	5
Skandia Cancerfonden	1.87%	10.02%	1.04	16
Skandia Småbolag Sverige	3.19%	11.45%	1.05	16
Skandia Sverige Exponering	3.20%	7.98%	1.02	8
Skandia Sverige Hållbar	4.85%	12.57%	1.03	3
Skandia Världsnaturfonden	1.86%	10.06%	1.05	16
Spiltan Aktiefond Investmentbolag	4.72%	8.04%	0.88	9
Spiltan Aktiefond Småland	3.82%	11.59%	1.13	13
Spiltan Aktiefond Stabil	2.29%	8.27%	0.83	16
Spiltan Småbolagsfond	2.83%	11.95%	1.10	16
SPP Aktiefond Sverige A	1.63%	9.20%	0.99	16
SPP Sverige Plus A	3.88%	9.07%	1.02	5
Strand Småbolagsfond	2.33%	10.71%	0.88	14
Swedbank Humanfond	1.24%	10.12%	1.09	16
Swedbank Robur Access Sverige A	1.08%	9.87%	1.00	14
Swedbank Robur Exportfond A	2.24%	11.18%	1.09	16
Swedbank Robur Småbolagsfond Sverige A	3.33%	11.61%	1.01	16
Swedbank Robur Sverigefond A	1.72%	10.27%	1.15	16
Swedbank Robur Sverigefond MEGA I	1.94%	10.23%	1.14	16
Swedbank Robur Sweden High Dividend A	1.03%	10.63%	1.13	14
Swedbank Robur Transition Sweden A	1.25%	10.12%	1.09	16
Swedbank Robur Transition Sweden MEGA J	1.57%	9.88%	1.08	16
Öhman Etisk Index Sverige A	1.37%	9.38%	0.96	16
Öhman Småbolagsfond A	3.01%	11.07%	0.98	16
Öhman Sverige Fokus A	2.91%	11.02%	1.02	3
Öhman Sverige Hållbar A	2.52%	7.97%	0.99	8
Öhman Sverige Marknad Hållbar A	2.73%	8.88%	0.96	4
Öhman Sweden Micro Cap A	3.30%	11.95%	1.03	16

Table 2: Summary Statistics, Independent & Dependent Variables

	Mean	Median	Min	Max	n	N
TopQ	0.02321499	0.04020684	-0.2268696	0.27309779	61	40
MiddleQ	0.02023618	0.046608	-0.242313	0.28289	61	56
BottomQ	0.02153637	0.04387773	-0.2487545	0.26893691	61	43
MarketQ	0.01943175	0.04018146	-0.2225963	0.25455491	61	1
TopY	0.14966631	0.179889	-0.484893	0.909764	59	38
MiddleY	0.07254032	0.111836	-0.520561	0.683524	59	59
BottomY	0.03053966	0.072508	-0.510489	0.611972	59	42
MarketY	0.09305215	0.133476	-0.478949	0.676516	59	1
Top2Y	0.18093592	0.2234654	-0.6222135	0.93435694	55	33
Middle2Y	0.17142284	0.188192	-0.645456	0.949088	55	62
Bottom2Y	0.11591984	0.10173262	-0.5635162	0.81140822	55	44
Market2Y	0.16718095	0.193828	-0.640834	0.909547	55	1
TopQOMX	0.02465294	0.04594317	-0.2274173	0.27352608	62	40
MiddleQOMX	0.02116883	0.04768248	-0.2412291	0.28199549	62	54
BottomQOMX	0.02187461	0.04685078	-0.2500685	0.26880266	62	45
MarketQOMX	0.01916478	0.04274565	-0.2327828	0.2384876	62	1
TopYOMX	0.1496202	0.17329495	-0.4850797	0.9105444	60	42
MiddleYOMX	0.07285568	0.10925568	-0.5198563	0.68185714	60	54
BottomYOMX	0.0317704	0.07331517	-0.5098672	0.60996505	60	43
MarketYOMX	0.08970304	0.1288715	-0.4635474	0.64018624	60	1
Top2YOMX	0.32447918	0.35216949	-0.621652	1.24339787	56	37
Middle2YOMX	0.17842427	0.21184673	-0.6350459	0.95055534	56	54
Bottom2YOMX	0.10025738	0.11683984	-0.6852984	0.81134562	56	48
Market2YOMX	0.22725914	0.20811278	-0.4431203	0.90272374	56	1
TopQR	0.02371721	0.04955846	-0.2353743	0.27718736	62	46
MiddleQR	0.01671306	0.03877646	-0.2428753	0.27947326	62	46
BottomQR	0.02120407	0.04672041	-0.243381	0.28043713	62	47
TopYR	0.08607839	0.13156566	-1.0443323	0.77445862	60	46
MiddleYR	0.09683942	0.13487269	-0.5100432	0.96700892	60	46
BottomYR	0.07306188	0.12888092	-1.1799498	0.7226759	60	47
Top2YR	0.18087535	0.25738274	-2.9236388	1.07515254	56	46
Middle2YR	0.24348692	0.29438818	-0.6509291	2.07538617	56	46
Bottom2YR	0.18498829	0.30964554	-2.9481048	1.18898681	56	47
TopYP1	0.14328244	0.17122965	-0.487939	0.90107611	59	67
MiddleYP1	0.07254138	0.11183642	-0.5205609	0.68352398	59	71
BottomYP1	0.03542611	0.07859401	-0.5111582	0.61769166	59	58
TopYP2	0.13273675	0.15868753	-0.4913885	0.86862675	59	83
MiddleYP2	0.07146416	0.11070096	-0.5156081	0.68575871	59	96
BottomYP2	0.04057549	0.08205291	-0.5124662	0.62606894	59	87
TopYP3	0.11304005	0.14467385	-0.4988393	0.79592327	59	97
MiddleYP3	0.07195384	0.11070096	-0.5156081	0.68575871	59	110
BottomYP3	0.05128984	0.10323574	-0.5125662	0.65576986	59	103
TopYP4	0.09868624	0.13212117	-0.4989166	0.77111762	59	113
MiddleYP4	0.0762959	0.11569312	-0.5062573	0.70789414	59	123
BottomYP4	0.06286776	0.11147744	-0.5104489	0.67958847	59	109
TopYP5	0.09295207	0.12999437	-0.4995486	0.75938388	59	124
MiddleYP5	0.0853908	0.11890513	-0.5057307	0.75028564	59	130
BottomYP5	0.08016414	0.11569312	-0.5062573	0.74789414	59	128
TopYP6	0.08935427	0.12999437	-0.4995486	0.75938388	59	139
MiddleYP6	0.08935427	0.12999437	-0.4995486	0.75938388	59	139
BottomYP6	0.08935427	0.12999437	-0.4995486	0.75938388	59	139
ESGY	0.07115977	0.11039711	-0.5090287	0.71013544	60	35
NonESGY	0.08183596	0.12075899	-0.5057368	0.71082424	60	104
SmallY	0.11677509	0.15064784	-0.5225774	0.81310905	60	34
NonSmallY	0.06670736	0.11304985	-0.5011892	0.67660732	60	105
TopSmall	0.1388192	0.1717589	-0.4890309	0.85975242	59	7
MidSmall	0.0711132	0.1098181	-0.4980341	0.66628226	59	17
BotSmall	0.04045957	0.0760756	-0.52125	0.64087172	59	12
TopNonSmall	0.13508495	0.17081287	-0.48023	0.96520298	59	10
MidNonSmall	0.06949825	0.10429417	-0.5003644	0.67719179	59	39
BotNonSmall	0.03094602	0.07396623	-0.509022	0.61446541	59	56
TopESG	0.14108582	0.17281442	-0.4840123	0.85975242	59	6
MidESG	0.07266954	0.12149017	-0.5136649	0.65124691	59	18
BotESG	0.03934032	0.07103238	-0.5180912	0.64052245	59	11
TopNonESG	0.15022704	0.17249153	-0.485003	0.9400762	59	25
MidNonESG	0.0720878	0.10803761	-0.5309334	0.70979095	59	41
BotNonESG	0.02854435	0.07312861	-0.5072303	0.60230989	59	38

Table 3: Results CAPM (quarterly)

	Dependent variable:		
	TopQ	MiddleQ	BottomQ
	(1)	(2)	(3)
MarketQ	1.068***	1.038***	1.071***
	(0.036)	(0.018)	(0.023)
Constant	0.002	0.0001	0.001
	(0.004)	(0.002)	(0.002)
Observations	61	61	61
R^2	0.937	0.982	0.974
Adjusted R^2	0.936	0.982	0.973
Residual Std. Error (df = 59)	0.027	0.014	0.017
F Statistic (df = 1; 59)	882.083***	3,193.851***	2,182.899***

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

Table 3 presents the results studying performance persistence in the three portfolios as defined in 4.4 with one quarter evaluation period and one quarter holding period, with SIXPRX as market proxy.

Table 4: Results w/ OMXSGI proxy (quarterly)

	Dependent variable:		
	TopQOMX	MiddleQOMX	BottomQOMX
	(1)	(2)	(3)
MarketQOMX	1.018***	0.974***	1.018***
	(0.040)	(0.026)	(0.029)
Constant	0.005	0.003	0.002
	(0.004)	(0.003)	(0.003)
Observations	62	62	62
R^2	0.916	0.959	0.955
Adjusted R^2	0.915	0.958	0.954
Residual Std. Error (df = 60)	0.031	0.020	0.022
F Statistic (df = 1; 60)	658.505***	1,400.338***	1,268.837***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4 presents the results studying performance persistence in the three portfolios as defined in 4.4 with one quarter evaluation period and one quarter holding period, with OMXSGI as market proxy.

Table 5: Results CAPM (1 year)

	Dependent variable:		
	TopY	MiddleY	BottomY
	(1)	(2)	(3)
MarketY	1.125***	1.029***	0.983***
	(0.047)	(0.021)	(0.024)
Constant	0.045***	-0.024***	-0.061***
	(0.011)	(0.005)	(0.006)
Observations	60	60	59
R^2	0.906	0.977	0.967
Adjusted R^2	0.905	0.977	0.966
Residual Std. Error (df = 58)	0.078	0.034	0.040
F Statistic (df = 1; 58)	561.569***	2,482.595***	1,654.382***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 5 presents the results studying performance persistence in the three portfolios as defined in 4.4 with one year evaluation period and one year holding period, with SIXPRX as market proxy.

Table 6: Results w/ OMXSGI proxy (1 year)

	Dependent variable:		
	TopYOMX	MiddleYOMX	BottomYOMX
	(1)	(2)	(3)
MarketYOMX	1.137***	1.049***	0.997***
	(0.053)	(0.025)	(0.027)
Constant	0.048***	-0.021***	-0.058***
	(0.012)	(0.006)	(0.006)
Observations	60	60	60
R^2	0.889	0.969	0.958
Adjusted R^2	0.887	0.969	0.958
Residual Std. Error (df = 58)	0.085	0.039	0.044
F Statistic (df = 1; 58)	464.518***	1,821.476***	1,335.027***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 6 presents the results studying performance persistence in the three portfolios as defined in 4.4 with one year evaluation period and one year holding period, with OMXSGI as market proxy.

Table 7: Results CAPM (2 years)

	Dependent variable:		
	Top2Y	Middle2Y	Bottom2Y
	(1)	(2)	(3)
Market2Y	0.998***	1.014***	0.826***
	(0.014)	(0.011)	(0.035)
Constant	0.014**	0.002	-0.022*
	(0.005)	(0.004)	(0.012)
Observations	55	55	55
R^2	0.990	0.994	0.913
Adjusted R^2	0.990	0.994	0.912
Residual Std. Error (df = 53)	0.031	0.026	0.081
F Statistic (df = 1; 53)	5,443.380***	8,285.212***	557.689***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 7 presents the results studying performance persistence in the three portfolios as defined in 4.4 with two years evaluation period and two years holding period, with SIXPRX as market proxy.

Table 8: Results w/ OMXSGI proxy (2 years)

	Dependent variable:		
	Top2YOMX	Middle2YOMX	Bottom2YOMX
	(1)	(2)	(3)
Market2YOMX	1.315***	1.134***	1.075***
	(0.062)	(0.031)	(0.031)
Constant	0.026	-0.079***	-0.144***
	(0.022)	(0.011)	(0.011)
Observations	56	56	56
R^2	0.893	0.961	0.958
Adjusted R^2	0.891	0.960	0.957
Residual Std. Error (df = 54)	0.129	0.064	0.064
F Statistic (df = 1; 54)	448.455***	1,331.352***	1,219.489***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 8 presents the results studying performance persistence in the three portfolios as defined in 4.4 with two years evaluation period and two years holding period, with OMXSGI as market proxy.

Table 9: Placebo Randomised Results (quarterly)

	Dependent variable:		
	TopQP	MiddleQP	BottomQP
	(1)	(2)	(3)
MarketQ	1.068***	1.039***	1.063***
	(0.024)	(0.035)	(0.025)
Constant	0.002	-0.004	-0.0003
	(0.002)	(0.003)	(0.002)
Observations	61	61	61
R^2	0.971	0.936	0.970
Adjusted R^2	0.971	0.935	0.969
Residual Std. Error (df = 59)	0.018	0.026	0.018
F Statistic (df = 1; 59)	1,981.646***	867.280***	1,879.389***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 9 presents the results studying performance persistence in three portfolios with a random set of funds, one quarter evaluation period, one quarter holding period, and SIXPRX as market proxy.

Table 10: Placebo Randomised Results (1 year)

	Dependent variable:		
	TopYP	MiddleYP	BottomYP
	(1)	(2)	(3)
MarketY	0.945***	0.857***	0.944***
	(0.122)	(0.115)	(0.126)
Constant	-0.006	0.014	-0.018
	(0.029)	(0.027)	(0.029)
Observations	60	60	60
R^2	0.509	0.489	0.492
Adjusted R^2	0.501	0.480	0.484
Residual Std. Error (df = 58)	0.201	0.190	0.208
F Statistic (df = 1; 58)	60.163***	55.429***	56.241***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 10 presents the results studying performance persistence in three portfolios with a random set of funds, one year evaluation period, one year holding period, and SIXPRX as market proxy.

Table 11: Placebo Randomised Results (2 years)

	Dependent variable:		
	Top2YP	Middle2YP	Bottom2YP
	(1)	(2)	(3)
Market2Y	0.989***	0.821***	0.924***
	(0.199)	(0.145)	(0.221)
Constant	0.006	0.099*	0.022
	(0.071)	(0.052)	(0.079)
Observations	55	55	55
R^2	0.317	0.378	0.248
Adjusted R^2	0.304	0.366	0.234
Residual Std. Error (df = 53)	0.464	0.337	0.514
F Statistic (df = 1; 53)	24.624***	32.188***	17.520***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 11 presents the results studying performance persistence in three portfolios with a random set of funds, 2 years evaluation period, 2 years holding period, and SIXPRX as market proxy.

Table 12: Placebo Phase 1 Results (1 year)

	Dependent variable:		
	TopYP1	MiddleYP1	BottomYP1
	(1)	(2)	(3)
MarketY	1.120***	1.035***	0.991***
	(0.047)	(0.020)	(0.023)
Constant	0.039***	-0.024***	-0.057***
	(0.011)	(0.005)	(0.005)
Observations	59	59	59
R^2	0.911	0.978	0.970
Adjusted R^2	0.909	0.978	0.969
Residual Std. Error (df = 57)	0.076	0.033	0.038
F Statistic (df = 1; 57)	580.478***	2,585.800***	1,815.928***
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 12 presents the results of phase 1 of the robustness check as defined in 5.2.2, studying performance persistence in the three portfolios with one year evaluation period, one year holding period, and SIXPRX as market proxy.

Table 13: Placebo Phase 2 Results (1 year)

	Dependent variable:		
	TopYP2	MiddleYP2	BottomYP2
	(1)	(2)	(3)
MarketY	1.105***	1.027***	0.997***
	(0.043)	(0.021)	(0.022)
Constant	0.030***	-0.024***	-0.052***
	(0.010)	(0.005)	(0.005)
Observations	59	59	59
R^2	0.922	0.976	0.972
Adjusted R^2	0.921	0.975	0.972
Residual Std. Error (df = 57)	0.070	0.035	0.037
F Statistic (df = 1; 57)	673.912***	2,303.931***	1,982.056***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 13 presents the results of phase 2 of the robustness check as defined in 5.2.3, studying performance persistence in the three portfolios with one year evaluation period, one year holding period, and SIXPRX as market proxy.

Table 14: Placebo Phase 3 Results (1 year)

	Dependent variable:		
	TopYP3	MiddleYP3	BottomYP3
	(1)	(2)	(3)
MarketY	1.085***	1.030***	1.006***
	(0.033)	(0.021)	(0.023)
Constant	0.012	-0.024***	-0.042***
	(0.008)	(0.005)	(0.005)
Observations	59	59	59
R^2	0.949	0.977	0.971
Adjusted R^2	0.948	0.976	0.971
Residual Std. Error (df = 57)	0.055	0.034	0.037
F Statistic (df = 1; 57)	1,057.121***	2,402.921***	1,935.079***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 14 presents the results of phase 3 of the robustness check as defined in 5.2.4, studying performance persistence in the three portfolios with one year evaluation period, one year holding period, and SIXPRX as market proxy.

Table 15: Placebo Phase 4 Results (1 year)

	Dependent variable:		
	TopYP4	MiddleYP4	BottomYP4
	(1)	(2)	(3)
MarketY	1.071***	1.029***	1.016***
	(0.029)	(0.025)	(0.024)
Constant	-0.001	-0.019***	-0.032***
	(0.007)	(0.006)	(0.006)
Observations	59	59	59
R^2	0.959	0.966	0.968
Adjusted R^2	0.958	0.966	0.968
Residual Std. Error (df = 57)	0.048	0.042	0.040
F Statistic (df = 1; 57)	1,330.500***	1,638.368***	1,745.704***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 15 presents the results of phase 4 of the robustness check as defined in 5.2.5, studying performance persistence in the three portfolios with one year evaluation period, one year holding period, and SIXPRX as market proxy.

Table 16: Placebo phase 5 Results (1 year)

	Dependent variable:		
	TopYP5	MiddleYP5	BottomYP5
	(1)	(2)	(3)
MarketY	1.062^{***}	1.053^{***}	1.056^{***}
	(0.029)	(0.029)	(0.029)
Constant	-0.006	-0.013^{*}	-0.018^{***}
	(0.007)	(0.007)	(0.007)
Observations	59	59	59
R^2	0.958	0.960	0.959
Adjusted R^2	0.958	0.959	0.958
Residual Std. Error (df = 57)	0.048	0.047	0.047
F Statistic (df = 1; 57)	$1,308.885^{***}$	$1,358.644^{***}$	$1,332.258^{***}$
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 16 presents the results of phase 5 of the robustness check as defined in 5.2.5, studying performance persistence in the three portfolios with one year evaluation period, one year holding period, and SIXPRX as market proxy.

Table 17: Placebo phase 6 Results (1 year)

	Dependent variable:		
	TopYP6	MiddleYP6	BottomYP6
	(1)	(2)	(3)
MarketY	1.056***	1.056***	1.056***
	(0.031)	(0.031)	(0.031)
Constant	-0.009	-0.009	-0.009
	(0.007)	(0.007)	(0.007)
Observations	59	59	59
R^2	0.952	0.952	0.952
Adjusted R^2	0.951	0.951	0.951
Residual Std. Error (df = 57)	0.051	0.051	0.051
F Statistic (df = 1; 57)	1,136.047***	1,136.047***	1,136.047***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 17 presents the results of phase 6 of the robustness check as defined in 5.2.7, studying performance persistence in the three portfolios with one year evaluation period, one year holding period, and SIXPRX as market proxy.

Table 18: Small Cap funds' performance against non Small Cap funds (1 year)

	Dependent variable:
	Small Cap Y
non Small Cap Y	1.106***
	(0.037)
Constant	0.043***
	(0.008)
Observations	60
R^2	0.938
Adjusted R^2	0.937
Residual Std. Error	0.062 (df = 58)
F Statistic	884.290*** (df = 1; 58)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 18 presents the results studying excess returns of Small Cap funds against non Small Cap funds, as defined in 4.6.

Table 19: Persistence Small Cap (1 year)

	Dependent variable:		
	TopYSmall	MidYSmall	BotYSmall
	(1)	(2)	(3)
MarketY	1.130***	1.019***	0.985***
	(0.051)	(0.020)	(0.023)
Constant	0.034***	-0.024***	-0.051***
	(0.012)	(0.005)	(0.005)
Observations	59	59	59
R^2	0.896	0.978	0.970
Adjusted R^2	0.895	0.978	0.969
Residual Std. Error (df = 57)	0.083	0.033	0.038
F Statistic (df = 1; 57)	493.527***	2,540.624***	1,832.590***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 19 presents the results studying performance persistence in the three portfolios as defined in 4.4 with the fund universe restricted to Small Cap funds as defined in 3.1.1, one year evaluation period and one year holding period, and OMXSGI as market proxy.

Table 20: Persistence Non Small Cap (1 year)

	Dependent variable:		
	TopLarge	MidLarge	BotLarge
	(1)	(2)	(3)
MarketY	1.131***	1.022***	0.974***
	(0.041)	(0.019)	(0.022)
Constant	0.030***	-0.026***	-0.060***
	(0.009)	(0.004)	(0.005)
Observations	59	59	59
R^2	0.931	0.981	0.972
Adjusted R^2	0.930	0.981	0.971
Residual Std. Error (df = 57)	0.067	0.031	0.036
F Statistic (df = 1; 57)	766.870***	2,979.850***	1,946.925***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 20 presents the results studying performance persistence in the three portfolios as defined in 4.4 with the fund universe restricted to non Small Cap funds as defined in 3.1.1, one year evaluation period and one year holding period, and OMXSGI as market proxy.

Table 21: ESG funds' performance against non-ESG funds

	Dependent variable:
	ESG
Non ESG	0.991***
	(0.010)
Constant	-0.010***
	(0.002)
Observations	59
R^2	0.994
Adjusted R^2	0.994
Residual Std. Error	0.017 (df = 57)
F Statistic	9,639.230*** (df = 1; 57)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 21 presents the results studying excess returns of ESG funds against non ESG funds, as defined in 4.6.

Table 22: Persistence ESG (1 year)

	Dependent variable:		
	TopYESG	MidYESG	BotYESG
	(1)	(2)	(3)
MarketY	1.131***	1.023***	0.983***
	(0.053)	(0.020)	(0.023)
Constant	0.036***	-0.023***	-0.052***
	(0.012)	(0.005)	(0.005)
Observations	59	59	59
R^2	0.890	0.978	0.969
Adjusted R^2	0.888	0.978	0.968
Residual Std. Error (df = 57)	0.086	0.033	0.038
F Statistic (df = 1; 57)	460.603***	2,524.934***	1,780.670***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 22 presents the results studying performance persistence in the three portfolios as defined in 4.4 with the fund universe restricted to ESG funds as defined in 3.1.2, one year evaluation period and one year holding period, and OMXSGI as market proxy.

Table 23: Persistence Non ESG (1 year)

	Dependent variable:		
	TopYNonESG	MidYNonESG	BotYNonESG
	(1)	(2)	(3)
MarketY	1.127***	1.044***	0.977***
	(0.049)	(0.022)	(0.027)
Constant	0.045***	-0.025***	-0.062***
	(0.011)	(0.005)	(0.006)
Observations	59	59	59
R^2	0.904	0.976	0.958
Adjusted R^2	0.903	0.975	0.958
Residual Std. Error (df = 57)	0.079	0.036	0.044
F Statistic (df = 1; 57)	539.583***	2,309.172***	1,309.044***
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 23 presents the results studying performance persistence in the three portfolios as defined in 4.4 with the fund universe restricted to non ESG funds as defined in 3.1.2, one year evaluation period and one year holding period, and OMXSGI as market proxy.