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ESG Investing; Does it come with a Financial Sacrifice?

Evaluating the difference in performance and investment risk for mutual funds with different ESG-scores.

By

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Abstract

Sustainability issues have been a growing concern in recent years, and as a consequence, the demand for sustainable investments has drastically increased. When considering sustainable investments, common factors taken into account are Environmental, Social, and Governance aspects referred to as ESG. The purpose of this bachelor thesis is to examine the potential disparity in performance and investment risk between sustainable and non-sustainable funds in terms of ESG-scores. Their differences are evaluated by utilizing a portfolio-approach where the most sustainable funds are compared to the least sustainable funds. This research paper is focused on the Swedish market, including a total of 215 funds, in a time period spanning from October 2010 to October 2020. This study's findings suggest that both the sustainable and non-sustainable funds outperformed the market, proxied by the MSCI World Index, in terms of risk-adjusted performance. Furthermore, a significant overperformance could be statistically proven for the non-sustainable funds relative to the sustainable; however, no significant difference in investment risk could be detected. Therefore, this study concludes that ESG investing comes with a financial sacrifice in terms of risk-adjusted performance, but not in financial risk taken.

Key Words: ESG, Mutual funds, Portfolio theory, Risk-adjusted performance, Investment risk

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1. Introduction

1.1 Background

Recently, we have seen an increase in actions from governments and companies in order to maintain a sustainable future. The United Nations (UN) launched in 2015 their Sustainable Development Goals (SDGs) in the 2030 Agenda (UN, 2020). The broad SDGs include everything from a zero poverty goal to responsible consumption and production. Since 2017, the total number of companies publishing sustainability reports corresponding to the SDGs standards has doubled (UN, 2020). The increase in corporations concerned about their environmental and social impact may be a result of greater awareness related to these matters. The sustainability reports from the corporations are often a part of their Corporate Social Responsibility (CSR). According to the European Commission, CSR is defined as "the responsibility of enterprises for their impacts on society" (2011). KPMG shows in their annual sustainability report that 80 percent of companies worldwide today incorporate CSR into their annual reports (2020). The increasing amount seems to be ever-growing, indicating that corporations see sustainability as long-term value-adding for stakeholders.

When seeking a broader perspective of sustainability within finance, environmental, social, and governance (ESG) is often the measurement taken into account. ESG investing can be defined as an investment process that considers these measurements in terms of impact or evaluation (Tucker and Jones, 2020). The environmental consideration of the ESG refers to aspects such as pollution and climate-changing activities (EC, 2020). The social aspect of the ESG is often referred to as companies' working environments, including social aspects such as labor relations or investments in human capital. The last part of the ESG is the governance, often referred to as companies' general organizational structure, which is often vital in the process of implementing the environmental and social aspects (EC, 2020). The increase in awareness from both a company- and an investment perspective has resulted in a growing demand for ESG investments and ESG funds (Nasdaq, 2020). Since 2010, ESG-incorporation in investment decisions by money managers has grown from 569 billion dollars to 16 564 billion dollars in total assets in the US alone (US-SIF, 2020). The increase in total assets represents a total growth of 2811%.

1.2 Problem Identification

Extensive research regarding ESG funds' performance has been performed in recent years due to the increase in attention. Markowitz (1952) writes in his well-known paper about portfolio selection that investors desire to maximize future returns and that variance is undesirable. Markowitz (1952) further proposes that a rational investor should invest in a portfolio located on the efficient frontier, a graph where the optimal return for each unit of risk can be obtained. The deviation of not investing on the efficient frontier should, therefore, result in suboptimal results. Hong and Kacperczyk (2009) argue that sin stocks, companies involved in industries such as gaming, alcohol, or tobacco, have higher expected earnings due to investors constrained by norms not investing in them, as well as a higher litigation risk.

Researchers investigating the performance of sustainable funds compared to conventional ones have found conflicting results. Kreander, Gray, Power, and Sinclair (2005) found no statistically significant differences in performance between sustainable and conventional funds. Jones, van der Laan, Frost, and Loftus (2008) did, however, find a statistically significant underperformance for ethical funds compared to the market. Gil-Bazo, Ruis-Verdú, and Santos (2010) did, contrary to previous studies, find a significant overperformance for Socially Responsible Investment (SRI) funds in comparison to conventional ones. As evident from these researchers, the results are inconclusive.

The research regarding risk is not as extensive as for performance. Mallin, Saadouni, and Briston (1995) and Kreander et al. (2005) concluded that non-ethical funds tend to be riskier than ethical ones. There are, however, contrary results regarding this subject as well. Climent and Soriano (2011) found that green funds tend to be riskier than their conventional counterparts. There are not many papers investigating the potential difference in risk between sustainable and non-sustainable funds, which we find problematic. The opinions diverge in regards to both differences in performance and risk, which is unsettling as well. Therefore, there is a need for more research regarding the subject of performance and risk.

1.3 Purpose, Research Questions, and General Findings

The purpose of this bachelor thesis is to examine the potential disparity in performance and investment risk between sustainable and non-sustainable funds. The study will be carried out based on two research questions, which are divided into two parts and will be treated separately.

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1. Is there any significant difference in risk-adjusted performance between sustainable and non-sustainable funds?
2. Is there any significant difference in risk between sustainable and non-sustainable funds?

This study shows that there is a significant overperformance for non-sustainable funds compared to sustainable funds. The results do, however, differ depending on how the portfolio is constructed. There is a significant difference in performance between the two value-weighted portfolios with different ESG-scores. This could be concluded by observing risk-adjusted performance measurements such as Sharpe ratio, Treynor ratio, and Jensen's alpha. If applying a naive diversification method of establishing weights, the results do not differ enough to be statistically proven. There is, though, a general overperformance for the Non-sustainable portfolio here as well. For research question number two, the results were noticeable. There was no significant difference in risk for any of the portfolios and cases. Therefore, this essay's general findings are that there is an overperformance for Non-sustainable funds compared to their sustainable peers, and this overperformance is not a consequence of an increase in investment risk.

1.4 Disposition

This essay is structured according to the following order: Chapter 2 will provide the reader with a theoretical background and review of the literature regarding this topic. Chapter 3 outlines our two hypotheses and the results we expect to find. In chapter 4, the data collection and delimitations are accounted for, while chapter 5 explains the methodology used to obtain the results. Chapter 6 presents the results and findings, which are further discussed in chapter 7. In chapter 8, a conclusion based on the result and discussion is presented.

2. Literature Review & Theory

This chapter aims to provide insight regarding the previous literature of the performance and risk for funds with ESG focus. The following section will be separated into three parts, one part explaining the general theoretical principles behind modern portfolio theory, one concerning studies on the performance of ESG-funds, and one regarding the risk.

2.1 Modern Portfolio Theory

Modern portfolio theory (MPT), introduced by Markowitz (1952), is one of the most fundamental theories regarding portfolio selection and how to optimize portfolios. The theory is based on the assumption that investors desire to maximize the value of future returns and that variance is to be seen as undesirable. However, some investors are prepared to take on risk in favor of higher returns, a trade-off distinguished by the risk-aversion of the individual investor. Markowitz (1952) essentially suggests that there exists a set of portfolios that form a graph on which the investor can obtain the highest possible level of return for each unit of risk, the efficient frontier. Thus, any deviation from the efficient frontier should result in a suboptimal risk-adjusted return. Consequently, Markowitz (1952) argues that every rational investor should invest in a portfolio on the efficient frontier and that the optimal portfolio is then decided by the risk aversion of the individual investor.

The main point of Markowitz (1952) is that portfolio risk can be substantially reduced by diversification. He explains in his article the power of diversification and how idiosyncratic risk[1] can be minimized in a portfolio through investing in different asset classes with low covariances. Accordingly, imposing restrictions on the investment universe will lead to fewer investment possibilities and may result in higher risk. Markowitz's work has been vastly influential, and many models have been developed within the framework of modern portfolio theory and the assumption of mean-variance optimization. The theoretical framework developed by Markowitz is, therefore, a fundamental part of evaluating the performance and risk of funds with different types of constraints.

2.2 Studies on the Performance of ESG-funds

Studies regarding the performance of ESG-funds have been a popular subject over the last two decades. One of the earliest studies on the matter was conducted by Hamilton, Jo, and

[1] Firm-specific risk that is uncorrelated to the market risk.

Statman (1993). The authors compared the performance, using Jensen's alpha, of 32 US sustainable funds with an index of conventional funds during the period 1981-1990. The authors did find a general underperformance of sustainable funds, but none could be statistically proven. Another early study was made by Kreander, Gray, Power, and Sinclair (2005). Kreander et al. (2005) executed a study in which 60 sustainable funds were analyzed through a matched pair process during the period 1995-2001. The funds were collected from the European countries UK, Sweden, Germany, and the Netherlands. The results from the study concluded that there were no significant differences in any of the performance measurements applied. Lastly, Bauer, Koedijk, and Otten (2005) performed research on 103 ethical funds from Germany, the UK, and the US between 1990-2001. The authors could not provide any evidence for a significant difference in performance between ethical and conventional funds. Bauer, Koedijk, and Otten (2005) could, however, document a learning effect of ethical funds, meaning that newly established ethical funds underperformed the index, while funds that had existed in a more extended period were performing closer to the index and their conventional peers.

Contrary to the results from previous studies, Jones, van der Laan, Frost, and Loftus (2008) found a significant underperformance for ethical funds compared to the market. The study performed by the mentioned authors was based on a selection of 89 SRI funds in Australia compared to the market under 1986-2005. The conclusion presented by Jones et al. (2008) is that funds constrained by sustainable factors suffer a financial sacrifice. Similar to this result, Climent and Soriano (2011) found a statistically significant difference in performance in the US. The authors in this report separated green funds from traditional SRI funds as well as conventional funds. The separation gave them a total amount of 7 green funds, 14 SRI funds, and 28 conventional funds. Comparing Jensen's alpha between 1987 and 2009, the authors found a significant underperformance from the green funds compared to the conventional funds. Another study about green funds was made by Chang, Nelson, and Witte (2012). This study separates green funds from SRI funds and investigates the difference in performance for all green mutual funds in the USA in the period 1996-2011. The conclusion is in line with Climent and Soriano (2011), green funds do generally underperform their conventional peers in terms of risk-adjusted returns.

Gil-Bazo, Ruis-Verdú, and Santos (2010) presented a different conclusion as they could prove a statistically significant overperformance for US SRI funds. The authors compared 86

SRI funds to 1761 conventional funds during 1997-2005. Gil-Bazo, Ruis-Verdú, and Santos (2010) concluded that SRI fund investors earn a premium regarding risk-adjusted performance relative to conventional funds. Statman (2000) found a similar result. He compared the performance of 31 SRI funds to 62 conventional funds under the period 1900-1998 in the US. The author concluded that sustainable funds produced higher risk-adjusted returns than conventional funds. The differences were, however, only marginally significant and could, therefore, not be statistically proven.

2.3 Studies on the Risk of ESG Investing

As regarding the risk aspect of ESG investments and sustainable funds, the existing research is not quite as extensive as for the performance aspect; however, a few studies have contributed to the subject by commenting on the topic. Mallin, Saadouni, and Briston (1995) added empirical material to the matter by concluding that non-ethical funds tend to be riskier than ethical. This conclusion was drawn from their study, which included 58 funds where ethical funds were compared to non-ethical funds in the United Kingdom during 1986-1993 through a matched pairs approach. One finding of the study was that in 21 of the 29 pairs, the beta of the ethical fund was lower than that of the corresponding non-ethical fund, leading to the inference that non-ethical funds generally are riskier. Kreander et al. (2005) further state this conclusion in the study reviewed in *section 2.2*. It was found in this study as well that non-ethical funds exhibit a higher beta and standard deviation than the ethical funds at a significance level of 5%. However, contrary results were found by Climent and Soriano (2011), which concluded that US green funds suffered from higher standard deviation and higher market sensitivity than their conventional counterparts in the sample period 1987-2009, suggesting that green funds were riskier. On the other hand, Humphrey and Lee (2011) examined the effect of ESG screening of funds on the Australian market in the period 1996-2008 and reached a more equivocal conclusion. They concluded that increasing the number of positive screens[2] significantly reduces the total and diversifiable risk while increasing the number of negative screens[3] reduces the investment opportunity set, thereby increasing the total risk. This speaks for the apprehension that there might not be an unambiguous answer to the question of whether ESG engagement reduces risk.

[2] Positive screening is the strategy of selecting funds that are focused on sustainability issues.
[3] Negative screening relates to excluding industries that are seen as non-desirable from a sustainability perspective.

More recent studies have also been made on the relationship between ESG engagement and risk on a stock level. Verheyden, Eccles, and Feiner (2016) investigated how ESG screening affects risk and diversification in stock portfolios between 2010 and 2015 in a global context. Slightly lower risk in terms of standard deviation was observed for the ESG-screened portfolios; however, not statistically significant. When investigating the portfolio's underlying stocks individually, it was found that the underlying stocks of the ESG-screened portfolios displayed a smaller downside risk than the corresponding unscreened portfolio. This was based on the fact that the stocks of the ESG-screened portfolios had a lower VaR (Value at Risk) and lower 3-sigma tail[4]. The inference based on this was that the portfolios that excluded the worst-performing companies from an ESG perspective also tended to exclude the companies with the most extreme negative returns. This result is consistent with the findings of Hoepner, Oikonomou, Sautner, Starks, and Zhou (2019). The paper investigated companies from different geographical markets in the period from 2005 to 2018. From their study, they could conclude that firms who, during this time period, had implemented an ESG strategy on average reduced their downside risk significantly compared to the firms who had not.

2.4 Conclusion from the Literature Review

The results from previous studies are summarized in *table 2.1* presented below. As is clear from the literature review, the results from previous studies are dissonant. As evident from *table 2.1*, there is a general underperformance for ESG-funds compared to the conventional funds. Even though the pattern exists, the results are not conclusive, and the underperformance is often non-significant. In regards to risk, much less research has been conducted. The general finding, as noticeable from *table 2.1*, seems to be that ESG-funds have less investment risk than their conventional counterparts, although the results differ here as well.

Our contribution to the literature will be to investigate the performance of ESG-funds further but focus more on the risk aspect than previous research. The study aims to research the performance of sustainable funds on the Swedish market and complement the lack of research on differences in risk and tail risk.

[4] 3-Sigma tail is defined as the number of observations that lie more than three standard deviations away from the mean in the left tail, that is in the 99,7th percentile.

Table 2.1

Authors	Conclusion
ESG Funds > Conventional Funds	
Gil-Bazo, Ruis-Verdú and Santos (2010)	A significant overperformance for SRI funds could be proven in this study of comparing 86 SRI funds to 1761 conventional funds during the period 1997-2005 in the US.
Statman (2000)	A general overperformance for SRI funds was obtained but could not be stastically proven in this research comparing the performance of 31 SRI funds to 62 conventional funds under the period 1900-1998 in the US.
Verheyden, Eccles and Feiner (2016)	ESG-screened portfolios displayed lower standard deviation as well as lower downside risk than their unscreened counterparts. The study was performed between 2010-2015 in a global context.
Humphrey and Lee (2011)	The authours found that positive ESG-screening significantly reduced the total risk, while negative ESG-screening increased the risk. The study was made in the Austrailian market between 1996-2008.
Hoepner et al. (2019)	The study concluded that firms who have implemented an ESG strategy exhibited a significantly lower downside risk. This paper was based on different geographical markets between 2005-2018.
Kreander et al. (2005)	Ethical funds had significantly lower standard deviation and beta than non-ethical funds. The paper was based on 60 sustainable funds from the UK, Sweden, Germany, and the Netherlands in the period 1995-2001.
Mallin, Saadouni, and Briston (1995)	Ethical funds were found less risky than non-ethical funds in terms of standard deviation and beta in this study based on the UK between 1986-1993.
ESG Funds < Conventional Funds	
Jones et al. (2008)	The authors could report a statistical underperformance for the SRI funds in this paper comparing 89 SRI funds to a benchmark in the Australian market between 1986-2005.
Climent and Soriano (2011)	A significant underperformance for US green funds in comparison to conventional funds in 1986-2009 could be proven. Green funds did also suffer from higher standard deviation and higher market sensitivity.
Chang, Nelson, and Witte (2012)	An underperformance for green funds could be concluded in this study investigating the difference in performance for all green mutual funds in the USA between 1996-2011.
ESG Funds = Conventional Funds	
Hamilton, Hoje, and Statman (1993)	The authors found no statistical difference in performance in their study comparing 32 sustainable funds with an index of conventional funds in the US between 1981-1990.
Kreander et al. (2005)	No statistical difference in performance could be proven in this study of comparing 60 funds to conventional peers from the european countries UK, Sweden, Germany, and the Netherlands during the period 1995-2001.
Bauer, Koedijk, and Otten (2005)	No evidence for any significant difference in performance between the 103 ethical funds and its conventional peers could be provided. The study was based on Germany, the UK, and the US between 1990-2001.

This table report a summary of the previous research performed on the subject of ESG-investing. For more extensive explanations, the readers are referred to section 2.2-2.3 or the original papers cited in the reference list.

3. Hypotheses

This section will outline our hypotheses and expected results. The hypotheses are formulated to enable an investigation of the research questions stated in *section 1.3.* Both hypotheses are tested separately and will be treated as such.

3.1 Hypothesis 1

Hypothesis 1: There is a significant difference in risk-adjusted performance between the two portfolios.

We expect to find a significant difference in performance. This expectation is based on the previous literature of the subject as well as own assessments. Markowitz (1952) mentions in his article that an investor should diversify his capital to those securities that yield the ultimate return. Therefore, the deviation from this matter may result in inferior results from the portfolio whose sole aim is not only to maximize return but also to be sustainable. In other words, the constraints connected with the Sustainable portfolio may limit the maximum return possible. There is a split in results when reviewing previous research, as evident from *section 2.2.* Gil-Bazo, Ruis-Verdú, and Santos (2010) could provide evidence in their report of an overperformance for US SRI funds compared to their conventional peers. The authors concluded that SRI investors earn a premium in terms of risk-adjusted returns. On the contrary, other reports, such as the one by Jones et al. (2008), found a significant underperformance for ethical funds relative to the market. The authors could conclude that sustainable constraints come with a financial sacrifice. With that said, the results regarding the performance of sustainable funds differ when observing previous reports. In the absence of corroborative results, we have based our hypothesis on the fundamentals of portfolio theory, where the constraints should reduce the returns and, therefore, result in an overperformance for the Non-sustainable portfolio.

3.2 Hypothesis 2

Hypothesis 2: There is no significant difference in risk between the two portfolios.

We expect to find that sustainable funds and non-sustainable funds do not exhibit any significant difference in risk. This hypothesis is based on the assumption that the diversification across the funds will be sufficient to reduce the idiosyncratic risk. Modern portfolio theory suggests that to attain necessary diversification, one should invest in companies with low covariances amongst them to minimize the variance (Markowitz, 1952). This implies that one should diversify as much as possible across industries since the covariance tends to be lower between firms in different sectors. Following this statement, the sustainable funds, which are subject to industry constraints, will not be able to diversify as much as the non-sustainable funds. However, Kreander et al. (2005) found that ethical funds have a significantly lower standard deviation and beta, and Verheyden, Eccles, and Feiner (2016) concluded that ESG focused equities tend to have lower downside risk. Thus, empirical evidence moderately indicates that ESG constraints not only does not affect the possibility of sufficient diversification but may even reduce risk, contradicting the theory of diversification. In our study, however, the assumption is made that the large sample of funds will reduce the diversification effects of the ESG constraints and that the reduction of the risk presented by previous researchers will not affect a portfolio of funds. Therefore, we hypothesize that the investment risk between portfolios of different ESG-scores will not differ significantly.

4. Data

In this chapter, the process and sources used for gathering data are presented and discussed. This section will outline the general method for acquiring data and how the data set has been constructed. Furthermore, it will also explain how the sustainability ratings are set and how they have been used to construct the different portfolios.

4.1 Financial Data

The primary sources that have been used to collect data for this thesis are Morningstar and Bloomberg. Morningstar is an investment research company that provides an open database of around 36.000 funds worldwide (Morningstar, n.d.). From this platform, we could screen funds and select according to our criteria as well as retrieve information about the total assets of the funds.

For the collection of historical data of the selected funds, Bloomberg Terminal has been the primary tool. Bloomberg is a financial information and news company that offers the software Bloomberg Terminal, a trading platform that can be used for financial analysis and historical performance evaluation (Bloomberg, n.d.). From this platform, we retrieved the monthly development of the Net Asset Value Per Share (NAVPS) for the selected funds, which was needed to analyze the historical performance. Also, the Morgan Stanley Capital International (MSCI) World Index development was retrieved from this platform, as well as the beta of each fund against the index.

4.2 Sustainability Data

To enable a comparison of the performance and investment risk of funds with different sustainability ratings, Morningstar's Sustainability Rating has been used. Morningstar provides a system that ranks funds regarding their sustainability, given data from their subsidiary company Sustainalytics, an independent ESG and corporate governance research company (Morningstar, 2020). Sustainalytics analyses listed companies based on their sustainability and assigns an absolute score of the company's ESG risk. The ESG risk score is a measure composed of the exposure to various ESG issues for a particular company and an assessment of how well the company manages these issues (Sustainalytics, n.d.). This score is then incorporated into Morningstar's methodology of assigning a historical portfolio sustainability score to a fund, which follows a two-step process. First off, a portfolio sustainability score is assigned to the fund, which is an asset-weighted average of the ESG risk of the portfolio's underlying assets (Morningstar, 2019). Secondly, a historical portfolio sustainability score is calculated through:

$$Historical\ Portfolio\ Sustainability\ Score = \frac{\sum_{i=0}^{11} (12-i) \times Portfolio\ Sustainability_i}{\sum_{i=0}^{11} i+1} \quad (4.1)$$

i = Number of months from present

This measure is a weighted average of the past 12 months that summarizes the average sustainability score of a fund over the time period; however, given the formula's construction, it puts more emphasis on the more recent portfolios (Morningstar, 2019). Note that since the measure is based on the underlying ESG risk, a lower score implicates higher sustainability.

4.3 Data Selection & Classification

Since the study is focused on the performance and investment risk of mutual funds from a sustainability point of view on the Swedish market, the first criterion for screening was that the funds were registered in Sweden. Furthermore, this study intends to examine the funds' risk over a ten-year horizon in the period from October 2010 to October 2020. Therefore, the funds that have not existed during the whole period were excluded. The time frame was chosen to obtain the longest time span possible, still sustaining a sufficient amount of funds, in order to enable a reliable long-term risk and performance evaluation. This way, the performance and risk of the funds will not be as dependent on temporary market fluctuations and business cycles. Once these limitations had been taken into account, 215 mutual funds remained, which constitutes the complete sample of this study.

The 215 mutual funds that were included in the study were then divided into two different subsamples, or portfolios henceforth, according to their Morningstar historical portfolio sustainability score, distributed as follows:

Table 4.1	Sustainable portfolio	Non-sustainable portfolio
Number of funds	107	108
Average ESG-score	20,74	23,90

This table denotes the total amount of funds in each portfolio as well as the average ESG-score. The total list of funds used in each portfolio are accounted for in Appendix A, and a hypothesis test on the difference in average ESG-score is reported in Appendix F.

The 107 funds with the lowest sustainability score (i.e., with the lowest ESG risk) were assembled in the Sustainable portfolio, and the 108 funds with the highest were assembled in the Non-sustainable portfolio. Since the ESG ratings vary in time, the last recorded historical portfolio sustainability score was fixed and used for the whole period of investigation.

5. Method

To increase the reliability of this study, two different cases or subsections were made where the individual funds have different weights. The first case is a value-weighted portfolio, where every fund's total assets were divided by the portfolio's accumulated value. This process created weights that represent every fund's contribution to the portfolio's total market value. The second case represents a naive diversification scenario where the weights are equal for every fund. In mathematical terms, the weights were computed through these formulas:

$$W_{i,\,Naive} = \frac{1}{Number\ of\ funds} \tag{5.1}$$

$$W_{i,\,Value} = \frac{Market\ value\ of\ fund\ i}{Total\ market\ value} \tag{5.2}$$

$i = Individual\ fund$

The weights obtained from both cases are fixed and will therefore be the same for each time period. After this, the measurements computed were calculated the same way, not depending on which of the cases in consideration. The methodology used for the measurements will, therefore, not be separated into two cases.

The returns for each fund were calculated using the formula:

$$r_{i,\,t} = \frac{P_{i,\,t} - P_{i,\,t-1}}{P_{i,\,t-1}} \tag{5.3}$$

$r_{i,\,t} = Return\ for\ asset\ i\ at\ time\ t$

$P_{i,\,t} = Price\ for\ asset\ i\ at\ time\ t$

$P_{i,\,t-1} = Price\ for\ asset\ i\ at\ time\ t-1$

When the returns for all the 215 funds were calculated, the portfolio returns could be obtained. Each funds' specific return has to be multiplied with the weights associated with that individual fund. This is formulated mathematically in formula 5.4:

$$r_{p,\,t} = \sum_{i=1}^{n} W_i * r_{i,\,t} \tag{5.4}$$

$r_{p,\,t} = Portfolio\ return\ at\ time\ t$

$W_i = Weight\ for\ asset\ i$

$r_{i,t} = Return\ for\ asset\ i\ at\ time\ t$

5.1 Variance and Standard deviation

Once the returns were obtained, the risk measurements could be calculated. The first risk measurement computed was the variance and standard deviation. These are popular measurements to quantify risk. In general, the variance can be defined as the dispersion of its probability distribution (Dougherty, 2011). The formula for variance when using observed values can be written as (Bodie, Kane & Marcus, 2018):

$$\sigma^2 = \frac{1}{n-1} \sum_{s=1}^{n} [r(s) - \bar{r}]^2 \tag{5.5}$$

n = Number of observations

$\bar{r}$ = Average return

r(s) = Return in scenario s

The variance formula 5.5 contains a squared unit to prevent that positive and negative number sum to zero. In order to return to original units of percent, the variance has to be square rooted. The square root of the variance is the standard deviation:

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{s=1}^{n} [r(s) - \bar{r}]^2} \tag{5.6}$$

n = Number of observations

$\bar{r}$ = Average return

r(s) = Return in scenario s

The most efficient procedure to compute the standard deviation of a portfolio is to use matrix algebra. The first step in this process is to obtain a covariance matrix for each portfolio. This can be solved using Microsoft Excel and their data analysis add-in. The covariance matrix is in further reading denoted by the greek sign omega (Ω). The standard deviation of the portfolio was calculated using the formula:

$$\sigma_p = \sqrt{w^T * \Omega * w} \tag{5.7}$$

w = Vector of weights for all funds

w^T = The transposed vector of weights

Ω = The covariance matrix

5.2 Distortions from the Normal Distribution.

The next step in our thesis was to calculate the skewness and kurtosis. Skew is a measurement of the asymmetry of the normal distribution. The formula for calculating the skew is:

$$Skew : E\left[\frac{(R-\overline{R})^3}{\widehat{\sigma}^3}\right] \tag{5.8}$$

E = *Expectation operator*

R = *Excess return*

$\overline{R}$ = *Average excess return*

$\widehat{\sigma}$ = *Observed standard deviation*

Positive skewness implies that the distribution is skewed to the right, and extreme positive values are more likely than negative. A positive skewness, therefore, results in a standard deviation that overestimates risk. When the skewness is negative, the distribution is skewed to the left of the normal distribution, and extreme negative values dominate positive. In contrast to a positive skewness, the negative asymmetry results in a standard deviation that underestimates risk (Bodie, Kane & Marcus, 2018).

Another measurement of the distortion from a normal distribution is kurtosis. The formula for this anomaly of normality is:

$$Excess\ Kurtosis = E\left[\frac{(R-\overline{R})^4}{\widehat{\sigma}^4}\right] - 3 \tag{5.9}$$

E = *Expectation operator*

R = *Excess return*

$\overline{R}$ = *Average excess return*

$\widehat{\sigma}$ = *Observed standard deviation*

The expected value for kurtosis of a normal distribution is 3, which is why this is subtracted in formula 5.9. The kurtosis from that formula is, therefore, the excess kurtosis. Kurtosis can be explained as a measurement that takes an interest in the outliers of the distribution; in other words, the extreme values. If a distribution suffers from an excess kurtosis above zero, the distribution's tails are "fatter", resulting in a larger mass than a normal distribution should have. Hence, the probability of extreme values will increase at the expense of the probability of the center. The kurtosis can, therefore, result in a standard deviation that underestimates extreme values, both positive and negative (Bodie, Kane & Marcus, 2018)

These asymmetry measurements were calculated for each of our portfolios. The equations were applied to the portfolios' cumulative returns for each time period.

5.3 Tail-risk Measurements

Both skewness and kurtosis are measurements of the distortion from a normal distribution that may increase the possibility of extreme values. There exist other measurements that quantify this risk, which will now be taken into regard. Value-at-Risk (VaR) is a risk measurement that quantifies the probability and size of a loss at a specific percentile of the return distribution (Bodie, Kane & Marcus, 2018). There are different approaches for calculating VaR for a portfolio. One procedure is to use a historical simulation (Asgharian & Nordén, 2007). The accumulated portfolio returns have to be calculated as demonstrated in formula 5.4. Once the portfolio returns are calculated for each period, one can observe the VaR for a specific percentile. The returns have to be sorted from largest to smallest to obtain the return at the chosen percentile. To find the specific return, one has to multiply the percentile with the number of observations. The percentage found at the percentile is the maximum loss of the portfolio's total market value in the chosen period (Asgharian & Nordén, 2007).

Another risk measurement that is associated with the VaR is the Conditional Value-at-Risk (CVaR). The VaR measurement observes the highest return at the percentile chosen, it can therefore be overly optimistic. One alternative is to calculate the expected loss of the bad scenarios of the chosen percentile. If the CVaR of the 5% percentile was calculated, one would estimate it by observing the 5% worst return outcomes and taking the average of those observations (Bodie, Kane & Marcus, 2018).

Lower Partial Standard Deviation (LPSD), or downside deviation, is a risk measurement that addresses the issue of computing the standard deviation when the distribution of the returns is asymmetric. LPSD uses only negative excess returns when calculating the measurement. The procedure used for calculating the risk measurement is to square the negative excess returns to obtain a hypothetical variance. An average of the squared values has to be obtained where the LPSD is the average square root. Therefore, Lower Partial Standard Deviation can be defined as the left tail's standard deviation (Bodie, Kane & Marcus, 2018).

5.4 Risk-adjusted Performance Measurements

Three different risk-adjusted performance measures are calculated and used in this essay. The first performance measurement is the Sharpe ratio. William F. Sharpe founded the commonly used risk-adjusted performance measurement in 1966. The well-known paper is an extension of Treynor's work, described later in this part. In the paper from Sharpe (1966), the author suggests an alternative approach for evaluating funds' performance, the Reward-to-Variability ratio (R/V ratio). Reward is simply the difference between average annual returns and the risk-free rate, while the variability in the denominator is the standard deviation of the annual return (Sharpe, 1966). The R/V ratio has since 1966 gained much attention, and in Bodie, Kane, and Marcus (2018), the ratio is named Reward-to-Volatility. The formula for the R/V ratio is defined in 5.10.

$$R/V\ ratio\ = Sharpe\ ratio = \frac{E(r_P) - r_f}{\sigma_P} \quad (5.10)$$

$E(r_p) = Expected\ portfolio\ return$

$r_f = Risk - free\ rate$

$\sigma_P\ = Portfolio\ standard\ deviation$

We used matrix algebra in order to calculate the Sharpe ratio. The formula used in this notation is:

$$R/V\ ratio\ = Sharpe\ ratio\ = \frac{w^T * ER}{\sqrt{w^T * \Omega * w}} \quad (5.11)$$

$W^T\ = Transposed\ weights$

$ER = Excess\ return$

$\Omega = Covariance\ matrix$

An alternative risk-adjusted performance measure is the Treynor ratio. The Treynor ratio was developed by Jack L. Treynor in 1965. The ratio differs from the R/V ratio as it uses systematic risk in the form of beta instead of standard deviation (Bodie, Kane & Marcus, 2018). The formula for calculating the Treynor ratio is:

$$Treynor\ ratio = \frac{E(r_P)-r_f}{\beta_p} \tag{5.12}$$

$E(r_p) = Expected\ portfolio\ return$

$r_f = Risk - free\ rate$

$\beta_p = Portfolio\ beta$

The denominator in this ratio is, as mentioned, beta instead of the standard deviation of the Sharpe ratio. The beta of an asset is a measurement of the security's systematic risk. Systematic risk is another word for market risk and can be defined as the risk that diversification can not erase. The formula for beta is (Bodie, Kane & Marcus, 2018):

$$\beta = \frac{Cov\ (r_i, r_M)}{\sigma_M^2} \tag{5.13}$$

$Cov\ (r_i, r_M) = Covariance\ between\ asset\ i\ and\ market$

$\sigma_M^2 = Market\ variance$

For a portfolio, the beta is additive and can therefore be calculated as the weighted beta of the underlying assets:

$$\beta_p = \sum_{i=1}^{n} (w_i * \beta_i) \tag{5.14}$$

$W_i = Weight\ for\ asset\ i$

$\beta_i = Beta\ of\ asset\ i$

$n = Number\ of\ assets$

It is established that the beta of the market portfolio itself will be 1. This follows from the derivation of the previous formula 5.13:

$$\beta = \frac{Cov\ (r_M, r_M)}{\sigma_M^2} = \frac{\sigma_M^2}{\sigma_M^2} = 1 \tag{5.15}$$

Therefore, the beta of an individual asset or portfolio is an indicator of the securities volatility relative to the market. An asset with a beta above one is to be considered aggressive, while a beta below one is considered defensive (Bodie, Kane & Marcus, 2018).

The last risk-adjusted performance measurement used in this essay is Jensen's alpha. Michael C. Jensen founded this measurement in 1968. Jensen emphasizes in the report the need for a performance measurement that investigates a manager's predictive ability in securities that can offer returns higher than what is expected, given the level of risk (Jensen, 1968). Jensen's alpha can, therefore, be formulated as (Bodie, Kane & Marcus, 2018):

$$Jensen's\ alpha = \alpha_P = \overline{r}_P - \left[\overline{r}_f + \beta_P(\overline{r}_M - \overline{r}_f)\right] \tag{5.16}$$

$\overline{r}_p$ = *Average portfolio return*

$\overline{r_f}$ = *Average risk − free rate*

$\overline{r}_M$ = *Average market return*

We have calculated the alpha for each of our portfolios according to the formula presented above (5.16). The results from these calculations have been statistically tested to determine if they are significantly different from each other or not. The procedure for the hypothesis tests is outlined in the following section.

5.5 Hypothesis Testing

To determine whether there is a significance in the findings of the report, a series of statistical tests have been performed to examine the differences between the portfolios. The first test that was conducted was testing if there is a significant difference between the Sharpe ratio of the two portfolios in the different scenarios, which was done in accordance with the Jobson and Korkie (1981) method. The general hypothesis that is to be examined is the following:

$$H0 : SR_{Sus} - SR_{Non} = 0$$

$$H1 : SR_{Sus} - SR_{Non} \neq 0$$

SR_{Sus} = *Sharpe ratio of Sustainable portfolio*

SR_{Non} = *Sharpe ratio of Non − sustainable portfolio*

However, Jobson and Korkie suggest using the transformed difference for the Sharpe ratio:

$$SR_{Sus,\,Non} = \sigma_{Non} * \overline{r}_{Sus} - \sigma_{Sus} * \overline{r}_{Non} \tag{5.17}$$

σ_{Non} = *Variance of Non − sustainable portfolio*

$\overline{r}_{Sus}$ = *Average excess return of Sustainable portfolio*

σ_{Sus} = *Variance of Sustainable portfolio*

$\overline{r}_{Non}$ = *Average excess return of Non − sustainable portfolio* since they found that it improved the reliability of the test statistics compared to using the standard sample differences (Jobson & Korkie, 1981). This is then used to test the null hypothesis $H0:\ SR_{Sus,\,Non} = 0$ by applying the test statistics

$$Z_{Sus,\,Non} = \frac{SR_{Sus,\,Non}}{\sqrt{\theta}} \tag{5.18}$$

where θ is the variance of the asymptotic distribution of the transformed difference between the Sharpe ratios and is given by:

$$\theta = \frac{1}{T}\left[2\sigma^2_{Sus}\sigma^2_{Non} - 2\sigma_{Sus}\sigma_{Non}\sigma_{Sus,\,Non} + \frac{1}{2}\bar{r}^2_{Sus}\sigma^2_{Non} + \frac{1}{2}\bar{r}^2_{Non}\sigma^2_{Sus} - \frac{\bar{r}_{Sus}\bar{r}_{Non}}{2\sigma_{Sus}\sigma_{Non}}(\sigma^2_{Sus,\,Non} + \sigma^2_{Sus}\sigma^2_{Non})\right]$$

(5.19)

$T = Number\ of\ observations$

$\bar{r}_{Sus} = Average\ excess\ return\ of\ Sustainable\ portfolio$

$\bar{r}_{Non} = Average\ excess\ return\ of\ Non-sustainable\ portfolio$

$\sigma_{Sus} = Variance\ of\ Sustainable\ portfolio$

$\sigma_{Non} = Variance\ of\ Non-sustainable\ portfolio$

$\sigma_{Sus,\,Non} = Covariance\ between\ Sustainable\ and\ Non-sustainable\ portfolio$

Using these variables, the Z-value could be calculated and thus also the P-value for the hypothesis of equal Sharpe ratios.

Furthermore, the difference between the two portfolios' Treynor ratios was also tested through the methodology presented by Jobson and Korkie (1981). Again, the difference between the portfolios is investigated by examining the hypothesis:

$$H0:\ Tr_{Sus} - Tr_{Non} = 0$$
$$H1:\ Tr_{Sus} - Tr_{Non} \neq 0$$

$Tr_{Sus} = Treynor\ ratio\ of\ Sustainable\ portfolio$

$Tr_{Non} = Treynor\ ratio\ of\ Non-sustainable\ portfolio$

For the hypothesis testing, the transformed difference was used since it was found that it could improve the statistical properties substantially. (Jobson & Korkie, 1981). This is calculated as follows:

$$Tr_{Sus,\,Non} = \frac{\sigma_{Sus,\,M} * \bar{r}_{Non}}{\sigma_M^2} - \frac{\sigma_{Non,\,M} * \bar{r}_{Sus}}{\sigma_M^2} \tag{5.20}$$

$\sigma_{Sus,\,M}$ = *Covariance between Sustainable portfolio and market*

$\sigma_{Non,\,M}$ = *Covariance between Non − sustainable portfolio and market*

$\bar{r}_{Sus}$ = *Average excess return of Sustainable portfolio*

$\bar{r}_{Non}$ = *Average excess return of Non − sustainable portfolio*

σ_M^2 = *Market variance*

This transformed difference is used in the numerator for the calculation of the Z-value in the testing of the null hypothesis $H0:\ Tr_{Sus,\,Non} = 0,$ which is:

$$Z_{Sus,\,Non} = \frac{Tr_{Sus,\,Non}}{\sqrt{\psi}} \tag{5.21}$$

where ψ is the variance of the asymptotic distribution of the difference between the Treynor ratios. The formula for ψ is given by Jobson and Korkie (1981), with corrections from Cadsby (1986), according to:

$$\psi = \frac{1}{\sigma_M^4} * \frac{1}{T}[\sigma_{Sus}^2\sigma_{Non,\,M}^2 + \sigma_{Non}^2\sigma_{Sus,\,M}^2 - 2\sigma_{Sus,\,M}\sigma_{Non,\,M}\sigma_{Sus,\,Non} + \bar{r}_{Sus}^2(\sigma_{Non}^2\sigma_M^2 - \sigma_{Non,\,M}^2)$$
$$+ \bar{r}_{Non}^2(\sigma_{Sus}^2\sigma_M^2 - \sigma_{Sus,\,M}^2) - 2\bar{r}_{Sus}\bar{r}_{Non}(\sigma_{Sus,\,Non}\sigma_M^2 - \sigma_{Sus,\,M}\sigma_{Non,\,M})]$$

(5.22)

T = *Number of observations*

$\bar{r}_{Sus}$ = *Average excess return of Sustainable portfolio*

$\bar{r}_{Non}$ = *Average excess return of Non − sustainable portfolio*

σ_{Sus} = *Variance of Sustainable portfolio*

σ_{Non} = *Variance of Non − sustainable portfolio*

$\sigma_{Sus,\,Non}$ = *Covariance between Sustainable and Non − sustainable portfolio*

$\sigma_{Sus,\,M}$ = *Covariance between Sustainable portfolio and market*

$\sigma_{Non,\,M}$ = *Covariance between Non − sustainable portfolio and market*

σ_M^2 = *Market variance*

Cadsby (1986) corrected the formula of Jobson and Korkie by suggesting that $\frac{1}{T}$ should be multiplied by $\frac{1}{\sigma_M^4}$ outside of the brackets, which was acknowledged and confirmed by Korkie.

Hence, the version of the formula suggested by Cadsby (1986) will be used in this study. When having obtained the value of these variables, a Z-value and a P-value could be calculated to investigate the null hypothesis of equal Treynor ratios.

Lastly, several statistical tests were conducted through the software Eviews. A Jarque-Bera test was performed on all portfolios to review if the individual portfolios' returns follow a normal distribution. Generally, the Jarque-Bera test tries the null hypothesis that the variables are normally distributed, which implies that the skewness and excess kurtosis is zero. If the null hypothesis is rejected, the assumption of normality can be rejected, and the skewness and kurtosis are significantly different from zero. A Jarque-Bera test was also conducted on a difference-portfolio for the two scenarios. That is a portfolio constructed of the returns of the Non-sustainable portfolio subtracted by the returns of the sustainable one. This was done to determine whether there is a statistically significant difference in the skewness and kurtosis of the two portfolios. Furthermore, Eviews was used to run regressions on the different portfolios against the benchmark index to determine alpha and beta for the portfolios. The regressions confirmed the values calculated through previously mentioned equations. These values were then tested with a Wald test in order to determine the statistical significance. Regressions were also made on the difference-portfolios previously mentioned to statistically test the difference between the portfolios' alpha and beta. Lastly, an F-test for equal variances between the different portfolios was carried out through Eviews.

5.6 Benchmark

A significant aspect of evaluating the performance and risk of funds is the selection of a benchmark index. The benchmark will function as a proxy for several calculations in this report and be used as a tool for comparing the two portfolios. The benchmark chosen for this study is the MSCI World Index, a broad market index that captures around 85% of the market capitalization in each of the 23 countries it covers (MSCI, 2020). The reason for choosing such a broad index is that the investment profile of the funds included in this study is worldwide and, therefore, covers a broad range of geographical markets and different industries. Therefore, even though the subject of investigation in this essay is Swedish funds, a Swedish index would not be an adequate benchmark.

5.7 Risk-free Rate

As this report covers funds that are registered and are marketing themselves on the Swedish market, a Swedish proxy for the risk-free rate has been used. Thus we have decided to use the 1-month Swedish treasury bill rate (SSVX). The data for the 1-month SSVX over the 10-year period examined was retrieved from Svenska Riksbanken's webpage (Sveriges Riksbank, n.d.), from which a geometric average was drawn in order to obtain the average monthly risk-free rate.

5.8 Reliability & Validity

In quantitative research, the reliability of a study can generally be defined as “the extent to which a measurement procedure yields the same answer however and whenever it is carried out” (Kirk & Miller, 1986, p. 19). This refers to the methodology used in the research and how stable the measurements that have been used are. One criterion for reliability is the repeatability of the test, that the investigation can be replicated with unvarying results. This report has utilized a collection of well-established performance and risk measures developed and used by previous researchers, which accounts for this test’s replicability. Furthermore, a relatively long period for investigation has been chosen in order to reduce the risk of temporary market fluctuations affecting the result to improve reliability. A number of statistical tests have also been applied to the tested variables to assure the reliability of the findings. The test statistics that have been used in the study have been circumspectly chosen and applied to the specific variable in accordance with precedent literature.

Regarding validity, Golafshani (2003) defines it as an assessment of whether the methodology applied is accurate and how well it investigates what it intends to investigate. This can further be divided into internal validity and external validity, where the internal validity refers to the cause-and-effect relationship between the method and result, while external validity refers to the generalizability of the findings of the study (Druckman, Green, Kuklinski, & Lupia, 2011). With respect to the internal validity, the methods that have been used in this study are incorporated from acknowledged literature, ensuring that the methods necessary for answering the research questions have been used. Concerning the external validity, the study is focused on the Swedish market, evaluating Swedish funds, and using a Swedish proxy for the risk-free rate. This way, the study provides a comparison of sustainable funds in contrast to non-sustainable funds from a Swedish investor's point of view, which may not be directly generalizable for different markets and time periods

6. Results

This section will present the results of the research. There will be a separation between performance- and risk measurements in order to obtain a clear distinction. Both portfolios will be treated and presented simultaneously.

6.1 General Descriptive Performance Statistics

This part will depict the performance measures of both portfolios with regard to both separations in weights and are calculated on a monthly basis. This part will also include test statistics regarding differences from zero. The mathematical methods for calculating the performance measures as well as the hypothesis testing procedures are accounted for in the method section of this essay.

Table 6.1	Average return	Average Excess return	Sharpe Ratio	Treynor Ratio	Jensens alpha
Value weighted					
Sustainable	0,812% (-2,594)**	0,577% (-1,842)*	0,1689	0,00811	0,3165% (1,716)*
Non-sustainable	0,967% (-3,055)***	0,731% (-2,311)**	0,2119	0,01039	0,4697% (2,496)**
MSCI World Index	0,603% (1,679)*	0,368% (1,024)	0,0935	0,00368	
Naive weighted					
Sustainable	0,731% (-2,378)**	0,495% (-1,612)	0,1478	0,00704	0,2375% (1,338)
Non-sustainable	0,783% (2,597)***	0,548% (-1,816)*	0,1665	0,00810	0,2975% (1,669)*
MSCI World Index	0,603% (1,679)*	0,368% (1,024)	0,0935	0,00368	

This table reports the general performance mesurements for both portfolios. All measurements are on a monthly basis and derived from the monthly returns of each portfolio. The risk-free rate is the geometric average of the one month SSVX in Sweden. The test statistic are reported inside the brackets and are based on the difference from zero.
* Statistically significant at 10% level
** Statistically signifacant at 5% level
*** Statistically significant at 1% level

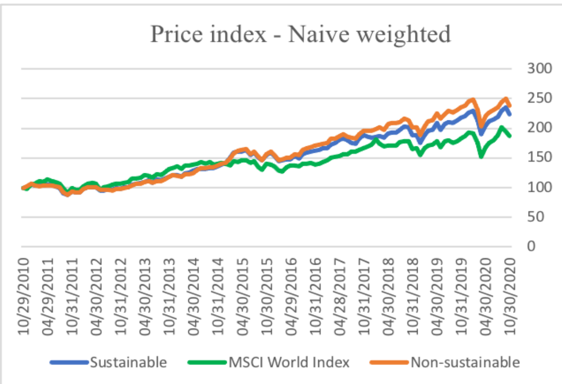
As one can see from *table 6.1*, the average return and excess return are, on average, significantly different from zero. The significance level for the Non-sustainable portfolio is in both scenarios at the 1% level, whereas the Sustainable portfolio is at the 5% level. In terms of return, there is a pattern of overperformance of the Non-sustainable portfolio. The MSCI World Index does not provide any conclusive results as the significance level differs from none to 10%. Both portfolios overperform the market index in regards to the returns. The Sharpe and Treynor ratios are not tested if they are statistically different from zero, as the results from those tests are inapplicable. The apparent pattern from the Sharpe and Treynor ratio is that there seems to be an overperformance in favor of the Non-sustainable portfolio here as well. The overperformance is more evident in the value-weighted scenario than in the naive weighted, which may indicate inconclusive results. A regression of the excess return relative to the market index MSCI World Index has been performed to further investigate the subject.

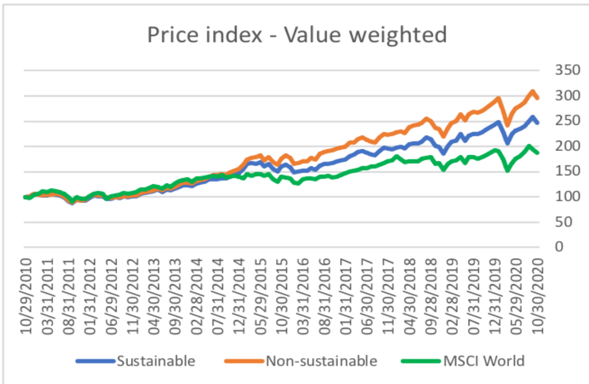
The alpha value for the Non-sustainable portfolio is in the value-weighted case significantly different from zero at a 1% level, while in the naive weighted case on a 10% level, which may be considered as only marginally significant. The Sustainable portfolio's alpha relative to the market index is statistically significant in the value-weighted case on a 10% level, while it can not be statistically proven in the naive scenario. Evidently, there exists a general overperformance for both portfolios relative to the market index. However, the overperformance can be statistically proven at a higher degree for the Non-sustainable portfolio.

6.2 Price Index

A price index has been computed to graphically visualize the difference in returns over time between the two portfolios and the broad MSCI World Index. The price index is computed with the starting value of 100 SEK.

Graph 6.1 **Graph 6.2**





From *graph 6.1* and *6.2*, the overperformance of the Non-sustainable portfolio is apparent in both scenarios. In the naive weighted scenario, the Non-sustainable portfolio has a slightly larger price development over the ten years but is quite similar to the Sustainable portfolio.

The total performance over the ten year period is for the index 87,6%, while for the Non-sustainable portfolio 138,85% and for the Sustainable 123,92%. In the value-weighted scenario, the overperformance is more evident. The Non-sustainable portfolio offers a total percentage development of 195,42%, while the Sustainable portfolio developed with a total of 146,05%, and MSCI development is equal to the previous with 87,6%.

6.3 Hypothesis 1: There is a significant difference in risk-adjusted performance

The first hypothesis states to investigate if there is a significant difference in risk-adjusted returns between the Sustainable and the Non-sustainable portfolio. The risk-adjusted performance measures considered in this section is the Sharpe ratio, Treynor ratio, and Jensen's alpha. The formal hypotheses investigated in this section are:

$H0 : SR_{Sus} = SR_{Non}$ $\quad$ $H0 : TR_{Sus} = TR_{Non}$ $\quad$ $H0 : \alpha_{Sus} = \alpha_{Non}$

$H1 : SR_{Sus} \neq SR_{Non}$ $\quad$ $H1 : TR_{Sus} \neq TR_{Non}$ $\quad$ $H1 : \alpha_{Sus} \neq \alpha_{Non}$

Table 6.2 is presented in order to give an overview of the results. The table will provide the reader with the differences, the transformed differences, P-values, and significance levels. The test statistics have been calculated in accordance with *section 5.5*.

Table 6.2	Sharpe Ratio	Treynor Ratio	Jensens alpha
Value weighted			
Difference Sus-Non	0,0430	0,0023	0,1521%
Transformed Difference	5,1E-05	0,0011	-
P - Value	0,0360**	0,0049***	0,0089***
Naive weighted			
Difference Sus-Non	0,0187	0,0011	0,065%
Transformed Difference	7,0E-10	0,0005	-
P - Value	0,2183	0,1479	0,3198

This table reports the differences of the risk-adjusted performance measures, the transformed differences, the P-values of the hypothesis testing and the significance levels. The P-values are calculated with different methods in order to acheive reliable results, which is accounted for in section 5.5 in this essay. All the measurements are on a monthly basis and derived from the monthly returns.The risk-free rate is the geometric average of the one month SSVX in Sweden. The original values are accounted for in table 6.1.
* Statistically significant at 10% level
** Statistically signifacant at 5% level
*** Statistically significant at 1% level

As one may observe from *table 6.2*, the results are inconclusive when considering the two different scenarios. In the value-weighted case, there is a significant difference between the two portfolios in every measure in favor of the Non-sustainable. In the Treynor ratio and Jensen's alpha, the null hypothesis of no difference is rejected at a one percent level. For the Sharpe ratio, the null hypothesis is rejected at a five percent level. In the naive weighted scenario, there is no statistically significant difference for any measure. The Treynor ratio has the lowest P-value, but there would have to be a significance level of 15% for the hypothesis of equality to be rejected.

The general conclusion from the two scenarios is, therefore, that there are ambiguous results. One scenario proves a significant difference in risk-adjusted performance while the other does not. However, the pattern of overperformance for the Non-sustainable portfolio is consistent. The overall conclusion that can be drawn from these results is discussed in *sections 7* and *8*.

6.4 General Descriptive Risk Measurements

This part will exclusively depict the risk measures of both portfolios with regard to both separations in weights. The separation of this part from the performance measurements is set in order to provide a general distinction between the return measurements and risk.

Table 6.3	Standard deviation	Skewness	Kurtosis	Value-at-Risk	Conditional Value-at-Risk	Beta	LPSD
Value weighted							
Sustainable	3,414%	-0,657	0,674	-6,198%	-7,357%	0,711	2,371%
Non-sustainable	3,452%	-0,659	1,231	-5,718%	-7,449%	0,704	2,321%
MSCI	3,937%	-0,530	1,189	-7,261%	-8,899%	1,000	2,788%
Naive weighted							
Sustainable	3,352%	-0,715	0,929	-5,717%	-7,287%	0,704	2,369%
Non-sustainable	3,288%	-0,816	1,808	-5,340%	-7,448%	0,676	2,316%
MSCI	3,937%	-0,530	1,189	-7,261%	-8,899%	1,000	2,788%

This table reports the general risk mesurements for both portfolios. All measurements are on a monthly basis and derived from the monthly returns of each portfolio. The methods used for obtaining these values are accounted for in section 5.

As one can see from *table 6.3*, there are conflicting results regarding the differences in the risk of the portfolios. The standard deviation is similar for both portfolios in the two scenarios, while the riskiest one concerning this measurement varies when considering the different separation in weights. The standard deviation is the highest for the MSCI World Index, indicating that Swedish funds, in general, are well hedged in terms of systematic risk. The more considerable volatility of the market index is also apparent when observing each portfolio's beta values. The Non-sustainable and Sustainable portfolio's beta values are on average 0,7, while the market beta is always 1. As previously mentioned, this indicates lower volatility relative to the market for both portfolios.

The negative skewness of both portfolios and scenarios suggests that the distribution is skewed to the left. This indicates heavier tails on the left side and thereby a larger probability of negative returns. The standard deviation calculated for both portfolios thereby underestimates the risk. One pattern obtained from *table 6.3* is that the excess kurtosis, in general, is higher for the Non-sustainable portfolio in comparison to the Sustainable and the market index. As mentioned previously in the text, kurtosis is a measurement of the extreme values in the tail of the distribution; in other words, the outliers. The Non-sustainable portfolio has twice as large kurtosis as the Sustainable portfolio, which indicates that the portfolio suffers from "fatter" tails and thereby a higher probability of extreme values. To statistically prove that the portfolios are not normally distributed, implying that the skewness and kurtosis are significantly different from zero, a Jarque-Bera test is performed.

Table 6.4	Value Weighted		Naive Weighted	
	Sustainable	Non-sustainable	Sustainable	Non-sustainable
Jarque-Bera	10,919	16,254	14,529	29,667
P - Value	0,00426***	0,000296***	0,0007***	0***

This table reports the Jarque-Bera statistics, the P-values and the significance level. All values are derived from Eviews. The test is more extensively expressed in section 5.5 of this essay.

* Statistically significant at 10% level

** Statistically signifacant at 5% level

*** Statistically significant at 1% level

Table 6.4 reports the P-values of each portfolio and scenario. All P-values are below the significance level of 1%, which statistically proves that none of the portfolios has a normal distribution. As mentioned previously in the text, this further indicates that the skewness and kurtosis are significantly different from zero. The kurtosis is interrelated with the VaR and the CVaR. The 95% monthly Value-at-Risk is larger for the Sustainable portfolio than for the Non-sustainable portfolio, as shown in *table 6.3*. The Conditional Value-at-Risk provides a contrary result; it is higher for the Non-sustainable portfolio. This is a consequence of the larger kurtosis and indicates further that the outliers of the Non-sustainable portfolio's distribution are larger than for the Sustainable portfolio. The LPSD of both portfolios is similar, and it is not possible to draw any conclusions based on this particular measurement.

6.5 Hypothesis 2: There is no significant difference in risk between the portfolios

The second hypothesis states to investigate if there is a significant difference in risk between the Sustainable and the Non-sustainable portfolio. The reason for a second hypothesis that only considers the investment risk is to make a statement if the significant improvement in risk-adjusted returns depends on more risk taken. The risk measurements that will be considered in this section are the standard deviation, the normal distribution assumption in the form of a Jarque-Bera test, and the beta differences. Formally, the hypotheses can be stated as such:

$$H0 : \sigma_{Sus} = \sigma_{Non} \qquad H0 : \ r_{Sus} - r_{Non} \in N(\mu, \sigma^2) \qquad H0 : \beta_{Sus} = \beta_{Non}$$

$$H1 : \sigma_{Sus} \neq \sigma_{Non} \qquad H1 : \ r_{Sus} - r_{Non} \notin N(\mu, \sigma^2) \qquad H1 : \beta_{Sus} \neq \beta_{Non}$$

Table 6.5 is presented in order to give an overview of the results. The table will provide the reader with the differences, P-values, and significance levels.

Table 6.5	Standard deviation	Jarque-Bera	Beta
Value weighted			
Difference Sus-Non	0,038%	0,3026	0,007
P - Value	0,9038	0,8596	0,749
Naive weighted			
Difference Sus-Non	-0,064%	0,6852	0,028
P - Value	0,8337	0,7099	0,191

This table reports the differences of the risk measures, the P-values of the hypothesis testing and the significance levels. The P-values are calculated with different methods in order to acheive reliable results, the methods used are accounted for in section 5.5 in this essay. All the measurements are on a monthly basis and derived from the monthly returns.

* Statistically significant at 10% level

** Statistically signifacant at 5% level

*** Statistically significant at 1% level

As can be observed from *table 6.5*, there is no significant difference in the risk measurements. The difference in kurtosis and skew that were mentioned in the previous part is, therefore, insignificant. The general conclusion from these hypothesis tests is clear; no statistically significant difference in risk can be proven between sustainable and non-sustainable funds.

7. Discussion

This section will discuss the general results obtained in *part 6* and the limitations of our research. This chapter will be divided into three separate parts, the first two outlining the answers to our research questions and the last part discussing the shortcomings of this paper. The answers are validated by connecting our results to previous literature about the subject.

7.1 Research Question 1

The first research question states to investigate the following:

Is there any significant difference in risk-adjusted performance between sustainable and non-sustainable funds?

The results obtained in *part 6* are inconclusive since the significance differs when applying different weights to each fund. There is a statistically significant difference in each of the risk-adjusted performance measures in favor of the Non-sustainable portfolio in the value-weighted scenario. In the naive weighted scenario, the risk-adjusted performance measures did not show any statistically significant difference, but there was a clear trend of overperformance for the Non-sustainable portfolio. The general tendency of superior performance for the Non-sustainable portfolio provides enough evidence to conclude a significant difference in risk-adjusted performance between the two portfolios. The result contradicts both Kreander et al. (2005) and Hamilton, Jo, and Statman (1993), who could not provide any evidence of significant differences between sustainable and conventional funds. Gil-Bazo, Ruis-Verdú, and Santos (2010) could, in their report, conclude a statistically significant overperformance for US SRI funds, which also serves as contrary to our result.

The theoretical principles of portfolio theory presented by Markowitz (1952) are in line with our findings. Markowitz argues that investors should allocate capital to securities yielding the ultimate return and that there exist a set of optimal portfolios in terms of return relative to risk, the efficient frontier. The Sustainable portfolios' constraints indicate a deviation of optimal risk-adjusted returns and should, therefore, result in suboptimal returns. This theory is in line with the results obtained in this report. Our findings are similar to Climent and Soriano (2011), Chang, Nelson, and Witte (2012), and Jones et al. (2008). The differences between these reports and ours are the geographical area covered and delimitations such as types and number of funds included in the research.

As mentioned above, no statistically significant difference could be proven in the naive weighted scenario. This finding was surprising as it contradicts the theoretical principles of portfolio theory. There was, however, a clear tendency of overperformance for the Non-sustainable portfolio in this scenario as well, which is why the overall result of this study remained clear. Although the general tendency of overperformance for the Non-sustainable portfolio was evident, one has to acknowledge that the weights assigned to each fund are vital in the process of providing statistical proof.

7.2 Research Question 2

The second research question aims to investigate the following:

Is there any significant difference in risk between sustainable and non-sustainable funds?

The results indicate that there are no significant differences in risk between sustainable and non-sustainable funds. Both scenarios present similar results, for which there is no statistical significance proven by any of the risk measurements. The results are in line with our hypothesis. One probable reason behind the result is that the diversification across the funds is sufficient to reduce the portfolios' idiosyncratic risk, and the constraints of the Sustainable portfolio are, therefore, irrelevant in terms of risk. We did find a pattern of higher distortion from a normal distribution for the Non-sustainable portfolio. The risk-measurements skewness and kurtosis were continuously more pronounced for the Non-sustainable portfolio, indicating higher probabilities of extreme values as the tails are "fatter". This is surprising considering our hypothesis of no difference in risk, although the differences were not significantly large enough to prove it.

Our results are contrary to the applied previous research regarding the subject. Mallin, Saadouni, and Briston (1995) found in their research that non-ethical funds tend to be riskier than ethical funds. Kreander et al. (2005) found similar results and could prove a statistical difference between the risk of sustainable and non-sustainable funds. Verheyden, Eccles, and Feiner (2016) made a study of portfolios consisting of stocks with high versus low ESG-ratings. Their report's conclusion was similar to previous ones, with non-sustainable stocks presenting a higher risk than sustainable ones. The authors argue that the reason is that the worst-performing companies, from an ESG point of view, also were the riskiest. From this point of view, our result might be troubling as previous literature tends to suggest another answer. One reason for our result might be that this report focuses on Swedish funds. Sweden is, in general, a conscious country in terms of sustainability. This may indicate that the differences in companies that these funds consist of are not as large as for research focused on other countries.

The conclusion of no difference in financial risk between sustainable and non-sustainable funds should, however, be interpreted with caution. As the awareness of ESG investment has increased, there exists a possibility of an escalation in the public's demand for business models not diminishing the development of a sustainable future. Hence, a business model not sustainable may be subject to a future aversion in the public’s mind and, therefore, be economically unsustainable as well. Furthermore, the public’s demand is often interrelated with the judiciary. The numbers presented in *section 6* do not capture the litigation risk correlated with higher judicial demands of sustainability incorporated in the business models of companies. The risk of legal disputes connected to non-sustainable industries is discussed and confirmed by Hong and Kacperczyk (2009). In that point of view, the financial risk of the non-sustainable funds may be underestimated.

7.3 Limitations of the Research

There are some limitations of this research that may have affected the outcome of the results. The benchmark used in this research was the broad index MSCI World, which may affect this study’s external validity. As accounted for in *section 5.6*, the MSCI World Index has been used due to the geographical spread of the funds' asset allocation. In retrospect, the study would have been more precise if comparing the portfolios to several indices and running regressions against different benchmarks. Still, the benchmark only serves the purpose of evaluating potential over-or underperformance of the portfolios towards the market. For the aim of comparing sustainable to non-sustainable funds, the benchmark index chosen serves an adequate function. Besides the choice of benchmark index, some critique against the computation of test statistics has been observed. Jobson and Korkie (1981) themselves draw attention to the possibility of Type 1 errors[5] due to estimation errors of the asymptotic variance in small samples. Nevertheless, it is stated that the estimation error decreases as the sample size increases and that a relatively well-behaved approximation will be obtained with

[5] The act of incorrectly rejecting a true null hypothesis.

a sample size of at least 60 observations (Jobson & Korkie, 1981). As our paper includes a total amount of 215 funds, the Type 1 error should be trivial.

There are several issues when considering the ESG-scores used in this study to separate sustainable from non-sustainable funds. The first issue is based on the fact that we only use one source for the sustainability score. There exist more financial services, for example, Bloomberg, that provides users with sustainability scores. The scores will differ between the different sources and may result in different portfolios and funds. It is reasonable to believe that this problem is insignificant due to the broad amount of funds limiting the importance of differences in individual funds. Another issue with the ESG-score is that it varies in time. There exists a possibility that some funds vary between the Sustainable and the Non-sustainable portfolio over time, which is an aspect not taken into consideration in this study. The differences between the portfolios may therefore suffer from some inaccuracy. The solution to this would be to rebalance the portfolios in some time-periods to achieve accurate portfolios in regards to the underlying ESG-score of each fund. The solution is not as easy as it seems. There is a lack of historical development information over the time period of ten years, which may result in inconclusive results. The last issue of the ESG-scores is the broad middle range of funds. Few funds are either excellent or very bad in sustainability terms. Therefore, the broad middle range may present some inaccuracy in the difference between the sustainable and non-sustainable funds as some of the funds in opposite portfolios are similar. However, our solution with only two portfolios is a method that will provide accurate results, as the average ESG-score of each portfolio differs significantly.

Our study may suffer from survivorship bias. Brown, Goetzmann, Ibbotson, and Ross (1992) explain this phenomenon as a risk of spurious inferences of historical performance evaluations because only the best performing funds on a competitive market will survive, and therefore be subject to the investigation. Our choice of time was the most extensive period that could provide a sufficient amount of funds. The survivorship bias exists as the only funds included in this study are the ones that have existed during the whole period. There are probably several active funds in previous years, which are now canceled due to poor performance, which are not included in our result. If these canceled funds were included, the result could differ from ours. There are limited practical possibilities to conduct a test that includes canceled funds as the information is problematic to collect, and the historical returns may be unrecorded. Nonetheless, it is reasonable to assume that this bias affects both funds classified as sustainable and non-sustainable equally, implicating that the process of comparing the funds is not compromised. The time period used may also affect the reliability negatively. The reason for the chosen period of ten years was to reduce the impact of market fluctuations affecting the result. The one thing that may be negative with a long time period in this scenario is the increase in ESG awareness for the general public. There is a possibility that the market in later years provides a premium for sustainability, which was not given ten years ago. The result may, therefore, differ when observing a smaller period located in recent years.

8. Conclusion

The purpose of this study states to investigate differences between sustainable and non-sustainable funds in regards to risk-adjusted performance and investment risk. This study is based on 215 Swedish funds separated into two portfolios in regards to their ESG-score and compared during the ten years between October 2010 and October 2020. The weights applied to each portfolio were divided into two sub-scenarios. One was based on a value-weighted approach and one where every fund received equal weights, a naive diversification method.

This study concludes that non-sustainable funds significantly overperform sustainable funds in terms of risk-adjusted performance. However, there was no significant difference in the investment risk between the two portfolios, indicating an overperformance not dependent on an increase in risk. The obtained results align with our hypotheses and may be explained by fundamental portfolio theory. The previous research regarding this topic has not been conclusive, and this research will, therefore, provide more knowledge about the subject with regards to the Swedish market. The results imply that sustainable funds do not provide the investor with equal possibilities of large risk-adjusted returns as its conventional peers, which may be troubling. The increase in awareness regarding sustainability within the financial sector and the general public has been extensive in the previous years. This development is essential for the world and must be continued in order to preserve a sustainable future. Today's reality may be that investors are willing to accept a financial sacrifice on behalf of more sustainability. However, the ability to maintain the tendency of increased sustainable investing may be at risk if the financial sector does not provide the area with any premiums behind investing with ESG constraints. Therefore, our study may serve as an indicator of caution; the financial sector has not yet valued sustainable investing superior or equal to conventional.

The authors of this study want to acknowledge the fact that this investigation is faced with limitations, and the results should be interpreted with caution. Most of the limitations are based on the quantification of ESG and how the portfolio consisting of funds should be built regarding their sustainability rating. The ESG-score is a measurement that is continuously updated, and some funds may vary between the Sustainable and the Non-sustainable portfolio, indicating that the separation may not be perfect. The optimal scenario would be to rebalance the portfolios in some time-periods to achieve an accurate separation. This scenario is, on the other hand, stressed with practical difficulties.

Further research on the topic is necessary to conclude the different opinions and results from previous researchers. We want to emphasize the importance of more research on the differences in financial risk between sustainable and non-sustainable funds as the results in this part differ significantly from previous studies. An interesting perspective that should be further investigated is the differences in tail risk between sustainable and non-sustainable funds in times of market recessions, especially in these times of a worldwide pandemic.

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Appendix

A. List of Funds

Sustainable Funds	Kolumn1
Aktie-Ansvar Avkastningsfond	Nordea Sverige Passiv icke-utd
Aktie-ansvar Sverige A	Nordnet indexfond Sverige
Aktiespararna Topp Sverige	Quesada Sverige
AMF Aktiefond Europa	SEB Europafond
AMF Aktiefond Global	SEB Hållbar Sverige Indexnära
AMF Aktiefond Nordamerika	SEB Hållbarhetsfond Global
AMF Aktiefond Sverige	SEB Hållbarhetsfond Sverige Index utd
AMF Aktiefond Världen	SEB Hållbarhetsfond Världen
AMF Balansfond	SEB Stiftelsefond Sverige
Avanza Zero	SEB Stiftelsefond Utland
Carnegie Spin-Off A	SEB Swedish Value Fund
Carnegie Sverigefond A	SEB Sveriefond
Catella Sverige Aktiv Hållbarhet	SEB Sverige Expanderad
Catella Sverige Hållbart Beta A	SEB Teknologifond
Cliens Mixfond A	SEB WWF Nordenfond
Cliens Sverige A	Sensor Sverige Select
Didner & Gerge Aktiefond	Simplicity Norden
Enter Cross Credit A	Skandia Cancerfonden
Enter Select A	Skandia SMART Balanserad
Enter Select Pro	Skandia Time Global
Folksam LO Sverige	Skandia USA
Folksam LO Världen	Skandia Världen
Folksam Lo Västfonden	Skandia Världsnaturfonden
Handelsbanken Global Tema (Criteria)	Spiltan Aktiefond Småland
Handelsbanken Global Tema A10 NOK	Spiltan Aktiefond Stabil
Handelsbanken multi Asset 50 (A1 SEK)	SPP Aktiefond Europa
Handelsbanken Norden Tema (A1 SEK)	SPP Aktiefond Sverige A
Handelsbanken Stiftelsefond (B1 SEK)	Swedbank Humanfond
Handelsbanken Sverige Index Criteria	Swedbank Robur Aktiefond Pension
Handelsbanken Sverige Tema (A1 SEK)	Swedbank Robur Allemansfond Komplett
KPA Etisk Aktiefond	Swedbank Robur Bas Action
KPA Etisk Blandfond 2	Swedbank Robur Bas Mix
Lancelot Camelot A	Swedbank Robur Europafond A
Lannebo Likviditetsfond	Swedbank Robur Fastighet A
Lannebo Mixfond	Swedbank Robur Globalfond A
Lannebo Sverige	Swedbank Robur Nordenfond
Lannebo Sverige Plus	Swedbank Robur Stiftelsefond
Lannebo Teknik	Swedbank Robur Stiftelsefond Utd
Länsförsäkringar Fastighetsfond A	Swedbank Robur Sweden High Dividend A
Länsförsäkringar Global Hållbar A	Swedbank Robur Sverigefond A
Länsförsäkringar Sverige Aktiv A	Swedbank Robur Sverigefond MEGA I
Länsförsäkringar Sverige Indexnära	Swedbank Robur Talented Aktiefond MEGA J
Lärarfond 21-44 år	Swedbank Robur Technology A
Lärarfond 45-58 år	Swedbank Robur Transfer 70
Nordea Alfa	Swedbank Robur Transfer 80
Nordea Avtalspensionsfond Midi	Swedbank Robur Transition Global MEGA J
Nordea Donationsmedelsfond utd	Swedbank Robur Transition Sweden A
Nordea Generationsfond 50-tal	Swedbank Robur Transition Sweden MEGA J
Nordea Generationsfond 60-tal	Swedbank Robur USA A
Nordea Generationsfond Senior	Öhman Etisk Index Europa
Nordea Inst Aktie Sverige utd	Öhman Etisk Index Japan
Nordea Olympiafond	Öhman Etisk Index Pacific
Nordea Swedish Stars icke-utd	Öhman Etisk Index Sverige A
	Öhman Etisk Index USA A

Non-sustainable Funds	Kolumn1
Aktie-Ansvar Europa	Nordea Inst Aktiefonden Stabil
AMF Aktiefond Asien Stilla havet	Nordea Inst Företagsobligation utd
AMF aktiefond Småbolag	Nordea Stabil
AstraZeneca Allemansfond	Nordea Stratega 50
Caprifol Nordiska Fonden	Nordea Stratega 70
Carnegie Indienfond A	Nordnet Offensiv
Carnegie Rysslandsfond A	OPM Listed Private Equity A
Catella Balanserad	Peab-Fonden
Catella Småbolag	Quesada Ränta
Didner & Gerge Småbolag	SEB Aktiesparfond
East Capital Ryssland	SEB Asienfond
East Capital Östeuropa	SEB Dynamisk Aktiefond
Enter Sverige A	SEB Emerging Marketsfond
Enter Sverige Pro	SEB Europafond Småbolag
Ethos Aktiefond	SEB Japanfond
Handelbanken Japan Tema (A1 SEK)	SEB Latinaamerikafond
Handelsbank Multi Asset 75 (A1 SEK)	SEB Läkemedelsfond
Handelsbanken Amerika Tema (A1 SEK)	SEB Nordamerika Små och Medelstora Bolag
Handelsbanken Asien Tema (A1 SEK)	SEB Nordamerikafond
Handelsbanken Euro Ränta	SEB Nordamerikafond Småbolag
Handelsbanken Europa Index Crit (A1 SEK)	SEB Nordenfond
Handelsbanken Hälsovård Tema (A1 SEK)	SEB PB Aktiv 75
Handelsbanken Latinamerika Tema (A1 SEK)	SEB Schweizfond
Handelsbanken Multi Asset 100 (A1 EUR)	SEB Sverigefond Småbolag
Handelsbanken Multi Asset 100 (A1 NOK)	SEB Sverigefond Småbolag C/R
Handelsbanken Multi Asset 100 (A1 SEK)	SEB Östeuropafond
Handelsbanken Nordiska Småbol (A1 SEK)	Skandia Asien
Handelsbanken Svenska Småbolag (A1 SEK)	Skandia Europa Exponering
Handelsbanken Tillväxtmark Tema (A1 SEK)	Skandia Idéer för Livet
IKC 0-100	Skandia Japan Exponering
IKC Sverige Flexibel	Skandia SMART Offensiv
Lannebo Småbolag	Skandia Småbolag Sverige
Lannebo Sverige Hållbar B SEK	Spiltan Småbolagsfond
Länförsäkringar Japan Indexnära	SPP Aktiefond Global A
Länsförsäkringar Asienfond A	SPP Aktiefond Global B
Länsförsäkringar Europa Aktiv A	SPP aktiefond USA
Länsförsäkringar Europa Indexnära	SPP Generation 60-tal
Länsförsäkringar Mix A	SPP Generation 70-tal
Länsförsäkringar Småbolag Sverige A	SPP Generation 80-tal
Länsförsäkringar Sparmål 2025	Swedbank Robur Asienfond A
Länsförsäkringar Sparmål 2030	Swedbank Robur Exportfond A
Länsförsäkringar Sparmål 2035	Swedbank Robur Japanfond A
Länsförsäkringar Sparmål 2040	Swedbank Robur Kinafond A
Länsförsäkringar Sparmål 2045	Swedbank Robur Medica A
Länsförsäkringar USA Aktiv A	Swedbank Robur Ny Teknik A
Länsförsäkringar USA Indexnära	Swedbank Robur Rysslandsfond A
Länsförsäkrningar Tillväxtmarknad Aktiv A	Swedbank Robur Småbolagsfond Europa A
Navigera Aktie 1	Swedbank Robur Småbolagsfond Norden A
Navigera Balans 1	Swedbank Robur Småbolagsfond Sverige A
Navigera Tillväxt 1	Swedbank Robur Östeuropafond A
Norde Aktieallokering	Öhman Global Growth
Nordea Generationsfond 70-tal	Öhman Global Hållbar A
Nordea Generationsfond 80-tal	Öhman Småbolagsfond A
Nordea Inst Aktie Världen	Öhman Sweden Micro Cap A

B. Regression Statistics

<u>Value-Weighted</u>

Sustainable

Dependent Variable: PORTFOLIO_RETURN_PLOW
Method: Least Squares
Date: 12/02/20 Time: 10:59
Sample (adjusted): 2010M10 2020M09
Included observations: 120 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003165	0.001845	1.715389	0.0889
RETURN_MSCI	0.706664	0.046856	15.08176	0.0000

R-squared	0.658426	Mean dependent var	0.005765
Adjusted R-squared	0.655531	S.D. dependent var	0.034286
S.E. of regression	0.020123	Akaike info criterion	-4.957359
Sum squared resid	0.047783	Schwarz criterion	-4.910901
Log likelihood	299.4416	Hannan-Quinn criter.	-4.938493
F-statistic	227.4596	Durbin-Watson stat	2.124055
Prob(F-statistic)	0.000000		

Non-Sustainable

Dependent Variable: PORTFOLIO_RETURN_PHIGH
Method: Least Squares
Date: 12/02/20 Time: 11:09
Sample (adjusted): 2010M10 2020M09
Included observations: 120 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004697	0.001882	2.495826	0.0139
RETURN_MSCI	0.711294	0.047792	14.88300	0.0000

R-squared	0.652434	Mean dependent var	0.007314
Adjusted R-squared	0.649488	S.D. dependent var	0.034669
S.E. of regression	0.020526	Akaike info criterion	-4.917766
Sum squared resid	0.049713	Schwarz criterion	-4.871308
Log likelihood	297.0660	Hannan-Quinn criter.	-4.898899
F-statistic	221.5038	Durbin-Watson stat	2.062886
Prob(F-statistic)	0.000000		

<u>Naive Weighted</u>

Sustainable

Dependent Variable: SUSTAINABLE
Method: Least Squares
Date: 12/02/20 Time: 10:36
Sample: 1 120
Included observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002375	0.001775	1.338068	0.1834
MSCI	0.700976	0.045073	15.55212	0.0000

R-squared	0.672102	Mean dependent var	0.004954
Adjusted R-squared	0.669324	S.D. dependent var	0.033663
S.E. of regression	0.019358	Akaike info criterion	-5.034944
Sum squared resid	0.044216	Schwarz criterion	-4.988486
Log likelihood	304.0966	Hannan-Quinn criter.	-5.016077
F-statistic	241.8685	Durbin-Watson stat	2.094322
Prob(F-statistic)	0.000000		

Non-Sustainable

Dependent Variable: NON
Method: Least Squares
Date: 12/02/20 Time: 10:32
Sample: 1 120
Included observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002975	0.001783	1.668870	0.0978
MSCI	0.679372	0.045275	15.00529	0.0000

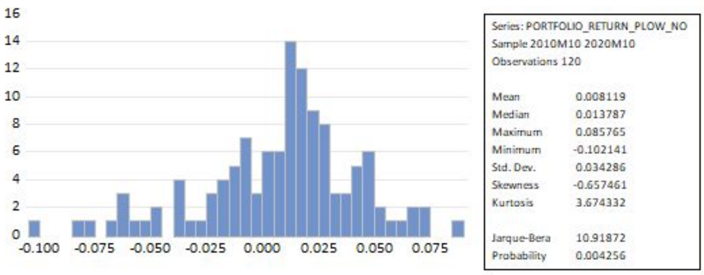
R-squared	0.656136	Mean dependent var	0.005475
Adjusted R-squared	0.653222	S.D. dependent var	0.033020
S.E. of regression	0.019445	Akaike info criterion	-5.025967
Sum squared resid	0.044615	Schwarz criterion	-4.979509
Log likelihood	303.5580	Hannan-Quinn criter.	-5.007100
F-statistic	225.1588	Durbin-Watson stat	2.007200
Prob(F-statistic)	0.000000		

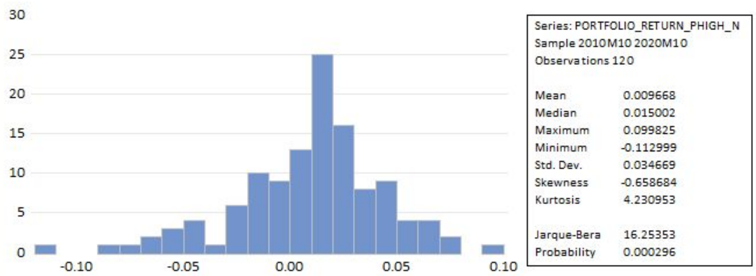
Note to Appendix B: The tables above present the regression equations for the different portfolios on a monthly basis. The variable C reported in the statistics is the constant of the equation, i.e., alpha. MSCI accounts for the market proxy, and the corresponding coefficient reported can be interpreted as the beta of the portfolio against the market. These variables are also given a P-value in the regression statistics, which have been used for the hypothesis testing Jensen's alpha towards zero.

C. Jarque-Bera Test

Value-Weighted

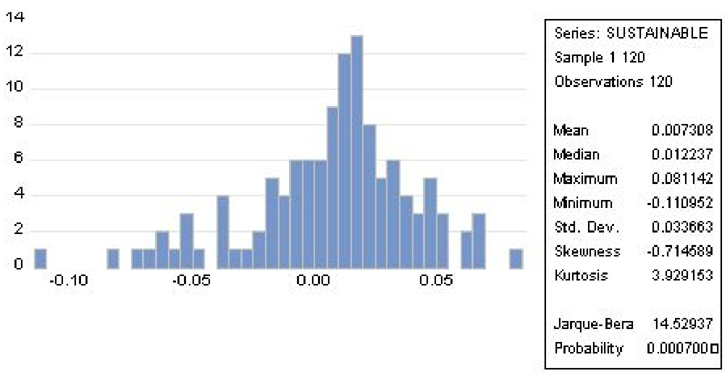
Sustainable | Non-Sustainable

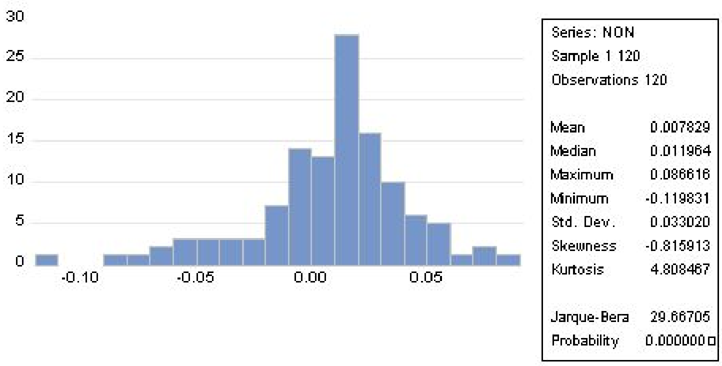




Naive Weighted

Sustainable | Non-Sustainable





Note to Appendix C: The tables above provide the test statistics of the Jarque-Bera test, which tests the null hypothesis that the dataset is normally distributed. The P-value is reported for every data set individually. Furthermore, some general descriptive statistics are also presented in the tables. Note that Eviews calculates the kurtosis while this report has consistently used excess kurtosis, which is:

$$Excess\ kurtosis = Kurtosis - 3 \qquad (C.1)$$

A normally distributed data set has a kurtosis of 3 and an excess kurtosis of 0.

D. Test for Equality of Means & Variance

Value Weighted

Test for Equality of Means Between Series
Date: 12/22/20 Time: 10:52
Sample: 1 120
Included observations: 120

Method	df	Value	Probability
t-test	238	0.348015	0.7281
Satterthwaite-Welch t-test*	237.9707	0.348015	0.7281
Anova F-test	(1, 238)	0.121114	0.7281
Welch F-test*	(1, 237.971)	0.121114	0.7281

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	0.000144	0.000144
Within	238	0.282924	0.001189
Total	239	0.283068	0.001184

Test for Equality of Variances Between Series
Date: 12/02/20 Time: 11:32
Sample: 2010M10 2020M10
Included observations: 121

Method	df	Value	Probability
F-test	(119, 119)	1.022451	0.9038
Siegel-Tukey		0.017665	0.9859
Bartlett	1	0.014604	0.9038
Levene	(1, 238)	0.006587	0.9354
Brown-Forsythe	(1, 238)	0.001439	0.9698

Category Statistics

Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.	Mean Tukey-Siegel Rank
PORTFO...	120	0.034286	0.025762	0.025207	120.4167
PORTFO...	120	0.034669	0.025521	0.025088	120.5833
All	240	0.034415	0.025642	0.025147	120.5000

Bartlett weighted standard deviation: 0.034478

Naive Weighted

Test for Equality of Means Between Series
Date: 12/02/20 Time: 11:14
Sample: 1 120
Included observations: 120

Method	df	Value	Probability
t-test	238	0.121028	0.9038
Satterthwaite-Welch t-test*	237.9115	0.121028	0.9038
Anova F-test	(1, 238)	0.014648	0.9038
Welch F-test*	(1, 237.912)	0.014648	0.9038

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	1.63E-05	1.63E-05
Within	238	0.264594	0.001112

Test for Equality of Variances Between Series
Date: 12/02/20 Time: 11:06
Sample: 1 120
Included observations: 120

Method	df	Value	Probability
F-test	(119, 119)	1.039326	0.8337
Siegel-Tukey		0.620150	0.5352
Bartlett	1	0.044075	0.8337
Levene	(1, 238)	0.187114	0.6657
Brown-Forsythe	(1, 238)	0.184532	0.6679

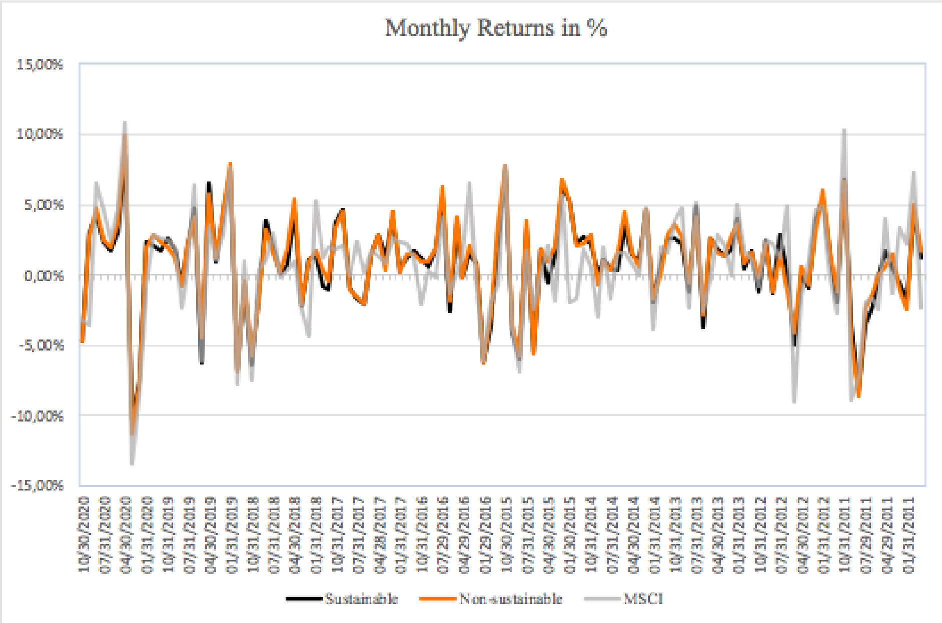
Category Statistics

Variable	Count	Std. Dev.	Mean Abs. Mean Diff.	Mean Abs. Median Diff.	Mean Tukey-Siegel Rank
NON	120	0.033020	0.023840	0.023357	123.2833
SUSTAINA...	120	0.033663	0.025098	0.024659	117.7167
All	240	0.033274	0.024469	0.024008	120.5000

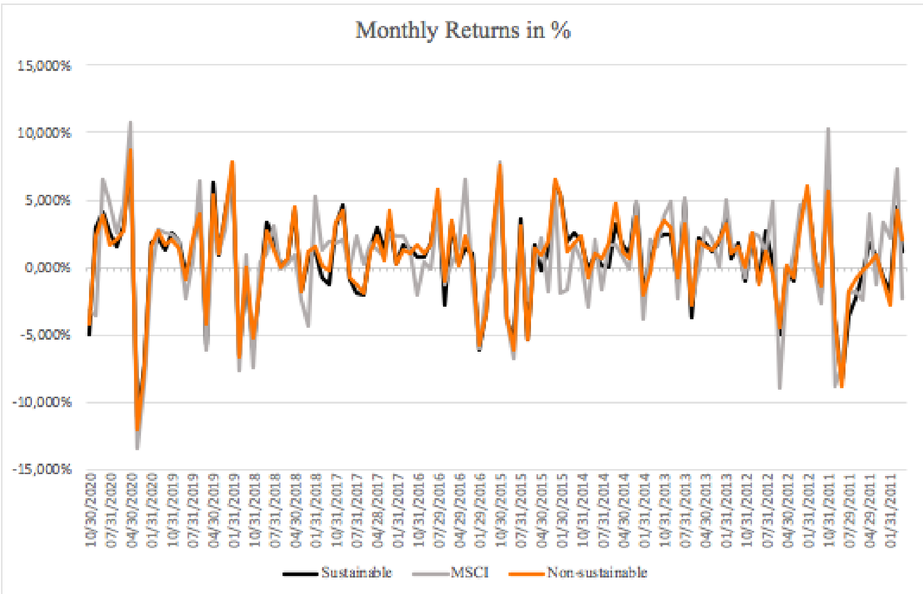
Note to Appendix D: The test for equality of mean and variance has been performed based on the differences between the two portfolios in the different scenarios. The t-test was used for the test for equality of means, and the F-test was used for the test for equality of variances. The P-value is reported in the corresponding column.

E. Monthly Returns

<u>Value Weighted</u>



<u>Naive Weighted</u>



Note to Appendix E: The graphs present the monthly[6] returns in percent for the different portfolios in the two scenarios. As shown from the graphs, the market index, MSCI World Index, is the most volatile in both cases, yielding both the most extreme positive and negative returns.

[6] Notice that the label on the x-axis reports the date for every third month, but the graphs show every monthly return.

F. Test For Differences in ESG-Scores

Test for Equality of Means Between Series
Date: 01/06/21 Time: 16:11
Sample: 1 120
Included observations: 120

Method	df	Value	Probability
t-test	213	-11.58465	0.0000
Satterthwaite-Welch t-test*	130.8280	-11.62797	0.0000
Anova F-test	(1, 213)	134.2040	0.0000
Welch F-test*	(1, 130.828)	135.2098	0.0000

*Test allows for unequal cell variances

Analysis of Variance

Source of Variation	df	Sum of Sq.	Mean Sq.
Between	1	538.1286	538.1286
Within	213	854.0834	4.009781
Total	214	1392.212	6.505664

Note to Appendix F: A t-test has been used to determine the difference in ESG-scores between the Sustainable and Non-sustainable portfolio. The null hypothesis that is subject to testing is that the portfolios have the same average ESG-score. As can be seen from the P-value, the null hypothesis can be rejected.