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Working Paper

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IUBH Discussion Papers - Business & Management, No. 7/2021

Provided in Cooperation with:

IU International University of Applied Sciences

Suggested Citation: Gardenier, Julius; Lac, Visieu; Ashfaq, Muhammad (2021) : Risk-adjusted return in sustainable finance: A comparative analysis of European positively screened and best-in-class ESG investment portfolios and the Euro Stoxx 50 index using the Sharpe Ratio, IUBH Discussion Papers - Business & Management, No. 7/2021, IU Internationale Hochschule, Erfurt

This Version is available at:

<http://hdl.handle.net/10419/235490>

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IUBH Discussion Papers

BUSINESS & MANAGEMENT

Risk-Adjusted Return in Sustainable Finance

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IUBH Discussion Papers, Series: Business & Management, Vol. 4, Issue 7 (June 2021)

ISSN-Nummer: **2512-2800**

Website: <https://www.iu.de/forschung/publikationen/>

RISK-ADJUSTED RETURN IN SUSTAINABLE FINANCE

A comparative analysis of European positively screened and best-in-class ESG investment portfolios and the Euro Stoxx 50 index using the Sharpe Ratio.

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Abstract:

This discussion paper aims at describing the risk-adjusted return of European sustainable and conventional investment portfolios and comparing them to determine whether sustainable investment portfolios generate superior risk-adjusted returns. The paper is based on the bachelor thesis of Julius Gardenier. In fulfilling this aim, we actively construct sustainable positively screened and best-in-class portfolios using the Sustainalytics ESG risk rating with the help of modern portfolio theory. In a second step, the Sharpe Ratios of these portfolios are compared with those of the Euro Stoxx 50, as a proxy for a conventional portfolio, for the time horizon between 2005 and 2019 that is divided into ten instances on whose Sharpe Ratios paired sample t-tests are applied. Results show a statistically significant higher mean Sharpe Ratio for both types of sustainable portfolios when compared to the Euro Stoxx 50 for the period under investigation. Additionally, it was found that best-in-class portfolios yielded higher mean Sharpe Ratios. We conclude that, under reference to the paper's limitations, sustainable investments yielded superior risk-adjusted returns when compared to the conventional investment portfolio. Furthermore, the paper's findings identify recommendations for future research and may contribute to the growing body of academic literature in the field of sustainable finance.

Keywords:

Sustainable finance, modern portfolio theory, Sharpe Ratio, ESG risk rating

JEL classification:

G11 – Q56

1. Introduction

In past years, public attention started to centre on the topic of sustainability with the challenges of climate change at the forefront of the discussion.

Questions of how a sustainable transformation of the fossil fuel dependent economy of the 20th century could look like are being raised and actors such as governments, companies, or investors are starting to position themselves within these emerging sustainability trends. In EU, the government is investing substantial amounts of stimulus packages into green recovery (Krukowska & Millan, 2020) and Ørsted, as an example for sustainable company business conduct, restructured its conventional, coal dependent business model to one focussed on renewable energy generation - earning it the rank of most sustainable company 2020 (Todd, 2020). The transformation of our fossil economy towards sustainability requires significant changes, which will coincide with significant shifts in particular within the finance industry funding these changes. A particularly prominent example for an investor that highlights this shift of mentality and attention is the investment company BlackRock Inc., one of the world's largest financial advisory firms, which started to change their understanding of investing the capital of their clients. In 2020, Larry Fink, CEO of Black Rock Inc., acknowledged and raised concern about the risk to investments that lie within climate change and called for more disclosure of information on these sustainability risks by companies (Fink, 2020). In his most recent letter, Larry Fink reflected on the year 2020 and concluded that his assessments in 2020 held true and a massive shift of capital into sustainable investments had occurred over the past year. According to Black Rock's CEO, *"[f]rom January through November 2020, investors in mutual funds and ETFs invested \$288 billion globally in sustainable assets, a 96% increase over the whole of 2019."* (Fink, 2021). Moreover, companies that performed well in terms of sustainability outperformed their peers in 2020 with 81% of sustainable indices outperforming their parent benchmarks (Fink, 2021) which indicates strong outperformance of sustainable investments.

However, whether this also holds true for the years before 2020 remains to be proven as - when reading about the financial performance of sustainable investments in the academic literature - we realized that the superior performance of sustainable investments seems to be more debated than confirmed, which will be discussed in detail within this discussion paper. What became apparent though was that past industry reports show indeed a significant allocation of capital into sustainable investments, which highlights the significance of investigating the financial implication of sustainable investing concerning their returns. After reviewing the current academic literature, we identified a gap in academic literature within the area of risk-adjusted return of actively constructed sustainable portfolios utilizing ESG [Environmental, Social and Governance] risk ratings. In light of this gap, we formulated the following research questions that this paper is set to answer:

Q1: Do European sustainable ESG investment portfolios provide superior risk-adjusted returns compared to conventional embodied by the Euro Stoxx 50?

Q2: Does one of the sustainable investment strategies provide superior risk-adjusted performance when compared to the other?

2. Literature Review

2.1 Overview of the sustainable finance industry

2.1.1 Terminology within the sustainable finance industry

The sustainable finance industry does not have a standardized terminology to describe which types of investment can be subsumed to the category of "sustainable investments". This led to investors defining sustainable investments by their own standards for sustainability and to confusion about terminology as *"[...] firms are using close to 80 different terms to describe various forms of sustainable investing [...]"* (IFF, 2019, p.2). Over time, however, certain terminologies emerged to be frequently used by investors and allow grouping investments into certain categories, which will be described in the following.

Terms that are used in academic literature to describe the broad landscape of sustainable finance on an aggregate level mostly consist of two definitions namely "Responsible investment" or "Sustainable investment". Responsible investment is defined by the Principles for Responsible Investment [PRI], an investor initiative partnership with a

total of 2300 signatories and a total of \$85 trillion assets under management [AUM] (PRI, n.d., p.6), as being “[...] a strategy and practice to incorporate environmental, social and governance (ESG) factors in investment decisions and active ownership[...]” (PRI, n.d., p.1). The second term “Sustainable Investment” was formed by the Global Sustainable Investment Alliance [GSIA] and is defined as “[...] an investment approach that considers environmental, social and governance (ESG) factors in portfolio selection and management [...]” (Global Sustainability Investment Alliance, 2018, p.7). An important concept in this area is the abovementioned term “ESG” which is frequently used as an indicator of and as information about environmental, social, and governance risks to the investment in view.

Sustainable Investing according to the GSIA is further refined into several investment approaches that describe how ESG information is used and which, according to GSIA, have emerged to be the global standard (Global Sustainable Investment Alliance, 2018, p.7). These strategies are:

- (1) Negative/Exclusionary screening which means that the investments are chosen by excluding companies according to predefined criteria such as industry or ESG criteria; this was one of the predominant investment strategies in 2018 with \$19.770 trillion (Global Sustainable Investment Alliance, 2018, p.10)
- (2) Positive/Best in class screening which specifically includes investments according to sector, ESG rating or positive ESG performance relative to peers; this strategy was among the smallest in volume but fastest growing with a CAGR of 50.1% between 2016 and 2018 and will therefore be the focus of this paper (Global Sustainable Investment Alliance, 2018, p.10)
- (3) Norms-based screening which selects investments according to “[...] standards of business practice based on international norms” (Global Sustainable Investment Alliance, 2018, p.7) issued for instance by the OECD;
- (4) ESG integration which is “[...] the systematic and explicit inclusion by investment manager of environmental, social and governance factors into financial analysis” (Global Sustainable Investment Alliance, 2018, p.7); like negative/exclusionary screening this strategy is one of the dominant ones with \$17.543 trillion (Global Sustainable Investment Alliance, 2018, p.10)
- (5) Sustainability themed investing which invests in “[...] themes or assets specifically related to sustainability” (Global Sustainable Investment Alliance, 2018, p.7) such as regenerative energy or green tech; like Positive/Best in class screening this strategy was among the smallest in volume but fastest growing ones with a CAGR of 92% between 2016 and 2018 (Global Sustainable Investment Alliance, 2018, p.10)
- (6) Impact/Community investing where investments target social or environmental problems and try to directly solve them where they occur, for instance, concerning individuals or in communities;
- (7) Corporate engagement and shareholder action that uses the voting power and influence of shareholders to impact corporate behaviour through directly approaching senior managers or influencing their decisions via proxy voting.

This assessment of different ESG related strategies within Sustainable Finance seems to largely coincide with the screening strategies used in practice as Amel-Zadeh & Serafeim (2017) pointed out in their analysis of ESG data usage among mainstream senior investment professionals. Most of the definitions of ESG strategies, although the naming is slightly different, are in their core similar to those described above except one, namely “Positive/Best in class screening” which is refined in two separate strategies in practice. “Positive screening”, according to Amel-Zadeh & Serafeim, “[...] is the inclusion of certain sectors, companies or practices in a fund or portfolio based on specific minimum ESG criteria[...]” (Amel-Zadeh & Serafeim, 2017, p.16), and “Relative/Best-in-class screening” is “[...] the investment in sectors, companies or projects selected for ESG performance relative to industry peers[...]” (Amel-Zadeh & Serafeim, 2017, p.16). This difference shows that there are various ways to use positive screening as an investment approach, seeing as “Best-in-class” can be understood as simply a form of positive screening criteria but seems to be differentiated from it in practice. This paper follows the definition laid out by Amel-Zadeh and Serafeim (2017) of separating the two strategies into individual strategies as it better reflects the ESG data use in practice.

2.1.2 Facts and figures of the global sustainable finance industry

Sustainable finance has been on the rise in the past years with strong growth rates in AUM. The number of signatories of the PRI and their AUM can be seen as an indicator of this trend, since, as of 2019, about 2300 investors have signed the PRI with a total of \$85 trillion in AUM, compared to ten years earlier in 2009, when only about 600 investors with a \$20 trillion AUM had signed the PRI which amounts to a fourfold increase in both signatories and AUM over the period of time (PRI, n.d., p.6).

A report, published by the GSIA every two years, which presents a picture of the development of the global sustainable finance industry, comes to a similar conclusion but gives a more detailed picture of the differences in regions as well as the ESG investing strategies used. The most recent report (Global Sustainable Investment Alliance, 2018) covered the development of the sustainable finance industry in the period between 2016 and 2018. It was found that total assets invested, according to the GSIA definition of sustainable investment and ESG strategies, grew from \$22.838 trillion to \$30.683 trillion in 2018 globally (Global Sustainable Investment Alliance, 2018, p.7) out of \$74.3 trillion total AUM worldwide (BCG, 2020) raising the sustainable share of AUM to about 43.7%. The largest geographical markets in 2018 were Europe with \$14.075 trillion followed by the United States with \$11.995 trillion, Japan with \$2.180 trillion, Canada with \$1.699 trillion and Australia/New Zealand with \$0.734 trillion (Global Sustainable Investment Alliance, 2018, p.7). When looking at the growth dynamics, Japan, Australia/New Zealand, and Canada exhibited the strongest growth between 2014 and 2018 with a CAGR of 308%, 50%, and 21% respectively which can be explained by a rather underdeveloped sustainable finance industry in those regions as compared to Europe and the United States. These two regions had a CAGR of 6% and 16% respectively for the same period of time (Global Sustainable Investment Alliance, 2018, p.7) but a more detailed assessment of Europe will be given at a later stage of this literature review.

2.1.3 The role of different types of investors within the sustainable finance industry

Apart from knowing which investment strategies are most widely used and understanding which is increasing in relevance, it is important to understand who is investing in ESG investments and into what they are investing as different types of investors have different interests and financial power. As of 2018, GSIA reported in their review that institutional investors held 75% of sustainable investing assets as opposed to 25% held by retail investors, even though the proportion of retail investors is growing. They also reported that sustainable asset allocation of those investors was globally dominated by public equity, which accounted for 51% of assets, as well as fixed-income investments, which made up 36% of the allocation (Global Sustainable Investment Alliance, 2018, p.12).

The relevance of institutional investors was also highlighted in a different report by KPMG International et al (2020). The report surveyed different institutional investors globally and found that “[...] *[t]he advance [of ESG investing] is principally driven by institutional investors and their consultants*” (KPMG International et al., 2020, p.4) which was underlined by 85% of respondents answering that institutional investors drive interest in ESG investing and 39% answered with institutional consultants (KPMG International et al., 2020, p.4).

In the more recent OECD Business and Finance Outlook 2020, the OECD marked that indeed “[t]hese [ESG] factors are of increasing interest for many institutional investors and other market players” (OECD, 2020, p.96). Furthermore, they underlined that the role of institutional investors is seen by some people as not being based on a voluntary integration of ESG consideration but rather that ESG integration is part of their fiduciary duty (OECD, 2020, p.99). This is in line with findings of Lawson (2012) who claimed that in a study “[they] found a substantial likelihood of SEC noncompliance on ESG issues” (p.57). Based on the information it can be concluded that institutional investors currently play and will continue to play a vital role within sustainable finance. They have the possibility to invest if “ESG investing will benefit the beneficiary directly by improving risk-adjusted return” (Schanzenbach & Sitkoff, 2020, p.382) which stresses the importance of analysing risk-return characteristics of ESG investment and which will, therefore, be one of the focuses of this paper.

One thing that is not highlighted enough in most of these reports but noteworthy to mention is the role and especially the future role of retail investors within the industry. In the report by GSIA, the dynamic behind the 25% retail investor market share is of particular interest, seeing as two years earlier, in 2016, only 20% of assets invested were held by retail and 80% by institutional investors (Global Sustainable Investment Alliance, 2018, p.12) and in 2014 only 13.1% of assets invested were held by this investor group (Global Sustainable Investment Alliance,

2014, p.10.). This means that institutional investors have lost a cumulative market share of about 12% in four years to retail investors, thus highlighting their increasing importance to the industry. GSIA (2018) commented that “[...] interest by retail investors in sustainable and responsible investing has been steadily growing [...]” (p.12). This interest might also be reflected in investments of private investors into sustainable stocks and sustainable retail investment products. It is therefore relevant to assess how individual investors might use ESG criteria in their portfolio construction. This question will be another focus of the paper and will be discussed in the ESG rating section of this literature review.

2.1.4 Potential problems within the sustainable finance industry

After characterizing the sustainable finance industry, this section of the literature review will look at what current obstacles, barriers, or limitations are when investing in the sustainable finance industry. These limitations can be summarized as being information-driven; in fact, a study found out that among 22,000 investors of different kinds, 57% said that they did not invest in sustainable investments because they had lacked information about sustainable investments (Schroders, 2018, p.4). The reasons why this is the case are multifaceted and will be discussed in the following.

In their article “Towards a common Language for Sustainable Investing”, Barbara Novick, vice president of BlackRock Inc., and her colleagues emphasised that there are three key areas in which sustainable finance has to improve (Novick et al. 2020). The overall goal of these recommendations is to gain a common taxonomy “that enables asset owners to differentiate products and provides clear, transparent data regarding product attributes” (Novick et. al, 2020, p.1). The first area is the standardization and regulation of financial product naming such as the description of ETFs or mutual funds as sustainable or to make the distinction of investments easier for investors.

The second area of improvement is corporate issuer disclosures, as, similar to the reporting of financial information, disclosure of material ESG issues by companies exists but is currently done on a voluntary and unregulated basis as “[...] private companies are not always required to disclose information related to ESG issues[...]” (OECD, 2020, p. 109). There exists a number of different reporting standards published by private organisations. These organisations aim at governing the disclosure of ESG information such as the Global Reporting Initiative (GRI) or Sustainability Accounting Standard Board (SASB). What the industry lacks, however, are mandatory and harmonized reporting standards which are recognized by governmental regulatory institutions similar to IFRS, US GAAP, or HGB. This leads to the abovementioned difficulty of the comparability and thereby the quality of ESG information disclosed by companies, which then translates into the investment process as analysis and decisions and will be based on this information. Those difficulties thereby also contribute to the overall confusion and lack of information mentioned earlier (IFF, 2019, p.2; Schroders, 2018, p.4).

The third challenge that sustainable finance faces is related to sustainable economic activities which require clarification and standardization of terminology and, according to Novick et al. (2020, p.2), a taxonomy of their own. This taxonomy “[...] relates not to entities or investment products but rather defines specific underlying activities that can affect sustainability objectives [...]” (Novick et al., 2020, p.2).

2.1.5 The role of external data providers and ESG ratings in sustainable finance

Further limitations concerning the issue of ESG information quality are related to the collection, analysis, and presentation of ESG information. Institutional investors follow two approaches of evaluating ESG information in their investment process namely they either conduct an in-house analysis or they outsource this analysis using external data and service providers (OECD, 2020, p. 106).

Frequently used forms of external data providers come in the form of rankings, indices, and ratings with “[...] ESG ratings and index providers [being] a common source of data on ESG risk and opportunities [...]” (OECD, 2020, 108). While general use of ratings is quite commonplace in the financial industry, for instance in the form of credit risk ratings, critics of the use of ESG rating say that rating models and metrics used to generate those ratings lack transparency and comparability among rating providers (OECD, 2020, p. 109).

In his paper, Doyle (2018) concluded that ESG ratings differ substantially in their assessment of companies' ESG risks and lack transparency as well as consistency about how environmental, social, and governance issues are

incorporated. At the same time, he also underlined the relevance of those ratings as “[...] investments are made increasingly based on a company’s ESG rating, [and] the rating agencies that assign these ratings have a vital impact on investment strategies [...]” (Doyle, 2018, p. 17) and gave recommendations for their future improvement.

Gibson et al. (2019) also focused their research on the divergence of ESG ratings but assessed and found evidence for effects on stock returns stemming from that. Moreover, the authors mentioned that “[...] [ESG ratings] are now commonly used in economics, management, and finance research [...]” (Gibson et al., 2019, p. 6) while asserting that “[...] the validity of these ratings has been debated critically [...]” (Gibson et al., 2019, p. 6) and stating that “research conclusions are potentially dependent on the choice of ratings providers” (Gibson et al., 2019, p.7). This academic debate highlights that, although ESG ratings are regularly used in academic research, potentially due to similar restraints that small institutional investors are facing, the abovementioned limitations must be considered when drawing conclusions that are based on ESG ratings.

2.2 The role of Europe within sustainable finance

When reading the academic literature on sustainable finance, Europe plays an important geographic role within the industry as was already hinted at in section 2.1.1. The region is not only the largest market, accounting for 45.87% of the total market, with \$14,075 trillion invested with regards to sustainable investment strategies in 2018 (Global Sustainable Investment Alliance, 2018, p.8) but also progresses furthest in terms of regulation from government authorities and political and economic strategy initiatives in the coming years which will be discussed in the following.

The European sustainable finance market has historically been larger and more developed than the one of other regions such as the United States, Canada, or Japan because sustainable investment practices are more commonplace and accepted by European investors (Global Sustainable Investment Alliance, 2018, p.13). In recent years, the market has started to show signs of beginning to mature (Global Sustainable Investment Alliance, 2018, p. 13), which was characterized by slower growth but also implies that empirical ESG data might have improved as data is available for a longer period of years as well as in larger quantities than in less developed markets.

Another factor that might be affected by the maturity of the industry is the governmental regulators’ perceived importance of introducing regulations to this market. In addition, indeed, the EU Commission announced the first taxonomy for the sustainable finance industry in the “EU Action Plan on Sustainable Finance” which aims at introducing regulatory and legislative standards for the sustainable finance industry. Other regions such as the US or Japan have taken steps of their own towards introducing regulation to the sustainable finance industry (OECD, 2020, p.25) but seem to lack the holistic taxonomy approach the EU wants to apply. The EU seems to take larger steps towards establishing regulation at multiple levels as the “EU Action Plan on Sustainable Finance” is supposed to support the EU in reaching goals committed to in the Paris Agreement and the UN 2030 Agenda for Sustainable Development with its sustainable development goals (European Commission, 2018, p.1). These legislative initiatives are further backed through the economic and fiscal policies in the EU, which are starting to be geared towards sustainable transformation of the economy and sustainable economic growth under the “European Green Deal” (European Commission, 2019, p.2).

These initiatives will likely contribute to the further development and the ESG information quality in the European sustainable finance market and highlight Europe’s importance for sustainable investors, data providers, and researchers in the coming years.

2.3 Financial performance of sustainable investments

In the past years, the question of what the financial performance of sustainable investments looks like was frequently posed in academic literature with a wide array of approaches and answers to it. Academic research in this domain dates back to the 1970s and continues to be a controversial discourse even today. The results of such studies were categorized by Naffa & Fain (2020) as falling under three hypotheses. The first is that there exists a positive relationship between ESG factors and financial performance, the second, the so-called trade-off hypothesis, asserts a negative relationship between ESG and financial performance and the third emphasises a neutral relationship between the two factors also called the “no-effect” premise (Naffa & Fein, 2020, p.4). An

overview of the financial performance of sustainable investments is presented in the following with the help of a selection of relevant studies with results of all these categories.

Friede et al. (2015) conducted a meta-analysis and vote to count analysis of more than 2200 primary studies between 1970 and 2014 to examine the relationship between ESG criteria and different kinds of corporate financial performance [CFP], in order to provide aggregate evidence on what the financial implication of ESG criteria are (Friede et al., 2015, pp. 210, 211, 212). They found that “[...] *the business case for ESG investing is very well-founded [...]*” (Friede et al., 2015, p.1) and that “[t]he distinct positive empiric result is found across various approaches, regions, and asset classes – except for portfolio-related studies [...]” (Friede et al., 2015, p. 225). This discrepancy is particularly interesting as the study asserted a generalizable, positive correlation between ESG and CFP. Portfolio-based studies seem to come to different conclusions, which result from three reasons as explained by the authors. Two of those reasons relate to the inference of other factors that hide the true ESG performance: One being that the combination of market and non-market influences hide potential ESG alpha (Friede et al., 2015, pp. 225/26). The second being that the combination of positive and negative ESG screening strategies, which ESG funds usually apply in portfolio composition, distorts and cancels any effects of either strategy. In order to get a differentiated view on the performance of ESG investment portfolios, isolated screening strategies might be more appropriate to gain an understanding of the effects of ESG factors on CFP (Friede et al., 2015, p.226). The final factor influencing these outcomes are costs of portfolio-based approaches, in particular those of mutual funds, such as performance and management fees which distort the real relationship between ESG performance and CFP by including implementation costs (Friede et al., 2015, p.226).

While Friede et al. provided an overview of existing literature, other researchers found it difficult to identify the true relationship between ESG and investment performance because “[...] *academic and industry literature reveals a wide range of approaches and results, which are largely inconsistent with one another[...]*” (OECD, 2020, p.29). Depending on how ESG factors are incorporated as well as how corporate financial performance is defined, results can potentially vary significantly. Another study published by Alshehhi et al. (2018) conducted an analysis of previous academic research to find an answer to this question, but which also categorized the methodological approaches and financial measures scientists chose to define ESG incorporation and CFP. They analysed 132 high quality and high impact journal articles between 1984 and 2017 (Alshehhi et al., 2018, p.3). Concerning the historic development of academic research, they highlighted that few articles were published before 2002 and that the bulk of them, namely 75%, were published only in recent years between 2012 and 2017 (Alshehhi et al., 2018, p.3), thus emphasising the relative youth of academic research in this area of study. What stood out when looking at the methodological approaches chosen by the researchers, was that methods of modern-day financial analysis were not frequently applied, seeing as approaches such as risk-adjusted analysis, Sharpe and Treynor, capital asset pricing model, or portfolio construction were underrepresented (Alshehhi, 2018, p.12). These observations signal a need for further research using other methodological approaches and market-based financial performance measures especially in the area of modern portfolio theory and risk-adjusted return.

In recent years, this academic gap was identified, and research began investigating market-based return characteristics of sustainable investments, especially focussing on the risk-return relationship of company performance as well as on shareholder return. Most of these studies compared the financial performance of either mutual funds or indices as a selection method of sustainable companies or investment products, thereby constructing their sample based on sustainable indices or the selection criteria of the mutual funds (Kempf & Osthoff, 2007; De la Torre et al., 2016; Kumar et al, 2016; Sharma, 2020). A few studies started to introduce portfolio-based approaches following an active ESG investment strategy as opposed to an index. A selection of studies with their methods and conclusions will be presented in the following:

Table 1. Summary of studies on risk-adjusted return of sustainable investments

Authors	Period, Market	Measures	Conclusions
Naffa & Fain (2020)	2015-2019, Global	Active, pure-megatrend factor portfolio construction, CAPM, Fama-French models, Jensen's alpha, Sharpe ratio	At least comparable returns of sustainable megatrend portfolios and conventional benchmark
Sharma & Jasuja (2020)	2012-2020, Indian stocks	CAPM, GARCH/ARCH models, Jensen's alpha, Sharpe ratio, Treynor ratio	Higher mean return and Sharpe ratios of conventional index than sustainable indices
Kumar et al. (2016)	2014-2015, Global	Own mathematical risk premium model, Sharpe ratio, Treynor ratio	Higher Sharpe and Treynor ratios for sustainable portfolio than conventional one
La Torre et al. (2016)	2008-2013, Mexican stocks	Standard deviation, Sharpe ratio, variance ration, CAPM	No difference in performance between sustainable and conventional funds
Shank et al. (2016)	2002-2012, Global	Active portfolio construction, Jensen's alpha, Treynor ratio, Sharpe ratio, M-square	Actively constructed, sustainable portfolio outperformed passive conventional and sustainable index

Many academic studies have focused on socially responsible or sustainable investing and its relationship to corporate financial performance, be it market- or financial statement-based while limited research has been conducted on ESG ratings and their impact on shareholder return (OECD, 2020, p.30). This observation was mirrored by Durán-Santomil et al. (2019) who used a Morningstar sustainability score to assess the impact of socially responsible investments on mutual fund performance instead of benchmarks like most previous studies did (p. 2). The role of ESG scores previously discussed in chapter 2.1.5. highlighted that “[...] ESG (or non-financial) ratings are now commonly used in finance research[...]” (Gibson et al., 2019, p. 1) but stands in contrast to the lower degree of representation of the topic in academic literature in comparison to the use of mutual funds or indices as a source of investable sustainable companies.

As of our knowledge, the earliest applications of sustainable ratings can be found in Van de Velde (2005), Brammer et al. (2006) and Kempf & Osthoff (2007). Brammer et al. (2006) utilized an ethical rating by the Ethical Investment Research Service and found a negative relationship between the rating and stock performance for UK companies (p.97). On the contrary, Kempf & Osthoff (2007) used a socially responsible rating by KLD Research & Analytics for portfolio selection (p.908) and found that their trading strategies, based on best-in-class and positive screening, yielded significant alphas and that the use of ratings can benefit investors (Kempf & Osthoff, 2007, p.921). These findings were mirrored by Van de Velde et al. (2005) using a similar methodological approach and a rating by Vigeo (p.129). When interpreting these early studies, the author concluded that their findings might not apply to

today's financial environment as the data used is relatively old, the ratings used vary significantly and none of today's most prominent ESG rating providers, for instance, Bloomberg, MSCI, Sustainalytics, Refinitive or RobecoSAM (Romero et al., 2018, p.38; OECD, 2020, p.27) were utilized.

Auer (2016) seems to be among the first to have used one of the abovementioned rating agencies, namely Sustainalytics, to select companies for his financial analysis. The author constructed equally weighted sustainable portfolios via negative and positive screening by using the Sustainalytics ESG rating and comparing their Sharpe Ratios to that of a passive portfolio represented by the equally weighted Euro Stoxx 600 index (Auer, 2016, pp.385, 387/88). He found that for negative screening strategies there is a non-negative, in times positive, risk-adjusted performance when compared to the passive portfolio but that this is not the case when applying positive screening (Auer, 2016, p.395) which stands in contrast to the findings of Kempf & Osthoff (2007).

In their paper, Hübel & Scholz (2020) used the Thomson Reuters ESG rating (now Refinitive) and self-constructed ESG factors, which act as indicators of ESG exposure, to build two types of sustainable portfolios out of an investment universe formed by the STOXX Europe Total Market Index (pp.54/55). They found that investors, when taking into account ESG risk exposure, can construct investment portfolios that “[...] *avoid ESG risks without sacrificing financial performance [...]*” (Hübel & Scholz, 2020, p.67) which can be interpreted as a non-negative conclusion.

After presenting the abovementioned academic literature on the relationship of sustainable investments and corporate financial performance as well as risk-adjusted one, we draw conclusions on the historic development of academic literature in this field. When looking at these trends in academic literature, a gap in academic research was identified in the area of comparatively analysing the risk-adjusted performance of active sustainable portfolios, which are constructed using ESG ratings from either of the larger rating providers and conventional market portfolios for recent years. Moreover, the fact that multiple studies have detected a positive relationship between sustainable investments and risk-adjusted financial performance justifies assuming a directional hypothesis which this paper will apply in research problem formulation.

3. Methodology

3.1 Research Design

This paper aims to describe the risk-adjusted return of European sustainable and conventional investment portfolios and compare the two to determine whether sustainable investment portfolios generate superior risk-adjusted returns. Within this broad description, we aim at filling the gap in academic literature described above and will lay out the methodological approach applied in this paper in the following. In order to answer the research questions posed in the introduction of this paper, we apply deductive reasoning. The overall research design is of quantitative nature as numeric, historical datasets are analysed which provide better comparability across time periods and organisations (Lewis et al., 2016, p.184). The research purpose is comparative as two different types of ESG portfolio are constructed and compared against each other and a benchmark portfolio represented by the Euro Stoxx 50. The time horizon that the research covers is longitudinal as it spanned from 2005 to 2019. This period is divided into ten instances, which cover a period of five years each. The resulting instances are 2019-15, 2018-14, 2017-13, 2016-12, 2015-11, 2014-10, 2013-09, 2012-08, 2011-07, and 2010-06. The division into instances has the goal to provide stronger statistical conclusions as it provides more data points and allows applying statistical significance test on the instance that in turn allows drawing stronger statistical inferences.

3.2 Sampling

The stocks are purposefully selected from a population of European listed companies divided into the two different kinds of sustainable portfolios. Homogeneous sampling is used to choose individual stocks for the portfolios according to certain parameters, which will be described in the following. Homogeneous sampling is used because it provides the researchers with the possibility to define the selection criteria based on which the sample is chosen as well as highlight potential differences within the sample as most characteristics are similar (Lewis et al., 2016 pp. 301/2). Secondary data is used in the form of monthly-adjusted closing prices of stocks provided by Yahoo Finance.

3.2.1 Conventional benchmark portfolio

The conventional portfolio acts as a benchmark against which the financial performance of the two sustainable portfolios are compared. The benchmark portfolio is the Euro Stoxx 50 by STOXX Ltd., whose monthly-adjusted closing prices for December 2004 – 2019 are retrieved from Yahoo Finance.

3.2.2 Sustainable ESG portfolios

The ESG investment portfolios are constructed using the ESG rating of Sustainalytics, one of the predominant rating providers mentioned in academic literature (Romero et al., 2018, p.38). ESG ratings seem to be underrepresented in the academic literature and therefore form a gap that this paper aims to focus on (see 2.3).

Using the ESG rating, we construct two types of sustainable portfolios. The first portfolio is constructed using positive screening and the second is a best-in-class screened portfolio in accordance with the definitions of Amel-Zadeh & Serafeim (2017). Using only one ESG screening strategy per sustainable portfolio is deemed most appropriate as it avoids the distortion or annulation of performance that could be tracked back to the individual ESG screening strategy but is “drowned” through combination with other strategies in the screening process (Friede et al., 2015, p.226).

3.3 Analysis

In the analysis section, we construct a set of efficient portfolios for each sustainable investment strategy that maximized the Sharpe Ratio. The portfolio construction follows an active investment strategy and involves only equities in the form of common stocks. Portfolio construction is based on modern portfolio theory as described by Harry Markowitz (1952), also called mean-variance portfolio, which builds on the theory that through the combination of different assets an investor can build an optimal portfolio that maximizes expected return or minimizing the variance of these returns (Markowitz, 1952, p.79).

The optimal portfolios for the risk-adjusted performance comparison are selected according to the maximum Sharpe Ratio, which is the portfolio that provides the maximum return in excess of the risk-free rate per unit of risk. The Sharpe Ratio is deemed an adequate estimator of risk-adjusted performance as it is among “[...] *[the] statistical techniques that are the most commonly used portfolio performance measures even today[...]*” (Arugaslan & Samant, 2014, p.50) which is reflected by the use within academic literature by De la Torre et al. (2016); Kumar et al. (2016) and Sharma & Jasuja (2020). In the course of the Sharpe Ratio calculation, the three-month EURIBOR is utilized as an indicator of the risk-free rate of return and retrieved from the European Central Bank (European Central Bank, n.d.).

The calculations for portfolio construction and optimization are carried out in Microsoft Excel with the help of matrix algebra and asset allocation is done using the Microsoft Solver tool. After portfolio construction and optimization, the risk-adjusted portfolios’ performance, portfolio characteristics, portfolio descriptive statistics, and statistical test results are presented. Based on the abovementioned research questions, we derive a set of hypotheses that are subsequently tested for statistical significance using paired sample t-tests in SPSS.

4. Analysis

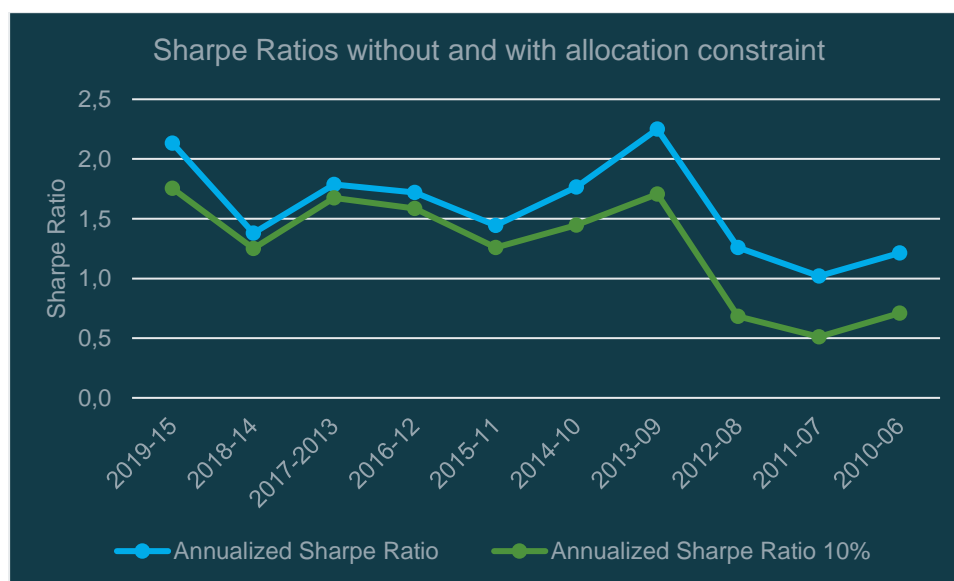
4.1 Results

In the following section, the results from portfolio construction, portfolio descriptive statistics, portfolio risk-adjusted return characteristics, and portfolio sustainability rating will be provided. In a second step, results from hypothesis testing using paired sample t-tests in SPSS will be presented to answer the abovementioned hypotheses. These tests are repeated with a second set of portfolios that has an additional 10% asset allocation constraint, in order to rule out an “Effect of estimation error” as described by Piñate & Oropeza (2013, p.7) and Lamm Jr (2000, p.28). We aim to adjust for this estimation error by constructing another - secondary - set of sustainable portfolios, which has an additional constraint that limits the capital allocation into an individual stock to 10% of the overall portfolio in accordance with the maximum weight restriction of individual stocks within the Euro Stoxx 50 (Qontigo.com, 2021, p.61).

4.1.1 Characteristics of the positively screened portfolio

The main measure of interest in this analysis is the Sharpe Ratio of the different optimized portfolios but also the return and risk (measured by the standard deviation), that determine the ratios' results. In this section, characteristics and descriptive statistics are interpreted jointly with presenting the results.

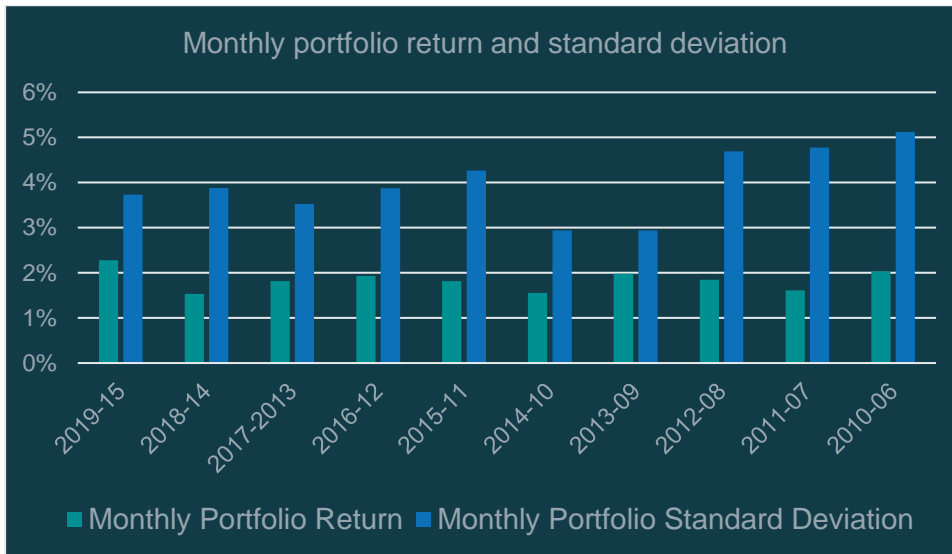
Figure 1. Annualized Sharpe Ratios of the positively screened portfolios



Source: Own illustration, own results

Figure 1 highlights that the instances 2019-2015 and 2013-2009 provide the highest annualized Sharpe Ratios and therefore risk-adjusted return for the period under investigation with 2.13 and 2.25 respectively. These ratio results are deemed very good risk-adjusted performance as they lie above two (Maverick, 2020). However, these high ratios are not stable over time as can be seen in the three instances between 2006 and 2012 where the Sharpe Ratios move closer to 1 which is deemed an acceptable level of risk-adjusted performance (Maverick, 2020). When adding the 10% allocation constraint to the portfolio optimization the same periods exhibit the highest and lowest Sharpe Ratios but are below those of the portfolios without constraint. The highest Sharpe Ratios are achieved again in the instances 2019-2015 and 2013-2009 with 1.75 and 1.71 respectively and the lowest in the 3 instances between 2006 and 2012 with Sharpe Ratios ranging from 0.51 to 0.71. The difference in Sharpe Ratios for positively screened portfolio without and with 10% allocation constraint are statistically significant when applying two-tailed paired sample t-tests with a 95% confidence interval. Positively screened portfolios without constraint exhibit higher annualized Sharpe Ratios ($M = 1.5970$, $SD = 0.40288$) than positively screened portfolios with constraint ($M = 1.2570$, $SD = 0.46555$), $t = 5.773$, $p < 0.001$. Expectedly, other differences are observed in asset allocation between the two sets of portfolios where the number of companies within the portfolio set without constraint ranges from 3-10 whereas the 10% constraint set ranges from 11-14.

Figure 2. Positively screened portfolio monthly return and standard deviation without constraint



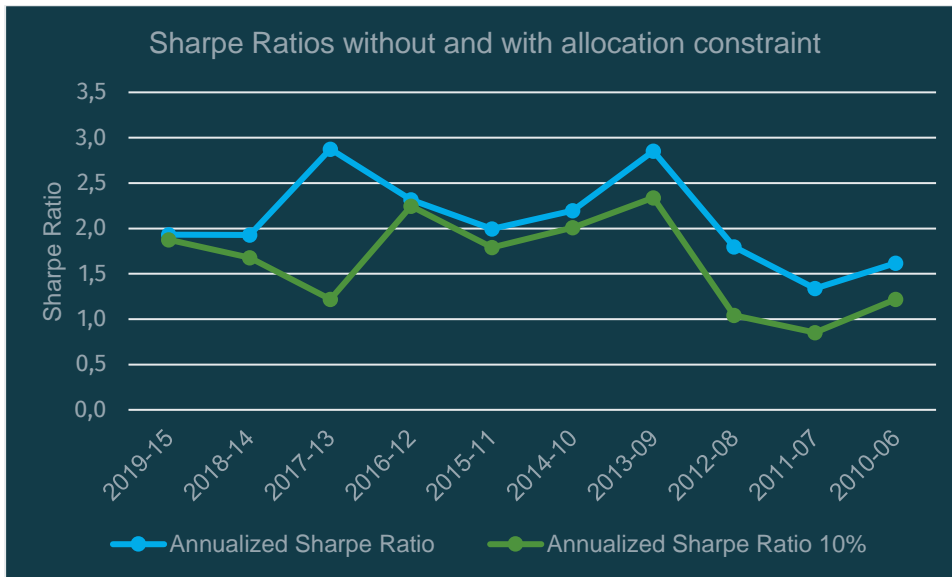
Source: Own illustration, own results

The findings for portfolio return and standard deviation in Figure 2 reflect the results obtained for the Sharpe Ratios of the set of portfolios without allocation constraint. The highest monthly portfolio returns are observed in the instance 2015-2019 with 2.28 % at a monthly portfolio standard deviation of 3.73% and one of the lowest monthly portfolio standard deviations is observed in the instance 2013-2009 with 2.94% at a monthly portfolio return of 1.98%. In the three instances between 2006 and 2012, the monthly portfolio standard deviation ranges from 4.69% to a standard deviation of 5.12% with corresponding monthly returns spanning from 1.61% to 2.03%, which results, once annualized, in lower annual risk-adjusted return measures. Results from two-tailed paired sample t-tests, with a 95% confidence interval, applied on monthly return indicate that the monthly portfolio returns of the portfolio set without asset allocation constraint shows statistically significant higher returns ($M = 0.0184$, $SD = 0.00232$) as compared to the portfolios with a 10% asset allocation constraint ($M = 0.0144$, $SD = 0.00304$), $t = 5.011$, $p = <0.001$. However, results from two-tailed paired sample t-tests, with a 95% confidence interval, applied on monthly portfolio standard deviation show no statistically significant difference between portfolios without allocation constraint ($M = 0.0397$, $SD = 0.00743$) and those with constraint ($M = 0.0398$, $SD = 0.00722$), $t = -0.029$, $p = 0.978$. This indicates that portfolios without allocation constraint provided statistically higher returns for a statistically similar level of risk.

4.1.2 Characteristics of the best-in-class portfolio

For best-in-class screened portfolios the display of results follows a similar scheme as the positively screened portfolios. In the following portfolio characteristics of the sets of best-in-class portfolios will be discussed.

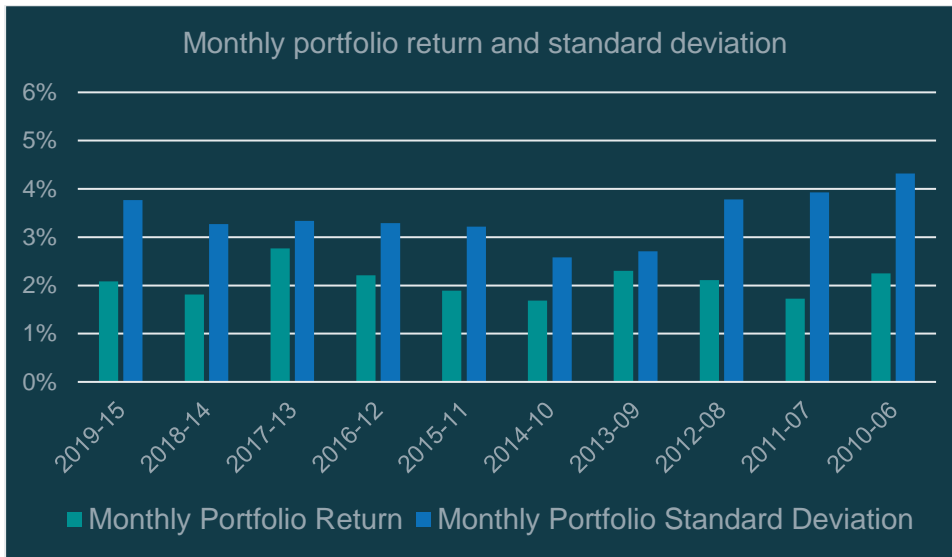
Figure 3. Annualized Sharpe Ratios of the best-in-class portfolios



Source: Own illustration, own results

For best-in-class portfolios, different trends emerge for the portfolio sets without and with constraint as can be seen in Figure 3. For portfolios without allocation constraint, the instances 2017-2013 and 2013-2009 yield the highest annualized Sharpe Ratios with 2.88 and 2.85 respectively, which are considered to be very good to excellent Sharpe Ratios (Maverick, 2020). As with positively screened portfolios, the three instances between 2006 and 2012 yield the lowest Sharpe Ratios ranging from 1.34 and 1.80, which again are considered an acceptable level of risk-adjusted returns (Maverick, 2020). When adding a 10% allocation constraint, the results vary from those without constraint as the Sharpe Ratios drop in the instances 2018-2014 and 2017-2013 instead of increasing. This drop is caused by decreased portfolio return and increased portfolio standard deviations in these instances respectively. The allocation constraint causes the optimization to include companies with less favourable relationships between risk and returns. Apart from this, the highest Sharpe Ratios are obtained in the instances 2016-2012 and 2013-2009 with 2.25 and 2.34 respectively whereas the lowest ones are obtained again in the three instances between 2006 and 2012 which range from 0.85 to 1.22. Statical two-tailed paired sample t-tests with a significance level of 95% are applied to determine the significance of differences. The tests show that portfolios without allocation constraint show higher Sharpe Ratios ($M = 2.0849$, $SD = 0.49375$) than those with allocation constraint ($M = 1.6266$, $SD = 0.51623$), $t = 3.057$, $p = 0.14$. When looking at the number of companies represented within the portfolio without constraint it can be seen that out of 38 potential investable companies the number of included companies ranges from five to 15. The portfolios with allocation constraints incorporate 11 to 19 out of the 38 investable companies.

Figure 4. Best-in-class portfolio monthly return and standard deviation without constraint



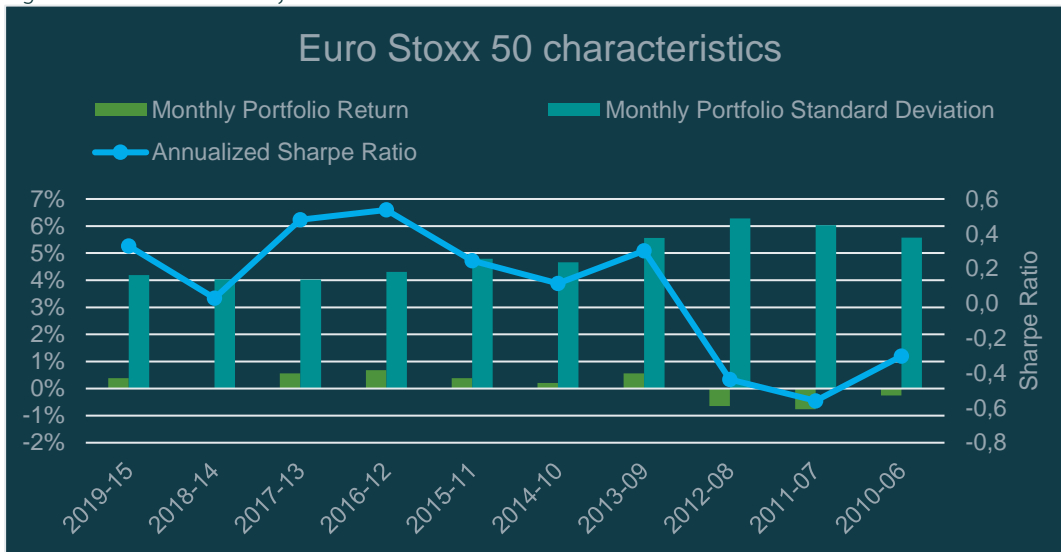
Source: Own illustration, own results

Figure four shows that for the instances 2017-13 and 2013-2009 a favourable relationship between monthly portfolio return and monthly portfolio standard deviation is realised which also translates, if annualized, into the corresponding high-annualized Sharpe Ratios. Monthly portfolio returns and standard deviation for 2017-2013 are at 2.77% and 3.34% respectively and the same measures for the instance 2013-2009 at 2.30% and 2.71% respectively. By contrast, the instances between 2006 and 2012 have monthly portfolio returns ranging from 1.72% to 2.25% and simultaneously have monthly portfolio standards deviation of 3.78% to 4.32%. After displaying the return and standard deviation of the best-in-class portfolios without allocation constraint, two-tailed paired sample t-tests with a 95% confidence interval are applied on the measures of both best-in-class portfolio types. The test show that the monthly portfolio return is higher for portfolio without allocation constraint ($M = 0.0208$, $SD = 0.00326$) than for portfolio with constraint ($M = 0.0181$, $SD = 0.00294$), $t = 2.827$, $p = 0.020$. When repeating the paired sample t-test for monthly portfolio standard deviation for the two types of portfolio sets it is found that portfolios without allocation constraint show statistically significant lower standard deviation ($M = 0.0342$, $SD = 0.00540$) than those with constraint ($M = 0.0382$, $SD = 0.00710$), $t = -2.959$, $p = 0.020$.

4.1.3 Characteristics of the Euro Stoxx 50

In the following the annualized Sharpe Ratios, monthly portfolio return, and monthly portfolio standard deviations of the Euro Stoxx 50 will be discussed.

Figure 5. Characteristics of the Euro Stoxx 50



Source: Own illustration, own results

Figure five highlights that the financial performance of the Euro Stoxx 50 is relatively low for the time horizon under investigation. The highest Sharpe Ratios are obtained in the instance 2018-2014 and 2016-2012 with 0.48 and 0.54 respectively. These results are seen as signs of low risk-adjusted returns as a Sharpe Ratio below one is considered “sub-optimal” (Maverick, 2020). The lowest Sharpe Ratios are again obtained for the three instances between 2006 and 2012 with ratios ranging from -0.56 to -0.30. This is not particularly meaningful anymore as monthly portfolio returns are negative during that period and the monthly risk-free rate of return, represented by the 3-month EURIBOR, yield a positive and thereby higher return than the Euro Stoxx 50 (Fernando, 2020). When looking at the monthly portfolio return and standard deviation of the mentioned instances, the best relationships between the two measures, as highlighted by the Sharpe Ratios, are found in the instances 2017-2013 and 2016-2012. The monthly returns for these periods are 0.56% and 0.68% respectively and standard deviation 4.02% and 4.31% respectively. For the periods between 2006 and 2012 these relationships are less favourable as, apart from negative returns, the monthly standard deviations range from 5.57% to 6.28%. However, it must be considered when looking at Figure 5 that there is a difference in measurement between Sharpe Ratios and the measures for return and standard deviation, as Sharpe Ratios are annualized in order to be reasonably interpretable whereas the return and standard deviation are displayed in monthly measures. In the previous description of characteristics of positive and best-in-class screen portfolios, this difference is less immanent and relevant due to the fact that the measures are presented separately.

4.1.4 Results from hypothesis testing

In the following, the results obtained from hypothesis testing are presented. All paired sample t-tests, both one- and two-tailed, are conducted with a 95% confidence interval where $\alpha = 0.05$ for two-tailed and $\alpha = 0.025$ for the one-tailed t-tests. One-tailed t-tests are right-tail t-tests that rejected the null hypothesis at a t-value of more than +2.262 (the number is taken from the student’s one-tailed t-table), given nine degrees of freedom, and a halved two-tailed p-value from SPSS of below 0.025.

The first t-test is applied on the Sharpe Ratios of the ten different instances of the positively screened portfolios without allocation constraint and those of the Euro Stoxx 50. The results obtained from the tests show that the positively screened portfolios have a statistically significant higher mean Sharpe Ratio ($M = 1.5970$, $SD = 0.40288$) than the Euro Stoxx 50 ($M = 0.0740$, $SD = 0.38532$), $t = 18.542$, $p < 0.001$. This leads to the rejection of the null hypothesis in favour of the alternative hypothesis H_1 that the positively screened portfolios provide higher mean Sharpe Ratios and therefore higher risk-adjusted return between 2005 and 2019 than the Euro Stoxx 50. Results for correlation show a high degree of positive correlation between the Sharpe Ratios, $r = 0.784$, $p = 0.007$.

The t-test is repeated using Sharpe Ratios of the positively screened portfolios with 10% allocation constraint and the Euro Stoxx 50 to test for the robustness of results. The results indicate that positively screened portfolios with constraint have a higher mean Sharpe Ratio ($M = 1.2570$, $SD = 0.46555$) than the Euro Stoxx 50 ($M = 0.0740$, $SD =$

0.38532), $t = 23.691$, $p = <0.001$. This leads to the rejection of the null hypothesis in favour of the alternative hypothesis H_1 that the positively screened portfolio with allocation constraint provides higher mean Sharpe Ratios and therefore higher risk-adjusted return between 2005 and 2019 than the Euro Stoxx 50. Results for correlation show a high positive correlation between the variables, $r = 0.948$, $p = <0.001$.

For best-in-class portfolios without allocation constraint, the same right-tailed paired sample t-tests are conducted. Results show that best-in-class portfolios without constraint show statistically significant higher mean Sharpe Ratios ($M = 2.0849$, $SD = 0.49375$) than the Euro Stoxx 50 ($M = 0.0740$, $SD = 0.38532$), $t = 21.061$, $p = <0.001$. This, again, leads to the rejection of the null hypothesis, which assumes that differences are equal to zero, in favour of the alternative hypothesis H_1 that best-in-class portfolios have higher mean Sharpe Ratios over the observed period than the Euro Stoxx 50 and therefore provide a higher risk-adjusted return. Correlation for these variables is high and positive, $r = 0.791$, $p = 0.006$.

The t-test is then repeated using best-in-class portfolios with 10% allocation constraint. The findings indicate that best in class portfolios with constraint have statistically higher mean Sharpe Ratios ($M = 1.6266$, $SD = 0.51623$) than the Euro Stoxx 50 ($M = 0.0740$, $SD = 0.38532$), $t = 14.247$, $p = <0.001$. Therefore, the null hypothesis is rejected in favour of the alternative hypothesis H_1 , that best-in-class portfolios have higher mean Sharpe Ratios and therefore provide higher risk-adjusted return than the Euro Stoxx 50 between 2006 and 2019. The correlation of the two variables is positive and high, $r = 0.745$, $p = 0.014$.

After the results of the right-tailed paired t-tests, the results of the two-tailed paired t-tests of the Sharpe Ratios for the ten instances of the two types of sustainable portfolios are presented in the following. For these tests, the null hypothesis will be rejected at a p-value of below 0.05 to determine whether one sustainable investment strategy provided superior risk-adjusted returns.

The results for the test on the sustainable portfolios without allocation constraint indicate, that, between 2005 and 2019, positively screened portfolios without allocation constraint exhibit a lower mean Sharpe Ratio ($M = 1.5970$, $SD = 0.40288$) than best-in-class portfolios ($M = 2.0849$, $SD = 0.40288$), $t = -4.871$, $p = <0.001$. This leads to the rejection of the null hypothesis that states that there is no difference in mean Sharpe Ratios in favour of the alternative hypothesis. This difference is positive for the best-in-class portfolio, which means that for a scenario without allocation constraint this investment strategy provides higher Sharpe Ratios and risk-adjusted return than the positive screen counterpart for the period under investigation. The correlation of the variables is high and positive, $r = 0.769$, $p = 0.009$.

When repeating the t-test for the sustainable portfolios with allocation constraint, positively screened portfolios, again, exhibit lower mean Sharpe Ratios ($M = 1.2570$, $SD = 0.46555$) than best-in-class portfolios ($M = 1.6266$, $SD = 0.51623$), $t = -3.556$, $p = 0.006$. This leads, again, to the rejection of the null hypothesis in favour of the alternative hypothesis and indicates that over the period of 2005 to 2019, best-in-class portfolios with allocation perform better than their positively screened counterparts. The correlation of the two variables indicates a high and positive relationship, $r = 0.781$, $p = 0.008$.

4.2 Discussion

Looking at the results of hypothesis testing, we conclude that the research questions, yet with reference to the limitations laid out in section 6, can be answered as follows.

Results from hypothesis testing for the positively screened portfolios show that this type of sustainable investment portfolio provides a statistically significant higher risk-adjusted return, represented through the Sharpe Ratio than the Euro Stocks 50. These findings were checked for robustness by repeating the test for portfolios with the 10% allocation constraint, which confirms the initial results and ruled out the “effects of estimation error” as described above by Piñate & Oropeza (2013) or Lamm Jr. (2000). In light of this, it is concluded, as mentioned before, that for the period of 2005-2019, positively screened investment portfolios provide superior risk-adjusted return compared to the conventional Euro Stoxx 50. A particular strength of this observed difference in performance comes from the fact that the positively screened portfolios are constructed out of the Euro Stoxx 50 and therefore can be seen as a peer-to-peer comparison. As previously mentioned, the positively screened portfolio is a sustainable version of the Euro Stoxx 50 and through this; it is possible to accurately highlight the

differences between sustainable and conventional portfolios at the example of the Euro Stoxx 50. The results indicate, that if somebody would have invested in the Euro Stoxx 50 companies that currently have a low ESG risk rating instead of the entire Euro Stoxx 50, he would have outperformed the benchmark in risk-adjusted but also in absolute terms. This means that, in turn, the unsustainable assets in it most likely reduce the Euro Stoxx 50's overall performance as the sustainable ones provide significantly better returns. Future research could contribute to this subject through further investigation of the unsustainable companies within the Euro Stoxx 50. This future research could also solve the limitation that the ESG risk rating and thereby portfolio selection was based on the present estimates of the companies' ratings and was not rebalanced over time with historic ratings as laid out in section 5.

For best-in-class portfolios, the results from hypothesis testing show that this sustainable investment strategy also yields statistically significant higher risk-adjusted returns than the Euro Stoxx 50. These differences remain statistically significant after the repetition of the test with a 10% asset allocation constraint and therefore are not sensitive to the "effects of estimation error" described by Piñate & Oropeza (2013) or Lamm Jr. (2000). Because the best-in-class portfolios' investable companies are selected based on the industry definition by Sustainalytics, the portfolio constructed out of them differs more significantly from the Euro Stoxx 50 than the positively screened portfolio. This confirms that, when altering the investment strategy and the investable companies, the risk-adjusted and absolute outperformance of the sustainable portfolio still holds true.

Because both sustainable investment strategies provide statistically significant higher returns when compared against the EuroStoxx 50, it can be inferred, that, in reference to the limitations of this paper, positively screened as well as best-in-class portfolios as proxies for sustainable investing outperform the Euro Stoxx 50 as a proxy for conventional investment portfolios. This indicates that when investing according to the sustainable investment strategies laid out in this paper, an investor would have chosen a superior investment strategy and outperformed the broader market between the years 2005 to 2019.

In this, our findings are in line with those of previous academic research on the topic of sustainable investing such as Shank et al. (2016, pp.200/201, 213) who found that an actively constructed portfolio of 'supersector leaders', similar to a best-in-class investment strategy, outperformed both the S&P 500 index and the sustainable version of the Dow Jones for the period 2002 to 2012. Similar results were obtained in a study by Kempf & Osthoff (2007) who, using socially responsible investment ratings, constructed negatively-screened, positively-screened and best-in-class portfolios and found that positively screened and best-in-class portfolios yielded significant abnormal returns (p.921).

Other studies that came to more neutral conclusions about the financial performance of sustainable investing are Auer (2016) and Naffa & Fein (2020). Auer (2016) found significant outperformance of certain types of negatively screened portfolios but an underperformance of positively screened ones for the period 2004 to 2012 which stands in contrast to the findings of Kempf & Osthoff (2007) and this paper. Naffa & Fein (2020, p.27) analysed different kinds of ESG megatrend portfolios and overall found that investments in these sustainable portfolios yielded non-negative alphas for the period of 2015-2019, which deviates from this paper's positive outperformance results which found a clear positive risk-adjusted return.

Finally, the findings from hypothesis testing allow answering the research question Q2 with its premises. Findings from hypothesis testing indicate that there is a statistically significant difference in mean Sharpe Ratios between the positively screened and the best-in-class portfolio for the years 2005-2019. These results were confirmed when repeating the test with the 10% allocation constraints. The results indicate that best-in-class portfolios, under reference to the limitations in chapter 6, provide higher mean Sharpe Ratios and subsequently risk-adjusted return than positively screened portfolios and therefore in this case are the superior investment strategy. Only few studies such as Kempf & Osthoff (2007) applied these specific investment strategies and came to the same conclusion as the paper that best-in-class portfolios provide the highest abnormal returns (Kempf & Osthoff, 2007, p.921).

5. Conclusion

The aim of this paper is to answer the question of whether sustainable ESG investment portfolios outperform conventional portfolios represented by the Euro Stoxx 50 on a risk-adjusted return basis. Additionally, the research aims at testing which ESG investment portfolio, out of the two sustainable investment strategies chosen for this paper's research, performs better. Positively screened and best-in-class portfolios are constructed under the utilization of ESG risk ratings and compared to the Euro Stoxx 50 as well as each other to answer these questions with the help of statistical significance tests.

Findings indicate that both types of sustainable portfolios outperform the conventional Euro Stoxx 50 index and that the best-in-class ESG investment strategy performs better than the positive screen investment strategies during the period of 2005 to 2019. The implications of this answer to the paper's research question are important to the financial industry as they indicate that sustainable finance is not necessarily an investment approach that caters to the needs of a broader group of stakeholders at the expense of financial returns for the investor. Instead, it provides an indication to be a superior investment strategy compared to conventional investments and therefore contributes both to the improvement of the society in which the economy operates and to the financial return of the investors that finance economic activity. As will be shown in chapter 6, limitations are to be considered and verified within further research.

Moreover, this paper contributes to filling the existing gap in the academic literature concerning research on the risk-adjusted performance of actively constructed investment portfolios with the help of ESG risk ratings. By this, the paper describes potential investment strategies and their financial performance during the last years, which can be used in portfolio construction in the future. The findings and limitations may also be relevant to academics as they raise new questions and open new opportunities for future research formulation. Other groups apart from academics that could benefit from this research and could be interested in its findings are institutional investors like fund managers or insurance companies as well as private investors interested in sustainable investing. Another potentially interested group are companies in search of a more sustainable business model as this paper's findings indicate that stock markets value sustainable conduct of business, which might secure better funding options for the company in the future.

In sum, this paper's research finds indications that sustainable investments are capable of benefitting broader society as well as providing better financial returns for investors and contributes to strengthen other studies' results. Sustainable investments, therefore, play an important role in the global transition towards sustainability and might be a solution that fuels this transition with free market-based methods.

6. Research limitations and recommendations

The methodology and findings described above face some limitations which will be discussed in the following. The findings from the research have limited generalizability as they only apply to the period between 2005-2019 for which stock prices have been collected. Due to the application of this ex-post analysis, the observed past performance is not indicative of future stock market performance. Moreover, the results obtained cannot be generalized to sustainable portfolios in general but rather apply only to the ESG investment strategies of positive screening and best-in-class screening. In addition, the use of an ESG rating poses some limitations, as described in 2.1.5, in the way that ratings currently lack transparency, comparability, and consistency among each other, which might limit the reliability of screening results. In using Sustainalytics, we chose one of the predominant rating agencies, which, due to its size, relevance, and experience, could provide one of the most reliable and consistent ratings and thereby screening results currently available. However, since Sustainalytics does not provide historic data of their company ESG risk ratings, it was not possible to rebalance the portfolios over the period in view and the selection of sustainable companies solely relies on today's estimate of a company's ESG risk. Another limitation with regard to modern portfolio theory is that not all companies had normally distributed stock returns over the different instances. Due to the fact that modern portfolio theory builds on the behavioural assumption that stock returns are normally distributed, those portfolios, which were built with, particularly many companies without normal distribution have the added limitation of not fulfilling this assumption (Francis & Kim, 2013, p.3).

Based on the limitations and findings of these paper, recommendations to guide future research can be made as follows. Regarding the limitations, the research approach can be widened to including all sustainable investment strategies outlined by GSIA (2018) and Amel-Zadeh & Serafeim (2017) to test whether the observed results hold true. This would provide more robust insights on the risk-adjusted return characteristics and could therefore allow the generalization of findings to sustainable investing, as a whole. In line with the goal of increasing the generalisability of results would be the option to further increase the time horizon beyond the 15 years under observation by including years before 2005 and adding future data in the coming years. When it comes to the use of ESG ratings there are several recommendations on how future research can make use of the ratings. One way of testing the results obtained for reliability would be to repeat the research approach described in this paper with a different ESG rating and test whether the findings hold true even if the screening process is done using a different rating.

Furthermore, rebalancing the sustainable portfolios over the years using historic data of the Sustainalytics ESG risk rating could reaffirm results and eliminate the abovementioned limitation that no rebalancing was conducted. This could sharpen the picture of how the sustainable portfolios performed over the years as a company considered to be sustainable might not always have been that way or, vice versa, companies that were sustainable in the past might be different nowadays. The limitation of non-normally distributed returns can be solved in future research by only including companies with normally distributed stock returns or by transforming returns for normality.

The finding that positively screened portfolios outperformed the Euro Stoxx 50 benchmark raised the assumption that the unsustainable assets within the Euro Stoxx 50 draw down its overall performance seeing as the sustainable assets outperformed the benchmark that combines both the sustainable and unsustainable assets. In order to reinforce these findings, future research could construct unsustainable investment portfolios with assets that have a high ESG risk rating out of the Euro Stoxx 50, using the same methodology as the positively screened, sustainable portfolios. The sustainable and unsustainable portfolios would then be compared with regard to risk-adjusted performance as described in this paper and would highlight whether the unsustainable portion of the Euro Stoxx 50 significantly underperforms when directly compared to the sustainable portion of the Euro Stoxx 50.

Finally, this paper's findings point to a need for further investigation into the reason why best-in-class portfolios exhibited higher risk-adjusted returns than positively screened portfolios.

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