How to choose green?

A comparative study in active and passive management for sustainable funds

Abstract:
This paper investigates if there is any difference between active managed funds and passive managed funds in regard to their risk-adjusted return. The thesis focuses on Swedish sustainable funds that invest in accordance with the ESG (environmental, governance and social) criteria during the time period 2011-2021. By using two models, the Capital asset pricing model and Carhart's Four-factor model we retrieve explanatory information for the return. Further, risk-adjusted measurements were used such as Jensen's Alpha, Sharpe ratio and Treynor ratio to draw the analysis. Finally we include the different expense ratios to see if any of the portfolios outperforms. The results vary between the different portfolios that we created. The active large cap portfolio performs better than the passive large cap portfolio in regard to its costs, i.e. expense ratio. When comparing the portfolios in the broader mixed segment the passive portfolio shows better performance than the active portfolio.

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1 Introduction

In the introductory section a background for the subject we are investigating is presented. Afterwards the purpose, research question and the hypotheses are stated, followed by a short description of the disposition for this thesis.

1.1 Background

Funds are a popular investment alternative in Sweden, since the first Swedish funds creation in the 1950s the popularity has had a steady increase. According to Fondbolagens Förening (2021) 8 out of 10 Swedish citizens invest in funds and if you include the pension system in Sweden everyone born 1938 and later with an income are investing in funds. The number of private investors and the value of the Swedish fund market are at historical top levels. Statistics from SCB (2011) indicate an increasing number of private investors and that the supply for different funds keeps increasing (Fondbolagens förening, 2021).

Sustainable funds have also increased in popularity during the last decade. According to a recent study from EFAMA (European Fund Asset Management Association) the net growth of sustainable funds increased 37,9 % in 2020 (EFAMA, 2021) which indicates a high growth in sustainable funds. There is a large variety between different funds when comparing performance as well as underlying assets. This report will focus on funds with an environmental label called ESG (Environmental, Social and Governance), henceforth they will also be known as sustainable funds.

A former study has shown evidence that there is almost no difference in risk-adjusted returns between active and passive managed conventional funds if accounting for momentum in individual stocks (Carhart 1997). Our aim is to investigate if this holds true for sustainable funds as well. Which raises the question:

- Is there an advantage of investing in active managed sustainable funds in regard to risk-adjusted return compared to passive managed sustainable funds?

1.2 Purpose

The purpose of this thesis is to analyze how the return differs between active and passive managed funds in the sustainable fund segment. This is done by comparing the risk adjusted return for active managed sustainable funds with passive managed sustainable funds using several performance measures. During the last decade the number of sustainable investments and their net capital have had a rapid growth. A comparative study by Asker et al. (2017) has shown that sustainable investments show the same risk adjusted return as conventional funds. Since the study suggests that the return does not differ between conventional and sustainable funds one can assume that the environmental advantage with sustainable funds clearly exceeds the conventional funds without reducing the risk adjusted return. Based on this assumption this thesis aims to reach a logical conclusion to see if there is any advantage in investing in active managed sustainable funds.

We will compare the performance of active managed sustainable funds to index funds i.e. passive funds, in the same field. To do so we will employ two models, the Capital Asset Pricing Model (CAPM), and Carhart's Four-factor model. The three factor Fama French model will be introduced in the Method section to give the reader a better understanding of the Carhart's four factor model. When comparing the funds, we will construct four different portfolios which will be covered in the Data section.

1.3 Hypotheses

By running models CAPM, Carhart and Fama and French factors the estimate of the expected returns were generated for the different portfolios. The regressions have generated betas and alphas to explain the systematic risk and excess return for each one of them. From these conclusions has been drawn on the performance of the portfolios.

In line with research of Chen and Scholten (2018) we measure the performance of the funds by taking their expense ratio into consideration. We want to know the proportion of the risk-adjusted return the expense ratio makes up for. The expense ratio is defined as the total annual costs for running the fund and is expressed as a percentage of the fund's net assets. By testing the relationship between alpha and expense ratio we are able to get an understanding of the performance after total fees. The outperformance of a fund has the following hypothesis:

Hypothesis 1

$$H_0: \alpha = -\frac{expense\ ratio}{12}$$

$$H_a: \alpha > -\frac{expense\ ratio}{12}$$

If the null hypothesis is rejected we can say that it is significant that the alternative hypothesis is true and thus alpha (excess return) is greater than the expense ratio. In this case it would be profitable to invest in the fund. And if they underperform:

Hypothesis 2

$$H_0: \alpha = -\frac{expense\ ratio}{12}$$

$$H_a: \alpha < -\frac{expense\ ratio}{12}$$

If the null hypothesis is rejected it is significant that the alternative hypothesis is true and the fund is underperforming. Thus the extra cost for holding this portfolio is not motivated.

Based on the results from Chen and Scholten (2018), which we will present in section 2.1, we expect that passive managed funds in most cases tend to give a higher alpha than active managed funds. Which means that we expect to not find sufficient evidence to conclude that there is an advantage in investing in active managed funds.

1.4 Disposition

This thesis is constructed in the following way: in the next section we present a literature review of former studies where we focus on our main source of inspiration for this thesis. The section also contains the efficient market hypothesis. In the third section, the method is introduced where we cover the theory of our models and performance measures. Afterwards the Data section is presented where we go through the data screening process and the construction of our portfolios. Lastly the statistical testing begins where we present the assumptions test followed by the result and a conclusion.

2 Literature review

In this segment former studies related to our subject will be reviewed and summarized with the main focus on our source of inspiration.

Numerous studies during the last decades have evaluated the difference in performance for active and passive management for conventional funds. Though there are studies that suggest that some active fund managers can outperform their index benchmark (Berk and Van Binsbergen, 2015), the general result is that there is not enough evidence to conclude that active management is the better option when comparing alphas i.e. risk adjusted excess return (Doshi, Elkamhi and Simutin, 2015). When concentrating on socially responsible investments, most studies compare ESG funds with conventional funds (Capelle-Blancard and Monjon, 2012). Instead of comparing ESG funds with conventional funds we want to compare active ESG funds with passive ESG funds and evaluate if the results on conventional funds are applicable to socially responsible investments in the Swedish market. Our main source of inspiration was the study by Chen and Scholten (2018) which focused on comparing the performance between active and passive managed SRI (Sustainable Responsible Investments) funds in the U.S. market.

2.1 Source of inspiration

In 2018 Chen and Scholten (2018) wrote the article *The urge to act: A comparison of active and passive socially responsible investment funds in the United States*. In their research they compared active and passive SRI funds in the United States for the time period 2004-2015. Their goal was to try and provide evidence that active managed SRI funds performed better than passive managed SRI funds. The results from their study did not provide any persuasive evidence of this claim which suggests that the average investor should choose the passive SRI funds. When comparing active and passive managed funds Chen and Scholten used the Carhart model to explain the potential excess return from a market benchmark.

These four factors are the factor loading on the market premium, firm size, book-to-market return and momentum factor. Chen and Scholten continue to establish an hypothesis test to measure the performance of the funds. Here they take the expense ratio for the funds into account. i. e. the annual operation cost for running the funds as a percentage of the fund’s net asset (Chen and

Scholten, 2018). We will use the same test on Swedish funds and the hypothesis test were examined more closely in the hypotheses section.

Chen and Scholten (2018) arrive at the results that active SRI funds tend to generate better alpha's than passive ones but in most cases the results are not significant. Thus, an investor would not be able to make larger risk-adjusted returns from investing in active portfolios with one exception, Environmental funds, i.e. funds investing in solar, wind and biotech, where active portfolios outperform the passive ones with significant results (Chen and Scholten, 2018). Their findings, when taking the expense ratio into account, is that there is a lack of outperformance in active managed funds, especially for social and environmental funds. Thus, the additional returns from investing in these funds are canceled out from the higher costs and there is little justification in investing in them.

3 Theory

In this section the theory framework for the modern portfolio theory and the efficient market hypothesis are presented.

3.1 Modern portfolio theory

Modern portfolio theory is a model first introduced by Markowitz (1952) in his paper *portfolio selection*. The author presents a method so that the investor can maximize the expected return within a certain level of risk. By the time the paper was written there were two rules to how one should pick investments. The first rule was that an investor could estimate the return of an investment by discounting the future expected returns to present values. This rule does not make any assumption about an investor being averse to risk. Thus, in this case the security with the higher expected return will always be the best option. Modern portfolio theory assumes that high anticipated returns are desirable, and that risk is undesirable (Markowitz, 1952). Markowitz therefore introduces a theory where the investor should take the variation of stock returns into consideration when constructing a portfolio. By increasing the number of stocks into the portfolio one will be able to gain the same expected return but with lower overall variance, and therefore lower risk. This can be calculated through the expected returns - variance of returns rule or as

Markowitz calls it, the E-V rule (Markowitz, 1952). This is a model that offers different expected returns and variance of the return through the combination of different securities.

With this model the investor gets different options of a portfolio with several combinations of expected return and risk. Through this derivation there will be an optimal portfolio that offers the highest return for the smallest amount of risk (Markowitz, 1952). Markowitz also argues that just increasing the number of stocks does not take the model's full potential into account. One should aim for the "right kind" of diversification (Markowitz, 1952). By combining stocks from different industries, i.e. stock with little covariance, the variation in an optimal portfolio will be smaller than a portfolio with stock with high covariance (Markowitz, 1952). This is a result of the fact that it is more likely that firms in the same industries are doing poorly at the same time. Through this method the risk that is held by a specific company or industry, sometimes referred to as *idiosyncratic risk*, could almost be eliminated.

3.2 Efficient market hypothesis

Efficient market hypothesis is the theory that claims that a market is efficient when the prices fully reflect all available information (Fama, 1970). A study by Kendall (1953) showed that there is no correlation between historical prices and thus the prices could be seen as a random walk, i.e. historical prices do not affect present prices. The conclusion is that the only thing affecting the prices is new information and since the stakeholders in the market do not have access to new information before it is presented one cannot predict the changes in advance. Thus, it can be seen as random.

The concept could be explained by a scenario where it is evident that a stock would increase to a certain level in the future, investors would then want to buy at the current price to gain profit. At the same time present holders of the stock would not want to sell for any less than the expected future price, thus the price would rise to the expected value. The theory is divided into three categories, the weak, semi-strong and strong form of an efficient market (Fama, 1970). They are distinguished by what information is considered. In the weak form hypothesis, the information set are historical prices. In a weak form hypothesis technical analysis would for instance not be useful to beat the market, but in this form an investor could find opportunities with a fundamental analysis. The semi-strong form takes into concern all available public information, for example announcements of annual earnings, stock splits etc. The strong form suggests that prices also reflect information such as insider information, if this is the case one could not be able to find profit opportunities even if one had information that was not public.

4 Method

For the following section we start with briefly explaining our choice of method. Then we move on to the theory behind our models, CAPM and Carhart's four factor model. We briefly explain the details behind the Fama-French three factor model and finally we go through the performance measures, i.e. Sharpe Ratio, Treynor Ratio and Jensen's alpha.

4.1 Choice of method

In order to compare the performance on active and passive managed sustainable funds we have implemented a quantitative method which is convenient since the report consists of a large sample and continuous data (Bryman, et al, 2018). The report aims to reach a logical conclusion from our hypothesis which were based on already established theories, i.e. a deductive approach. By implementing our dataset in STATA, we were able to retrieve our regressions. When comparing the performance of funds just taking returns into account is not enough. It is expected that an asset that carries more risk should yield a larger return to make up for the risk held. Thus, when comparing the performance of funds it is important to calculate the risk-adjusted return. When adjusting for risk there are a few methods mainly used which we will examine in this section.

4.2 Capital asset pricing model

The capital asset pricing model was developed through conclusions drawn by previous research in Modern Portfolio Theory. This suggested that through diversification idiosyncratic risk could be eradicated (Markowitz, 1952). Sharpe then came to the conclusion that if all investors were seeking to find an optimal portfolio, i.e., where idiosyncratic risk is eradicated, then in equilibrium there will be a simple linear relationship between expected return and risk for efficient combinations of risk assets (Sharpe, 1964). Through following the rational procedure of diversification, the investor will be able to pick different combinations of risk and return on the line named the capital market line. Since the theory implies that the rate of returns only comes from combinations of risk minimized portfolios one can expect that the risk on the capital market line comes from variations in the overall economic activity, more commonly known as systematic risk. Through this research the capital asset pricing model could be constructed. The linear relationship described by Sharpe results in following equation to estimate the price of assets:

$$\mathrm{E}[R_i] = r_f + \beta_i(E[R_{Mt}] - r_f) + e_{it} \qquad (4.1)$$

$E[R_i]$ = Expected return for portfolio i
r_f = Risk-free interest rate
β_i = Measure of systematic risk for portfolio i
$E[R_{Mt}]$ = Expected market return
e_i = Error term

4.3 Fama-French three factor model

Although CAPM has been effective in measuring risk-adjusted returns, research by Fama and French (1996) has identified several patterns that are not described by the model. There has been evidence that shows that the average return is related to a firm's size, book-to-market equity, earnings/price, cash flow/price and past sales cash flows. These factors are not captured in CAPM and can be thought of as anomalies to the expected return estimated by the model (Fama and French, 1996). Fama and French argued that these factors were related and that they could be combined to two factors that captured variations in prices that CAPM did not. Apart from the excess return from the broad market portfolio, which we also find in CAPM, they added a factor called SMB to capture the difference in return from a portfolio of small stocks and a portfolio of large stocks. There was then a third factor included called HML to capture the effect on prices between the difference on return on a portfolio with high-book-to-market stock and the return on low-book-to-market stocks. These added factors made up for expected premiums and the sensitivity a portfolio had to them was slope coefficient. Firms with low book to market value will have a negative coefficient on the HML-factor and thus they are expected to yield lower returns, whereas high value firms will have a positive coefficient on HML and are expected to have higher return. There is evidence that there is a relationship between small stocks and higher returns which CAPM fails to capture. This effect is captured by the SMB-factor which has a positive coefficient if the portfolio consist of small firms and negative if it consists of large firms. (Fama and French, 1996). These factors result in the Fama-French three factor model (Fama and French, 1996).

$$R_{it} = \alpha_i + \beta_{iM}R_{Mt} + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + e_{it} \quad (4.2)$$

Additionally, from equation 4.1, following variables are added:
SMB_t = Size factor (small-minus-big)
HML_t = Book-to-market factor (high-minus-low)

4.4 Carhart four-factor model

Carhart's four-factor model is based on the idea of hot hands and is derived from research by Jegadeesh and Titman on momentum in stocks (Carhart, 1997). Jegadeesh and Titman found that stocks that have positive returns in the past tend also tend to do so in the subsequent period, meanwhile stocks that have failed to perform in the past seem to do so as well in the future. Thus, one could implement a strategy of buying winners and selling losers to gain a profit. Carhart proceeds from the Fama and French three-factor model to build the four-factor model that also takes the momentum factor into account. He was able to show that the momentum factor could explain a substantial amount of variation but at the same time have a low cross-correlation to the factors in the Fama and French model, this imply that multicollinearity does not affect the model. Thus, this could improve the pricing error of the three-factor model. The factor that captures the momentum have had various names in finance research but in this thesis, we have decided to go with UMDt which is short for up-minus-down. It is constructed by taking long positions in winning stocks and short positions in losing stocks. With this added factor the equation for the model is as follows:

$$R_{it} = \alpha_i + \beta_{iM}R_{Mt} + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + \beta_{iUMD}UMD_t + e_{it} \quad (4.3)$$

Additionally from equation 4.2 we also add the following variable:
UMD_t = Momentum factor (up-minus-down)

4.5 Jensen's Alpha

Jensen's alpha is a tool to measure the performance of a portfolio in absolute terms. Previous to this theory the measurements had been relative i.e., comparing one fund in relation to another (Jensen, 1967). The concept of portfolio performance can be divided into two dimensions. It is to measure the ability of a portfolio manager to increase returns through prediction on future prices and the ability to minimize the risk for holders of the portfolio (Jensen, 1967). Since investors are risk averse, securities that carry higher risk must yield higher returns, hence when measuring performance, the degrees of risk must be taken into account.

The theory behind Jensen's alpha is derived from the Capital Asset Pricing Model and developed by Sharpe, Lintner and Treynor (Jensen, 1967). The Capital Asset Pricing model tells us what a portfolio can expect to earn given a certain level of systematic risk. Through simple algebra the equation of CAPM can be re-written as:

$$E[R_i] - r_f = \beta_i(E[R_{Mt}] - r_f) + e_i \tag{4.4}$$

Variables are the same as in equation 4.1

It is evident that the excess return of portfolio i is $R_i - R_f$ and that it depends on the market return multiplied by the risk coefficient $\beta_i$where the expected error is equal to zero. If a portfolio manager possesses skills to be a superior forcaster one can expect higher returns at the expected level of risk, thus this would imply that $e_i > 0$. By adding a non-zero constant to the equation we allow for the regression to not only pass through the origin. The equation would then look like:

$$R_i - R_f = \alpha + \beta_i R_{Mt} + e_i \tag{4.5}$$

We reach the conclusion that a portfolio manager's predictive ability can be measured as the ability to earn returns that are different from what is expected at a certain risk level. Thus $\alpha > 0$ would imply that the managers had made better results than what is expected, $\alpha < 0$ that it is worse and $\alpha = 0$ that the performance is what is expected.

4.6 Sharpe Ratio

Sharpe ratio is a reward to volatility ratio introduced by William Sharpe. It is a common measure to evaluate the performance of different investments. It divides the risk premium by the standard deviation of the portfolio. The standard deviation can be considered as the overall risk of the portfolio. The risk premium is calculated by taking the expected return of the portfolio and subtracting the risk free-rate. The formula is expressed as (Bodie et al, 2021):

$$\frac{E(r_P)-r_f}{\sigma_P} \tag{4.6}$$

$E[r_p]$ = Expected return for portfolio p
r_f = Risk-free interest rate
σ_P= Idiosyncratic risk

4.7 Treynor ratio

The Treynor measure is similar to the Sharpe ratio but instead of idiosyncratic risk it uses systematic risk, i.e., risk that affect the whole market and is denoted by . To evaluate the systematic risk, we use CAPM and Carhart's four factor model. The formula is expressed as (Bodie et al, 2021):

$$\frac{E(r_P)-r_f}{\beta_P} \tag{4.7}$$

$E[r_p]$ = Expected return for portfolio p
r_f = Risk-free interest rate
β_P = systematic risk

4.8 Expense ratio

The expense ratio is the annual operating and management costs for running a fund. It is taken as a percentage of an investor's assets and is usually reflected in the funds daily net asset value. It is calculated as the total fund costs divided by the total fund assets.

$$Expense\ ratio\ = \frac{Total\ fund\ costs}{Total\ fund\ assets}$$

By taking a percentage of the invested assets the fund reduces the return to investors. A former study by Redman and Gullet (2007) found that funds with a higher expense ratio tends to have lower returns. It is common that expense ratios are higher for active managed funds compared to passive managed funds. According to EFAMA (2021) the expense ratio consists of a few different fees on an ongoing basis. These are management fees, distribution retrocessions fees and other expenses. The management fees are the fees that the shareholder pays to the manager of the portfolio. For instance, an actively managed fund requires a team for research, the cost for these will be passed on to the investors in form of a higher expense ratio. The distribution retrocessions fee is a fee paid out to distribution organizations, for example banks or wealth managers, as a form of a commission for bringing in new business or clients. With the demand for support from distributors these fees also involve marketing and sales functions. Other expenses are a category that include providing services for the stakeholders such as accounting and client administration. This category also involves transaction cost for the trades the funds make.

5 Data

In the fifth section the screening process for the fund data and the construction of the portfolios is described as well as the data collection for the other factors.

5.1 Fund selection

During the negative screening process, we selected funds from a specific criteria list. As previously mentioned, this thesis aims to investigate specific mutual equity funds that focus on the Swedish industry, with an environmental label called *ESG*, both active and passive managed funds, available for Swedish investors. This thesis chose to not study other types of funds like hedge funds and exchange-traded funds. If the geographical allocation of the holdings in the fund were less than 50% in Sweden, they were also excluded. By using Bloomberg Terminal fund screening service and applying the criteria list stated below this thesis was able to generate a fund sample containing a total of 17 mutual funds, 3 index funds and 14 active funds.

- *Fund asset class focus: equity*
- *Fund type: fund of fund, closed end mutual fund or open-end fund*
- *Country of availability: Sweden*
- *Fund Geographical focus: Sweden*
- *Currency: SEK*
- *Market status: inactive, liquidated, acquired or active*
- *General attribute: ESG*

Though a sample of 17 funds can be small it contains the whole population for the aforementioned criteria and by combining the sample with the monthly excess return data for each fund we have still acquired significant test results. When determining the return for each fund, different approaches are possible, this thesis chose to obtain the Net Asset Value (NAV). The NAV is calculated from securities' closing prices for each trading day and is equivalent to the total assets of the fund. It also covers the reinvested dividends which makes it a good approach when comparing the historical performance. The NAV for each fund was collected from the time period 2011-08-31 - 2021-08-31 with a monthly time frequency.

By applying the general attribute, *ESG*, we exclude funds that are not identified as a fund company who invests in companies compliant to the ESG criteria i.e., environmental, social and governance factors have to be integrated in their investment strategy (Bloomberg, 2013).

5.2 Portfolio construction

With the gathered data, we construct four equally weighted portfolios depending on the market cap segment of the underlying assets and the type of management. We divide the portfolios in active and passive managed portfolios which are then further divided into two additional subgroups, large cap and mixed assets. Mixed assets are funds that invest in all cap categories i.e., small, medium and large. We exclude two active managed funds because their underlying assets focus merely on the small cap segment which none of the passive funds are. Therefore, we cannot compare the active small cap funds with passive small cap funds.

5.3 Bias

When collecting data, it is important to comprehend potential biases that might occur in the process of assembling data. One of the potential biases is the survivorship bias, therefore the selected list of funds also includes inactive and acquired funds which means funds that have existed during the time period but have either been liquidated or merged with other funds. When including inactive funds, one minimizes the risk of survivorship bias. When including only funds that have survived the time period the performance results will be better than the full sample of funds (Brown et al., 1992).

5.4 Benchmark

We have selected the SIX RX index as the benchmark in this thesis. Since this index covers the average return, including dividends, on Stockholm Stock Exchange it is suitable to our data sample which consists of the monthly average return, including dividends, for funds who invest in Large, Mid and Small-Cap. We collected the index data from Bloomberg Terminal.

5.5 Risk free interest rate

A treasury bill is an asset which is the most unlikely interest-bearing security to suspend payments and can therefore theoretically be considered risk free according to Berk & DeMarzo (2013). In line with Fama and French (2010) we chose to use a 1-month Treasury Bill as a proxy which we retrieved from Riksbanken (2021).

5.6 Factors

For the Carhart four factor model and the Fama and French three factor model, additional factors apart from the index benchmark are needed. We collect the three factors, SMB, HML and UMD for the Swedish equity market from AQR's database with a monthly frequency (AQR, 2021). The factors are explained in the Method section. AQR is a global investment management firm with over 63 rewards for their research (AQR, 2021). They provide extended and updated data sets with factors for 24 equity markets, including Sweden. The factors are based on the research of Fama and French and Asness, Frazzini and Pedersen (Frazzini and Pedersen, 2014).

6 Results and Analysis

In the sixth section we present the descriptive statistics of our data and the results from our regression models. Thereafter the results from the performance measures and the results from our hypothesis tests are also presented.

6.1 Descriptive statistics

Descriptive statistics are presented below in table 6.1 where the main characteristics of the data sample is specified. The descriptive statistics table contains the return, risk and the number of observations, By comparing the results from the portfolios we screen for outliers. We will also later on use the average return and standard deviation for calculating the Sharpe ratios.

Table 6.1 Descriptive statistics

	Active Large	Active Mixed	Passive Large	Passive Mixed	SIX Index
Average Return	1.2%	0.95%	1.01%	1.22%	1.21%
Median Return	1.39%	1.18%	1.21%	1.7%	1.51%
Max	11.8%	10.6%	11.7%	11.9%	11.49%
Min	-17.0%	-15%	-12.5%	-13.3%	-13.10%
Standard Deviation	4.44%	4.44%	4.25%	4.33%	4.24%
Number of funds	2	10	2	1	1

Note: The table shows the index and all the funds in our data sample.

From the table above we do not find any substantial differences between our portfolios and therefore choose to keep all the funds in our portfolios since we could not find any harmful outliers from the descriptive table. The portfolios contain different numbers of funds, but since the underlying assets are diversified we see approximately equal standard deviation and therefore deem that this imbalance in the number of funds does not affect the results.

6.2 Correlation

Additionally, when running multiple regression models, it is advised to evaluate the presence of correlation between the factors. If the factors are correlated, the regression models may generate results that could be skewed and misleading. When there is a high correlation between two independent variables the problem occurs. By creating a matrix where the correlation between the variables are stated, one can easily screen for any high correlation. As shown in the table 6.2, none of the independent variables have a high correlation with each other.

Table 6.2 Correlation matrix

	mktrf	smb	hml	umd
mktrf	1			
smb	-0,0669	1		
hml	0,1374	-0,0083	1	
umd	-0,1616	-0,0449	-0,1257	1

Note: The results from the correlation matrix for the independent variables

6.3 Regression results - Single Index Model

In table 6.3 the single index model for the different portfolios are found. Comparing the results, we see that all of them are underperforming compared to the benchmark index. We find significance for the negative alpha for the two mixed portfolios at 1 %, respectively 5 % significance level which suggests that the mixed portfolios underperform the market. Even if they both underperform, the results for the passive portfolio are slightly better. For the large cap portfolios, the active managed portfolio seems to estimate a better alpha value, with a p-value at 0.0097 which is statistically significant at 1 %. The Passive Large Portfolio is also significant, but the performance is worse than the active.

Further we can see that the regression seems to be a good fit, in regard to beta. With beta significant at 1% for all portfolios. All portfolios have $\beta > 1$, this indicates that the portfolios are more sensitive to systematic risk than the benchmark index. When comparing betas in regarding how they are managed, we see that the Active Large is exposed to higher systematic risk than the Passive Large Portfolio. We can also see that the Passive Mixed Portfolio is subject to less systematic risk than the Active Mixed, thus we can draw the conclusion that the actively managed funds are more sensitive to broad economic fluctuations overall. This is in line with the theory of an efficient market hypothesis where a portfolio with a beta of one, act just like the market. Lastly, most portfolios show rather good R-squared values with all of them having results over 90%. Thus, a substantial amount of the variance in the portfolios is related to the market return.

Table 6.3: Single Index Model Portfolio Results

	Large Active	Mixed Active	Large Passive	Mixed Passive
α	-0.0019***	-0.0042***	-0.0033***	-0.0015**
	(0.0097)	(0.0000)	(0.0002)	(0.0280)
β	1.0513***	1.0417***	1.0126***	1.0408***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R-squared	0.9405	0.9424	0.9536	0.9655
N	120	120	120	120

Note: The results from the equation 4.1, Single Index Model

* Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

6.4 Regression results - Four-Factor Model

When evaluating the results from the four-factor model we see in table 6.4 that the R-squared values have improved slightly from the single-factor model (table 6.3). The takeaway from this is that the additional factors have improved the level of explanation power in all portfolios. Thus, the Carhart model explains the variance of the portfolios better than CAPM. We can also ascertain that all portfolios show β_{iM} at a significance level of 1%. Like the single factor model all portfolios have positive β_{iM} and they are all exposed to more systematic risk than the benchmark index. Although there is not a large difference in coefficients from the single-factor model there are some new interesting results.

The β_{iM} for the Active Large Portfolio has increased, and at the same time there is evidence for a smaller β_{iM} for the Passive Large Portfolio. Thus, the outcome is that the actively managed portfolio is even more sensitive to systematic risk, compared to the passively managed portfolio that first was established. It is also worth noticing that the passive portfolio β_{iM} (1.0066) in table 6.4 is now very close to the being exposed to the same systematic risk as the benchmark index, i.e., is equal to one. The difference between the mixed portfolios has now changed in an interesting way where the Passive Mixed Portfolio is now exposed to more systematic risk than the Active Mixed Portfolio, which is the opposite case in the single-index model.

When it comes to the other factors the results vary. When evaluating the Large Active Portfolio it is now evident that some of the variance is explained by the SMB factor at a significance level of 1%. The positive value of the coefficient indicates that when prices in small stocks rise so does the portfolio. This could seem contradictory since it is a portfolio constructed by large stocks. HML factor indicates a negative relationship between the portfolio with high-book-to-market stocks at a significance level of 10%. This shows that the returns go down as high value stocks go up. Since both of these factors are significant, we can clearly see that we have improved the estimation of the independent variable and we get a better idea on how sensitive this portfolio is to systematic risk. UMD indicated a negative relationship with the return of the portfolio, but with a rather low significance level which makes it unsuitable to draw conclusions in an analysis. It is also evident that this portfolio underperforms compared to the market, i.e., display negative alpha with a level of significance at 5%.

When evaluating the results for the Passive Large Portfolio we see that, like the Active Large, some of the variance is being picked up by the small-minus-big factor. This shows a negative relationship to the returns at a significance level of 5%. The negative value of the coefficient indicates that when prices in small stocks rise the return of the portfolio goes down. Unlike the Active Large Portfolio this is the result that one could expect by adding this factor. This portfolio presents a negative alpha with a significance level of 5%.

When evaluating the Active Mixed Portfolio, we see that neither of the added factors are significant, thus this model does not offer any improvements from the single factor model. The same is true for the Passive Mixed Portfolio where the only factor that is significant is the market-factor, thus the four-factor model does not give us additional information from the single-factor model.

Table 6.4: Four Factor Model Portfolio Results

	Large Active	Mixed Active	Large Passive	Mixed Passive
α	-0.0021***	-0.0039***	-0.0027***	-0.0017*
	(0.0065)	(0.0010)	(0.0035)	(0.0580)
β	1.0570***	1.0434***	1.0066***	1.0466***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
SMB	0.1099***	0.0497	-0.0684***	0.0336
	(0.0006)	(0.1530)	(0.0030)	(0.1220)
HML	-0.0016*	-0.0402	-0.0199	-0.0447
	(0.0972)	(0.3280)	(0.4120)	(0.2350)
UMD	-0.0049	-0.0376	-0.0316	-0.0009
	(0.8720)	(0.2610)	(0.3360)	(0.9800)
R-squared	0.9459	0.9446	0.9562	0.9667
N	120	120	120	120

Note: The results from the equation 4.1, Single Index Model
* Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

6.5 Sharpe and Treynor ratio

Table 6.5 gives the results from the different performance measurements. When evaluating the results, we will start by looking at Jensen's alpha. For the single factor model we see that the Passive Mixed Portfolio is giving us the least negative alpha. Both the Active Mixed and Passive Mixed portfolios have significant alpha-values, and it is possible to make the assumption that a passively managed portfolio is doing better, but both are underperforming when compared to the benchmark index. When looking at the large cap portfolios the opposite relationship is present. The active portfolio is doing better than the passive portfolio. When running the regression for the four-factor model we still acquire alphas that indicates that all portfolios are underperforming. When comparing the mixed portfolios we see similar results as in the single factor model, where the passive portfolio is performing best out of the two but still underperforms the market. In the case of the large cap portfolios the active one is still the one with the better results. The effect of the added values has narrowed the gap and the difference is no longer as substantial.

Table 6.5: Summary of Performance Measurements Results

	Active Large	Active Mixed	Passive Large	Passive Mixed
Sharpe ratio	0.2680	0.2227	0.2263	0.2828
Treynor ratio (Single-factor)	1.1319	0.9408	0.9487	1.1818
Treynor ratio (Four-factor)	1.1258	0.9392	0.9543	1.1752
α(Single-factor)	-0.19%***	-0.42%***	-0.33%***	-0.15%**
α(Four-factor)	-0.21%***	-0.39%***	-0.27%***	-0.17%*
Expense Ratio (monthly)	0.10%	0.13%	0.02%	0.05%

Note: The results from the Sharpe and Treynor ratios, equation 4.6 and 4.7, and a summary of the alphas with the expense ratio.

* Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

When it comes to the Treynor ratio, from table 6.5 we see similar patterns to those of Jensen's alpha. When calculating the Treynor ratio with the systematic risk estimated by the single-factor model it is evident that the Passive Mixed Portfolio is giving the best risk-adjusted return with a ratio at 1.1752. The Active Mixed and Passive Large have the worst Treynor ratios with values below one. This means that by holding these portfolios one would be taking a higher unit of systematic risk than what one is being rewarded in return. When calculating the Treynor ratios from the estimates of the four-factor model the Treynor ratios are slightly lower for all portfolios except the Passive Large that has now received a higher risk-adjusted return. When evaluating the differences between risk-adjusted returns, regarding systematic risk, the actively managed portfolio is doing better for the large cap portfolios and the opposite is true for the mixed portfolios.

The last measurement was the Sharpe ratio, this measures each portfolio's ability to generate risk-adjusted returns in regard to idiosyncratic risk i.e. firm specific risk and not risk that can be explained by the broad economic fluctuations. In table 6.5 we can see that the Passive Mixed

Portfolio does better than the Active Mixed with a Sharpe ratio at 0.28 compared to 0.22. For the large cap portfolios, the active portfolio is doing better with a Sharpe ratio of 0.27 compared to 0.23.

6.6 Expense Ratio

When analyzing the expense ratio, we state two hypotheses. Performing hypothesis 1 and 2 we have used a student's t-test, in table 6.6 we present the results from the two hypotheses in section 1.3. Rejecting the null hypothesis for the first hypothesis indicates the portfolio is outperforming. Rejecting the null hypothesis for the second hypothesis indicates that the portfolio is underperforming. From the table the conclusion we can see is that when running the first hypothesis we did not manage to reject the null hypothesis for any of the portfolios. Thus, we have evidence that neither of the portfolios manage to outperform. In the second hypothesis we test if the portfolio underperforms. The null hypothesis could be rejected at a significance level of 5% for the Passive Large Portfolio, whilst for the Active Large Portfolio we could not reject the null hypothesis. For the Active and Passive Mixed Portfolio, we are also able to reject the null hypothesis at a significance level of 5%. Worth mentioning is that the sample for the Passive Mixed Portfolio only consisted of one fund which gives this comparison less weight in an analysis than the large cap portfolios.

In contrast to Chen and Scholten (2018) we found that depending on the investment strategy paying the extra fee for an active fund could actually be worth it. To clarify, when an investor wants to invest in the large cap segment for sustainable funds, the active funds tend to perform better and seem to justify their higher costs, i.e. higher expense ratios. If an investor wants to diversify their investments even further and invest in the mixed cap segment for sustainable funds the passive funds perform better even though they cannot justify their costs. Our assumption is that the large cap portfolios consist of more developed businesses that behave in a more expected manner, where investors know what to expect from these companies. A mixed portfolio makes it harder for a manager to generate great results and beat the market. It is not unreasonable to conclude that the mixed portfolios also include smaller companies that are still under development. Business in the ESG segment is for example likely subject to new technologies that are yet difficult to predict the future outcome of and thus hard to evaluate. Our conclusion is that in this case it is better to stick to a passive portfolio and rely on the theory behind the efficient market hypothesis.

Table 6.6 Outperformance and underperformance hypothesis tests

	Active Funds		Passive Funds	
	Large	Mixed	Large	Mixed
Hypothesis 1 Single	-	-	-	-
Hypothesis 1 Four	-	-	-	-
Hypothesis 2 Single	-	**	**	**
Hypothesis 2 Four	-	**	**	**

Note: The results from the first and second hypotheses.
* Significant at the 10% level ** Significant at the 5% level *** Significant at the 1% level

7 Statistical testing

In this section the statistical testing for the OLS assumptions is presented.

7.1 Homoscedasticity

With the purpose of finding the potential presence of homoscedasticity in our residuals we have used the White's test in Stata. The test assumes that heteroscedasticity could be a function of the independent variables, squared values and their cross products. The test consists of the null hypothesis H_0: Homoscedasticity, $\sigma_i^2 = \sigma^2$ and the alternative hypothesis H_A: Unrestricted heteroscedasticity, $\sigma_i^2 \neq \sigma^2$. The test generates a chi-squared value which is then compared to a critical value. If the test is statistically significant we can reject the null hypothesis and we have evidence of heteroscedasticity (White, 1980).

Table 7.1 White's test for homoscedasticity

H_0: homoscedasticity H_A: unrestricted heteroscedasticity

	Prob > chi2			
	Active Large	Active Mixed	Passive Large	Passive Mixed
Single index	0,0149	0,1593	0,4359	0,9539
Four Factor	0,6676	0,1704	0,9380	0,7118

Note: The result presents p-values from the White's test for the four portfolios.

By examining the table 7.1 above we see that the test indicates the potential presence of heteroscedasticity in the Single Index model at 5% significance level while in the remaining models we find sufficient evidence to assume the presence of homoscedasticity. Another test we can use to add more value to our assumption of the presence of homoscedasticity is the Breusch-Pagan test. The test determines whether we find evidence that heteroscedasticity is present in the residuals. The test consists of the null hypothesis H_0: Constant variance, i.e., homoscedasticity is present, and the alternative hypothesis H_A: Heteroscedastic variance. Similarly, to the White's test, if the test fails to reject the null hypothesis we can assume that homoscedasticity is present.

Table 7.2 Breusch–Pagan/Cook–Weisberg test for heteroscedasticity

H_0: Constant variance H_A: Heteroscedastic variance

	Prob > chi2			
	Active Large	Active Mixed	Passive Large	Passive Mixed
Single index	0,6445	0,1139	0,0001	0,9535
Four Factor	0,9879	0,1964	0,0003	0,9472

Note: The results from the Breusch–Pagan and Cook–Weisberg test for the four portfolios.

From the information provided in the above table 7.2 we find enough evidence to assume that homoscedasticity is present in all portfolios except the Passive Large where we reject the null hypothesis at 1% significance level and therefore have found evidence that we have heteroscedasticity. To deal with the heteroscedasticity problem we used robust standard errors.

7.2 Autocorrelation

Since we are working with time series data, there is a possible problem with autocorrelation. Autocorrelation means that residuals can be correlated with residuals from past time periods. If the error terms are correlated it violates the fifth OLS assumption, that the error terms should be independent. In order to examine the potential presence of autocorrelation in our data we used the Breusch-Godfrey test in Stata. The test has the null hypothesis H_0: No autocorrelation, and the alternative hypothesis H_A: Autocorrelation. If we reject the null hypothesis, we have evidence of autocorrelation. The test is derived from Lagrange multiplier testing which is why it is also called an LM test for autocorrelation (Godfrey, 1978).

Table 7.3 Breusch–Godfrey LM test for autocorrelation

H_0: no autocorrelation H_A: autocorrelation

Prob > chi2

	Active Large	Active Mixed	Passive Large	Passive Mixed
Single index	0,5302	0,1347	0,8314	0,0119
Four Factor	0,5011	0,341	0,901	0,0224

Note: The results from the Breusch–Godfrey test for the four portfolios.

From the table 7.3 we can deduce that there is sufficient evidence to reject the null hypothesis of no autocorrelation. The Newey-West procedure has then been used to account for the autocorrelation problems. Which means using HAC (Heteroscedasticity and Autocorrelation Corrected) standard errors. The procedure accounts for the presence of autocorrelation and homoscedasticity which we encountered in our times series data. The Stata command Varsoc is used to obtain the optimal lag length.

7.3 Normal Distribution

In order to not violate the assumptions for OLS we also tested the residuals for normality by using the Kernel density estimation in STATA. Which graphically illustrated that the residuals were normally distributed. We also want to assume that our data is normally distributed in order to calculate it in the general way for the standard deviation and means for the Sharpe and Treynor ratios. Testing the distribution, we plotted the excess returns for each fund group and found that they can be assumed to be normally distributed as the data can be graphically illustrated to show the classic shape of a normal distribution which is presented in the appendix in table A.1 - A.4.

8 Conclusion

In this thesis the purpose is to investigate whether it is worth investing in active managed funds or if one should stick to the less costly passive funds in the ESG segment. In an attempt to reach a conclusion, we ask the following question: Is there an advantage of investing in sustainable active managed funds in regard to risk-adjusted return compared to passive managed funds? To answer this, we compare performance measures and conduct a hypothesis, testing for how well the risk-adjusted returns for a portfolio absorbs their expense ratios.

From this study, we can conclude that the results of the research from the different portfolios vary depending on the mixed cap and large cap portfolios. For the large cap portfolios, we find that the active managed portfolio seems to give a better risk-adjusted return than the passively managed portfolio. The risk-adjusted return for the active large cap portfolio also seems to survive the expense ratio, indicating that the managers are justifying their work, but they do not create any extra profit. Although on the other hand, when taking the broader market portfolio into consideration, the results show an opposite relationship. In this context the passive portfolios seem to do better in terms of risk-adjusted returns. Further, we can see that neither of the portfolios generates alpha values greater than the expense ratios, therefore one pays a higher fee for the management of the portfolio than one gains in excess return. Based on this, when considering the broader market portfolio, it is not worth paying the extra fee for having a portfolio actively managed. These are the same findings that Chen and Scholten (2018) had, and our research seems to strengthen their conclusion.

As the popularity for sustainable investments keeps increasing, the supply for sustainable funds should also increase. For future research it would be interesting to take a larger sample when the sample space has increased, or one could broaden the sample region. For example, instead of just focusing on Sweden, one could research the whole Nordic region which should deliver a larger fund sample. That could perhaps produce better significant results. When the ESG segment is more developed it would also be interesting to see if the difference in risk-adjusted return between active and passive ESG funds is more obvious.

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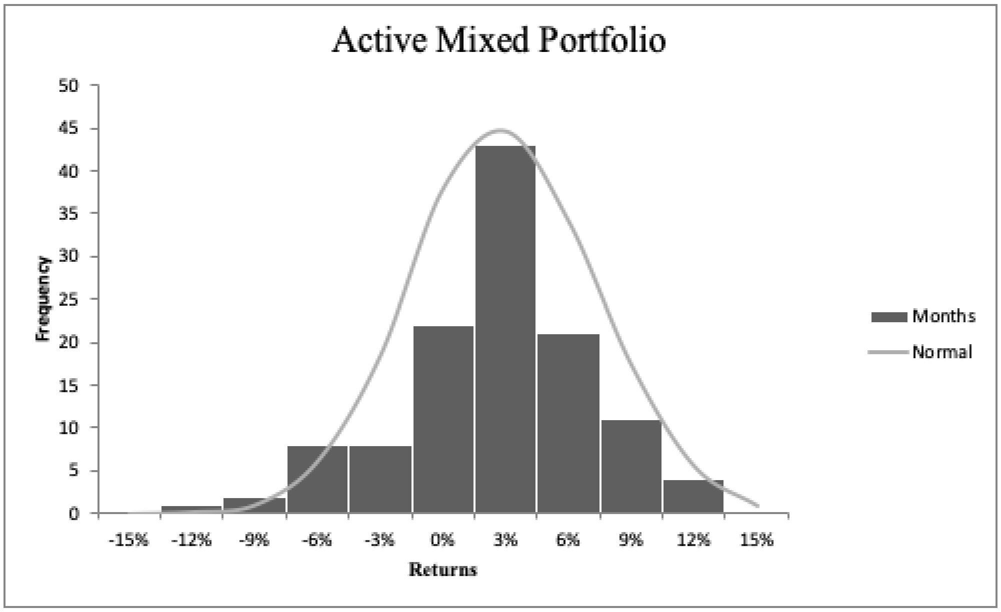
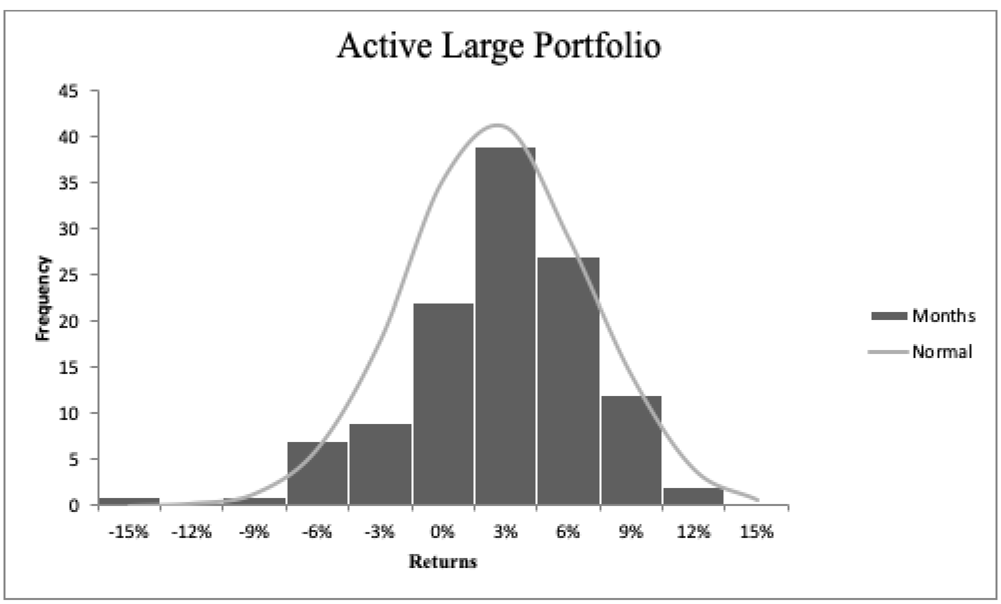
Appendix

Table A.1: Graphical illustration of Normality Distribution Active Mixed Portfolio



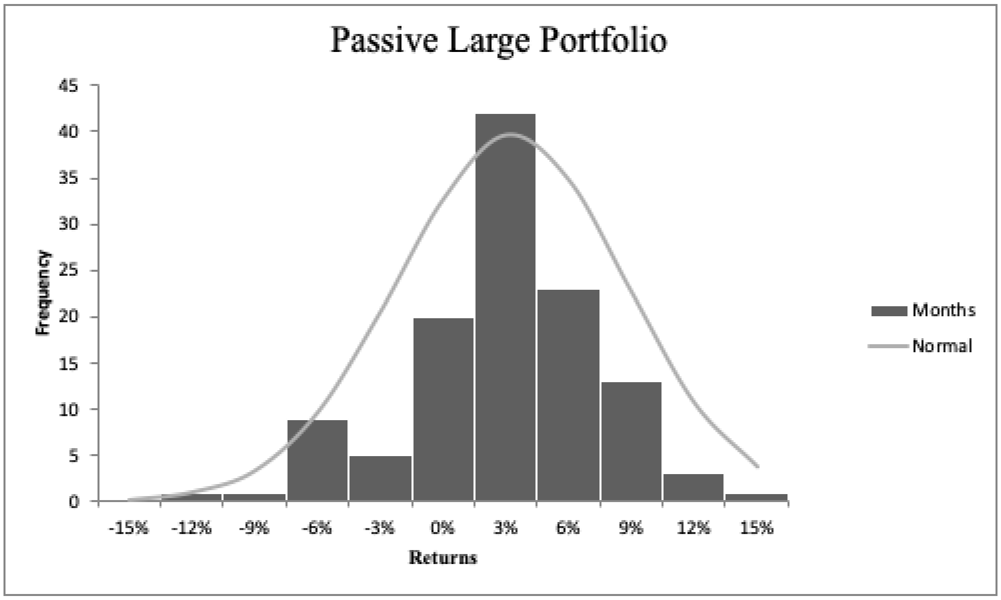
Note: Normal distribution of the monthly excess return for Active Mixed Portfolio

Table A.2: Graphical illustration of Normality Distribution Active Large Portfolio



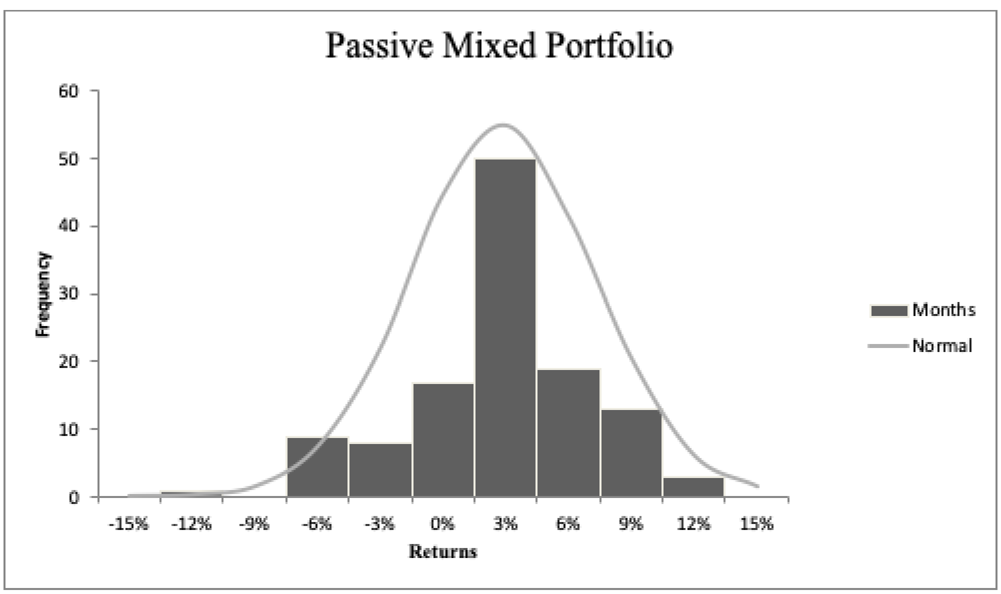
Note: Normal distribution of the monthly excess return for Active Large Portfolio

Table A.3: Graphical illustration of Normality Distribution Passive Large Portfolio



Note: Normal distribution of the monthly excess return for Passive Large Portfolio

Table A.4: Graphical illustration of Normality Distribution Passive Mixed Portfolio



Note: Normal distribution of the monthly excess return for Passive Mixed Portfolio

Table A.5: List of Funds

ALFRED BERG HÅLLBAR TILLVÄXT SVERIGE
BANCO ETISK SVERIGE SPECIAL
BANCO HJÄLP
BANCO IDEEL MILJÖ
BANCO SVENSK MILJÖ
HANDELSBANKEN SVERIGE INDEX CRITERIA
LÄNSFÖRSÄKRINGAR SVERIGE INDEX
NORDEA SWEDISH STARS
SAMARITFONDEN
SEB HÅLLBARHETSFOND SVERIGE INDEX D
SEB- SVERIGE STIFTELSEFOND
SEB SWEDEN EQUITY FUND ID
SWEDBANK HUMANFOND
SWEDBANK ROBUR ETHICA SVERIGE/TRANSITION
ÖHMAN SVERIGEFOND 2