The difference in risk adjusted performance between socially responsible and conventional equity mutual funds: Evidence from Sweden

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Abstract:

This thesis aims to study the difference in risk-adjusted performance between socially responsible (SR) and conventional equity mutual funds from a Swedish perspective. The study uses mutual fund data from the time-period January 2010 to January 2020. The performance is measured by using the Single-Index model, Fama-French three factor model, Carhart's four factor model, Sharpe's ratio and Treynor's ratio.

Mutual fund managers that takes socially responsible criteria into consideration limits their investment possibilities. This should, theoretically, reduce the performance of mutual funds. This raises the question whether there exists a difference in performance between SR and conventional mutual funds, which is the fundamental research question of this paper.

The differences in performance is not only studied based on the SR criteria. The potential effects from the mutual funds cap size and age is also included in this study. Furthermore, it includes an analysis on the differences between mutual funds on an individual level. The result suggests that in the ten-year period January 2010 to January 2020, SR mutual funds underperform compared to the conventional mutual funds. However, after February 2015, SR mutual funds overperform in relation to the conventional.

The mutual funds cap size seems to have a minimal effect on the differences in performance, while age seems to have a small effect. More specifically, the result suggest that young SR mutual funds might underperform less than old SR mutual funds. On an individual level, a larger proportion of the SR mutual funds underperform the market compared to the conventional.

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Abbreviations:

Socially Responsible Investments – SRI
Socially Responsible – SR
Sharpe's ratio – Shr
Treynor's ratio – Trr
Capital Asset Pricing Model - CAPM
Small minus Big (factor) – SMB
High minus Low (factor – HML
Momentum (factor) - UMD
Capitalization - Cap

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1. Introduction

1.1 Motivation

Socially responsible investments (SRI) are investments that consider socially responsible (SR) criteria. More specifically, it is the practice to fulfil SR criteria by either excluding or including certain investments (Eurosif, 2018). These criteria are not generally accepted and there exist a variety of definitions from different institutions, (e.g. (Bloomberg, 2013), (Eurosif, 2018) and (Sustainalytics, 2020)). In general, the definitions focus on criteria's relating to corruption, labour relations, arms, ethics, human rights, and the environment.

In Sweden, the interest in SRI has increased for the past decade. In the year 2011, 396 million euros was invested in socially responsible assets, six years later it had increased to 1966 million euros (Statista, 2019). For the past two decades, a variety of pension mutual funds around the world, (e.g. Swedish and Belgian and UK mutual pension funds), are legally obliged to use SRI strategies in their investment policy process (Eurosif, 2018).

In 2018, Eurosif, (a European organization that promotes SRI in Europe), wrote a report about the current state of SRI in Europe. They argue that the financial institutions and investors in Sweden has a developed approach regarding SRI (Eurosif, 2018). According to Bengtsson (2008), Sweden was the first country to introduce a public mutual fund that took SRI into consideration. Furthermore, Sweden was one of the first countries to create a legislation that forces Swedish national pension funds to implement ethical factors in their investment strategies.

The private sector in Sweden is not legally obliged to invest socially responsible. However, mutual funds that claim to be SR are required by law to be transparent with their SRI strategy. According to Eurosif (2018), the regulatory framework for public mutual funds and the transparency legislation has promoted the private sector to take socially responsible factors into consideration. Furthermore, Swedish investment institutions have a common practice to include the United Nations ten principles for responsible investment (Eurosif, 2018).

In Sweden, some investors seem to think that SRI will have a negative impact on the mutual fund performance. Swedish Investment Fund Association (2020b) hired Kantar Sifo Prospera to study how individual investors in Sweden thought of SRI, and how much they implemented it in their own investment policy. They found that 32% of the private investors in Sweden holds at least one socially or environmentally responsible mutual fund in their portfolio. Yet, only 15% of these investors thought it would generate a higher return (Swedish Investment Fund Association, 2020b). The results from this study could suggest that some investors believe that SR criteria will lower the performance of portfolios. However, empirical studies do not necessarily support this belief.

The academic community have shown considerable interest in the research field regarding the differences in performance between SR and conventional mutual funds. However, results from this field of research does not give conclusive results. Revelli and Viviani (2015) did a meta-analysis of this field of research where they included 85 studies made between the years 1972 to 2012. The study concluded that it was neither good nor bad to include SRI strategies in terms of the differences in risk-adjusted performance (Revelli and Viviani, 2015). This study focused on identifying the overall differences in performance between SR and conventional mutual funds. However, it did not focus on specific characteristics that might affect the differences in performance, such as geographical factors and market status.

Bauer et al. (2005) studied differences in performance based on the mutual fund's geographical holdings in the United States. The difference in performance was not significant, but they did find that SR mutual funds were less volatile, (i.e. less risky), than conventional mutual funds. Nofsinger and Varma (2014) studied how market status affected the differences in performance between SR and conventional mutual funds. Their results suggest that SR mutual funds can overperform compared with conventional mutual funds in times of market crisis. These articles illustrate how mutual funds can perform differently depending on the geographical and financial setting.

From a Swedish perspective, Leite et al. (2017) studied the differences in performance between SR and conventional mutual funds in the time period November 2002 to October 2012. The authors claim that they were the first to study the difference in performance between SR and conventional mutual funds from a Swedish perspective. Since this article was published, this thesis has not found any other articles that has studied the differences in performance from a Swedish perspective. It could therefore be interesting to further add to this research field by providing a recent study from a Swedish perspective. Furthermore, the time-period is especially interesting to study because the market was relatively stable, (i.e. market non-crisis).

1.2 Purpose

The purpose of this thesis is to analyse the differences in risk-adjusted performance between Swedish socially responsible and conventional equity mutual funds. The thesis aims to analyse this difference on both an aggregate and individual level, during the ten-year time-period January 2010 to January 2020. Additionally, the thesis aims to examine whether the difference in performance depends on mutual fund cap size, age and market status. To examine this difference, the thesis will use the Single-index model, the Fama-French three factor model, and the Carhart’s four factor model. The thesis will also use Sharpe’s ratio and Treynor’s ratio.

1.3 Research questions

- Is there a difference in the risk-adjusted performance between Swedish socially responsible and conventional equity mutual funds?
- Does the difference in the risk-adjusted performance between the Swedish socially responsible and conventional equity mutual funds depend on the mutual fund characteristics age, cap size, or on the time-period?

1.4 Limitations

This thesis defines the mutual funds as socially responsible (SR) at the time they are screened. As a result, this thesis is limited to assume that the mutual funds have been SR since their inception date. This is because the financial software, Bloomberg Terminal, (Bloomberg Terminal, 2020), did not offer continuous screen data.

The mutual equity funds in this thesis are considered Swedish if they are domiciled in Sweden and holds more than 50% of their assets in Swedish equities. However, the benchmark that is used in the models only contains Swedish equities. This limits the consistency of the model results. For instance, a mutual fund with 51% of its holdings in Sweden is compared to a mutual fund with 95% of the holdings in Sweden. In addition, these mutual funds are simultaneously compared to a benchmark with 100% holdings in Sweden. There is no available benchmark that matches the specific geographical holding composition of the mutual funds in this thesis.

1.5 Contributions

The differences in performance between socially responsible (SR) and conventional mutual funds is a research field that has been studied for a couple of decades. The first article used in the previously mentioned meta-analysis by (Revelli and Viviani, 2015), was published almost five decades by Moskowitz (1972). However, the authors claim that most articles have been published since the 90s. This area of research is well studied, but there is room for a large variety of possible contributions, especially in terms of geographic and time varying factors.

This thesis aims to add to the field of research by focusing on Swedish mutual funds with a majority of their assets in Swedish equities. The thesis focusses on comparing the risk-adjusted performance between SR and conventional Swedish mutual funds, established before January 2010. The performance is studied on both an aggregated and individual level. The chosen time-period January 2010 to February 2020 is characterized by a relatively stable market from a Swedish perspective. Therefore, the thesis also contributes to the field of research by studying how the differences in SR and conventional mutual fund performance is affected by the market status. More specifically, it studies how the differences in performance is affected by a market status which is considered non-crisis from a Swedish perspective.

Furthermore, this thesis provides a cross-sectional analysis where the differences in performance will studied from three specific perspectives. Firstly, the mutual funds are divided based on their age. This provides results for how the differences in performance between SR and conventional mutual funds differ depending on experience. Secondly, the mutual funds are divided based on their cap size. This provides results for how the differences in performance differ depending on the size of stock that the mutual funds invest in. Lastly, the time-period is divided into two separate sub-periods (February 2010 to January 2015 and February 2015 to January 2020). This provides results for how the performance differ depending on time.

1.6 Framework

The overall structure of this thesis takes the form of nine sections, including the introductory Section 1. The remaining part of the thesis proceeds as follows: Section 2 provides a review of the previous literature within this field of research. Section 3 introduces the basics of modern portfolio theory and other theories relating to the socially responsible criteria. Section 4 describes the method behind the Single-index model, Fama-French three factor model and the Carhart's four factor model. This section also includes a description of the performance measurements; Jensen's alpha, Sharpe's ratio and Treynor's ratio. Furthermore, Section 4 includes the testable hypothesises.

Section 5 describes the delimitations, data collection process, portfolio construction and the econometric approach. Section 6 contains the results for the descriptive statistics, OLS-assumption tests, T-tests, and regressions. Section 7 provides a conclusion based on the differences in performance between the socially responsible and conventional mutual funds. The results are compared with previous literature and theory. Section 7 also includes a discussion of future research. The remaining sections contain a list of reference and an appendix.

2. Literature Review

This section starts with a short history of socially responsible investments (SRI) and how it started to be incorporated into mutual funds' investments. The second part of this section provides a literature review of the previously written articles within this field of research.

2.1 Short history of socially responsible investments

The origins of investments that takes ethics into consideration is likely difficult to pinpoint. Religious groups such as the Catholic church have over the past centuries often argued the importance of ethics and religious morals when investing in new projects. In Italy and Spain during the seventieth century, various lenders promoted financial actors to give out interest free loans to poorer parts of the society. In the late 60s and early 70s, the Vietnam War triggered a response from parts of the American public who detested the use of American arms in Vietnam. For example, American university students started to raise awareness of the destruction that American armaments caused in Vietnam. This led to a change in investor sentiment and during this period of unrest the Pax World mutual fund was created. This was the first US socially responsible (SR) mutual fund (Ballestero et al., 2015, 8).

From a Swedish perspective, Bengtsson (2008) argues that the first SR mutual fund was created the in year 1965. The Baptist Church and the Temperance movement created a public ethical investment mutual fund. This mutual fund was not allowed to include producers of firearms, armament, tobacco, or alcohol. In the 90s SRI gained interest because of the increased interest in the environment. One of the most recent increase in SR can according to Joliet and Titova (2018) be related to the events evolving around the great recession in 2007-08. The authors argue that large parts of the American public lost its confidence in the financial industry.

2.2 Previous research

There does not seem to exist a mutual agreement regarding the differences in performance between socially responsible (SR) and conventional mutual funds. Revelli and Viviani (2015), compared 85 empirical studies between 1972 to 2012 within this field of research. The authors concluded that socially responsible investment (SRI) strategies did not affect the performance of an equity portfolio. The result from this meta-analysis might give an overview of this field of research. However, it does not give enough information about the specific characteristics that might affect the performance of mutual funds.

On an aggregate level, Renneboog et al. (2008b) studied the differences in performance between SR and conventional mutual funds between multiple countries. In the time-period January 1991 to December 2003, the overall difference in performance was insignificant, but in Sweden, Japan, Ireland and France, the SR mutual funds underperformed compared to its conventional counterpart.

The performance for the SR and conventional mutual funds is studied for a certain time-period. This time-period can also be separated into different sub-periods which enables the possibility to study time varying differences in performance. Bauer et al. (2005) studied the difference in performance in the time-period 1990 to 2001 in United States (US), United Kingdom, and Germany. The authors also divided the time-period into three sub-periods. Over the entire time-period there was no significant differences in performance. However, the sub-period analysis reported that the difference in performance varied. In the first time-period the conventional mutual funds outperformed the SR, but in the last period, the SR mutual funds performed similar to the conventional. (Bauer et al., 2005) argue that the SR mutual funds might have experienced a period of catching up due to learning.

The performance of mutual funds likely depend on the state of the market, e.g. if the market is in crisis or non-crisis. Nofsinger and Varma (2014) focused on analysing the difference in performance based on the state of the US market in the time-period 2000-2011. The authors found that conventional mutual funds overperforms in relation to SR mutual funds during periods of non-crisis. In periods of crisis, SR mutual funds overperformed compared to the conventional mutual funds. A similar study made in the United Kingdom and France by Syed (2017) found that before and during the great recession, the differences in performance was insignificant.

The geographical focus of mutual funds can also affect the risk-adjusted performance. Leite et al. (2017) studied the differences between SR and conventional mutual fund performance in Sweden during the time-period November 2002 to October 2012. The authors divided the mutual fund sample into three portfolio groups, based on the geographical focus. The mutual funds had the majority of their holdings in either Swedish, European or global assets. The study reported that SR mutual funds with holdings in Sweden and Europe tend to have similar performance to the conventional. However, SR mutual funds investing on a global scale tended to underperform the conventional. Leite et al. (2017) also found that SR mutual funds underperform compared to conventional mutual funds in times of non-crisis, but they had similar performance in times of crisis.

3. Theory

This section presents the theory of modern portfolio selection and discusses how this theory can be applied when analysing the risk-adjusted performance of securities restricted to socially responsible (SR) criteria.

3.1 Modern portfolio theory

The theory of modern portfolio selection is based on the theoretical work of Markowitz (1952). This theory assumes that investors only take expected return and variance into consideration. The investors are assumed to consider the expected return as desirable and variance of return as undesirable. When selecting securities into a portfolio, investors will aim to optimize the risk-adjusted return by choosing the most efficient combination of all securities available. A combination of securities is considered efficient if their expected return is maximized given a fixed level of variance. Or, if their variance of return is minimized given a fixed level of expected return.

Diversification of securities is a key factor for minimizing risks. An investor can diversify and stabilize the portfolio return by spreading securities among multiple industries and sectors. Additionally, to achieve an effective diversification, the securities should preferably correlate as little as possible with each other. For example, if the price of one security falls because of an exogenous shock, other securities might increase in price since these stays unaffected by the shock. The two effects would in this example offset one another, and the combined portfolio return will be unaffected by the exogeneous shock. Diversification can minimize the firm specific risks, but it has limited ability to offset risks that exist in the entire market. Risks that are not possible to remove with diversification are called systematic risks (Bodie et al., 2018, 194 - 195). The systematic risk will be referred to as market risks in this thesis.

The modern portfolio theory implies that investors which restrict their selection of securities will face a limited number of investment options, due to non-financial criteria. This restriction of securities should reduce diversification and will therefore penalize the risk-adjusted performance. Mutual funds that are restricted to socially responsible (SR) criteria would therefore underperform compared to unrestricted and more well-diversified conventional mutual funds. However, reduced diversification capabilities are not the only theoretical aspect in the discussion regarding the differences in performance between SR and conventional mutual funds.

Barnett and Salomon (2006) argue that restricting mutual funds with SR screening criteria will not always have a negative effect on the risk-adjusted performances. The authors claim that the process of screening for SR mutual funds can be beneficial for the mutual fund performance. This is because the SR screening finds securities of better managed and more stable firms. The loss of diversification capabilities can therefore be offset by the overall benefits received from the socially responsible screening.

For example, one type of SR criteria is evolved around the improvement of labour relations. Barnett and Salomon (2006) argue that there is evidence suggesting that improved labour relations enhance a firm’s productivity and profits. This should also improve the financial performance of the firm’s securities. Consequently, a SR mutual fund that invests in this firm’s securities will benefit from this as well.

4.Method

This section presents the method and underlying theory for the different performance measuring models and ratios. It also includes a description of the testable hypothesis.

4.1 Choice of method

This thesis has chosen a quantitative method to analyze the difference in performance between socially responsible (SR) and conventional equity mutual funds. The method of this thesis follows a descriptive and comparative research design. Furthermore, it emphasizes to measure the mutual fund performance in an objectively and statistically manner. To achieve this, the thesis will take use of monthly compounded data of mutual fund returns, market return, the risk-free rate of return and of the three factors: size, value, and momentum.

4.2 Capital asset pricing model

Based on the theory of Markowitz, the authors Sharpe (1964) and Lintner (1965) developed the Capital asset pricing model (CAPM). CAPM is a single factor model which measures the interaction of risk and expected return between securities and the market. In CAPM, the sources of risk for a security is classified into the two the market risk and firm specific risk (Bodie et al., 2018, 277).

4.2.1 Single-index model

The Capital asset pricing model (CAPM) uses a regression to estimate the relationship between the portfolio return and the market. The Single-index model regression is based on CAPM and uses the excess portfolio return and excess market return as variables. The market return can be represented as a broad benchmark of stocks and the Single-index model is expressed with the following regression equation:

$$R_{i(t)} = \alpha_i + \beta_{iERM} ERM_{(t)} + e_{i(t)} \qquad (1)$$

The equation states that the excess return of the portfolio $R_{i(t)}$ is equal to the sum of the intercept, α_i, the excess market return (ERM), the ERM slope coefficient β_{iERM} and the error term $e_{i(t)}$. α_i represent the expected excess portfolio return if the excess market return would have been zero. The slope coefficient, β_{iERM}, describes how sensitive the portfolio return is to the fluctuations in the market. The value of β_{iERM} explains how much the excess portfolio return is estimated to change due to an 1% change in the market factor. The residual of the regression, $e_{i(t)}$, accounts for the firm specific surprises that causes changes in the portfolio return. $e_{i(t)}$ is usually expected to be zero (Bodie et al., 2018, 249).

4.3 Multi factor models

4.3.1 Fama-French three factor model

The Capital asset pricing model (CAPM) is intuitive but have some drawbacks. For example, the model does not empirically exhibit the entire relationship regarding the performance of securities (Fama and French, 2004). Fama and French (2004) argue that CAPM has more explanatory power and empirical support when adding the size factor (SMB) and value factor (HML). When adding these factors, the model is often referred to as the Fama-French three factor model and is considered better suited for measuring portfolio performance. The Fama-French three factor model is expressed with the following regression equation:

$$R_{i(t)} = \alpha_i + \beta_{iERM} ERM_{(t)} + \beta_{iSMB} SMB_{(t)} + \beta_{iHML} HML_{(t)} + e_{i(t)} \qquad (2)$$

The equation states that the excess portfolio return $R_{i(t)}$, is equal to the sum of the intercept α_i, the variables excess market return (ERM), SMB and HML and their slope coefficients β_{iERM}, β_{iSMB} , β_{iHML} . Furthermore, it includes the error term $e_{i(t)}$.

The size factor, $SMB_{(t)}$, captures the effect of the excess return of the markets small-cap-stock portfolio minus the big-stock portfolio. β_{iSMB} measures how sensitive the excess portfolio return is to the size factor (Bodie et al., 2018, 325). A negative β_{iSMB} implies that the portfolio is more sensitive to changes in large stocks. While a positive β_{iSMB} implies that the portfolio is more sensitive to changes in small stocks (Fama and French, 1993).

The value factor, $HML_{(t)}$, captures the excess return of the market portfolio of value stocks (i.e. stocks with high book-to-market ratio) minus the market portfolio of growth stocks (i.e. stocks with low book-to-market ratio). β_{iHML} measures how sensitive the excess portfolio return is to the value factor (Bodie et al., 2018, 325). A negative β_{iHML} implies that the portfolio is more sensitive to growth stocks. While a positive β_{iHML} implies that the portfolio is more sensitive to value stocks (Fama and French, 1993).

4.3.2 Carhart's four factor model

To increase the explanatory power and explain the behaviour of securities even further, Carhart (1997) added the momentum factor. The momentum factor enables the model to take past security performance into consideration. When adding the fourth factor, the model is often referred to as Carhart's four factor model. Frazzini and Pedersen (2014) denotes the momentum factor as up minus down (UMD). The model is expressed with the following regression equation:

$$R_{i(t)} = \alpha_i + \beta_{iERM}ERM_{(t)} + \beta_{iSMB}SMB_{(t)} + \beta_{iHML}HML_{(t)} + \beta_{iUMD}UMD_{(t)} + \varepsilon_{i(t)} \quad (3)$$

The equation is similar to the Fama-French three factor model. The additional variable $UMD_{(t)}$ captures the effect of securities having a persistent return lasting over several months (Carhart, 1997, Bodie et al., 2018, 413). This persistence continues for time-periods longer than what can be explained by the market factor or other known factors (Jegadeesh and Titman, 1993). The coefficient β_{iUMD} measures how sensitive the excess portfolio return is to the momentum factor. A negative β_{iUMD} implies that the portfolio is more sensitive to stocks which exhibits a negative return persistency. While a positive β_{iUMD} implies that the portfolio is more sensitive to stocks which exhibits a positive return persistency (Carhart, 1997).

4.4 Measuring the risk-adjusted performance

4.4.1 Jensen's alpha

The intercept, α_i, (often referred to as Jensen's alpha), is used as an important variable when evaluating the risk-adjusted performance. More specifically, it measures the performance of individual securities or of a portfolio with multiple securities. Fama and French (2004) describes Jensen's alpha as a variable that exhibit the abnormal portfolio performance.

Alpha illustrates, according to Jensen (1968), the investors predictive ability of predicting securities prices. A positive/negative alpha implies that the investor has a superior/inferior ability to predict security prices compared to the market. Investors will additionally, given this ability, outperform/underperform compared to the market.

Alpha can also be used to evaluate how attractive securities or portfolios are compared to each other. If portfolio A has a higher alpha than portfolio B, then portfolio A predicts security prices better than portfolio B. Portfolio A is then overperforming portfolio B and should therefore be considered more attractive for investors to hold (Bodie et al., 2018, 815).

4.4.2 Sharpe's ratio

Sharpe's ratio measures a portfolios risk-adjusted return in terms of expected excess return and total portfolio risk. Sharpe's ratio (Shr) is calculated by the following formula:

$$Shr_p = \frac{E(r_P)-r_f}{\sigma_p} \qquad (4)$$

The numerator $E(r_P) - r_f$ represents the expected excess portfolio return, calculated as the expected return minus the risk-free rate. σ_p represent the portfolio standard deviation, also referred to as the total portfolio risk. Sharp's ratio can be used as a relative measurement of the risk-adjusted return in terms of excess return to the total portfolio risk between different portfolios. If portfolio A has a higher Sharpe's ratio than portfolio B, it implies that portfolio A generates a higher excess return given the total portfolio risk (Bodie et al., 2018, 815).

4.4.3 Treynor's ratio

Treynor's ratio measures a portfolios risk-adjusted return in terms of expected excess return and market risk. Treynor's ratio is calculated by the following formula:

$$Trr_p = \frac{E(r_p) - r_f}{\beta_{iERM}} \qquad (5)$$

As in the previous formula, $E(r_p) - r_f$ represents the excess expected return. The variable β_{iERM} represents the market risk in terms of how sensitive the portfolio return is to fluctuations in the market. Treynor's ratio can be used as a relative measurement of the risk-adjusted return terms of the expected excess return and market risk. If portfolio A has a higher Treynor's ratio then portfolio B, it implies that portfolio A generates a higher excess return given the level of market risk exposure (Bodie et al., 2018, 817).

4.5 Testable hypothesis

The risk-adjusted performance of the mutual funds will be measured using the intercept alpha (α). Alpha is retrieved from the model regressions of the Single-index model, the Fama-French three factor model and Carhart's four factor model. Sharpe's ratio (Shr) and Treynor's ratio (Trr) will also be used as an additional measurement of mutual fund performance. By using these measures, the research question of this thesis can be examined against the following three sets of statistical hypothesizes:

$$H_0(\alpha): \alpha_{Dif.} = 0$$
$$H_1(\alpha): \alpha_{Dif.} \neq 0$$

$$H_0(Shr): Shr_{SR} = Shr_{Con.}$$
$$H_1(Shr): Shr_{SR} < Shr_{Con.}$$

$$H_0(Trr): Trr_{SR} = Trr_{Con.}$$
$$H_1(Trr): Trr_{SR} < Trr_{Con.}$$

The first set of hypothesises examines whether there is a difference in alpha between the socially responsible (SR) and conventional portfolios. $H_0(\alpha): \alpha_{Dif.} = 0$ states that there is no difference in alpha and $H_1(\alpha): \alpha_{Dif.} \neq 0$ states that there is a difference.

The second set of hypothesises examines whether the Sharpe's ratio for the SR mutual funds is equal to or lower than for the conventional mutual funds. $H_0(Shr): Shr_{SR} = Shr_{Con.}$ states that there is no difference in Sharpe's ratio and $H_1(Shr): Shr_{SR} < Shr_{Con.}$ states that the Sharpe's ratio is lower for the SR mutual funds.

The third set of hypothesises examines whether the Treynor's ratio for the SR mutual funds is equal to or lower than for the conventional mutual funds. $H_0(Trr): Trr_{SR} = Trr_{Con.}$ States that there is no difference in Treynor's ratio. $H_1(Trr): Trr_{SR} < Trr_{Con.}$ states that the Treynor's ratio is lower for the SR mutual funds. All sets of hypotheses are tested at the significance level of 10%, 5% and 1%.

5. Data

This section is divided into eight sub sections. The first subsection describes the delimitations of this thesis. Subsection 2 and 3 describe the mutual fund sample, data collection process and portfolio construction. Subsection 4 describes the construction of the performance measuring regression models and ratios. The next three sub sections, (5, 6 and 7), describes the factors and variables that is related to the regressions of the performance measuring models and ratios. The last sub sections provide a discussion about missing values.

5.1 Delimitations

This thesis focused on actively managed equity mutual funds that was both domiciled in Sweden and invested more than 50 % of its asset in Swedish equities. The thesis did not study mutual funds with other geographical holdings. Other types of funds such as passively managed index funds, exchange-traded funds, or hedge funds were not studied either.

This thesis focused mainly on the mutual fund attribute *socially responsible*. Other potential attributes, (also called screenings), such as the *environment, social and governance* (ESG) or *environmentally friendly,* was not used as a criterion in the data collection process. However, the overlap among these attributes and the *socially responsible* attribute was found to be substantial.

This thesis compared how the funds cap size and age effects the differences in performance between SR and conventional mutual funds. For example, the differences between young SR and young conventional. The thesis did not compare how the mutual fund cap size and age effects the performance for SR and conventional mutual funds individually. In other words, how e.g. young SR mutual funds perform compared to old SR mutual funds. The comparison approach used in this thesis has rarely been studied in the previous literature.

The thesis was restricted to the time-period of January 2010 to January 2020 with focus on mutual funds established before January 2010. This restriction limits the possibility to draw conclusions about the current mutual fund population. However, the analysis of difference in risk adjusted performance between the Swedish SR and conventional mutual can still be considered relatively trustworthy within a certain sub-population. Namely, the sub-population of Swedish mutual funds established before January 2010.

The size factor, value factor and momentum factor in the multifactor model regressions, (see equation (2) and (3)), were in this thesis used as control variables to minimize the omitted variable bias. The factors were therefore not of primary interest in the analysis of the differences in performance between socially responsible and conventional mutual funds.

5.2 Sample construction

This thesis used the public mutual fund screener Bloomberg Terminal, (Bloomberg Terminal, 2020), to collect the mutual fund data sample. The Bloomberg Terminal has different types of criteria's, (text in italic below). If a mutual fund did not fulfil the chosen criteria, they were excluded from the sample. In this thesis, the following criteria was used in the data collection process:

- *Fund asset class focus:* equity
- *Fund type*: fund of fund, closed end mutual fund or open-end mutual fund.
- *Country of domicile*: Sweden
- *Currency*: Swedish krona (SEK)
- *Fund status*: inactive, liquidated, acquired or active
- *General attribute:* socially responsible

Funds, (formally referred to as "investment companies" or "investment mutual funds"), can be described as financial intermediates that collect capital from individual investors. The financial intermediates then invest this capital in a wide range of different securities. One of the specific types of investment funds is the equity mutual funds which primarily invest in stocks (Bodie et al., 2018, 91, 95 - 96). The mutual funds in this sample were classified as equity by Bloomberg Terminal if they had 80% or more of its total capital invested in stocks (Bloomberg, 2013).

The criteria: *fund asset class focus:* equity, excluded other mutual fund classes, such as exchange-traded mutual funds and hedge mutual funds. The criteria *Fund type:* allowed the mutual funds to be either fund of fund, closed end mutual fund or open-end mutual fund. The survivorship bias was managed by including all funds, regardless of whether they were classified as inactive, liquidated, acquired or active. The mutual funds were additionally classified as *socially responsible* by Bloomberg Terminal if they invested restrictively in stocks of companies that acted in accordance to socially responsible standards (Bloomberg, 2013).

The passively managed index mutual funds were excluded manually from the sample. These mutual funds were identified in two ways. They were either classified as such by Bloomberg Terminal or clearly stated that the mutual fund was following an index in their key investment information documents (KIID: s). Mutual funds which held less than 50% of their assets in Swedish equities and was established after January 2010 were also excluded from the sample.

The final sample of mutual funds consisted of 109 Swedish equity mutual funds. All the mutual funds were actively managed, had most of their assets in Swedish equities, were domiciled in Sweden, established before 2010 and used SEK as currency. 19 of these mutual funds were classified as *socially responsible* by Bloomberg Terminal. According to all the socially responsible (SR) mutual funds KIID: s, ethical and/or social considerations was included in their investment strategies.

5.3 Portfolio construction

This thesis constructed multiple portfolios to study the performance between socially responsible (SR) and conventional mutual funds. It uses these portfolios for a main analysis were the mutual funds were divided into three main portfolios. Furthermore, the thesis includes a cross-sectional analysis. The portfolios for this analysis were divided based on their age, cap size and sub-period. The construction of these portfolios is discussed in section 5.3.1 – 5.3.4, but first, certain overall aspects of the portfolio construction needs to be mentioned.

The portfolios were constructed to be equally weighted. The survivorship bias was managed for by weighting each mutual fund based on their active time-period. Meaning that once a mutual fund became inactive, its weight and proportional contribution to the portfolio was excluded as new weights were equally redistributed for the remaining number of mutual funds.

The monthly mutual fund return was calculated with the following formula: $return(t_1) = \frac{NAV(t_1)-NAV(t_0)}{NAV(t_0)}$. $NAV(t_0)$ represented the net asset value (NAV) of the mutual fund at the first observation in the period. $NAV(t_1)$ represented the NAV of the same mutual fund one month later. The NAV for each mutual fund was retrieved form Bloomberg Terminal. The portfolio returns were calculated as the aggregated sum of each individual mutual funds monthly return multiplied by its weight.

The standard deviation (σ_p) of the monthly portfolio return was calculated by the following formula: $\sigma_p = \sqrt{\frac{\sum(r_t-r_{avg})^2}{n-1}}$. The variable r_t represents the equally weighted portfolio returns per month and r_{avg} was the average monthly portfolio return. This calculation of the standard deviation assumes that the data follows a normal probability distribution (Bodie et al., 2018, 132). The data of the mutual fund returns in this thesis could be considered as normally distributed by looking at figure A in the Appendix.

5.3.1 Main Portfolio construction

Three portfolios were constructed for the main analysis. The first portfolio included all funds that had fulfilled the Bloomberg *socially responsible* (SR) criteria. It will be referred to as the SR portfolio in this thesis. The second portfolio consisted of the remaining mutual fund sample and will be referred to as the conventional portfolio. The third portfolio represents the difference between the SR and conventional portfolio and will be referred to as the difference portfolio. The difference portfolio was constructed by subtracting the conventional portfolio's monthly return from the SR portfolio's monthly return. This method to divide the mutual funds into three separate portfolios will be used for the age, cap-size and sub-period portfolios as well.

5.3.2 Age portfolio construction

The mutual funds were divided into groups based on their inception date which was collected with the Bloomberg Terminal. This date was used to divide socially responsible (SR) and conventional mutual funds separately into the two age groups: young and old.

The SR funds were considered old if they, before January 2010, had been active for more than 11.4 years. The mutual funds were considered young if they had been active for less than 11.4 years. The number of 11.4 years was calculated as the average number of years between the period of January 2010 and the inception date of each mutual fund.

5.3.3 Cap size portfolio construction

The mutual funds were divided into groups based on their value of market capitalization. This value was gathered using the Bloomberg Terminal. Three different cap size groups were created; small-cap, mid-cap and large-cap.

The mutual funds were considered small-cap if their average market capitalization was below the 33rd percentile. The mutual funds were considered mid-cap if they had a market capitalization above the 33rd percentile and below the 66th percentile. Lastly, the mutual funds were considered large-cap if their market capitalization was above the 66th percentile. The mutual funds were additionally considered large-cap if their market capitalization was above the 66th percentile.

The percentiles were calculated individually for the conventional and SR mutual funds. The average market capitalization value of the SR and conventional 33rd percentile (calculated in million SEK), were 119 937 and 142 287, respectively. The average market capitalization value of the SR and conventional 66th percentile (calculated in million SEK), were 177 000 and 181 491, respectively. The SR and conventional mutual funds were divided into equally distributed percentiles, to ensure that the portfolios could be consistently comparable with each other.

5.3.4 Sub-period portfolio construction

The sub-period portfolios were created by dividing the time-period into two separate sub-period. To achieve this, the monthly returns of the socially responsible, conventional and difference portfolio was divided into the sub-periods; February 2010 to January 2015 and February 2015 to January 2020.

5.4 Regressions

The Single-index model, Fama-French three factor model and Carhart four factor model, (which are described in section 4), will be used to construct regressions. The excess portfolio returns, ($R_{i(t)}$), of the conventional, socially responsible (SR) and difference portfolio was used as the dependent variable for the regressions in the main and cross-sectional analysis. $R_{i(t)}$ was calculated by subtracting the monthly risk-free rate from respective monthly portfolio return by using the following formula: $R_{i(t)} = r_{i(t)} - r_{f(t)}$. $r_{i(t)}$ is the return for the SR, conventional and difference portfolio, and $r_{i(t)}$ is the risk-free rate.

The excess market return (ERM), size factor (SMB), value factor (HML) and the momentum factor (UMD) was used as independent variables in both the main and cross-sectional analysis. To analyze how these variables effected $R_{i(t)}$, certain regressions needed to be estimated.

5.4.1 Main portfolio regressions

The regressions in the main analysis was estimated in accordance with the Capital asset pricing model, (equation (1)), Fama-French four factor model, (equation (2)), and Carhart's four factor model, (equation (3)). Stata, (StataCorp, 2019), was used to estimate the regressions.

5.4.2 Cross-sectional portfolio regressions

The excess portfolio returns of the conventional, SR and difference portfolios were divided by age, cap size and time. These were than used as the dependent variables for the regressions in the cross-sectional analysis. The regressions in the cross-sectional analysis was estimated in accordance with Carhart's four factor model, (equation (3)). Stata, (StataCorp, 2019), was used to estimate the regressions.

5.4.3 Individual mutual fund regressions

The excess return of each mutual fund was used as the dependent variable in the individual mutual fund analysis. As the excess portfolio return, the excess mutual fund return was calculated by subtracting the monthly risk-free rate from respective monthly mutual fund return. The regressions in the individual mutual fund analysis was estimated in accordance with the Capital asset pricing model, (equation (1)), Fama-French four factor model, (equation (2)), and Carhart's four factor model (equation (3)). Statsmodels, (Seabold and Perktold, 2010), was used to estimate the individual fund regressions.

5.5 Benchmark

The Single-index model, Fama-French three factor model and Carhart's four factor model all used the excess market return (ERM) as an independent variable in their regressions. ERM is calculated by subtracting the risk free rate from the market return by using the following formula: $ERM_{(t)} = r_{M(t)} - r_{f(t)}$ where $r_{M(t)}$ is the market return and $r_{f(t)}$ is the risk-free rate.

The benchmark that was used in this thesis to represent the Swedish market return was the Six Return Index (SIXRX). This benchmark was chosen for three main reasons: Firstly, SIXRX is an index that consist of all shares traded on the Stockholm Stock Exchange. The index can therefore be used as a suitable approximation of the joint activities in the Swedish stock market. Secondly, the SIXRX is calculated with dividends included (Swedish Investment Fund Association, 2020a). This was an important feature since the market return was compared with the mutual fund net asset value (NAV) return, which included dividends. Lastly, many of the mutual funds KIID: s stated that they already used SIXRX as a sell chosen comparison index.

5.6 Risk-free rate

The rate used to represent the Swedish risk-free rate in this thesis was the Swedish one-month treasury bill (SSVX1M). This risk-free rate was retrieved from Riksbanken (2020), and was originally denominated as a monthly percent rate. To make the risk-free rate comparable to the mutual fund and market return, the risk-free rate was recalculated by using the following formula: $r_{f(t)} = \frac{SSVX1M_{(t)}}{100}$, where $r_{f(t)}$ represented the monthly compounded risk-free rate, stated in hundredths.

5.7 Factor loading data

The size factor (SMB), value factor (HML) and momentum factor (UMD) are found to empirically affect the excess return of assets (Fama and French, 1993). These factors were therefore used as control variables in the regressions of Fama-French three factor model and Carhart's four factor model to avoid omitted variable bias. SMB, HML and UMD were all collected from AQR (2020). The factors were available for 24 different national equity markets with the Swedish equity market included. The factor values were monthly compounded and stated in hundredths (AQR, 2020).

5.8 Missing values

The risk-free rate encountered one missing observation for May 2019. This observation was replaced by the risk-free rate of -0.3957 which was the average risk-free rate of April 2019 (-0.40) and June 2019 (-0.39). 11 mutual funds, (five SR and six conventional mutual funds), encountered missing data for the average market capitalization. These mutual funds were excluded from the cap size grouped portfolios.

6. Empirical results

This section is divided into four subsections. The first section presents and discusses the descriptive statistics for the socially responsible (SR) and conventional portfolios. The second section presents the results for the heteroscedasticity, autocorrelation, and multicollinearity tests. The third section presents the results from the regressions for the main and cross-sectional mutual fund performance. Furthermore, it includes the results for the t-test between the ratios and the results for the individual mutual fund regressions. In the last section, the results are summarized and compared.

6.1 Descriptive statistics

Table 1 provides a summary of the descriptive statistics for the mutual fund monthly return data. The descriptive statistics reports the main characteristics of the mutual fund data in terms of return, risk, number of mutual funds, age, and average market capitalization. In addition, these statistics can also be used to detect survivorship bias and outliers.

The descriptive statistics in Table 1, reports that the difference in return and risk between the socially responsible (SR) and conventional portfolio is relatively small. The SR portfolio has a slightly lower average monthly return and a slightly higher average monthly risk. The median return is higher than the average return for both the SR and conventional portfolio. However, the difference in median return between the two portfolios is quite small, and again slightly lower for the SR portfolio. The maximum and minimum return for the two portfolios is quite similar. This indicates that the data is free from outliers, and the potential problems of bias caused by outliers is therefore small. The percentage of inactive mutual funds and the average age in years are quite similar for both portfolios. The average market capitalization is slightly smaller for the SR portfolio compared to the conventional portfolio.

Survivorship bias appears when the performance of mutual funds is estimated only on currently existing mutual funds. More specifically, it appears when the performance is only estimated on mutual funds which have survived. One complication in presence of survivorship bias is that the results becomes positively skewed. This is because the currently existing mutual funds usually survives due to superior risk-adjusted performance as other non-surviving mutual funds disappeared due to inferior performance (Brown et al., 1992). The data in this thesis is found to encounter a tendency for survivorship bias. This is because the average return for all mutual funds is lower compared to the average return when inactive mutual funds are excluded. This bias is managed by consistently using the returns for all mutual funds with the inactive mutual funds included.

Table 1: Descriptive statistics for mutual fund sample

This table reports the descriptive statistics for the SR and conventional portfolios. Furthermore, the table reports the difference in descriptive statistics between the two portfolios. It reports this in terms of mean return (inactive mutual funds included), mean return (inactive funds excluded), the median return, maximum and minimum return, Standard deviation (risk), number of total mutual funds, number of inactive mutual funds, percentage of inactive mutual funds, mean age (years) and mean market capitalization. Microsoft Excel, (Microsoft Corporation, 2019), was used to estimate these statistics.

Variable	SR Portfolio	Con. Portfolio	Difference
Mean return (inactive included)	0.0097	0.0103	-0.0006
Mean return (inactive excluded)	0.0101	0.0119	-0.0018
Median return	0.0133	0.0135	-0.0002
Max	0.1094	0.1055	0.0039
Min	-0.1039	-0.1023	-0.0016
Standard deviation (risk)	0.0405	0.0392	0.0013
Number of mutual funds	19	90	-71
Number of inactive mutual funds	10	40	-30
Percentage of inactive mutual funds	53%	44%	8%
Mean age (years)	11.7	11.4	0.3
Mean market cap (million SEK)	149 434	151 258	-1 824

Table 2 reports the results for the difference in variance of return between the SR and conventional portfolio. This difference is tested by using a F-test. The p-value when testing for unequal variance is equal to 0.3693 and therefore insignificant. These results show that the null hypothesis, assuming equal variance, cannot be rejected. This means that there is no significant difference in the variance between the SR and conventional portfolio. The results from the descriptive statistics suggest that the data is sufficiently equally distributed, (see Appendix A for a graphic representation).

Table 2: Results for the F-test between SR and conventional portfolios

This table reports the F-test results for the SR and conventional portfolios. The F-test testes for differences in variance. The variables reported are the mean return, variance, number of observations (Obs.) and degrees of freedom (Df), p-value and critical value. The test has a null hypothesis which assumes equal variance and an alternative hypothesis testing for unequal variance. Microsoft Excel, (Microsoft Corporation, 2019), was used to estimate this F-test.

Variable	SR Portfolio	Con. Portfolio
Mean return	0.0097	0.0103
Variance	0.0016	0.0015
Obs.	120	120
Df	119	119
P-value	0.3693	
Critical value	1.3536	

6.2 Statistical analysis of OLS-assumptions

6.2.1 Test for heteroscedasticity

This thesis uses the Breusch-Pagan's, (Breusch and Pagan, 1979) and White's, (White, 1980), test to detect heteroscedasticity in the sample data. Heteroscedasticity appears when the variance of the error term is changing given the different values for the explanatory variables. Thus, the variance of the error term is not the same for all observations. In presence of heteroscedasticity the estimators of the regression are biased, so the significance and test statistics cannot be trusted (Jaggia and Kelly, 2016, 478 - 479).

The White's and Breusch-Pagan test were estimated on the main portfolio regressions. The regressions for the Single-index model, Fama-French four factor model and Carhart four factor model can be observed in Table 3: Panel A, B and C. The tests were also estimated on the cross-sectional portfolios divided by age and cap size in Panel D and E. The portfolio regressions are tested for heteroscedasticity with the null hypothesis $H_0: Homoskedasticity$ for the White's test and $H_0: Constant\ variance$ for the Breusch-Pagan's test.

In Panel A: Table 3 the p-value of the White's test for the Single-index model difference portfolio is (0,0937). The p-value in the Breusch-Pagan test for the same portfolio is (0,1200). These results imply that the null hypothesises assuming homoscedasticity and/or constant variance can be marginally rejected. Thus, there might exist some tendency for heteroskedasticity.

Panel B: Table 3 reports the p-values of the White's test for the Fama-French three factor model. The socially responsible (SR) and conventional portfolio p-values are significant at the 1% level ($p_{SR} = 0.0069$ and $p_{Con.} = 0.0098$). The p-values in the Breusch-Pagan test for the same portfolios are marginally significant ($p_{SR} = 0.0189$ and $p_{Con.} = 0.0508$). These results imply that the null hypothesises assuming homoscedasticity and/or constant variance can be rejected. This means that there exists heteroskedasticity in the data for the Fama-French three factor model.

Panel C: Table 3 reports the p-values of the White's test for Carhart four factor model. The SR, conventional and difference portfolios p-values are significant at the 1% level ($p_{SR} = 0.0076$, $p_{Con.} = 0.0042$, and $p_{Dif.} = 0{,}0065$). The p-values in the Breusch-Pagan test for the same portfolios are significant on the 5% level ($p_{SR} = 0.0285$, $p_{Con.} = 0.0420$, and $p_{Dif.} = 0{,}0282$). These results imply that that the null hypothesises assuming homoscedasticity and/or constant variance can be rejected. This means that there exists heteroskedasticity in the data for the Carhart four factor model.

Panel D and Panel E: Table 3 reports the p-values of the White's test for the cross-sectional analysis which is only estimated with the Carhart four factor model. The p-values are marginally significant for most of the portfolios divided by age and cap size. These results imply that that the null hypothesises, assuming homoscedasticity and/or constant variance, can be rejected. Thus, there exists heteroskedasticity in the data for most of Carhart's four factor models cross-sectional portfolios as well.

Table 3: Test results for heteroscedasticity

This table reports the results for the White's test for heteroskedasticity with $H_0\colon Homoskedasticity$, Breusch-Pagan's test for heteroskedasticity with $H_0\colon Constant\ variance$. For the White's test, the results reported is the chi-square (chi^2), degrees of freedom (df), and the p-value (p). For the Breusch-Pagan test, the results reported is the chi-square (chi^2) and p-value (p). The table reports test results for the main SR, conventional and difference portfolio regressed with equation (1) in Panel A, equation (2) in Panel B, and equation (3) in Panel C. The table also reports test result for the cross-sectional portfolios divided by age (young and old) in Panel D and cap size (small-cap, mid-cap and large-cap) in Panel E. Stata, (StataCorp, 2019), was used to estimate these tests.

Panel A: Single-index model: Main portfolio					
Portfolios	White's test			Breusch-Pagan test	
	chi^2	df	p	chi^2	p
SR	0.94	2	0.6253	0.42	0.5187
Con.	0.26	2	0.8790	0.20	0.6574
Dif.	4.74	2	0.0937	3.42	0.1200
Panel B: Fama-French three factor model: Main portfolio					
Portfolios	White's test			Breusch-Pagan test	
	chi^2	df	p	chi^2	p
SR	22.69	9	0.0069	9.96	0.0189
Con.	21.71	9	0.0098	7.78	0.0508
Dif.	13.58	9	0.1379	3.12	0.3731
Panel C: Carhart four factor model: Main portfolio					
Portfolios	White's test			Breusch-Pagan test	
	chi^2	df	p	chi^2	p
SR	30.02	14	0.0076	10.83	0.0285
Con.	31.85	14	0.0042	9.91	0.0420
Dif.	30.51	14	0.0065	10.86	0.0282
Panel D: Carhart four factor model: Cross-sectional portfolios divided by age					
Portfolios	White's test			Breusch-Pagan test	
	chi^2	df	p	chi^2	p
Old SR	46.55	14	0.0000	20.59	0.0004
Old Con.	29.64	14	0.0086	7.33	0.1196
Old Dif.	28.43	14	0.0125	13.98	0.0074
Young SR	22.23	14	0.0740	5.93	0.2048
Young Con.	18.90	14	0.1688	5.13	0.2746
Young Dif.	23.95	14	0.0465	5.03	0.2840
Panel E: Carhart four factor model: Cross-sectional portfolios divided by cap size					
Portfolios	White's test			Breusch-Pagan test	
	chi^2	df	p	chi^2	p
Small-cap SR	12.40	14	0.5746	2.19	0.7016
Small-cap Con.	17.59	14	0.2261	2.82	0.5889
Small-cap Dif.	14.90	14	0.3848	4.66	0.3244
Mid-cap SR	16.42	14	0.2883	16.07	0.0029
Mid-cap Con.	20.99	14	0.1018	11.31	0.0233
Mid-cap Dif.	22.04	14	0.0777	10.00	0.0404
Large-cap SR	28.36	14	0.0128	8.14	0.0867
Large-cap Con.	40.31	14	0.0002	12.22	0.0158
Large-cap Dif.	28.93	14	0.0107	12.60	0.0134

6.2.2 Test for autocorrelation

The thesis uses the Breusch-Godfrey's LM test, (Breusch, 1978, Godfrey, 1978), to detect autocorrelation. Autocorrelation appears when variables are strongly correlated with time dependent activities (Jaggia and Kelly, 2016, 480). The variables in this thesis are constructed as time series data, (meaning that the individual variables retrieved multiple observations over time). It is therefore important to test for autocorrelation in the error term. In presence of autocorrelation, repeated observations are not independent of each other. Jaggia and Kelly (2016) argues that this causes the standard errors of the regression to become biased and the test statistics cannot be trusted (480).

The Breusch-Godfrey's LM tests were estimated on the main portfolio regressions with 1- and 2-months lags. The regressions for the Single-index model, Fama-French four factor model and Carhart four factor model can be observed in Table 4: Panel A, B and C. The tests were also estimated on the cross-sectional portfolios divided by age and cap size in Panel D and E. The portfolio regressions are tested for autocorrelation with the null hypothesis $H_0\text{: }No\ serial\ correlation$.

Panel A: Table 4 reports the p-values of the Breusch-Godfrey's LM test, for the Single-index model. The socially responsible (SR) and difference portfolio are significant at the 1% level using one and two months lag ($p_{SR,1} = 0.0005$, $p_{SR,2} = 0{,}0004$ and $p_{Dif.,1} = 0{,}0000$, $p_{Dif.,2} = 0{,}0000$). The p-values for the Breusch-Godfrey's LM test are also strongly significant for the SR and difference portfolios, when using the Fama-French three factor model, (see Panel B: Table 4), and Carhart's four factor model, (see Panel C: Table 4). These results show that the null hypothesis assuming no serial correlation can be rejected. Thus, there is a strong presence of autocorrelation in the data, especially for the SR and difference portfolio.

Panel D and Panel E: Table 4 reports the p-values of the Breusch-Godfrey's LM test, for the cross-sectional analysis. The p-values are marginally significant for most portfolios divided by age and cap size. These results imply that that the null hypothesises, assuming no serial correlation, can be rejected. Thus, there is a strong presence of autocorrelation in the data for most of the portfolios divided by cap size and age.

The biasedness caused by heteroskedasticity and autocorrelation is corrected for in the portfolio regressions by using Newey-West standard errors. The biasedness for the individual mutual fund regressions is corrected for by using heteroscedastic and autocorrelation correcting (HAC) standard errors.

Table 4: Test results for autocorrelation

This table reports the results for the Breusch-Godfrey's LM test for autocorrelation with $H_0\!: No\ serial\ correlation$ tested for 1 and 2 months lag. The results reported in the table are the chi-square (chi^2), degrees of freedom (df), and the p-value (p). The table reports test results for the main SR, conventional and difference portfolio regressed with equation (1) in Panel A, equation (2) in Panel B, and equation (3) in Panel C. The table also reports test result for the cross-sectional portfolios divided by age (young and old) in Panel D and cap size (small-cap, mid-cap and large-cap) in Panel E. Stata, (StataCorp, 2019), was used to estimate these tests.

Panel A: Single Index model						
Portfolios	Breusch-Godfrey test lag (1)			Breusch-Godfrey test lag (2)		
	chi^2	df	p	chi^2	df	p
SR	11.99	1	0.0005	15.72	2	0.0004
Con.	2.73	1	0.0985	2.73	2	0.2549
Dif.	61.40	1	0.0000	71.40	2	0.0000
Panel B: Fama-French three factor model						
Portfolios	Breusch-Godfrey test lag (1)			Breusch-Godfrey test lag (2)		
	chi^2	df	p	chi^2	df	p
SR	10.50	1	0.0012	12.79	2	0.0017
Con.	1.10	1	0.2953	2.41	2	0.2999
Dif.	65.97	1	0.0000	76.22	2	0.0000
Panel C: Carhart four factor model						
Portfolios	Breusch-Godfrey test lag (1)			Breusch-Godfrey test lag (2)		
	chi^2	df	p	chi^2	df	p
SR	10.50	1	0.0012	13.02	2	0.0015
Con.	1.41	1	0.2350	2.69	2	0.2606
Dif.	65.91	1	0.0000	76.35	2	0.0000
Panel D: Carhart four factor model: Cross-sectional portfolios divided by age						
Portfolios	Breusch-Godfrey test lag (1)			Breusch-Godfrey test lag (2)		
	chi^2	df	p	chi^2	df	p
Old SR	14.09	1	0.0002	18.18	2	0.0001
Old Con.	1.35	1	0.2454	1.74	2	0.4189
Old Dif.	33.20	1	0.0000	46.31	2	0.0000
Young SR	16.29	1	0.0001	32.03	2	0.0000
Young Con.	5.68	1	0.0172	5.97	2	0.0505
Young Dif.	109.1	1	0.0000	111.7	2	0.0000
Panel E: Carhart four factor model: Cross-sectional portfolios divided by cap size						
Portfolios	Breusch-Godfrey test lag (1)			Breusch-Godfrey test lag (2)		
	chi^2	df	p	chi^2	df	p
Small-cap SR	1.12	1	0.2909	2.41	2	0.3002
Small-cap Con.	0.27	1	0.6048	3.38	2	0.1848
Small-cap Dif.	20.46	1	0.0000	34.29	2	0.0000
Mid-cap SR	4.18	1	0.0410	5.20	2	0.0743
Mid-cap Con.	3.23	1	0.0724	4.20	2	0.1222
Mid-cap Dif.	60.54	1	0.0000	68.65	2	0.0000
Large-cap SR	10.20	1	0.0014	12.08	2	0.0024
Large-cap Con.	3.09	1	0.0788	3.117	2	0.2105
Large-cap Dif.	44.13	1	0.0000	53.57	2	0.0000

6.2.3 Test for multicollinearity

Multicollinearity appears when the independent variables are highly correlated with each other. In presence of multicollinearity, the regression models encounter larger standard errors. A high correlation between the independent variables makes it difficult to identify the independent effect for each variable. Strong correlation among these variables can therefore generate insignificant estimators and incorrect regression results (Jaggia and Kelly, 2016, 477). In this thesis, multicollinearity will be detected by studying the variables for the Fama-French three factor model and Carhart four factor model.

The market factor, size factor, value factor and momentum factor are tested for multicollinearity. This is done by measuring the correlation coefficient and variance inflation factor for the variables in Fama-French three factor model and Carhart's four factor model separately.

Table 5 reports the correlation coefficient and the variance inflation factor for all loading variables. The variance inflation factor is close to one for all loading variables in both the Fama-French three factor model and the Carhart four factor model. The correlation among the loading variables is also low. The strongest correlation coefficient is between the market factor (ERM) and the size factor (SMB) and has only a value of (-0.1629). These results imply the loading variables to be relatively free from multicollinearity.

Table 5: Test results for multicollinearity

This table report the correlation coefficient and variance inflation factor for the market factor (ERM), size factor (SMB), value factor (HML) and momentum factor (UMD). The correlation coefficients and variance inflation factor are displayed for the variables in regression equation (2) in Panel A and equation (3) in Panel B. Stata, (StataCorp, 2019), was used to estimate these test.

Panel A: Fama-French three factor model				
Variable	ERM	SMB	HML	Variance inflation factor
ERM	1			1.05
SMB	-0.1629	1		1.03
HML	0.1468	-0.0318	1	1.02

Panel B: Carhart four factor model					
Variable	ERM	SMB	HML	UMD	Variance inflation factor
ERM	1				1.06
SMB	-0.1629	1			1.04
HML	0.1468	-0.0318	1		1.04
UMD	-0.1064	-0.0766	-0.1384	1	1.04

6.3 Results for the model regressions and ratios

6.3.1 Single-index Model – Main analysis

The results for the Single-index model regression is reported in Table 6. The alpha, (which is an indication for mutual fund performance), is negative for both portfolios. However, it is only significant for the socially responsible (SR) portfolio ($\alpha_{SR} = -0.0011$) at the 10% significance level. This implies that the SR portfolio underperforms the market. The alpha for conventional portfolio ($\alpha_{Con.} = -0.0002$) tends to underperform the market but it is statistically insignificant. The alpha of the difference portfolio is negative ($\alpha_{Dif.} = -0.0036$) and significant at the 1 % level. This implies that the SR portfolio on average underperforms in relation to the conventional portfolio.

Table 6 also reports the results for the market beta, which is significant at the 1 % level for both the SR and conventional portfolio, ($\beta_{ERM,SR} = 1{,}0266$ and $\beta_{ERM,Con.} = 0.9948$). The difference portfolio has a positive market beta of (0.0850) and is significant at the 1 %. These results imply that the SR portfolio is more sensitive to changes in the market and is therefore considered more volatile.

Table 6: Results for the Single-index model regression

The table reports the Single-index model regression results for the SR, conventional and difference portfolio regressed with equation (1). The table reports the results for the intercept (α), the market factor (β_{ERM}), adjusted r-square, (R^2) and the number of observations. The Newey West's standard errors are reported within the parenthesises (). * represents significance at the 10% level, ** represents significance at the 5% level, *** represents significance at the 1% level.

	SR Portfolio	Con. Portfolio	Dif. Portfolio
α	-0.0011*	-0.0002	-0.0036***
	(0.0006)	(0.0007)	(0.0012)
β_{ERM}	1.0266***	0.9948***	0.0850***
	(0.0195)	(0.0198)	(0.0221)
R^2	0.9678	0.9594	0.1183
Number of obs.	120	120	120

Table 7 reports the results of the Sharpe's and Treynor's ratio T-test on the main analysis. To test whether there exists a significant difference in total risk adjusted return and market risk adjusted return between the SR and conventional mutual funds, Sharpe's and Treynor's ratio are estimated for each mutual fund individually. The differences in these ratios are tested portfolio-wise in Stata, (StataCorp, 2019), by using a two sampled T-test with unequal variance assumed.

The Sharpe's ratio, (which is the same across all models because the portfolio total risk is fixed), is lower for the SR portfolio ($Shr_{SR} = 0.0568$) compared to the conventional portfolio ($Shr_{Con.} = 0.0984$). These results imply that there is a tendency for conventional mutual funds to achieve a higher risk-adjusted reward in terms of excess return to total risk compared to the SR mutual funds. The difference in Sharp's ratio, however, is insignificant ($p_{Shr} = 0.1524$). This means that the difference in risk-adjusted return in terms of total risk between the SR and conventional portfolio is statistically insignificant.

Treynor's ratio in Panel A: Table 7 is lower for the SR portfolio ($Trr_{SR} = 0.0018$) compared to the conventional portfolio ($Trr_{Con.} = 0.0040$). However, the difference between the two portfolios ratio is statistically insignificant ($p_{Trr} = 0.1311$). These results imply that there is only a tendency for conventional mutual funds to achieve a higher risk-adjusted return in terms of market risk compared to the SR mutual funds.

Table 7: Result for two-sampled T-test for Treynor's and Sharpe's ratio

This table reports the t-test results for the SR and conventional portfolios Sharpe's and Treynor's ratio for the Single index model, (equation (1)) in Panel A, Fama-French three factor model, (equation (2)), in Panel B and Carhart four factor model, (equation (3)), in Panel C. The t-test testes for differences in Sharpe's and Treynor's ratio which are estimated by using equation (4) and (5) respectively. The variables reported are the number of observations (Obs.), mean, standard deviation (SD), and p-value (p). The t-test assumes unequal variance and uses the null hypothesis; $H_0(Shr): Shr_{SR} = Shr_{Con.}$ and $H_0(Trr): Trr_{SR} = Trr_{Con.}$ and the alternative hypothesis: $H_1(Shr): Shr_{SR} < Shr_{Con.} and$ $H_1(Trr): Trr_{SR} < Trr_{Con.}$

Panel A: Single-index model							
	SR Portfolio			Con. Portfolio			H_a: Diff < 0
	Obs.	Mean	SD	Obs.	Mean	SD	p
Sharpe's ratio	19	0.0568	0.1595	90	0.0984	0.1477	0.1524
Treynor's ratio	19	0.0018	0.0075	90	0.0040	0.0071	0.1311
Panel B: Fama-French three factor model							
	SR Portfolio			Con. Portfolio			
	Obs.	Mean	SD	Obs.	Mean	SD	
Sharpe's ratio	19	0.0568	0.1595	90	0.0984	0.1477	0.1524
Treynor's ratio	19	0.0018	0.0074	90	0.0039	0.0069	0.1348
Panel C: Carhart's four factor model							
	SR Portfolio			Con. Portfolio			H_a: Diff < 0
	Obs.	Mean	SD	Obs.	Mean	SD	p
Sharpe's ratio	19	0.0568	0.1595	90	0.0984	0.1477	0.1524
Treynor's ratio	19	0.0017	0.0075	90	0.0038	0.0069	0.1324

Table 8 reports the number of positively and negatively estimated alphas for the individual SR and conventional mutual funds. The table also reports the number of significantly positive and significantly negative alphas at the 10%, 5% and 1% level, respectively. To easier understand the results, the output of Table 8 will be reported in the text as percentual proportions.

Panel A: Table 8 reports the estimated individual alpha for the Single-index model regression. 26.3% of the alphas for the SR mutual funds are estimated as positive. 5.3% of these are at least marginally significant at the 10% level. 26.6% of the alphas for the conventional mutual funds are estimated as positive. 7.7% of these are significant at the 10% level. Additionally, 42.1% of the alphas for the SR mutual funds and 34.4% of the alphas for the conventional mutual funds are estimated as significantly negative. These results imply that the proportion of individual mutual funds that overperform the market is smaller for the SR mutual funds compared to the conventional mutual funds.

Table 8: Results for the individual mutual fund regressions

This table reports the number of mutual funds with positive/negative estimated alphas. It also reports the number of mutual funds with significantly estimated alphas at the significance level of 1%, 5% and 10%. The alphas are estimated individually for each mutual fund with heteroskedasticity and autocorrelation correcting (HAC) standard errors. The alphas are estimated for the SR and conventional portfolios separately, with equation (1) in Panel A, equation (2) in Panel B, and equation (3) in Panel C.

	Panel A: Single-index model							
		Significance Level				Significance Level		
	Positive	1%	5%	10%	Negative	1%	5%	10%
SR Portfolio	5	0	0	1	14	5	7	8
Con. Portfolio	24	2	4	7	66	7	26	31
	Panel B: Fama-French three factor model							
SR Portfolio	2	0	0	1	17	6	8	9
Con. Portfolio	28	2	4	9	62	10	27	33
	Panel C: Carhart's four factor model							
SR Portfolio	2	0	0	0	17	1	6	9
Con. Portfolio	27	0	0	1	63	9	23	32

6.3.2 Fama-French three factor model – Main analysis

The results for Fama-French three factor model regression are reported in Table 9. The alpha is negative for both the socially responsible (SR) ($\alpha_{SR} = -0.0011$) and conventional portfolio ($\alpha_{Con.} = -0.0004$), but only significant for the SR portfolio at the 5% level. The difference portfolio has a negative alpha ($\alpha_{Dif.} = -0.0036$) that is significant at the 1% level. These results imply that the SR portfolio underperforms the market, while the conventional portfolio only tends to underperform the market. The negative alpha for the difference portfolio implies that the SR portfolio, on average, underperforms in relation to the conventional portfolio.

The results for the market beta are reported in Table 9. The market beta is higher than one and significant at the 1% level for both the SR ($\beta_{ERM,SR} = 1.0347$) and conventional portfolio ($\beta_{ERM,Con.} = 1.0129$). The market beta of the difference portfolio ($\beta_{ERM,Dif.} =$

0.0802) is positive and significant at 1%. These results imply that both portfolios are more volatile than the market. The positive market beta for the difference portfolio also implies that the SR portfolio is more volatile compared to the conventional portfolio.

The results of Treynor's ratio (Trr), estimated with the Fama-French three factor model regression, are reported in Panel B: Table 7. These results show that the Treynor's ratio is lower for the SR portfolio ($Trr_{SR} = 0.0018$) compared to the conventional portfolio ($Trr_{Con.} = 0.0039$). The difference in Treynor's ratio between the two portfolios is statistically insignificant ($p_{Trr} = 0.1348$). These results imply that there is a tendency for conventional mutual funds to achieve a higher risk-adjusted return in terms of market risk compared to the SR mutual funds.

The results for the size factor are reported in Table 9. Beta for the size factor (SMB) is positive for both the SR ($\beta_{SMB,SR} = 0.0393$) and conventional portfolio ($\beta_{SMB,Con.} = 0.1201$). Size beta is only significant for the conventional portfolio at the 1% level. Size beta is negative but statistically insignificant for the difference portfolio ($\beta_{SMB,Dif.} = -0.0142$). These results imply that there is only a tendency for the conventional portfolio to be more sensitive to changes in large stocks.

The results for the value factor are reported in Table 9. Beta for the value factor (HML) is negative and insignificant for both the SR ($\beta_{HML,SR} = -0{,}0426$) and conventional ($\beta_{HML,Con.} = -0{,}0497$) portfolio. Value beta is positive but statistically insignificant for the difference portfolio ($\beta_{HML,Dif.} = 0{,}0371$). These results imply that there is a tendency for the SR to be more sensitive to value stocks (i.e. stocks with a high book to market ratios).

The individual mutual fund alphas are, in panel B: Table 8, estimated with the Fama-French three factor model using regression equation (2). 10.5% of the alphas for the SR mutual funds are estimated as positive. 5.3% of these are at least marginally significant at the 10% level. 31.1% of the alphas for the conventional mutual funds are estimated as positive. 10.0% of these are significant at the 10% level. Additionally, 47.4% of the alphas for the

SR mutual funds and 36.7% of the alphas for the conventional mutual funds are estimated as significantly negative. These results imply that the proportion of individual mutual funds that overperform the market is larger for the conventional mutual funds compared to the SR mutual funds.

Table 9: Results for Fama-French three factor model regression

The table reports the Fama-French three factor model regression results for the SR, conventional and difference portfolio regressed with equation (2). The table reports the results for the intercept (α), the market factor (β_{ERM}), size factor (β_{SMB}), value factor (β_{HML}), adjusted r-square, (R^2) and the number of observations. The Newey West's standard errors are reported within the parenthesises (). * represents significance at the 10% level, ** represents significance at the 5% level, *** represents significance at the 1% level.

	SR Portfolio	Con. Portfolio	Dif. Portfolio
α	-0.0011**	-0.0004	-0.0036***
	(0.0006)	(0.0007)	(0.0012)
β_{ERM}	1.0347***	1.0129***	0.0802***
	(0.0200)	(0.0178)	(0.0241)
β_{SMB}	0.0393	0.1201***	-0.0142
	(0.0247)	(0.0261)	(0.0346)
β_{HML}	-0.0426	-0.0497	0.0371
	(0.0325)	(0.0344)	(0.0403)
R^2	0.9690	0.9671	0.1272
Number of obs.	120	120	120

6.3.3 Carhart's four factor model – Main analysis

The results for Carhart's four factor model regression are reported in Table 10. The alphas are negative for both the socially responsible (SR) ($\alpha_{SR} = -0.0015$) and conventional portfolio ($\alpha_{Con.} = -0.0010$), but only significant for the SR portfolio at the 10% level. The difference portfolio has a negative alpha ($\alpha_{Dif.} = -0.0037$) that is statistically significant at the 5% level. These results imply that the SR portfolio marginally underperforms the market, while the conventional portfolio only tends to underperform the market. The negative alpha for the difference portfolio implies that the SR portfolio, on average, underperforms in relation to the conventional portfolio.

The results for the market beta are reported in Table 10. The market beta is higher than one and significant at the 1% level for both the SR ($\beta_{ERM,SR} = 1.0364$) and conventional portfolio ($\beta_{ERM,Con.} = 1.0200$). The market beta of the difference portfolio ($\beta_{ERM,Dif.} = 0.0807$) is positive and significant at 1%. These results imply that both portfolios are more volatile than the market. The positive market beta for the difference portfolio also implies that the SR portfolio is more volatile compared to the conventional portfolio.

The results of Treynor's ratio (Trr), estimated with the Carhart's four factor model regression, are reported in Panel C: Table 7. These results show that the Treynor's ratio is lower for the SR portfolio ($Trr_{SR} = 0.0017$) compared to the conventional portfolio ($Trr_{Con.} = 0.0038$). The difference in Treynor's ratio between the two portfolios is statistically insignificant ($p_{Trr} = 0.1325$). These results imply that there is a tendency for conventional mutual funds to achieve a higher risk-adjusted return in terms of market risk compared to the SR mutual funds.

The results for the size factor are reported in Table 10. Beta for the size factor (SMB) is positive for both the SR ($\beta_{SMB,SR} = 0.0415$) and conventional portfolio ($\beta_{SMB,Con.} = 0.1241$). Size beta is only significant for the conventional portfolio at the 1% level. Size beta is negative but statistically insignificant for the difference portfolio ($\beta_{SMB,Dif.} = -0.0136$). These results imply that there is a tendency for the conventional portfolio to be more sensitive to changes in large stocks.

The results for the value factor are reported in Table 10. The beta for the value factor (HML) is negative and insignificant for both the SR ($\beta_{HML,SR} = -0.0390$) and conventional ($\beta_{HML,Con.} = -0.0432$) portfolio. Value beta is positive but statistically insignificant for the difference portfolio ($\beta_{HML,Dif.} = 0.0381$). These results imply that there is a tendency for the SR to be more sensitive to value stocks.

The results for the momentum factor are reported in Table 10. The beta for the momentum factor (UMD) is positive and insignificant for both the SR ($\beta_{UMD,SR} = 0.0234$) and conventional ($\beta_{UMD,Con.} = 0.0423$) portfolio. The momentum beta is positive but insignificant for the difference portfolio ($\beta_{UMD,Dif.} = 0{,}0063$). These results imply that there is a tendency for the SR portfolio to be more sensitive to stocks which exhibits a negative persistency. Nevertheless, the difference in sensitivity between the two portfolios are statistically insignificant.

The individual mutual fund alphas can be observed in Panel C: Table 8. They are estimated with the Carhart's four factor model using regression equation (3). 10.5% of the alphas for the SR mutual funds are estimated as positive. None of these are at least marginally significant at the 10% level. 30.0% of the alphas for the conventional mutual funds are estimated as positive. 1.1% of these are significant at the 10% level. Additionally, 47.4% of the alphas for the SR mutual funds and 35.6% of the alphas for the conventional mutual funds are estimated as significantly negative. These results imply that the proportion of individual mutual funds that overperform the market is larger for the conventional mutual funds compared to the SR mutual funds.

Table 10: Results for the Carhart's four factor model regressions

The table reports the Carhart four factor model regression results for the SR, conventional and difference portfolio regressed with equation (3). The table reports the results for the intercept (α), the market factor (β_{ERM}), size factor (β_{SMB}), value factor (β_{HML}), momentum factor (β_{UMD}), adjusted r-square, (R^2) and the number of observations. The Newey West's standard errors are reported within the parenthesises (). * represents significance at the 10% level, ** represents significance at the 5% level, *** represents significance at the 1% level.

	SR Portfolio	Con. Portfolio	Dif. Portfolio
α	-0.0015*	-0.0010	-0.0037**
	(0.0008)	(0.0009)	(0.0015)
β_{ERM}	1.0364***	1.0200***	0.0807***
	(0.0198)	(0.0174)	(0.0243)
β_{SMB}	0.0415	0.1241***	-0.0136
	(0.0254)	(0.0264)	(0.0341)
β_{HML}	-0.0390	-0.0432	0.0381
	(0.0337)	(0.0372)	(0.0417)
β_{UMD}	0.0234	0.0423	0.0063
	(0.0304)	(0.0329)	(0.0405)
R^2	0.9693	0.9679	0.1275
Number of obs.	120	120	120

6.3.4 Cross-sectional analysis: age and cap size

In the cross-sectional analysis regressions, the portfolios were divided by age, cap size, and two sub-periods. Firstly, the results for the age and cap size regressions will be presented in Table 11, following this, Table 12 reports the Sharpe's and Treynor's ratio for the age and cap size portfolios. Lastly, Table 13 shows the results for the cross-sectional regressions for the sub- period portfolios. The results for these tables will be interpreted with a focus on the alpha, Sharpe's ratio and Treynor's ratio.

Table 11: Panel A and B, reports Carhart's four factor model cross-sectional regressions result for the age and cap size divided portfolios. The alphas are estimated as negative for both the socially responsible (SR) and conventional portfolios. With exception for the young SR portfolio where alpha is positive but insignificant ($\alpha_{SR,Young} = 0.0019$). The alphas in the main portfolio analysis alpha is negative and at least marginally significant for all difference portfolios. These results imply that the SR portfolio, on average, underperforms in relation to the conventional portfolio.

The cross-sectional analysis in Table 11 reports differences in the magnitude of underperformance between the SR and conventional portfolios. The results for the cap size portfolios in Panel B reports that the alphas of the small-cap, mid-cap and large-cap difference portfolios are quite similar to the results in the main analysis, ($\alpha_{Dif.,Small} = -0.0034$, $\alpha_{Dif.,Mid} = -0{,}0030$, $\alpha_{Dif.,Large} = -0.0035$). These results suggest that the size of stocks that mutual funds invest in has a minimum effect on the differences in performance.

However, for the age portfolios in Panel A, the results are somewhat different. The alpha for the old difference portfolio is more negative than the alpha for the young difference portfolio, ($\alpha_{Dif.,Old} = -0.0051$, $\alpha_{Dif.,Young} = -0.0003$). The results for the age portfolio show that there is a tendency for the young SR portfolio to underperform less compared to the old SR portfolio.

Table 11: Results for the cross-sectional regressions: age and cap size

The table reports the Carhart four factor model regression results for the cross-sectional SR, conventional and difference portfolio divided by age in Panel A and cap size in Panel B. The portfolios are regressed with equation (3). The table reports the results for the intercept (α), the market factor (β_{ERM}), size factor (β_{SMB}), value factor (β_{HML}), momentum factor (β_{UMD}), adjusted r-square, (R^2) and the number of observations. The Newey West's standard errors are reported within the parentheses (). * represents significance at the 10% level, ** represents significance at the 5% level, *** represents significance at the 1% level.

Panel A: Portfolios divided by age							
	α	β_{ERM}	β_{SMB}	β_{HML}	β_{UMD}	R^2	Obs.
Old SR.	-0.0025*** (0.0009)	1.0498*** (0.0259)	0.0141 (0.0259)	-0.0785* (0.0452)	0.0168 (0.0388)	0.9590	120
Old Con.	-0.0007 (0.0009)	1.0232*** (0.0176)	0.1153*** (0.0272)	-0.0334 (0.0385)	0.0402 (0.0326)	0.9678	120
Old Diff.	-0.0051*** (0.0016)	0.0868*** (0.0297)	-0.0321 (0.0391)	-0.0111 (0.0462)	0.0019 (0.0393)	0.1098	120
Young SR	0.0019 (0.0015)	0.9735*** (0.0276)	-0.0101 (0.0339)	-0.0548 (0.0544)	0.0012 (0.0480)	0.9293	120
Young Con.	-0.0010 (0.0008)	1.0287*** (0.0186)	0.0532** (0.0262)	-0.0237 (0.0319)	0.0244 (0.0285)	0.9670	120
Young Diff.	-0.0003** (0.0001)	0.0050*** (0.0018)	0.0058** (0.0025)	0.0028 (0.0034)	0.0021 (0.0028)	0.1126	120
Panel B: Portfolios divided by cap size							
	α	β_{ERM}	β_{SMB}	β_{HML}	β_{UMD}	R^2	Obs.
Small-cap SR	-0.0003 (0.0016)	1.0155*** (0.0305)	0.1859*** (0.0526)	-0.0033 (0.0584)	0.1535 (0.0509)	0.8769	120
Small-cap Con	-0.0001 (0.0013)	1.0137*** (0.02567)	0.2623*** (0.0439)	-0.0490 (0.0555)	0.0921* (0.0482)	0.9209	120
Small-cap Dif.	-0.0034** (0.0015)	0.0620** (0.0259)	-0.0075 (0.0410)	0.0796 (0.0517)	0.0867* (0.0473)	0.1017	120
Mid-cap SR	-0.0012* (0.0008)	1.0317*** (0.0203)	-0.0214 (0.0225)	-0.0471 (0.0339)	-0.0145 (0.0272)	0.9694	120
Mid-cap Con.	-0.0015 (0.0009)	1.0251*** (0.0199)	0.0706*** (0.0199)	-0.0387 (0.0381)	0.0076 (0.0340)	0.9650	120
Mid-cap Dif.	-0.0030* (0.0016)	0.0669** (0.0272)	-0.0230 (0.0367)	0.0254 (0.0459)	0.0032 (0.0418)	0.0808	120
Large-cap SR	-0.0019** (0.0009)	1.0489*** (0.0254)	0.0039 (0.0259)	-0.0354 (0.0358)	-0.0453 (0.0370)	0.9643	120
Large-cap Con	-0.0015** (0.0006)	1.0125*** (0.0144)	0.0331* (0.0197)	-0.0370 (0.0299)	0.0195 (0.0248)	0.9804	120
Large-cap Dif.	-0.0035** (0.0017)	0.0966*** (0.0309)	0.0399 (0.0372)	0.0355 (0.0446)	-0.0394 (0.0406)	0.1487	120

The t-test results of Sharpe's ratio (Shr), for the cross-sectional portfolios divided by age and cap size, is reported in Panel A: Table 12. These results show that Sharpe's ratio is higher for the old and large-cap conventional portfolio ($Shr_{Con.,Old} = 0{,}0971$ and $Shr_{Con.,Large} = 0{,}1305$) compared to the old and large-cap socially responsible (SR) portfolio ($Shr_{SR,Old} = -0.0132$ and $Shr_{SR,Large} = 0.0528$). Panel A: Table 12 additionally show that Sharpe's ratio is higher for the young, small-cap, and mid-cap SR portfolio ($Shr_{SR,Young} = 0.1077$, $Shr_{SR,Small} = 0.1718$ and $Shr_{SR,Mid} = 0.1063$) compared to the young, small-cap, and mid-cap conventional portfolio ($Shr_{Con.,Young} = 0.0999$, $Shr_{Con.,Small} = 0.1463$ and $Shr_{Con.,Mid} = 0.0464$). The difference in Sharpe's ration is only marginally significant for the old portfolio ($p_{Shr,Old} = 0{,}0610$). These results imply that old conventional mutual funds on average achieves a higher risk-adjusted return in terms of total risk compared to the old SR mutual funds.

The results of Treynor's ratio (Trr), for the cross-sectional portfolios divided by age and cap size, is reported in Panel B: Table 12. These results show that Treynor's ratio is higher for the old and large-cap conventional portfolio ($Trr_{Con.,Old} = 0{,}0038$ and $Trr_{Con.,Large} = 0{,}0053$) compared to the old and large-cap socially responsible (SR) portfolio ($Trr_{SR,Old} = -0.0016$ and $Shr_{SR,Large} = 0.0013$). Panel B: Table 12 additionally show that Treynor's ratio is higher for the young, small-cap, and mid-cap SR portfolio ($Trr_{SR,Young} = 0.0042$, $Trr_{SR,Small} = 0.0073$ and $Trr_{SR,Mid} = 0.0040$) compared to the young, small-cap, and mid-cap conventional portfolio ($Trr_{Con.,Young} = 0.0039$, $Trr_{Con.,Small} = 0.0061$ and $Shr_{Con.,Mid} = 0.0014$). The difference in Treynor's ratio is only marginally significant for the old portfolio ($p_{Trr,Old} = 0{,}0574$). These results imply that old conventional mutual funds on average achieves a higher risk-adjusted return in terms of market risk compared to the old SR mutual funds.

Sharpe's ratio, Treynor's ratio and alpha of the difference's portfolio show deviating results in terms of the risk-adjusted performance for the small-cap, mid-cap and young portfolios. Treynor's and Sharpe's ratio is estimated as higher, for the small-cap, mid-cap and young SR portfolios, while alpha remains significantly negative.

This deviation can sometimes occur as an observable phenomenon in studies that uses multi factor models (Hung and Yang, 2006). However, the deviating results for the small-cap, mid-cap and young portfolios are not statically significant, due to insignificant estimates. This means that the deviations could have appeared because of irregularities in the sample data. Nevertheless, Chen and Lee (1981; 1986) argue that this deviation might occur because of the market conditions during the sample periods, the investment horizon or on the sample size. In this thesis, these deviations might therefore exist due to the SR criteria, the relatively small sample sizes, or because of the time-period.

Table 12: Results for T-test for the cross-sectional Treynor's and Sharpe's ratio

This table reports the t-test results for the SR and conventional portfolios divided by age in Panel A, and cap size in Panel B, using the Carhart four factor model, (equation (3)) . The t-test testes for differences in Sharpe's and Treynor's ratio which are estimated by using equation (4) and (5) respectively. The variables reported are the number of observations (Obs.), mean, standard deviation (SD), and p-value (p). The t-test assumes unequal variance and uses the null hypothesis; $H_0(Shr): Shr_{SR} = Shr_{Con.}\ and\ \ H_0(Trr): Trr_{SR} = Trr_{Con.}$ and the alternative hypothesis: $H_1(Shr): Shr_{SR} < Shr_{Con.} and\ H_1(Trr): Trr_{SR} < Trr_{Con.}$.

Panel A: Cross-sectional - Sharpe's Ratio							
	SR Portfolio			Con. Portfolio			H_a: Diff < 0
	Obs.	Mean	SD	Obs.	Mean	SD	p
Old	8	-0.0132	0.1697	38	0.0971	0.1561	0.0610
Young	11	0.1077	0.1373	52	0.0999	0.1430	0.5663
Small-cap	4	0.1718	0.1017	28	0.1463	0.1452	0.6610
Mid-cap	5	0.1063	0.1180	28	0.0464	0.1654	0.8196
Large-cap	5	0.0528	0.1844	28	0.1305	0.0986	0.2027
Panel B: Cross-sectional – Treynor's Ratio							
	SR portfolio			Con. Portfolio			H_a: Diff < 0
	Obs.	Mean	SD	Obs.	Mean	SD	p
Old	8	-0.0016	0.0082	38	0.0038	0.0072	0.0574
Young	11	0.0042	0.0062	52	0.0039	0.0068	0.5541
Small-cap	4	0.0073	0.0043	28	0.0061	0.0067	0.6739
Mid-cap	5	0.0040	0.0053	28	0.0014	0.0082	0.8112
Large-cap	5	0.0013	0.0091	28	0.0053	0.0042	0.1979

6.3.5 Cross-sectional analysis: sub-periods

Table 13 reports Carhart's four factor models' cross-sectional regressions result for the portfolios divided in sub-periods. The results from the first sub-period, February 2010 to January 2015 is consistent with the results from the main analysis. The alphas are negative and insignificant for both the socially responsible (SR) ($\alpha_{SR,(2010-15)} = -0.0017$) and conventional portfolio ($\alpha_{Con.,(2010-15)} = -0.0014$). The difference portfolio has a negative alpha ($\alpha_{Dif.,(2010-15)} = -0.0114$) that is significant at the 1% level. These results imply that the SR portfolio underperforms in relation to the conventional portfolio in the first sub-period of February 2010 to January 2015.

The results from Table 13 for the first sub-period, show that market beta is higher than one and strongly significant for both the SR ($\beta_{SR,(2010-15)} = 1.0812$) and the conventional portfolio $\beta_{Con.,(2010-15)} = 1.0340$). Market beta for the difference portfolio ($\beta_{Dif.,(2010-15)} = 0.0967$) is positive and significant at the 1% level. These results imply that both portfolios are more volatile than the market and that SR portfolio is even more volatile compared to the conventional portfolio.

The results for the later sub-period, February 2015 to January 2020, deviate from the results of the main analysis. Table 13 reports that alpha is negative but insignificant for both the SR ($\alpha_{SR,(2015-20)} = -0.0004$) and the conventional portfolio ($\alpha_{Con.,(2015-20)} = -0.0004$). But alpha for the difference portfolio ($\alpha_{Dif.,(2015-20)} = 0.0055$) is positive and significant at the 1 % level. These results imply that the SR portfolio overperform compared to the conventional portfolio in the later sub-period of February 2015 to January 2020.

The results from Table 13, for the later sub-period, show that market beta is lower than one and strongly significant for both the SR ($\beta_{SR,(2015-20)} = 0.9778$) and the conventional $\beta_{Con.,(2015-20)} = 0.9896$) portfolio. Market beta for the difference portfolio ($\beta_{Dif.,(2015-20)} = -0.0138$) is negative but statistically insignificant. These results imply that both portfolios are less volatile than the market. The results also show that the SR portfolio only tends to be less volatile compared to the conventional portfolio.

The comparison between the two sub-periods can be somewhat inconsistent. Even though both sub-period portfolios have the same number of observations (i.e. 60 months of excess portfolio return), the number of mutual funds in each sub-period is different. This is because more mutual funds become inactive over time. Once a mutual fund becomes inactive, it gets excluded from the portfolios and the return is recalculated on the number of remining mutual funds. In the beginning of the first sub-period, the SR/conventional portfolio consisted of 19/90 mutual funds. In contrast to the beginning of the later sub-period when the SR/conventional portfolio consisted of 12/67 mutual funds. This makes the comparison between the two sub-periods somewhat inconsistent. However, the number of mutual funds combined with the number of monthly return observations is still large enough in terms of generating trustworthy test-results.

Table 13: Results for the cross-sectional regressions: sub-period portfolios

The table reports Carhart's four factor model regression results for the cross-sectional SR, conventional and difference portfolios divided in the two sub-periods. The portfolios are regressed with equation (3). The table reports the results for the intercept (α), the market factor (β_{ERM}), size factor (β_{SMB}), value factor (β_{HML}), momentum factor (β_{UMD}), adjusted r-square, (R^2) and the number of observations. The Newey West's standard errors are reported within the parentheses (). * represents significance at the 10% level, ** represents significance at the 5% level, *** represents significance at the 1% level.

	February 2010 - January 2015			February 2015 - January 2020		
	SR Portfolio	Con. Portfolio	Dif. Portfolio	SR Portfolio	Con. Portfolio	Dif. Portfolio
α	-0.0017 (0.0011)	-0.0014 (0.0012)	-0.0114*** (0.0011)	-0.0004 (0.0010)	-0.0004 (0.0011)	0.0055*** (0.0007)
β_{ERM}	1.0812*** (0.0311)	1.0340*** (0.0295)	0.0967*** (0.0198)	0.9778*** (0.0221)	0.9896*** (0.0232)	-0.0138 (0.0168)
β_{SMB}	0.0931** (0.0404)	0.1593*** (0.0387)	-0.0458 (0.0330)	-0.0403 (0.0334)	0.0485 (0.0423)	-0.0868** (0.0338)
β_{HML}	-0.0726 (0.0478)	-0.0847 (0.0525)	0.0167 (0.0391)	-0.0416 (0.0375)	-0.0194 (0.0448)	-0.0169 (0.0323)
β_{UMD}	0.0330 (0.0372)	0.0312 (0.0412)	0.0598** (0.0242)	0.0528 (0.0447)	0.1046** (0.0456)	-0.0526* (0.0266)
R^2	0.9712	0.9682	0.3774	0.9727	0.9708	0.2697
Obs.	60	60	60	60	60	60

6.4 Summary of the risk-adjusted performance results

In the main analysis, alpha is lower for the socially responsible (SR) portfolio compared to the conventional portfolios, across all three models, (i.e., the Single-index model, the Fama-French three factor model and Carhart's four factor model). Alpha for the difference portfolios are negative and significant at the 1% level for the first two models. In addition, alpha for the difference portfolio remains negative and significant at the 5% level for the third model, (i.e., Carhart's four factor model). It is worth mentioning that the adjusted R-square for the difference portfolio increases for every model. This suggest that the explanatory power increases when adding the factors of cap size, value, and momentum. This suggest that the Carhart's four factor model could be considered the most trustworthy and relevant model.

In the cross-sectional analysis for the difference portfolios divided by age, cap size and sub-period, alpha is negative and significant for almost all difference portfolios. The only exception is for the later sub-period February 2015 to January 2020. The alpha for the difference portfolio is in this case positive and significant at the 1% level. The magnitude of underperformance is quite similar for the cap size divided difference portfolios compared to the main portfolios. However, for the age-divided difference portfolios, the young SR portfolio is suggested to underperform less compared to the old SR portfolio. The combined results from the main and cross-sectional analysis suggest that the null hypothesis $H_0(\alpha)$ can be marginally rejected. This is because the difference alpha is at least significant at the 10% level for all models.

On an individual level, the proportion of negative and significantly negative alphas is higher for the SR mutual funds compared to the conventional mutual funds. This result implies that a higher proportion of the SR mutual funds underperforms the market compared to the conventional. This result is also consistent with the alphas from the portfolio regressions, which on an aggregated level tended to be estimated as more negative for the SR portfolio compared to the conventional portfolio.

The market beta is slightly higher for the SR portfolio compared to the conventional, across all three models in the main analysis. In addition, market beta for tends to be higher for the cross-sectional SR portfolios as well. Except for the sub-period February 2015 to January 2020. Market beta for the difference portfolio is, during this sub-period, negative but insignificant. These results imply that the SR portfolios are more volatile than the conventional, with exception for the later sub-period.

In the main analysis, Sharpe's and Treynor's ratio are estimated as lower for the SR mutual funds across all three models. This suggest that the risk adjusted return is lower for the SR mutual funds, both in terms of total risk and market risk. The difference in risk adjusted return between the two types of mutual is not big enough to be statistically significant.

In the cross-sectional analysis, Sharpe's (Shr) and Treynor's (Trr) ratio is only found to be higher for the conventional mutual funds in the old and large cap sized portfolio. In the remaining portfolios, the two ratios are found to be higher for the SR mutual funds. The difference in risk adjusted return is only marginally significant for the old portfolio. None of the ratios are significantly higher for the SR mutual funds in any of the portfolios. Given these results the null hypothesis $H_0(Shr)$ and $H_0(Trr)$ cannot be rejected.

7. Discussion

This section is divided into two subsections. The first section summarizes what the thesis has contributed to the field of research and reports the main results of the thesis. The results are then discussed and compared to theory and previous literature. The second subsection discusses potential future research within this field of research.

7.1 Conclusion

This thesis aimed to answer the following research questions: Is there a difference in the risk-adjusted performance between Swedish socially responsible (SR) and conventional equity mutual funds? Furthermore, does this difference depend on the characteristics age, cap size or on the time-period? In this thesis attempt to answer these questions, it has contributed to an already existing research field.

It contributes to this field of research by studying the difference in performance on both an aggregated and individual level. On an aggregate level, it contributes by studying how Swedish mutual funds age, cap size, and time-period impact the differences in performance. On an individual level, it contributed by studying the proportion of SR mutual funds that underperformed the market compared to the conventional mutual funds. Based on the results found in this thesis, three important conclusions can be drawn.

Firstly, the main results in this thesis suggest that Swedish SR mutual funds, established before January 2010, underperform compared to the conventional mutual funds. This result holds for the total ten-year time-period between January 2010 to January 2020. However, the study finds that there are differences depending on the time-period. In the first five-year sub-period, (February 2010 to January 2015), SR mutual funds are estimated to underperform compared to the conventional. In the later five-year sub-period, (February 2015 to January 2020), SR mutual funds are surprisingly estimated to overperform.

Secondly, the results suggest that the difference in performance could be slightly affected by age, but the cap size of the mutual funds seems to have a minimal effect. More specifically, the study found that young SR mutual funds might underperform less than old SR mutual funds. Thirdly, the results show that on an individual mutual fund level, a larger proportion of the SR mutual funds underperform the market compared to its conventional counterpart. This suggest that the SR mutual funds underperform the conventional at an individual level as well.

The main results of this thesis are similar to Renneboog et al. (2008a), who found that Swedish SR mutual funds underperform in relation to conventional. However, in their study they compounded the portfolios based on the mutual fund’s country of domicile, but not based on its geographical holdings.

In contrast to Renneboog et al. (2008a), this thesis focusses on portfolios which only includes mutual funds with most of its holdings in Swedish equities. This methodology is similar to Leite et al. (2017), who studied the differences in performance between Swedish SR and conventional equity mutual funds during the time-period November 2002 to October 2012.

The combined results of Leite et al. (2017) show that Swedish SR mutual funds perform similar to the conventional mutual funds. However, the authors did also find evidence for SR mutual funds to underperform compared to conventional in times of non-crisis, but to perform similar in times of crisis. The results of Leite et al. (2017) are also in line with the results of Nofsinger and Varma (2014), which studied the performance of SR mutual funds in the United States during a similar time-period. The results from these studies are line with the main result of this thesis, which once again found that Swedish SR mutual funds to underperform in times of non-crisis.

The main results in this thesis could confirm the theoretical association between reduced diversification capabilities and worse financial performance discussed by Markowitz (1952). However, in the later five-year sub-period, the results deviate not only from theory, but also from previous literature.

This is since the SR mutual funds are estimated to overperform during this time. Even though the later sub-period is also considered as non-crisis on the Swedish market. This result could corroborate the effect mentioned by Barnett and Salomon (2006), who argue that the SR screening process increases fund performance because of the unique investment style. Another potential explanation for this change in performance might be due to learning mentioned by Bauer et al. (2005).

7.2 Future Research

This thesis found that the socially responsible (SR) mutual funds performed better in the later sub-period. This is similar to Bauer et al. (2005) who found in their article that SR mutual funds tended to increase their performance in the end of their studied period. They suggest that there existed a "…catching up-phase, due to learning", however, their time-period was 1990-2001. There might exist a phenomenon were the SR mutual funds in a business cycles catches up. This could be interesting to study further by using a cross country analysis for specific sub-periods.

Another characteristic that might be worthwhile to study is the differences in performance based on the mutual funds age. In the result section of this thesis, (see Table 11), young mutual funds, (although not significantly), tend to overperform the market. Furthermore, the young SR portfolio underperformed the conventional portfolio less than the old SR portfolio. It would be interesting to find out more about this mutual fund characteristics.

The legitimacy of the SR criteria could be necessary to further analyse. Utz and Wimmer (2014) found that SR mutual funds in United States between 2002 to 2012 on average did not hold more ethical assets than conventional mutual funds. The authors therefore argue that the SR label does not guarantee that the mutual fund did not contain less unethical stocks compared to conventional mutual funds. This result is an issue which the financial market needs to take into consideration since one of the key foundations of SRI is the legitimacy of the SR criteria. Since this criterion might differ from country to country, it might become relevant to study this from a Swedish perspective as well.

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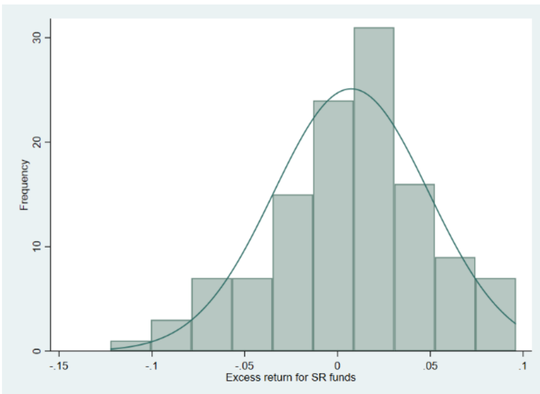
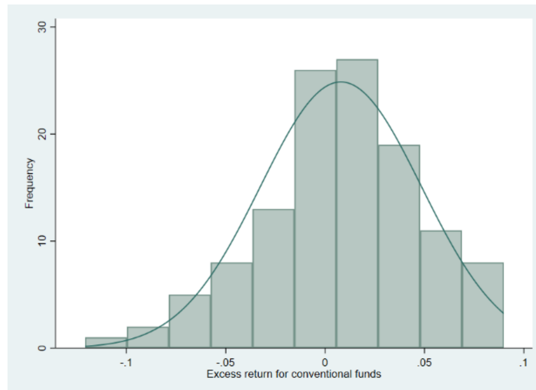
9. Appendix

Appendix A – Normal distribution of mutual fund sample: The normal distribution of the excess return for socially responsible and conventional mutual fund sample.





Click on me to get back to portfolio construction
Click on me to get back to F-test

Appendix B – Socially responsible and conventional mutual fund sample: The socially responsible and conventional mutual fund sample stated in Bloomberg-tickers (SS Equity).

		The SR mutual fund sample		
BANHJAL	BANSAMA	CARSVER	CSRISVB	SWEMJOS
BANHUMA	BANSVER	CARSVKO	SEBETAK	SWESVMG
BANIDEE	BANSVSP	CARSWMC	SEBSVST	TRETIII
BANKULT	CARSMAB	CARVARL	SVEMILJ	
		The conventional mutual fund sample		
ABSMABO	DGAKTIE	HBOFOND	NOREQSW	SIMINOR
AKSVERA	DIDGERS	HQSVEAA	OHMNRNI	SKAASMS
AKTIESV	DSVERIG	HQSVERA	OHMSVER	SKAASVE
AKTIEVA	DSVFOKU	HQSVSEL	PSGSMAL	SKASOFF
ALFSREA	ENTSELE	HREAVIN	QSVERIG	SKASWST
ALFSVEA	ENTSPRO	HSMABOL	ROBAFIA	SPADALA
AMFSMAB	ENTSVER	KAUSMAB	ROBAFVA	SPAKSTA
BANINOV	ENTSVFK	LANFAST	ROBAIIA	SPASMAL
BANSMAB	FOKLOSV	LANNORA	ROBEXPA	SPPAKSV
CARCANC	FOLAKSA	LANSMAA	ROBIIIA	STAKSVE
CARNSMA	FOLOVFD	LANSMAB	ROBSVMA	SWHKYFD
CASE	FOLTJSV	LANSVER	SEBSSCR	SWSMANO
CATREAV	GDAKSVE	MERNOAL	SEBSVA1	SWSMSVE
CATSVSE	GUSTSVE	MERNOBE	SEBSVA2	SWSTSVE

CATTENS	HANDAST	MERNOOL	SEBSVAK	SWSVAKT
CIMOSVB	HANNORS	MERNOSE	SEBSVCR	SWSVERG
DAKJSMA	HBNSA1S	MERNOSV	SEBSWFO	SWVASAL
DAKJSVE	HBNSB1S	NEQSTRA	SEBSWVF	TANGEQY