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School of Business and Management

Strategic Finance and Business Analytics

Master's Thesis

Performance comparison of sustainable and conventional Exchange Traded Funds for German private investors

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Abstract

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Title	Performance comparison of sustainable and conventional Exchange Traded Funds for German private investors
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This thesis investigates two recent trends of the financial world: sustainable and responsible investing and passive asset management with Exchange Traded Funds (ETFs). Within this context, the performance of sustainable and responsible ETFs will be compared with conventional ETFs in order to assess whether it might be beneficial for private investors to combine both trends in terms of the actual portfolio performance.The study covers a time frame of 260 weeks or five years, from 01.11.2013 to 19.10.2018.

The used data consists of ETFs that are available on the German market only. The data is based on Thomson Reuters Datastream as well as searching for available ETFs at www.justetf.com. For performance comparison, different factor models have been applied, i.e. the CAPM, the Fama-French 3- and 5-factor model as well as the Carhartt 4-factor model.The analysis is further complemented by the Sharpe ratio as a total risk-adjusted performance measure.

The empirical results show discussable outcomes. While making SRIs with ETFs, the performance is not worse compared to conventional ETFs. However, the supply of sustainable ETFs is still relatively low, leading to less diversification opportunities and possibly higher costs and risks due to their low volume.

Acknowledgements

Writing this Master Thesis has been the biggest scientific project of my life so far. It has been challenging yet a rewarding experience. Due to my personal motivation of the topic, it has also added new insights towards my existing knowledge.

I would like to thank you my family and friends for the constant support while writing on this research. It has not been always easy to find motivation, but they have supported me even in challenging times.

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Lappeenranta, 1 June 2020

Christian Bernstein

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1 Introduction

1.1 Motivation & Background

In the financial markets, there are two recent trends that both have shown an exponentially increasing interest over the recent years: sustainable and responsible investing and passive asset management, mostly implemented with Exchange Traded Funds.

Both trends are underlying recent changes in the mindset within the society. Regarding sustainable and responsible investing, people realize that concrete measurements have to be implemented in order to act in a sustainable and responsible manner. The current worldwide protests, pointing out the urgency of global warming as one example, shows the mindset shift so that people are constantly increasing the integration of a sustainable and responsible lifestyle. While most would think about changing existing habits such as eating less meat, avoiding flights and using public transport instead of the own car, this mindset has also reached the financial world. Thus, private investors think more about how they might invest their money in a sustainable and responsible way.

As sustainability and responsible investing also implies that investors seek for a long-term perspective for a sustained and continuing engagement, the second recent trend comes into play: passive asset management or passive investing. Here, additional reasons could be a motivating factor as well to invest on a long-term perspective. Speaking of long-term investments, saving for (early) retirement could be one reason.

Demographic change in the society has the effect that more people retire than new people go into working life. This has also consequences for the welfare system of governments, especially with regards to pension rates. While people who retired recently can still expect to get a sufficient level of pension payments, it will dramatically change for the younger generations. As a consequence, they need to think ahead with regards to their financial activities. It does not necessarily need to be the pension as a ultimate long-term goal, but it might be also driven by the idea of financial freedom so that one does not need to work his or her entire life to cover their living expenses, but to create a financial buffer in order to freely decide about his or her acitivites. The author of this thesis is therefore seeking for answers with regards to the above-mentioned areas, by combining sustainable and responsible investment with the passive investment strategy using ETFs. As the author is of German origin, it is important to mention that this study is also meant to focus on the German market to increase the practicability of this thesis. However, it is also important to analyze the

performance of both alternatives, speaking of either investing with conventional methods or having a sustainable and responsible investing style. Within this context, the central question is which of these methods show the better performance and thus do also increase the value for private investors.

To sum it up, the motivation is to find answers on the research topic on how to integrate sustainable and responsible investing into a passive investment strategy and whether it also might be beneficial for German private investors in terms of the actual return.

1.2 Objectives & Limitations

The overall objective of the thesis is to give a structured and scientific research about how German private investors may invest their money in ETFs, and whether sustainable ETFs perform better or worse than a conventional ETF portfolio. This research should combine a practical guide for German private investors that seek fundamental and scientific information about investment opportunities, as well as the scientific analysis of the historical performance of the chosen investment vehicles. It therefore gives not only a theoretical analysis and adds towards the research within this field but can be also read by (German) private investors to understand the general theory behind investments into ETFs. It could also contribute to support the decision-making process for private investors as this paper delivers valuable information for structuring the world of sustainable investment on a broad level and sustainable ETF investments in particular. To sum it up, the research should find answers to the following questions:

- What does sustainable and responsible investing mean for German private investors?
- How can those investors use ETFs as investment vehicles for their purposes?
- With which techniques and theoretical models can one measure the performance of an investment portfolio?
- What actual ETFs are available for sustainable and responsible investment? And what ETFs would be a conventional alternative?
- While analyzing the performance of the considered ETFs, is it better to invest in sustainable or conventional ETFs?

However, as the research area is relatively new, the search for historical data has aggravated the process of drawing a reasonable conclusion. In this context, the availability of sustainable ETF investments for German private investors is relatively low, considering certain parameter

for selecting suitable funds for a performance comparison. Thus, the research is limited based on the scarce availability of the data. Nonetheless it is ensured that the data is sufficient to draw conclusions out of them. As it was also mentioned before, the research is focused on German private investors as target audience, and thus only ETFs will be considered that can be traded in Germany. Furthermore, the last five years could be only considered as a reference since most of the sustainable ETFs have a relatively short time of existence.

1.3 Outline of the Thesis

This research paper is split into several chapters. It follows the logic that the theory will be introduced to the reader at first, while after that the used data, the underlying methodology as well as the results of the empirical elaboration are presented.

The second section will concentrate on sustainable and responsible investing. Here, the evolution and historical development will be outlined to get a first understanding what it means to invest in a sustainable and responsible manner. Furthermore, the most commonly used framework for structuring SRI investments, the ESG framework, will be introduced. It will help to better understand the range of SRI investments and the segments within it. In addition, investment principles and strategies will be elaborated. This part is essentially important to understand the link between theoretical frameworks and the actual practical application of those. This section will mostly refer to the most commonly used frameworks of the United Nations that have established those as a guideline that every company can use. To get a better understanding on how the selection of sustainable and responsible companies is made, the MSCI ESG Rating Methodology will be shortly explained as MSCI is the biggest provider of ETFs and has a dedicated, scientifically proven approach to establish their ESG ratings. That is why MSCI is also one of the biggest providers of ETFs and it thus have a strong position on the market. As a final section, the value of SRI investments will be theoretically elaborated with key insights how SRI investments are creating value.

Since the thesis is also covering the universe of exchange traded funds, the third section will introduce major concepts, ideas and content that need to be elaborated while discussing investment opportunities related to those instruments. At first, the evolution and historical development will be presented for showing the short but yet rapid development of those investment instruments. Furthermore, it is also important to differentiate ETFs from other investment instruments such as index funds or mutual funds. After understanding the core of ETFs, a segmentation of different ETF types helps to explain the diversity and possibilities

that Exchange Traded Funds deliver. This is followed by the subsection regarding investment principles and strategies which should serve as a basis for any investment decision of a private investor. Here, the concept of passive investment will be elaborated while explaining its benefits compared to active investment methods. It is essential to shed light on this concept as ETFs are predestined to be used for a passive investment strategy. While each investment regardless of its type bears risk, the final subsection will concentrate on risks and costs of ETFs that need be considered while investing with the help of those instruments.

After elaborating the necessary theoretical frameworks, the fourth section set the foundation for the actual research topic. Here, the basic performance measurement methods are introduced that will be later applied on the selected data for this thesis. The fifth chapter will introduce the complete data lifecycle – from data gathering and collection to matching the correct sustainable ETFs with the corresponding conventional ones. In addition, descriptive statistics help to get a first picture of the used data and to better understand the basis for further analysis. However, as mentioned above, some limitations needed to be made in order to have a profound data quality and to make the thesis also applicable to German private investors.

In the sixth section, the methodology will be shortly introduced. Here, the performance measurement methods are used as the basis for building the actual models in order to perform the tests accordingly. Also, the involved variables are explained to better understand the results in the following section. This will be followed by the actual performance analysis, where the sustainable and conventional ETFs are compared with each other and conclusions are drawn about the superior or inferior performance of the respected sustainable instruments. After all, a summarizing conclusion will take place to recap on the elaborations of the thesis. Here, further comments are made to encourage a discussion about the related results.

2 Sustainable and Responsible Investing

This section will encounter the first theoretical component of the thesis by outlining the principle questions of “what”, “how” and “why” investing in a sustainable and responsible manner. Therefore, the first subsections focus on the development of evolving standards, followed by strategies that might be applied to strictly achieve a sustainable and responsible investment behavior. An example will additionally point out how MSCI, a leading financial institution providing methodologies and ratings, is assessing companies with a structured and profound framework. As the last part, the value creation through sustainable and responsible investing is elaborated by summarizing the most recent studies on this topic.

2.1 Evolution and Historical Development

Sustainable Investing per se is a relatively broad term that includes different frameworks on how to structure certain peculiarities, depending on the perspective, scope and filter criteria that are used to label certain investment instruments as sustainable. For this reason, this section will focus on the relevant classifications that are interesting for private investors to know. The phenomenon of sustainable investment is not new – it has already been used centuries ago as the below figure illustrates (Fulton et al., 2012):

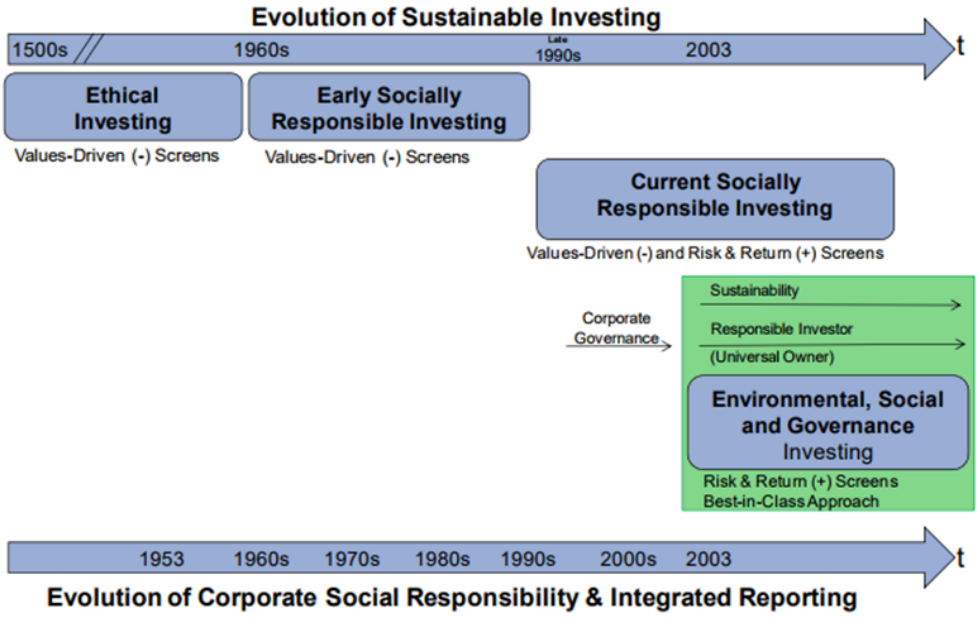

Figure 1: Evolution of Sustainable Investing (Fulton et al., 2012)

However, there are various terms and acronyms, many of which can be defined differently and thus are interchangeable. Therefore, those different terms may seem confusing, especially for the ones who would like to get transparency about specific investment opportunities. Nonetheless, the nowadays commonly used term “sustainable investment” should comprise all of the synonyms that can be found in literature.

With regards to its long-standing history, sustainable investments have already been defined based on religious beliefs. For example, during medieval times in the 16th century Jewish law has specified first rules for ethical investments. In the 17th century, the Methodist Church followed those principles and introduced similar rules. (Schueth, 2003) In the upcoming 1900s, specific religious requirements from the Islamic community have been considered in investment portfolios as well, for example by not investing in pork production sectors. As another example, they also do not tolerate receiving and paying interest rates so that investments with regards to Islamic beliefs need to consider this as well. (Hussein & Omran, 2005)

Furthermore, environmental concerns have also pushed sustainable investments during the second half of the 20th century. (Fowler & Hope, 2007) Hence, ethical and sustainable banks have been established to serve the needs of investing money in ecological and sustainable projects. In the recent history, personal ethics and social convictions have transformed the investments towards a more sustainable approach. For example, the Pax World Fund was founded because of the Vietnam War to ban investments in the production of weapons. Other funds have excluded investment opportunities in South Africa during the Apartheid regime. nuclear and oil disasters such as Chernobyl, Fukushima or Exxon Valdez show that investments should also include environmental concerns and have an influence on investment habits. (Renneboog et al., 2008)

As an overall consequence, investment theory and its underlying parameters have changed. Initially, investment decisions followed three essential principles with certain tradeoff-characteristics: liquidity, risk and return. The tradeoff can be seen at best with one simplified example: if a person just has its money on its bank account, the liquidity is very high, whereas risk and return are very low. By contrast, high risk investments have also higher returns, but do not necessarily include high liquidity. Sustainability adds another perspective on investment decisions that do not only consider economic circumstances in decision making. The following figure illustrates this as a development from a “magical” triangle to a “magical” square (Cengiz et al., 2010):

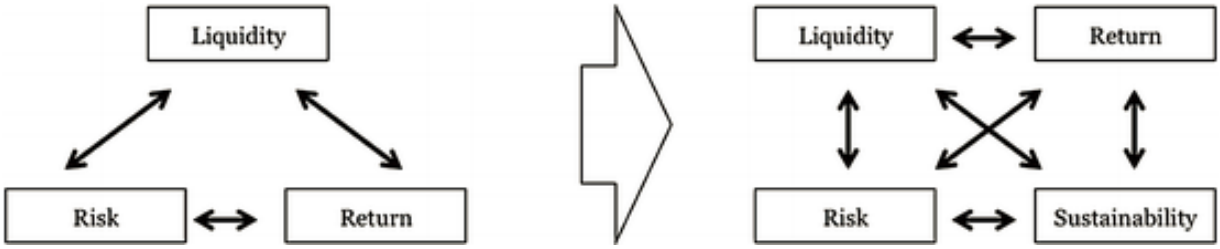

Figure 2: Trade-off Relationship in the Magical Square for Investment Decisions (Cengiz et al., 2010)

2.2 ESG Framework

The most commonly used framework for categorizing sustainable and responsible investments is based on Environmental, Social and Governance factors – or short ESG. Besides classical financial criteria that are taken into consideration to build up any financial portfolio, corporations and asset managers are using this classification to extend the existing financial decision criteria with non-financial decision criteria. Consequently, not only risk and return as key indicators are considered to perform an optimal portfolio, but the assets within the portfolio are screened for the three area of environmental, social and governance impact, covering both quantitative and qualitative effects. (UN Principles for Responsible Investment, 2019a)

Environmental	**Social**	**Governance**
• Climate change – including physical risk and transition Risk • Resource Depletion, including water • Waste and pollution • Deforestation	• Working conditions, including slavery and child labor • Local communities, including indigenous communities • Conflict • Health and safety • Employee relations and diversity	• Executive pay • Bribery and corruption • Political lobbying and donations • Board diversity and structure • Tax strategy

Figure 3: ESG Criteria (UN Principles for Responsible Investment, 2019a)

Within those three categories, the concrete factors that are being used for assessment differ from model to model as there is no fixed definition what factors to include. Obviously, each of the factors involve specific information about the category, used as foundation for building ESG rankings with a profound methodology.

The overall trend during the last years shows a tremendous expansion of sustainable investments that mainly use one or another instrument to assess the ESG criteria. Not only the number of instruments for ESG criteria have been therefore increased, but also the number of assets under management. The following graphic summarizes the development of SRI themed investment in Europe from 2005 to 2017. Although the increase reached its peak during the last years and it will probably not exponentially grow as in the decade before, it still reflects the importance of the topic with regards to financial investments. From a niche existence, it will more and more develop towards an integrated part of each financial investment.

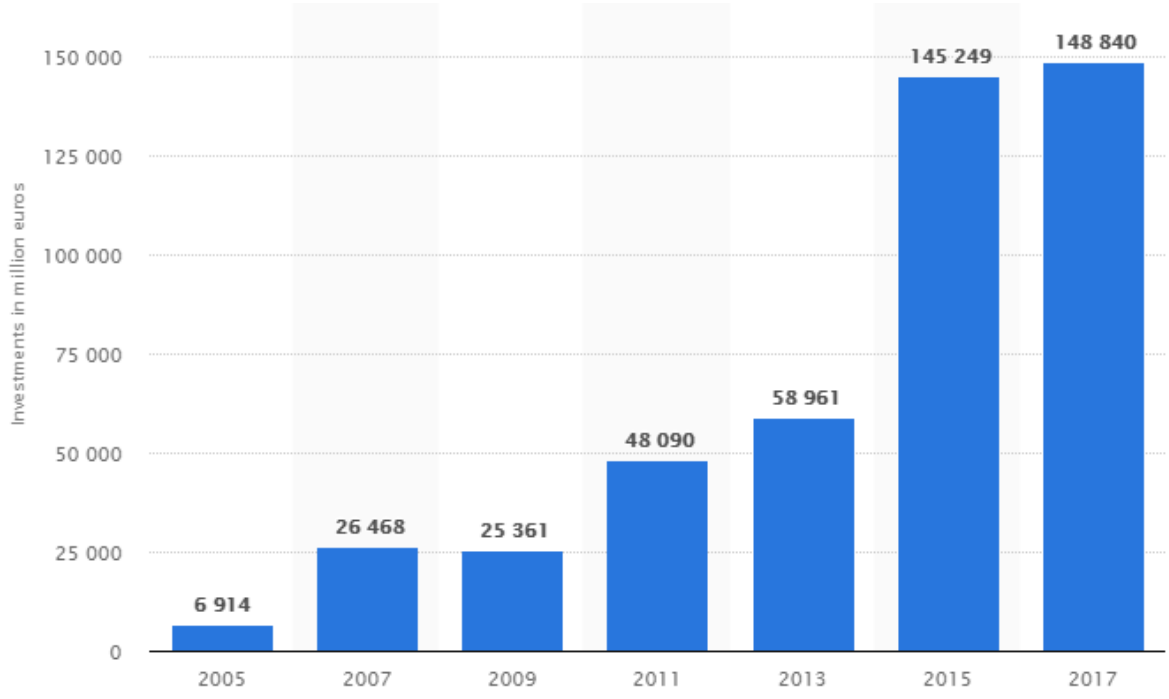

Figure 4: Development of sustainability themed socially responsible investments (SRI) in Europe biannually from 2005 to 2017 (in million euros) (Cherowbrier, 2019)

2.3 Investment Principles and Strategies

In order to provide guidance for companies and asset managers to evaluate sustainable and responsible investment opportunities, various principles and strategies have been developed for incorporating ESG factors in their operations. Two of the most-recognized institutions are the UN principles for responsible investment (UN PRI) and the forum for sustainable and responsible investment (SIF) that both have defined guidelines for the majority of SRIs. They follow different categorization principles and vary between countries; nonetheless they are focusing on similar areas.

Within this context, the UN PRI is considered as the most important organization that promotes sustainable investments in the financial markets. The independent and non-governmental organization was firstly introduced in 2006 at the New York Stock Exchange (NYSE). Since then, the number of signatory investor members has increased from 100 to almost 2000. Its mission is to facilitate sustainable investing by assisting its signatory members to achieve long-term value creating through sustainable and economically effective fiscal systems. It consequently also supports its members to implement ESG decision criteria into its business operations, so that it not only benefits the fiscal system, but also for society overall. (UN Principles for Responsible Investment, 2019b)

The UN Principles for responsible investing are based on the following six statements (UN Principles for Responsible Investment, 2019c):

“1. We will incorporate ESG issues into investment analysis and decision-making process.

2. We will be active owners and incorporate ESG issues into the ownership policies and practices.

3. We will seek appropriate disclosure on ESG issues by the entities in which we invest.

4. We will promote acceptance and implementation of the principles within the investment industry.

5. We will work together to enhance our effectiveness in implementing the principles.

6. We will each support on our activities and progress towards implementing the principles.”

Those leading principles serve as a guideline for its members, helping them to implement ESG screening into their operations and overall creating an impact by sustainable and responsible investment practices.

As a second framework, SIF has structured its strategy by using seven different approaches. (Eurosif, 2019) Whereas the above principles define guidelines for its members, the seven strategies by SIF classify methods how to implement and evaluate sustainable and responsible investment overall. The following table summarizes those classifications:

Table 1: Responsible Investment Strategies by SIF

Best-in-class	A method in which top or best-performing investors are chosen or weighted depending on ESG requirements within a range, category or class. This methodology includes selecting or weighing the highest performing or most advanced businesses or resources as defined by ESG assessment. This method involves best-in-class, best-in-universe, and best-efforts.
Engagement and Voting	Engagement and effective participation by purchasing stocks and interacting in ESG activities with enterprises. This is a long-term process in which behavior is influenced or disclosure is increased. It is only essential to engage and vote on corporate governance, but not enough to be measured in this approach.
ESG Integration	The clear incorporation in traditional financial analysis and business options of ESG threats and opportunities by asset managers dependent on a systematic process and adequate scientific findings. This form includes clear recognition of ESG variables in the common investment analysis as well as economic variables. The inclusion method relies on the opportunities (positive and negative) effect of ESG topics on corporate finance, which may in turn influence investment decision. **Environmental** issues relate to any part of the operation of a company that positively or negatively impacts the ecosystem. Examples include emissions of greenhouse gases, renewable energy, power effectiveness, depletion of resources, chemical pollution, disposal governance, wildlife governance, biodiversity effect, etc. **Social** issues range from society-related problems such as safety and education development to work-related problems, including compliance to human rights, non-discrimination, and stakeholder engagement. Examples include labor standards (along the supply chain, child labor, forced labor), relations with local communities, talent management, controversial business practices (weapons, conflict zones), health standards, freedom of association, etc. **Governance** problems relate to leadership performance, culture, risk profile, and other features of a company. It involves the board's accountability and commitment to cultural and economic results and strategic management. Furthermore, it emphasizes principles, such as transparent reporting and the realization of management tasks in an abuse- and corruption-free manner. Examples include corporate governance issues (executive

	remuneration, shareholder rights, board structure), bribery, corruption, stakeholder dialogue, lobbying activities, etc.
Exclusions	A method that excludes sectors or asset categories from the business universe. This method systematically excludes businesses, industries or nations from the permissible business universe if they are engaged based on requirements in certain operations. Weapons, pornography, tobacco and animal testing are common criteria. Exclusions can be implemented throughout the full asset item spectrum at the personal grant or policy stage, but also progressively at the asset manager or asset holder stage. This strategy is also related to as exclusions relying on ethics or beliefs, as requirements for exclusion are typically focused on decisions taken by asset executives or asset holders.
Impact Investing	"Impact Investments are investments generated in businesses, organizations and resources aimed at generating cultural and environmental impact alongside economic returns. Impact investments can be created in developing and developed markets and, based on the conditions, deliver a variety of yields from below market-to-market rates. Investments are often project-specific and different from philanthropy, as the investor maintains the asset's ownership and wants a favorable economic yield. Investment in impact involves microfinance, community investment or social business / entrepreneurship resources.
Norms-based screenings	Investment screening in accordance with international standards and rules. This strategy includes checking investors depending on global standards or standard mixes involving ESG variables. International ESG standards are those identified by global institutions such as the UN.
Sustainability-themed	Investment in topics or resources related to sustainability growth. Themed donations concentrate on ESG-related or various issues. Investments focused on sustainability add significantly to solving personal and/or economic problems such as climate change, eco-efficiency, and health. In order to be measured in this strategy, funds are needed to have an ESG assessment or investment monitor.

With regards to the implementation of the strategies, exclusions are still leading the way of how to incorporate sustainable investments. It might also seem the most straightforward way to do so as certain companies and industries are just excluded from a certain portfolio. Most prominent examples are the tobacco and weapon industries or companies dealing with pornographic content. Another leading approach is to actively engage stakeholders to participate in the transformation of companies by implementing sustainable issues in their strategic agenda. This is mostly done by using the shareholders' voting rights and becomes increasingly important. However, ESG Integration must be highlighted here as it shows the highest CAGR increase of 27%. It reflects that an increasing amount of companies do consider

integrating the ESG framework into their corporate guidelines so that it is turning from a rather distinguishing feature to a standard component of company governance. (Eurosif, 2018)

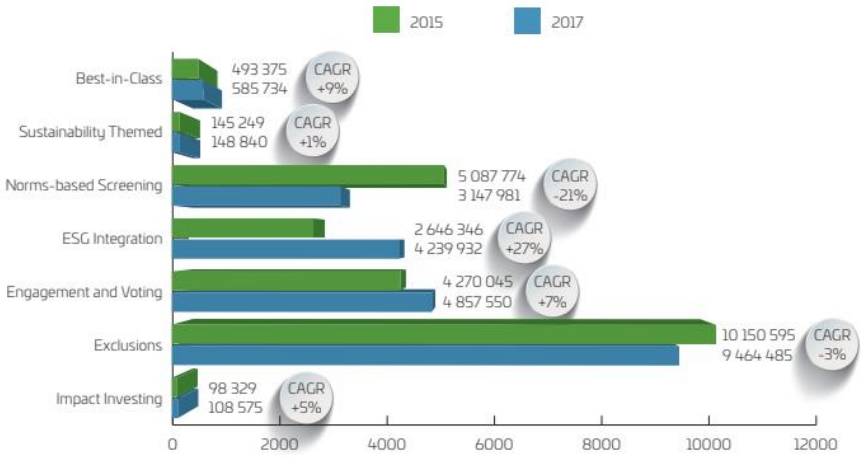

Figure 5: Development of the different Responsible Investment Strategies 2015-2017 (in bln. EUR) (Eurosif, 2018)

2.4 Practical Example – MSCI ESG Rating Methodology

In the previous chapter, the general principles and strategies are mentioned as guidelines for companies to implement them accordingly. However, each of the company follows its own approach so that there is no universal legislation that must be introduced since it is not obligatory for companies to do so. Nonetheless, most of the asset management and financial institutions have a clearly defined methodology and rating mechanism that can be found in the internet.

As it will be shown later, most of the ETFs, both sustainable and conventional, are based on Morgan Stanley Captal International (MSCI). According to their information, they are the world's largest provider of ESG research and data for index-based funds such as ETFs. They provide over 700 equity and fixed income indexes, totaling to over 170 billion US$ in the recent years. Thus, it makes sense to shed light on their methodology and ranking mechanisms as those also build the basis for many of the available sustainable ETFs. The figure below illustrates the complete process from gathering the data towards the final creating of an ESG rating. (MSCI, 2018)

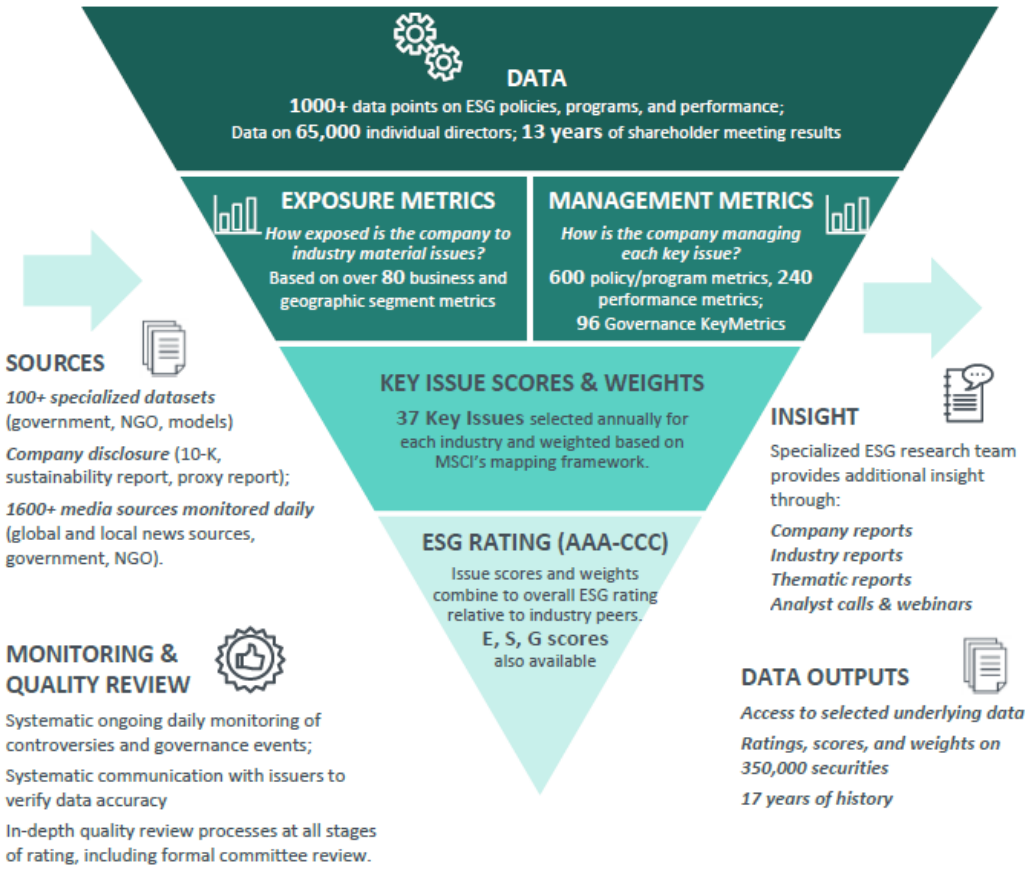

Figure 6: ESG Rating Framework and Process Overview (MSCI, 2018)

With their methodology, they try to find answers on four key questions related to the evaluation of the companies (MSCI, 2018):

- What are the most significant ESG risks and opportunities facing a company and its industry?
- How exposed is the company to those key risks and/or opportunities?
- How well is the company managing key risks and opportunities?
- What is the overall picture for the company and how does it compare to its global industry peers?

Environmental, social and governance risks and opportunities arise from large-scale trends (e.g. climate change, resource scarcity, demographic shifts) as well as from the nature of the company's operations. Companies in the same sector usually experience the same significant challenges, although the exposure to each may differ. The involved risk is tangible to the sector when it is expected that firms in a specified environment will face additional significant expenses in association with it (for instance, a legislative prohibition on important chemical inputs needing reformulation). An opportunity is tangible for the sector when it is likely that

businesses in a specified sector could capitalize on it for profit (for instance: possibilities in clean technology for the LED lamps sector). (MSCI, 2018)

The MSCI approach identifies the above-mentioned material risk and opportunities for each sector through a quantitative model that looks for externalized effects such as carbon intensity, water intensity, and injury rates for ranges and average values for each sector. Companies with uncommon business models can face fewer or more main challenges and opportunities for their industries. For firms with differentiated business models, facing controversy or based on industry laws, company-specific exceptions are permitted. In addition to those external exposure, internal management initiatives are also being assessed and evaluated, mostly summarized in the governance pillar. With regards to this segment, the company itself is not determined by externalized factors, but by its own management and underlying vision and strategy. These key issues are allocated to each sector and business once identified. The below table gives an overview about the key issues that are used within the framework. (MSCI, 2018)

Table 2: ESG Classification for MSCI Rating Methodology (MSCI, 2018)

3 Pillars	10 Themes	37 Key Issues	
Environment	Climate Change	Carbon Emissions	Financing Environmental Impact
		Product Carbon Footprint	Climate Change Vulnerability
	Natural Resources	Water Stress	Raw Material Sourcing
		Biodiversity & Land Use	
	Pollution & Waste	Toxic Emissions & Waste	Electronic Waste
		Packaging Material & Waste	
	Environmental Opportunities	Opportunities in Clean Tech	Opportunities in Renewable Energy
		Opportunities in Green Building	
Social	Human Capital	Labor Management	Human Capital Development
		Health & Safety	Supply Chain Labor Standards
	Product Liability	Product Safety & Quality	Privacy & Data Security
		Chemical Safety	Responsible Investment
		Financial Product Safety	Health & Demographic Risk
	Stakeholder Opposition	Controversial Sourcing	
	Social Opportunities	Access to Communications	Access to Health Care
		Access to Finance	Opportunities in Nutrition & Health
Governance	Corporate Governance	Board	Ownership
		Pay	Accounting
	Corporate Behavior	Business Ethics	Corruption & Instability
		Anti-Competitive Practices	Financial System Instability
		Tax Transparency	

Based on those categories, a scoring system is being established. To achieve a final letter rating, the Key Issue Scores weighted averages are aggregated and their industries standardize the outcomes of firms. After factoring in any overrides, the Final Industry-Adjusted Score of each company refers to a score of the highest (AAA) and the worst (CCC). These business efficiency estimates are not universal but are clearly designed to be comparative to sector members' norms and efficiency. The following figure illustrated the bottom-up design of the rating methodology. Each pillar is divided into a exposure score and a management score, where the weighted average score is being used for assessing the observed companies on a scale from 0-10. Those pillars are then aggregated to the key issue score which is then directly flowing into the final industry adjusted score that builds the basis for the final ESG Letter Rating. (MSCI, 2018)

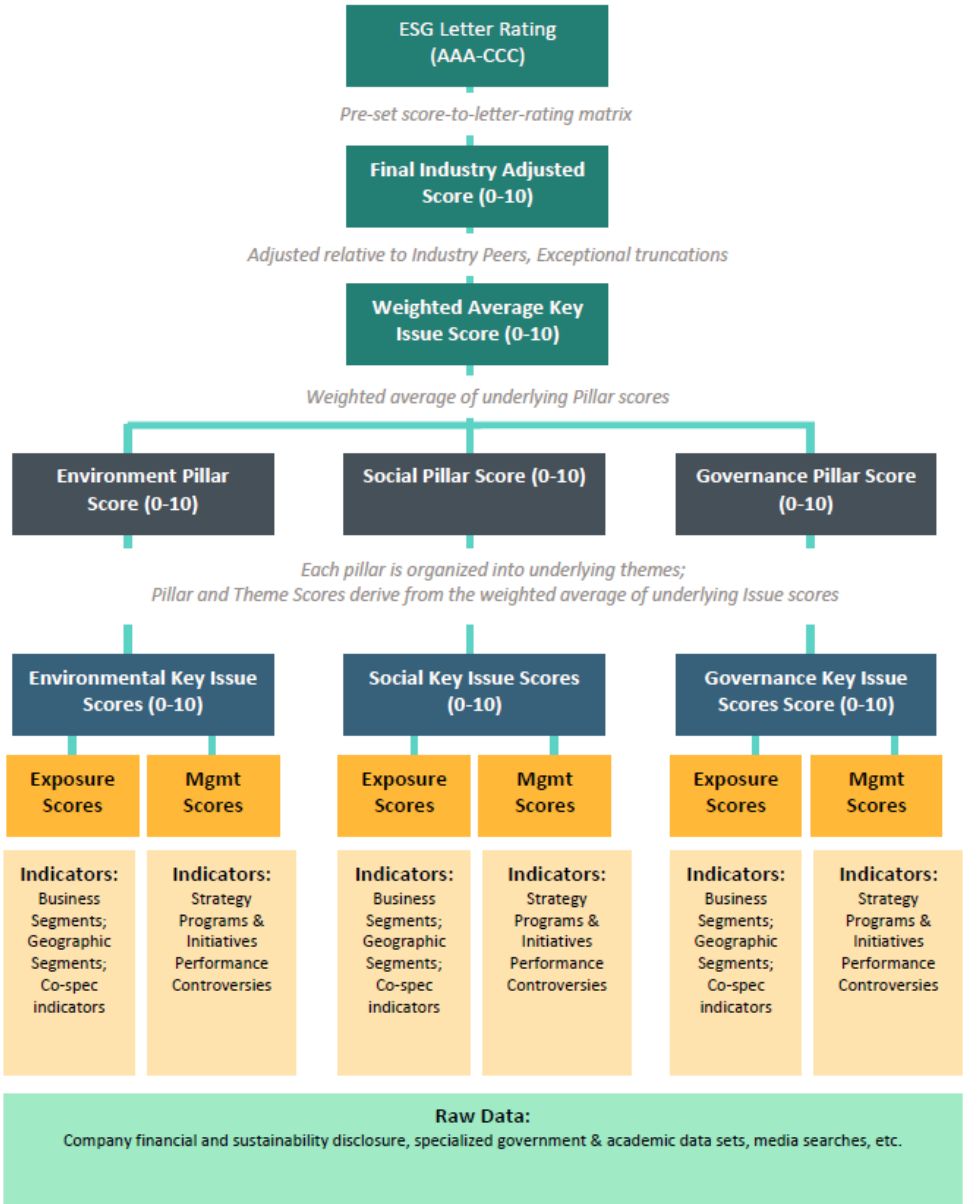

Figure 7: Hierarchy of ESG Scores (MSCI, 2018)

To summarize, the ESG Rating Methodology is a multi-step process in which thousands of externally collected datapoints are used in order to ensure a profound classification of the observed companies. Also, within the process, the different steps ensure that each of the sub steps is performed on a solid basis, resulting into a rating that can be an industry-benchmark among other providers. As MSCI is one of the leading providers of such ratings, its methodology serves as a standard for assessing the ESG performance of both their own scores as well as individual companies.

2.5 Creating Value through SRI

As the research is focused on the performance comparison between conventional and sustainable ETF portfolios, it is also essential to research about studies that have been already conducted to find answers on this question. However, it is no only about the financial performance of the sustainable portfolio, the quantitative results, but also about the additional value for the private investor that reflect a qualitative character. Within this section, those qualitative factors will be shortly analyzed in order to complement the overall research that is more focused on the financial performance of the ETF portfolios.

To start with, it is essential to understand what it means to invest in a broad sense, regardless of sustainability or not. It is the process by which the investor is binding current available assets in exchange for an expected benefit in the future. This benefit can be referred to as an additional gain, may it be financially or non-financially. (Bodie et al., 2011) However, the theory also states that investors follow the principle of wealth maximization and that he/she operates in a rational way towards their goal. During this process, positive value or negative value can be created, either by increasing or decreasing development of the committed resources. This up- or down-development might be affected by multiple factors, from time-value of money, general expenses of the investment, macroeconomic development, regulations and financial policies and others. As also mentioned in the previous section, the risk-return relationship is one of the most fundamental relationships in finance. This trade-off relationship describes that the higher the risk, the higher the return should be. Concerning the risk, associated factors have been discovered that influence the performance. Those are mainly indicators such as the size of the company, book-to-market ratio or the momentum of stock returns. Those influencing factors have then also been implemented in financial models to deeper understand their impact on the overall performance as it will be also explained in the following chapters regarding performance measurement. (Bodie et al., 2011)

Besides those traditionally used theories and financial indicators, additional factors also need to be considered as private investors may not only follow pure rational behavior but are driven by other principles. A sustainable mindset of a private investor might be a reason to also invest in a sustainable manner, even though the investor is willing to accept smaller returns compared to conventional alternatives. Nonetheless, sustainability is not only a niche-topic anymore, but is reflected by the number of available instruments as well as the general concern of a more sustainable lifestyle in society. That is why SRIs do not necessarily have to perform weaker than their conventional counterparts but have potential to add value for companies. The combination of financial performance and sustainable and responsible behavior of companies is therefore deeply connected and needs to be observed carefully. (Renneboog et al., 2011) (Hafenstein & Bassen, 2016)

In general, two opposing schools can be found regarding the combination of sustainability and financial performance. On the one hand, the cost-concerned school sees sustainable impact negatively on the financial performance since additional costs for companies occur while they need to invest in ESG measures explained above. Consequently, this decreases the profit and lower market value. On the other hand, however, the value-creating school states that the financial performance of a company is increased by competitive advantage through sustainable investments. The company can therefore protect itself from bad reputation and increasing future environmental costs, e.g. the increase of fossil resource prices or the increase of CO2 emission prices. (Hassel et al., 2005)

Moreover, three different theories consider corporate sustainable activities in combination with a positive market value development, following the before-mentioned value-creation school. The first theory is the stakeholder theory, proposed by Freeman. (1984) Since companies are one part of the society, they should also embrace their societal commitment and responsibility. Not only shareholder value should be maximized according to this theory, but companies should also consider interests of their stakeholders, especially customers and employees. If companies invest in good stakeholder relations, the risks involved will be reduced, leading to larger investor base and ultimately also reduce the costs of capital. Therefore, sustainability is having a positive impact on the development of companies, also with regards to their financial performance. However, it is also a matter of the overall corporate performance whether companies can additionally invest in this field. If financial challenges on a short-term exist, it is rather hard to concentrate on long-term value creation through sustainable measures. (Waddock & Samuel, 1997)

As a second theory, the legitimacy theory describes sustainability as a going concern and a crucial managerial responsibility. The theory assumes that companies commit to their social

contract towards their stakeholders and in society overall in order to build up successful relationships and ensure the long-term survival. Ignoring this circumstance would lead to the deterioration of the company's profit and market value as it would not be accepted by the social framework the company is acting in. (Lopotta & Kaspereit, 2014)

As an additional point of view, the resource-based view as a third theory complements this theoretical segment. It considers the achievements of companies to put effort into sustainability and stresses the importance of creating a balance between the company's resources, competences and competitive edge. Furthermore, it states that the company is determined by its surrounding, leading to the the circumstance that the environment affects the company's performance based on their available resources and build-on competencies. Consequently, each company needs to understand that it also needs to utilize its surrounding factors to create a competitive advantage towards its peers. (Hart, 1995) The theory can be also extended to the point of view that it helps to decrease costs with regards to its resources, i.e. by shrinking production waste, optimizing process or improving recruiting. In addition, due to the changing mindset within society overall, stakeholders will prefer companies with higher standards with regards to ESG criteria mentioned above. (Lopotta & Kaspereit, 2014)

With regards to the position of the private investor, one can also find different theories how sustainability and financial investment interfere and how private individuals base their decision for their investments. Basically, two main theories are relevant here: the expected utility theory and the prospect theory. The expected utility theory is a fundamental idea in the field of economics that also has its stake concerning portfolio construction. As the name suggests, it identifies the expected utility and potential outcome by comparing the alternatives that exist for the private investor. Every individual has a different preference of those existing preferences that can be also quantified, also known as utility. In the "conventional" financial decision-making process, the utility of each individual investor would be increased by creating an optimum of the risk-return level and by finally maximizing the wealth of the investor. (Davis et al., 1998) (Copeland & Weston, 2005) However, private investors do not only make rational decisions, but may also choose options that do not offer the highest potential (financial) wealth. (Swalm, 1966) This circumstance might be explained by the fact that investors do not only consider the risk-return relationship of the assets in their portfolio, but also their personal risk-return relationship and their connected trade-off consequences. Thus, investors do not only follow the pure rational decision making by choosing the highest probable economic utility but take into considerations other dimensions with regards to the trade-off relationship of risk and return. (Bodie et al., 2011)

Secondly, the prospect theory is concentrating more on the perception of risk tolerance. It states that the experienced utility of an investor is mainly impacted by the changes of the amount of wealth, thus profit and losses are perceived and appreciated differently. To be more concrete, faced losses do create a bigger distress than generated profits create a positive utility for the investor. Consequently, this irrational behavior of individuals is being explained with this theory, providing evidence why gaining assets are sold too quickly and losing assets are hold too long within a portfolio. (Kahneman & Tversky, 1979) (Bodie, et al., 2011) However, this psychological “game” can be won by strictly following a passive investment strategy as it will be also explained in the following section.

Overall, one can state that individuals are not only rationally taking decisions with regards to their investment behavior, although this might generate more gain, in theory. In practice, each individual investor considers also non-financial aspects in their investment decision, adding another dimension in the trade-off relationships between liquidity, risk, return and sustainability. For this reason, companies like MSCI do create ESG rating methodologies that transparently explains their approach on how to assess sustainable companies and integrate them in their financial products. However, the ranking might be also criticized as the chosen factor reflect certain sustainable factors, but also show room for improvement to cover the full spectrum of sustainable issues.

3 Exchange Traded Funds

As the second theoretical part of the thesis, Exchange Traded Funds as investment instruments are introduced in more detail. Likewise, the questions of “what?”, “how?” and “why?” are being answered regarding ETFs. Concerning the “what?”, the evolution and historical development will be shortly outlined, before a classification among ETF categories is being made as well as pointing out differences compared to similar investment instruments, e.g. mutual funds or index funds. Following this, it is crucial to mention how ETFs are perceived with regards to this thesis. Thus, the investment principles and strategies are important to understand the underlying logic of so-called passive investments. As a last part, risks and costs by using ETFs are summarized to complete the whole spectrum of this section.

3.1 Evolution and Historical Development

Exchange Traded funds are relatively new investment vehicles, compared to other investment opportunities like single stocks. They firstly appeared in the beginning of the 1990s as a spin-off of mutual funds. However, ETFs did not gain such big popularity and interest among private investors as they nowadays do. This exponential growth has started in the beginning of the 2000s, when ETFs have established itself in the market and new companies have issued new ETF products for private investors. (Statista, 2019) In addition, the spread of the Internet made it easier for private investors to firstly provide better information about such products as well as managing their own portfolios via online broker. As it can be seen in the figure below, the assets under management have almost increased by factor seven with a very strong increase during the two or three recent years. However, ETFs are still niche products with regards to their usage as financial investment. In 2016, only 4% of the surveyed individuals have invested their money in ETFs, while above 90% have invested in call money or on a savings account. However, due to the development of the financial investment opportunities for private investors, the amount of people is likely to steadily increase who use ETFs as form of investments, among other typical investments for individuals such as owning stocks. (Janson, 2018)

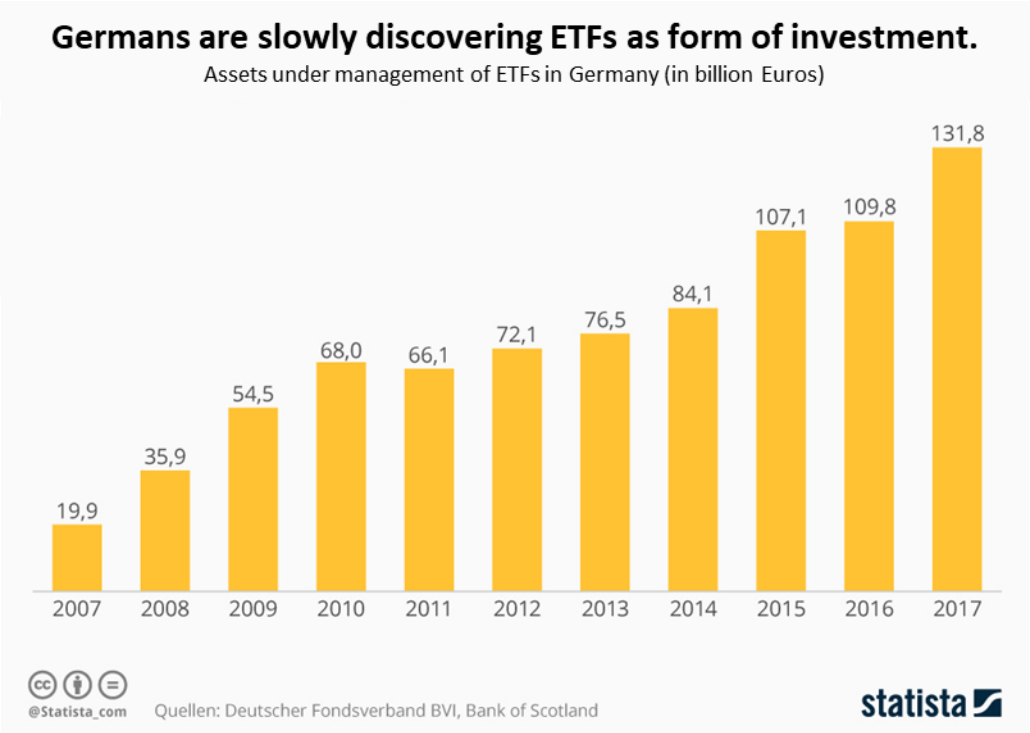

Figure 8: "Germans are slowly discovering ETFs as form of investment. Assets under management of ETFs in Germany (in billion Euros)" (Statista, 2018)

3.2 Distinction to other Asset Classes

For a better understanding and distinction, it is crucial to have a proper classification between the existing terms of Exchange Traded Funds, Investment Funds, Mutual Funds and other related asset classes. As it was already mentioned in the previous chapter, ETFs have evolved as a spin-off of mutual funds. But where exactly is the difference?

A mutual fund, in a classical sense, is an investment vehicle that collects money from larger amount of (individual) investors to invest it in certain assets, mostly in stocks, bonds and other securities. The collectors are professional fund managers who are responsible to allocate the investor's money in order to achieve the goals of the mutual fund in form of capital gains, dividends or other income. Thus, investors do only indirectly and not directly invest into the securities so that they not have any obligations and rights for the assets, e.g. voting rights for stocks. This logically means that the investor is not a shareholder per se, but that the fund manager represents the individual investor in this role. The price of a mutual fund is the Net Asset Value (NAV) and calculated as the quotient of value of the total portfolio divided by the number of assets outstanding within the portfolio. Since a mutual fund includes different forms of assets, it also benefits from diversification effects that consequently leads to a better risk-return ratio. (Vanguard, 2019)

There are different types of mutual funds, among them index funds. Unlike other forms such as equity funds that, as the name suggests, invests in stock and other equity assets, or fixed-income funds, focusing on bonds that deliver a fixed return, index funds follow the strategy of buying underlying assets that represent major indexes on the financial market. Most prominent examples are the S&P500 or Dow Jones Industrial Average (DJIA) in the United States or the DAX30 in Germany. Thus, those funds mimic the market and do not follow the aim to beat it with a higher return as this also involves higher costs in terms of risk as well as active steering of the portfolio. Therefore, index funds are also known as passive funds compared to actively managed mutual funds. (Chen, 2019)

This passive principle is what an index fund and an exchange traded fund have in common. However, what mainly differentiates them is the following: index fund as a special form of mutual funds are managed by professionals that also overtake the responsibility for maintaining the portfolio. Thus, they sell and buy the assets within this portfolio based on the fund's strategy. ETFs, in contrast, are baskets of securities that are traded on an exchange, like stocks. Those are sole and "ready-made" instruments that can be bought and sold on the market like any other assets. Thus, they rather share similarities with equities such as exchange-traded shares rather than with funds. Whereas index funds are only priced at the

end of the day, ETFs can be bought and sold at any time of the day, making this instrument more liquid than index funds. Also, ETFs cannot only mimic certain indexes, but also industries/sectors or specific market regions. However, the concrete definition and components of both index funds and ETFs depend on the underlying strategy. (Investopedia, 2019)

As one can conclude, it is important to underline the differences between the three mentioned terms, i.e. mutual funds, index funds and exchange traded funds. While they all share the same “DNA” with the principle of being a fund, they do have certain peculiarities. Overall, mutual fund is the umbrella term, under which index funds as a specific form of mutual funds exists. And finally, Exchange Traded Funds are a special form of funds that have similarities with an index fund but are rather traded like other equities such as shares on an exchange.

3.3 Segmentation of different ETFs

The universe of ETFs is tremendously diverse, resulting into different segments where ETFs are used as investment vehicles. To give a better overview, this section will cluster those segments and will explain them in brief in order to get a better understanding of the structure. The figure below reflects this structure for a better illustration:

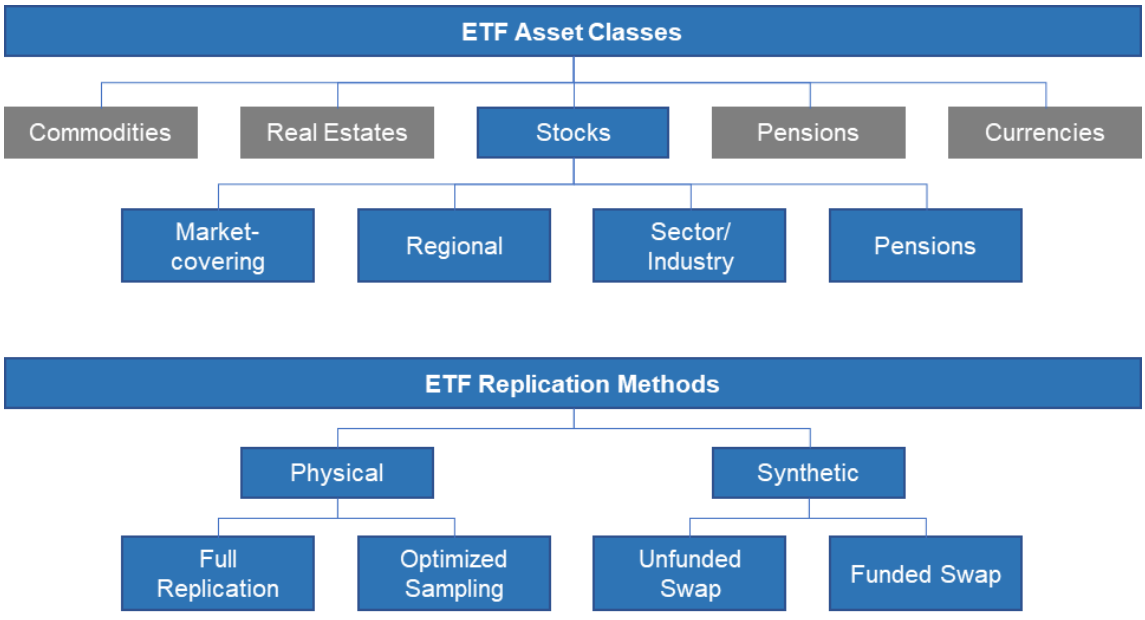

Figure 9: ETF Classification and Replication Methods (own illustration)

At first, one need to understand that there are different asset classes in which a private investor may invest with Exchange Traded Funds. Private investors need to decide for themselves which asset class might fit to their personal investment strategy. The classical asset classes include stocks, real assets, commodities, pensions as well as currencies. Across those asset classes, there are indexes available that are traded on exchange and represent a certain set of assets. Overall, the aim for a private investor is to invest in such classes that have a favorable development on the exchange market, considering the individual risk-return-profile of the investor. (FactSet, 2017)

However, as the focus on this research is concentrating on ETFs that represent stock indices, the following sections will spotlight this asset class. Nonetheless, a private investor might add other asset classes to his portfolio as well if it is in line with his investment strategy. With regards to stock indices, one may invest in different categories using ETFs. (FactSet, 2017) To those categories belong:

- Market-covering indices, including stocks that are represented in a specific global market. Typical examples are the S&P500, covering the 500 biggest listed US companies or DAX, covering the 30 biggest listed German companies. Usually, those indices are connected to a corresponding country where the companies are listed.
- Regional indices, representing stocks from specific regions, such as the MSCI Emerging Markets that includes 850 single stocks across 24 emerging markets across different countries. It might sound contradicting to the term of regional indices as those are also spread across the globe. However, those indices differentiate from market-covering indices that they are broader and not limited towards a certain country but covering a certain group of countries that share similar characteristics, either geographically or economically.
- Sector or industry-specific indices, covering a single industry or sector, either within a certain region or globally. A typical example here is the ETF from iShares Global Water, including the 50 biggest companies worldwide whose business is connected to the natural resource. Despite its clear focus on one industry, those ETFs might include a certain risk, especially within economic challenging times. Furthermore, booming or trending sectors and industries might change over time, making it necessary to adapt the investor's strategy accordingly.
- Strategic indices, following a predefined strategy with the chosen ETF. Those might include strategies with regards to dividends, small cap companies or other underlying selection criteria. For example, the DivDAX from iShares tries to beat the ordinary DAX stock index by including the 15 companies with the highest dividend payouts within the 30 companies that are listed in the DAX.

Whereas this classification refers to a rather strategic and global approach, in which markets, regions, industries or sectors should be invested, it is also important to understand how ETF providers actually do ensure that the selected ETFs follow the same development as the chosen market, region, industry or sector. Consequently, there are different replication methods that are used by ETF providers to represent the same development as the chosen index. In general, one can differentiate between a physical and a synthetic replication method. (justETF, 2019a)

Physical replication methods reflect that the underlying assets of the ETFs are physically represented by buying and selling those underlying assets. Within this section, the ETF provider may follow a full replication method by buying the same proportion of underlying assets that are also represented in the index. Another strategy for the ETF provider might be the optimized sampling method. Here, the provider only buys a representative sample of underlying assets that reflect the identical development as the chosen index. This strategy is especially in favor concerning global indices that cover a three or four-digit number of companies to decrease transaction cost and reduce complexity within the portfolio. The provider would therefore only concentrate on the companies with the largest stake in the index and disregard smaller stock positions. Physical replication methods have the advantage of high transparence, as the underlying assets are physically bought in the portfolio. However, transaction costs might be disadvantageous for a physical replication, especially if the index covers a global portfolio or certain assets show illiquidity. For this reason, as already mentioned above, optimized sampling might reduce transaction costs. (justETF, 2019b)

In contrast to the physical replication methods, synthetic replication methods try to replicate the market with the help of derivatives, especially with swaps. One can differentiate between two synthetic ETF structures. The unfunded structure is based on the transaction that the ETF issues shares and receives cash in return. The received cash is being used to acquire a substitute basket from the counterparty. In practice, that means that the ETF is performing a swap agreement where it exchanges the substitute basket's return for the return of the target assets. Logically, the ETF itself holds the assets in the substitute basket. The basket itself might include diverse securities that heavily differ from the target benchmark, i.e. by including assets from other categories as mentioned above. For example, instead of investing in the target region of Europe, the basket may include assets in Asia Pacific or USA. Nevertheless, the swap contracts and the contract partners agree upon which assets are included in the basket. Logically, it makes sense that the ETF includes stable and liquid assets in order to protect against any counterparty's financial distress, while the counterparty itself might follow its investment strategy, may it be investing in certain asset classes or hedging against specific asset risks. (justETF, 2019c)

As a second swap method, the funded structure shares a similar process as the unfunded structure, but without a substitute basket. Instead, the ETF swaps the return of the target asset to cash with the help of a collateral basket for securing the exposure of the derivate. This collateral basket is being built in cooperation with a third and independent party. Consequently, for both structures, the counterparty bears the responsibility for the return of the ETF to the investor so that the risk of the counterparty is crucial for the synthetic ETF performance. (justETF, 2019c)

Moreover, ETFs may be also differentiated between leveraged and inverse forms. Whereas the leveraged ETFs are focused on multiplying the return of the corresponding benchmark by mainly using swaps, inverse ETFs try to reduce the risk involved by hedging the specific exposure. They both follow a specific time frame for realizing the target performance. A combination of both methods is also available, known as leveraged inverse ETFs. Those are also called ultra-short funds. All three models have in common that they are based on synthetic mechanisms by using derivatives to achieve their goals. (U.S. Securities and Exchange Commission, 2009)

3.4 Investment Principles and Strategies

In general, investments in ETFs follow certain principles and strategies. For this reason, this section will differentiate between those, the purposes of the different investment strategies and will explain the main principles behind them. As this research is scientificially profound and does not only reflect current investment trends, it will also conclude which strategy should be preferred based on scientific findings.

To start with, the main principle investment strategies can be classified in two contradicting point of views: the active investment and passive investment strategy. Active asset management is based on a specific investment strategy that aims to outperform the average return of the overall market as a benchmark, also known as excess return, abnormal rate of return or alpha as a measure to describe the ability to ‘beat’ the market. To put it in other words, active investors try to identify assets or stocks that other market participants are currently over- or under-evaluating. As soon as the other market participants recognize this and try to correct this, the active investor can realize a profit from this by either selling or buying the related assets. This approach is always speculative as the investor consciously decides to shift the weight of the assets within his portfolio in favor of changing evaluation of the asset, considering also less diversification in his portfolio overall. This strategy can be also

implemented with ETFs, for example by investing in attractive developing markets that have a higher expected return or by investing in sector or industry ETFs that also promise to have a higher return than the average market. (Kommer, 2018)

In contrast, passive investment refers to the strategy of buying the respective assets and keeping them in the portfolio without selling them, consistent with a long-term investment horizon. Consequently, active trading by constantly buying and selling will not take place. Passive investment does not follow any active strategy to outperform the market, but to ideally replicate the same return performance as the market within the constructed portfolio. Depending on the market, time period and research method, it has been found out that passive investment portfolios have shown more success as active managed portfolios, measured by their inflation-adjusted annual returns. This circumstance is not just happening based on pure randomness but follows a pattern that can be explained by using scientific elaborations. To better understand why passive investment result into a better performance, different theories underline the effectiveness of this approach. Those theories evolve into principles that should be kept in mind while constructing a passive investment portfolio with the help of ETFs. (Kommer, 2018)

As mentioned already, different theories underline the effectiveness of a passive investment strategy. The first theory is based on the so called “Arithmetic of Active Management”. It states, in simple term, that the likelihood of outperformance for an actively management portfolio is 50:50. This might be not necessarily true for a short-term interval, but the longer the considered time interval gets, the more this 50:50 chance applies. This can be explained by the following circumstance: all investors, may it be active or passive or any kind of “form” of investor, represent as the sum of all market participants the overall market. Logically, every monetary unit on the market has a 50:50 chance to outperform (without considering transaction costs) the overall market. In Sharpe’s famous essay (1991), who has been awarded with the Nobel Memorial Prize in Economic Sciences in 1990, the following simple but essential connection is stated: “If ‘active’ and ‘passive’ management styles are defined in sensible ways, it must be the case that (1) before costs, the return on the average actively managed dollar will equal the return on the average passively managed dollar and (2) after costs, the return on the average actively managed dollar will be less than the return on the average passively managed dollar. These assertions will hold for any time period. Moreover, they depend only on the laws of addition, subtraction, multiplication and division. Nothing else is required.” (Sharpe, 1991) This would also imply that although the overall market performance is positive on the long-term, the dispersion of the market returns across the market participants is a mathematical zero-sum game. By now additionally considering transaction costs and other additional costs that inevitably occur with active trading, an active

portfolio needs to create a higher yield to reach the same performance as passively managed portfolios. Thus, not 50% are outperforming the overall market, but less. With regards to passive investment strategies, the transaction costs and additional costs will be lower as the frequency of trading is limited to a minimum. Also, if the portfolio is constantly increased by investing into it in steady intervals, the cost average effect will limit the portfolio from having an increased level of additional costs. (Kommer, 2018)

As another supporting theory, the Modern Portfolio Theory (MPT) by Markowitz (1952) in combination with the Efficient Market Hypothesis (EMH) by Fama (1970) underline the passive investment philosophy. Those two essential financial theories include all aspects that need to be considered while investing into the financial market, including relationships between risk and return, diversification and other relevant terms. With regards to both theories one could write a whole scientific report solely on the related insights. To keep it short, the key messages are the following, according to Kommer (2018):

- Return and risk are inextricably connected with each other. Without risk, there is also no return. Thus, riskier assets such as stocks need to compensate the higher risk with a higher expected return, although those higher returns cannot be guaranteed over a specific time frame.
- The value of an investment is based on the expectations of future generated cash flows for the investor, either via price fluctuation and/or dividend payouts.
- The whole financial markets are information-efficient social systems, in which all related publicly available information are involved to reflect the related market price for a specific asset. Since this market underlies this high information efficiency, financial investors fail to beat the market based on a long-term perspective, including the considered risk, transaction costs and taxes. And if outperformers exist, it is likely that those happen on pure randomness, but not on a long-term success. Thus, outperformers do exist, but they change over time and consequently, past outperformance in the presence cannot be used to predict outperformance in the future.
- If an investor detects an arbitrage opportunity based on a market anomaly, the other market participant will also follow and will copy this strategy, leading again to market-efficient asset prices. However, if there is a chance to beat the market, it can be only done by considering a higher risk that is somehow bought by a higher price, reflected by less diversification and consequently, by a higher fluctuation in the portfolio.
- On a short-term perspective, asset prices (especially stocks, currencies and bonds) on the financial marker will follow a so-called “random walk”. For timeframe above 5 years, a regression toward the mean will take place. This infers that those assets and their returns are floating around their long-term historical mean, although high variances can be seen

on a short-term. Logically, it is more likely that a period of a below-average return will be followed by a period of above-average return.

- Through diversification by holding multiple single financial assets (that are non-correlated in the best case), more than half of the return fluctuations of assets can be eliminated without simultaneously losing percentage points on the expected return. Diversification consequently helps to optimize the portfolio regarding the return-risk-relationship without facing any disadvantages in the expected return.
- Overall, the most important influencing factors on risk and net return are
    a) the asset allocation, i.e. the classification and split of the portfolio into different asset classes (stocks, bonds, commodities, real estates, etc.),
    b) any additional expenses, i.e. transaction costs, total expense ratio of the brokerage platform, etc.,
    c) the portfolio's tax burden.

Based on those theoretical aspects, every investor can draw his/her own conclusion how his/her personal investment strategy might look like. However, as shown above, the passive investment strategy shows non-neglectable advantages in comparison towards an actively managed portfolio. As a consequence, the following conclusions can be drawn as general investment principles for passive investment, based on the scientific elaborations of Kommer (2018):

- A private investor should follow the buy-and-hold principle. In practice, this means that assets/ETFs are once bought and hold on long-term. This will limit the above-mentioned transaction costs to a minimum. Also, it helps the portfolio to withstand critical times and consequently to recover sooner. In practice, this would mean that the portfolio, or a part of it, will be liquidated only if the money is really needed, e.g. for a retirement payout or bigger "strategic investments" like buying a house. For consumption purposes, liquidating the portfolio should be avoided to make use of the compound interest effect.
- A private investor should also follow the concept of diversification. Vice versa, stock picking is a counter productive strategy as a focus on single assets or asset groups might result in higher short-term returns due to current trends but is not advisable for a portfolio that should perform well over a long-term period. Consequently, a well-diversified portfolio should be not only spread across sectors and industries, but also across countries and developed/developing markets. This will help to limit the fluctuation of the assets' return while reflecting the markets' average return.
- Market timing should be avoided as well for a private investor. This means, that he/she buys only assets for his/her portfolio, if the he/she expects that the price of the asset is relatively low. Instead, it is rather advisable to buy in constant intervals for a portfolio

increase to use the cost averaging effect to not follow any speculative price development. This maybe might not lead to the most cost-effective way on a short-term perspective but will lead to a long-term benefit.

As mentioned earlier, ETFs per se cannot be set equal to passive investments. They can be also used for active investment strategies to invest in promising sectors, industries or markets. However, those sector or market-specific ETFs should not be solely used to follow a passive investment strategy. Instead, only broad ETFs that cover full markets and regions allow a full diversification across industries and the globe. For this reason, ETFs are an excellent investment vehicle to follow a passive investment strategy as already one single fund can cover most the world's biggest companies across almost 50 countries.

3.5 Risks and Costs

For a private investor, the net return is the key parameter for evaluating his investment portfolio. Therefore, one needs to carefully analyze the asset allocation and fee structure of each investment instruments in order to achieve the maximum gain. Within this context, the asset allocation influences the overall level of risk, based on the portfolio theory explained in the previous section. Fee structures, on the other side, impacts the net return of the portfolio, especially in times of low interest rates as nowadays. (Bourgi, 2017)

Consequently, both risks and costs need to be balanced according to the need of the investor. One part of the risks includes the overall market risk. As mentioned before, ETFs are replicating the development of a specific index, may it be based on region, industry or investment strategy. Thus, the market fluctuations are principal determinants of the ETF development, so if the market shows a specific fluctuation scheme, the ETF also does. This risk might be only soothed by shifting the proportion of asset classes within the investor's portfolio, e.g. from more-risky asset classes towards less-risky ones, considering that this might also influence the overall performance. In addition, ETFs bear the risk of closure. The managers of the ETFs might liquidate the instrument and investors receive their share, deducting taxes, transaction costs and other additional fees. To avoid this risk, a fund should have a reasonable size. As it will be mentioned later, the chosen ETFs have also been selected according to a specific fund size to reduce these costs to a minimum. Nonetheless, this risk can never be fully hedged as it is based on decisions of the issuing ETF company. (ETF database, 2017)

In relation to other funds, ETFs show typically lower expense ratios due to avoiding unnecessary expenses in marketing or sales. Also, the passive investment philosophy plays an important role here as it also decreases transaction costs. Due to the trades via brokers, management costs can be reduced as well because brokerage fees are usually lower than subscription fees of other fund instruments. In direct comparison to mutual funds, ETFs do neither have the pbligation to cash in assets, forcing the mutual fund to sell some assets, resulting in taxation on the capital gains. (ETF database, 2017)

Nonetheless, ETFs also encounter tax risks as any other financial instrument. In general, ETFs seem to be tax efficient, but due to different taxation policies it might depend on a specific case and specific ETF how this effect impact the performance. With regards to German taxation policies on funds, ETFs are taxed as other financial instruments (e.g. dividend paying stocks) or other financial income with a flat-free of 25%. (known as “Abgeltungssteuer”). In addition to this, there is an earnings ceiling of currently 801 Euros, meaning that every cumulative payout that is higher than this sum will be taxed with 25%. Worth to mention is also the circumstance that only the actual payout will be taxed so that “virtual” returns due to increasing prices of the ETFs are not taxed until the asset owner sells the ETF. The underlying value of computing the taxed amount is the difference between buying and selling price. In the case of dividend-paying ETFs, the dividend amount is directly taxed with the flat fee of 25%. (Kommer, 2018)

Furthermore, ETFs involve the risk based on their alignment as the underlying assets are not fully identical to the ones that are reflected in the corresponding index. This risk includes that the weights of the assets within the ETF portfolio may differ from the target to a certain extend. Consequently, the return of an ETF portfolio deviates from the reflected index. Especially with regards to sector or industry specific ETFs, this risk should be taken into consideration as it is not clearly defined which companies belong to a certain group of industry or sector, compared to a market index such as the DAX or S&P 500. Additionally, ETFs might be impacted by allocation change and additional volatility, also known as methodology risk. This term reflects how the investment basket is constructed and how it is being managed, especially with regards to its asset allocation, their weights and possible rebalancing. (Bourgi, 2017)

Holding an ETF portfolio also bears risks for the private investor, known as trading risk. This risk mainly includes fees for maintaining the ETF portfolio, e.g. brokerage commissions, expense ratios and taxes on capital income that the investor needs to pay. Although those risks might be lower compared to other funds, those costs need to be considered as well. Additional management feeds also contribute to those trading risks and should be carefully considered before investing into ETFs on a broker platform. (ETF database, 2017)

Tracking error risk is another type of risk that needs to be considered while analyzing ETFs. The net asset values may slightly deviate from actual trading prices, resulting into potential differences that lead to the deterioration of the cost benefits of ETFs compared to mutual funds. However, the arbitrage mechanism should correct this mispricing phenomenon relatively quickly. In general tracking errors are mostly based on the timing of the dividends, taxation policies as well as fees of the specific fund. Tracking errors show a larger occurrence for physically replicated ETFs rather than for synthetically replicated ETFs. (Bourgi, 2017)

If the investor would like to redeem the assets of the ETF in order to use the generated cash for its purposes, the liquidity and its corresponding risk needs to be considered as well. However, this risk can be neglected for most of the ETFs as it does not contribute substantially towards other risk types explained in this section. In contrast, the counterparty risk might be a serious element to which the investor is exposed. Especially if ETFs use synthetic replication methods, this type of risk is of essential importance. Fortunately, collateral agreements help to hedge against this risk, e.g. for diminishing the risk of swap exposure. As the private investor is directly faced with that kind of risk, he/she needs to be compensated in certain measures. Consequently, swap-based ETFs have usually lower fees and tracking errors compared to its physical replicated counterparts. (Bourgi, 2017)

As a last point to consider, ETFs are currently popular investment instruments, also driven by the bull market conditions of the last years, making it more interesting to invest in a diversified ETF portfolio. This positive trend, however, could be partially explained by a herd behavior of the investors, resulting into a so-called hype risk. That is why investors need to ensure that their investment behavior does not follow a certain trend but builds up on a long-term strategy. Due to its highly increasing demand during the last decade, intensified market regulations might be an additional risk for investors, although this effect cannot be evaluated yet. While the popularity of ETFs as investment vehicles is still on the rise, investors also need to be educated to which extent ETFs can be used to reflect the investor's individual investment strategy. This aspect has been also described in the beforementioned section with regards to a passive investment philosophy and its underlying assumptions. (ETF database, 2017)

Overall, the above-mentioned aspects should be considered by every private investor while choosing the ETFs for building up a portfolio. Some risks and costs have a stronger impact on portfolio performance than somer others, especially running costs like transaction and brokerage fees, and some are describing rather general issues of ETFs as investment instruments, such as the tracking error risk.

4 Data

This section covers the data that is being used in this research – explaining the sample of sustainable ETFs that has been analyzed as well as its corresponding, 'conventional, unsustainable pendants. Furthermore, it will be also explained how the data has been collected and how the matching process has taken place. As the last step in this section, descriptive statistics and correlations help to understand the relationship among the chosen datasets.

4.1 Data Collection Process

Since the topic of sustainable investment with ETFs is relatively new, the data collection process has been also challenging. The biggest challenge in this case was to find enough historical data so that sustainable and conventional ETF pairs could be compared based on their historical performance. Next to the availability of historical data, additional criteria needed to be fulfilled in order to create a realistic outcome by decreasing specific risks explained in the preceding sections, especially with regards to the fund size. Throughout this filtering process, only a handful of ETFs can be considered for this research. However, this increases the explanatory power as the selected instruments are chosen based on a systematical approach.

Since the research is focused on private investors that are based in Germany, only ETFs will are taken into consideration that are traded on retail broker platforms available in Germany. Furthermore, only ETFs that can be bought on the German Exchange Traded Funds market (mostly Xetra in Frankfurt) are included due to the following reasons:

- It has a practical relevance for German private investors since they might apply the findings of this research in their investment practice.
- It simplifies the comparability of the results between the sustainable ETF portfolio and the conventional ETF portfolio as both can be constructed under real conditions of searching the appropriate ETF for the investor's portfolio.
- The available ETFs on the German market are most likely also available on other European and International Market leading to the fact that it will not have an influence on the practical relevance of the thesis.

- It furthermore eases the data collection process for the author of this master thesis as he has German citizenship.

On the biggest European information platform for ETFs, www.justetf.com, one can find all ETFs that are traded Germany. The research will only focus on equity ETFs as other categories such as ETFs in bonds or commodities cannot be easily assessed in the context of a sustainable framework due to missing existence of those funds. With regards to socially responsible ETFs, 82 different ETFs are currently traded. (justETF, 2019d) However, not all of those 82 ETFs will be analyzed. Instead, they will be sorted after certain criteria explained above. Based on this selection of suitable sustainable ETFs, the corresponding conventional ETFs will be used to compare the overall performance with respect to the explained methodology below.

For finding the matching conventional ETFs, the data collection process has been smoother as those instruments have been longer on the market and have already reached a sufficient fund size. Furthermore, the conventional ETFs also share the same criteria as their sustainable counterparts with regards to the issuing institution, their fund domicile, replication method and whether they are dividend-paying or accumulating. However, for some it was not possible to find an exact match, especially concerning the issuing institution. For those exceptions, alternatives have been used that otherwise almost share the same characteristics. This is important to mention as different companies use different ESG criteria and schemes to filter the included companies in the ETF.

The platform justETF is good in order to get an overall insight about the available ETFs in the German market, especially in the field of sustainable instruments. However, they do not deliver enough historical data. For this reason, Datastream has been used as it contains reliable and complete historical data for the chosen instruments. As a second source of information, the factor data for performing the analysis with different factor models has been used, based on the research of Fama & French. They have published the relevant data on their website, so that the daily data set just needs to get converted into weekly data. (French, 2019a)

As the data has been accessed and extracted in the early stage of this report, updates might have happened on the respected data sources. Nonetheless this research focus on the retrieved dataset based on the beginning of March 2019.

4.2 Selection of Sustainable ETFs

As mentioned above, only t hose ETFs that fulfill certain criteria in terms of traded volume, availability of historical data and the possibility to diversify the investor's portfolio in an optimal way will be considered. Consequently, the below-mentioned filter criteria have been applied to limit the number of sustainable ETFs to be analyzed:

- The fund size should not be below 100 million Euros since there might be liquidity problems as well as the chance that smaller funds might be merged together to reach a critical size.
- The ETFs should be at least five years on the market so that enough data is available for proper analysis. This criterion will be true for all chosen ETFs, but the availability of the data has faced several challenges for the author of the research.
- The ETF itself should be "broad" enough to not only reflect a certain industry or small country index (with respect to market capitalization), but also to include different sectors and regions as the aim of the investor is to diversify the portfolio as widely as possible. Thus, certain sustainable sector ETFs have been discarded as they only might reflect a small economic area or only focus on a specific industrial sector.

Following this process, it has turned out that not many of the existing 69 sustainable ETFs fulfill those requirements. In fact, only eight sustainable ETFs could be found that will be further taken into consideration. Those ETFs are the ones listed below.

1. MSCI World Socially Responsible from UBS:

This index fund is designed to measure global equity market performance considering only companies with high Environmental, Social and Governance (ESG) ratings relative to their sector peers, to ensure the inclusion of the best-of-class companies from an ESG perspective. It invests in 23 developed countries, while the US has the biggest proportion with almost 60% of the weight in the index due to its companies with high market capitalization. (UBS, 2019a)

2. MSCI USA Socially Responsible from UBS:

Like the MSCI World Socially Responsible index, it only includes companies that with high Environmental, Social and Governance (ESG) ratings relative to their sector peers. As the name suggests, the index only contains US American companies. (UBS, 2019b)

3. MSCI EMU Socially Responsible from UBS:

This ETF aims to replicate the price and return performance of the MSCI EMU Socially Responsible 5% Issuer Capped Index, including only companies with the highest ESG rating

relative to their sector peers, but do not have a higher weighting than 5% within the whole index. (UBS, 2019c)

4. MSCI Europe Socially Responsible from iShares:

The fund seeks to track the performance of an index composed of the European companies which are leaders in the sustainability field based on the ratings of MSCI for ESG criteria. The fund invests in 118 companies across different industries in Europe, where France, Germany, the UK as well as Switzerland have a dominant position in the ranking. (iShares, 2019a)

5. Dow Jones Eurozone Sustainability Screened from iShares:

This index, excluding Alcohol, Tobacco, Gambling, Armaments & Firearms and Adult Entertainment businesses, covers the top 20% of the largest Eurozone sustainability companies of the Dow Jones Global Total Stock Market Index. The selected companies are based on long term economic, environmental and social development of their business. (iShares, 2019b)

6. Dow Jones Global Sustainability Screened from iShares:

Likewise, the Dow Jones Global Sustainability Screened excludes Alcohol, Tobacco, Gambling, Armaments & Firearms and Adult Entertainment businesses. The index consists of the global top 20% of the largest 2500 sustainable companies based on the Dow Jones Global Total Stock Market Index. The selection criteria are also based on the long term economic, environmental and social development of their business. (iShares, 2019c)

7. MSCI Pacific Socially Responsible from UBS:

As the other sustainable ETFs before, the fund only includes companies with high Environmental, Social and Governance (ESG) ratings relative to their sector peers. The index has very strong country exposure to Japan with almost 63%, similar to the country exposure of the United States for the MSCI World index. (UBS, 2019d)

8. Think Sustainable World:

Unlike the other indexes that are either based on MSCI or Dow Jones, this ETF is based on the German-based index provider Solactive. The fund covers 250 sustainable companies across developed countries with all companies being equally weighted. (Think ETFs, 2019)

To summarize the most important quantitative facts about the chosen ETFs, the following table structures the most relevant information in a compact manner.

Table 3: Overview about chosen sustainable ETFs

ID	ETF Name	ISIN	Issuing Institution	Launch Date	Fond Volume (MEUR)	TER (% p.a.)	Domicile	Replication Method	Distribution Policy
1S	MSCI World Socially Responsible	LU0629459743	UBS	19.08.2011	957	0,25	Luxembourg	Physical, full replication	Distributing, semi-annually
2S	MSCI USA Socially Responsible	LU0629460089	UBS	18.08.2011	831	0,33	Luxembourg	Physical, full replication	Distributing, semi-annually
3S	MSCI EMU Socially Responsible	LU0629460675	UBS	18.08.2011	705	0,28	Luxembourg	Physical, full replication	Distributing, semi-annually
4S	MSCI Europe Socially Responsible	IE00B52VJ196	iShares	25.02.2011	683	0,30	Ireland	Physical, opt. sampling	Accumulating
5S	Dow Jones Eurozone Sustainability Screened	DE000A0F5UG3	iShares	27.03.2006	201	0,42	Germany	Physical, full replication	Distributing, annually
6S	Dow Jones Global Sustainability Screened	IE00B57X3V84	iShares	25.02.2011	193	0,60	Ireland	Physical, opt. sampling	Accumulating
7S	MSCI Pacific Socially Responsible	LU0629460832	UBS	22.08.2011	242	0,40	Luxembourg	Physical, full replication	Distributing, semi-annually
8S	Think Sustainable World	NL0010408704	VanEck	13.05.2013	295	0,30	Netherlands	Physical, full replication	Distributing, quarterly

4.3 Compatible Conventional ETFs

Analogously to the above-mentioned process, conventional and non-sustainable ETFs have been searched to find compatible counterparts that share the same characteristics. However, this process of finding matching ETFs has remained uncomplicated as such ETFs have already been longer on the market, thus reaching an adequate fund size as well as well as having enough historical data to be analyzed.

Following the same structure as in the previous chapter, the below-listed ETFs have been chosen as equivalents to their sustainable counterparts. Furthermore, the most relevant information is summarized in a table for a better understanding of the chosen ETFs and comparability with its sustainable peers.

1. **MSCI World from UBS:**

This instrument is a free float market capitalization index designed to measure the performance of the stock markets of industrialized countries worldwide. The market value of the index stocks is determined based on the free float principle. In addition, the size and liquidity of the securities as well as their minimum free float are examined. The index includes companies across industrialized countries (i.e. USA as biggest share with over 60%l Japan and UK, among others) that are open to investors around the world. (UBS, 2019e)

2. MSCI USA from iShares:

This index covers the biggest country with regards to its market capitalization – USA. It invests in all major assets that are available on this market, with IT and health companies leading the shares of the total index portfolio. Thus, with this ETF, private investors are also directly invested into the “hyped” FAANG companies (Facebook, Apple, Amazon, Netflix, Google) and can benefit from their current market evaluation. (iShares, 2019d)

3. MSCI EMU from UBS:

The EMU (European Economic and Monetary Union) Index comprises a selection of large caps and mid-caps from ten industrialized countries of the EMU. The 245 index constituents cover around 85% of the market capitalization on a free-float basis of EMU. (UBS, 2019f)

4. MSCI Europe from iShares:

The Fund aims to track the performance of an index made up of companies from industrialized countries in Europe. Its biggest share is invested in the financial sector, followed by non-cyclical consumer goods industrial companies and the health sector. Consequently, the top companies in which are invested are Nestle, Novartis and Roche and HSBC. (iShares, 2019e)

5. MSCI Europe ex UK from iShares:

The Fund aims to track the performance of an index consisting of companies from industrialized countries in Europe, excluding the United Kingdom. The other preliminaries are the same as the instrument before. (iShares, 2019f)

6. MSCI World from iShares:

The Fund aims to track the performance of an index made up of companies from industrialized countries. It is the biggest index on industrialized countries, covering over 20 countries across America, Europe and Asia/Pacific. Since over 60% are covered by the USA as biggest country, it also holds the same valuable assets as the MSCI USA, plus additional major shares across the other countries. (iShares, 2019g)

7. MSCI Pacific from ComStage:

The index is based on free float market capitalization weighted index that reflects the performance of the developed equity markets in the Pacific region on a basis of the total return with a value of reinvested net dividends. The net dividends reinvested in Index reinvested net dividends correspond to the respective gross dividends less a notional dividend of withholding tax. Currently, the maximum withholding tax rate is withholding tax rate application, the foreign tax rate domiciled institutional investors who are exposed to the not from a double tax treaty benefit. (ComStage, 2019)

8. Think Global Equity from VanEck:

The Solactive Global Equity Index provides access to 250 global companies. Unlike in other indexes, all companies in the index are equally weighted. Furthermore, the regions North America, Europe and Asia are limited to a maximum weight of 40%. (justETF, 2019e)

Table 4: Overview about chosen conventional ETFs

ID	ETF Name	ISIN	Issuing Institute	Launch Date	Fond Volume (MEUR)	TER (% p.a.)	Domicile	Replication Method	Distribution Policy
1C	MSCI World	LU0340285161	UBS	25.06.2008	964	0,30	Luxembourg	Physical, full replication	Distributing, semi-annually
2C	MSCI USA	IE00B52SFT06	iShares	12.01.2010	463	0,33	Ireland	Physical, full replication	Accumulating
3C	MSCI EMU	LU0147308422	UBS	19.09.2002	1 959	0,18	Luxembourg	Physical, full replication	Distributing, semi-annually
4C	MSCI Europe	IE00B1YZSC51	iShares	06.07.2007	4 467	0,12	Ireland	Physical, optimized sampling	Distributing, quarterly
5C	MSCI Europe ex-UK	IE00B14X4N27	iShares	02.06.2006	1 794	0,40	Ireland	Physical, optimized sampling	Distributing, quarterly
6C	MSCI World	IE00B4L5Y983	iShares	25.09.2009	13 562	0,20	Ireland	Physical, optimized sampling	Accumulating
7C	MSCI Pacific	LU0392495023	ComStage	05.12.2008	243	0,45	Luxembourg	Synthetic (Unfunded swap)	Distributing, annually
8C	Think Global Equity	NL0009690221	VanEck	14.04.2011	890	0,20	Netherlands	Physical, full replication	Distributing, quarterly

4.4 Descriptive Statistics and Correlations

This chapter will analyze basic statistical characteristics of the used data, especially with regards to descriptive statistics and correlation. At first, the chapter will concentrate on the descriptive statistics of both sustainable and conventional ETFs, before analyzing the correlations of sustainable and conventional ETFs with each other.

The following two tables summarize the descriptive statistics, one each for the chosen sustainable ETFs and one for the conventional counterparts. In the tables, the average return as well as the standard deviations are compared with each other, as well as the number of observations. However, the number of observations is constantly at 260 as we have considered five years as an observation time frame, equaling to 260 weekly data points.

The weekly return is simply calculated based on those 260 observations, based on the following formula:

$$Weekly\ Return = \frac{(Return_{t-1} - Return_{t})}{Return_{t-1}}$$

After that, the average return across the whole time frame will be used in order to calculate the annualized average return with the help of the following formula:

$$Annualized\ Return = (1 + R)^{n} - 1$$

Important to mention is that it would be wrong to take N = 260 since the aim is to find the annualized return, and not the 5-year cumulated return. Thus, n = 52 and will deliver the below-stated results.

With regards to annualized standard deviation, the following formula has been applied:

$$Annualized\ Standard\ Deviation = Return_{n} \times \sqrt{n}$$

Since in our example n = 52 due to the weekly return data, the weekly return is considered and is being multiplied by the square root of 52. The results are also stated in the below-mentioned tables.

As a following step, one can now analyze the performance of each ETF pair to compare their general development throughout the observed timeframe.

Table 5: Descriptive Statistics of Conventional ETFs

		Average Return	Standard Deviation	Observations (N)
1	**UBS MSCI WORLD**	10,00%	14,15%	260
2	**iShares MSCI USA**	16,30%	14,22%	260
3	**UBS MSCI EMU**	4,13%	15,93%	260
4	**iShares MSCI Europe**	3,52%	14,77%	260
5	**iShares MSCI Europe ex UK**	4,51%	14,84%	260
6	**iShares MSCI World**	12,39%	13,87%	260
7	**Comstage MSCI Pacific**	8,52%	16,04%	260
8	**Think Global**	7,78%	14,28%	260

Table 6: Descriptive Statistics of Sustainable ETFs

		Average Return	Standard Deviation	Observations (N)
1	**UBS MSCI World SRI**	11,68%	13,60%	260
2	**UBS MSCI USA SRI**	14,20%	14,03%	260
3	**UBS MSCI EMU SRI**	10,15%	14,74%	260
4	**iShares MSCI Europe SRI**	6,57%	14,67%	260
5	**iShares Dow Jones Eurozone Sustainability Screened**	6,97%	16,36%	260
6	**iShares Dow Jones Global Sustainability Screened**	10,40%	14,04%	260
7	**UBS MSCI Pacific SRI**	9,44%	16,20%	260
8	**Think Sustainable World**	11,00%	14,67%	260

As the focus on this research is on the performance comparison of sustainable ETFs in comparison to their conventional peers, the analysis will also stress this point out. As it can be seen in the tables, the sustainable ETFs have a better average return over the respected timeframe than their conventional counterparts. Only in case of the MSCI USA index, the performance of the sustainable ETF differs with 210 basis points. What can be also seen is the fact that the European-focused ETFs show the worst performance across the regionally dispersed and diversified ETFs, but also in this case the sustainable ETFs outperform their conventional counterparts. However, the standard deviation as a degree of dispersion is higher in half of the cases, while the other half is mostly on the same level as the corresponding conventional ETF. This is also evident due to the circumstance that the sustainable ETFs exclude companies that do not fulfill the criteria of being sustainable and responsible. Thus, they have a smaller size that might also lead to less diversification, resulting in a higher fluctuation over time. Noteworthy to mention is, however, the fact that the difference between those sustainable ETFs with a higher standard deviation than their conventional peers is relatively low.

As a second part, the correlation between the ETFs is interesting to look on. The below tables summarize the correlations of each sustainable and conventional ETFs. Obviously, both tables have high correlation values ranging from 1,00 to 0,77 that is lying in a rather high correlation relationship. In both cases, the conventional and sustainable correlation tables show the same relationship between the ETFs so that bigger differences cannot be seen. The high correlation in both cases does make sense in a logical way as the chosen ETFs only consider developed countries as data from developing countries was not enough to be included in the analysis. Thus, they share the same economic background with a similar economic development, although they are geographically spread. Furthermore, the selection also includes similar ETFs, such as the MSCI World from iShares and UBS or the MSCI EMU/Europe from UBS and iShares. Thus, they naturally have the same development and a strong interconnection with each other. In addition, the USA has a predominant position in those ETFs, being either directly reflected in the MSCI USA ETF or indirectly through other ETFs such as the MSCI World where USA has a share of 60%, or also through strong economic ties with the USA.

Table 7: Correlation Table of Conventional ETFs

		1	2	3	4	5	6	7	8
1	**UBS MSCI WORLD**	1,00							
2	**iShares MSCI USA**	0,97	1,00						
3	**UBS MSCI EMU**	0,86	0,77	1,00					
4	**iShares MSCI Europe**	0,89	0,82	0,96	1,00				
5	**iShares MSCI Europe ex UK**	0,87	0,80	0,97	0,98	1,00			
6	**iShares MSCI World**	0,98	0,98	0,87	0,91	0,89	1,00		
7	**Comstage MSCI Pacific**	0,88	0,83	0,79	0,83	0,81	0,90	1,00	
8	**Think Global**	0,96	0,93	0,90	0,94	0,93	0,98	0,90	1,00

Table 8: Correlation Table of Sustainable ETFs

		1	2	3	4	5	6	7	8
1	**UBS MSCI World SRI**	1,00							
2	**UBS MSCI USA SRI**	0,97	1,00						
3	**UBS MSCI EMU SRI**	0,90	0,79	1,00					
4	**iShares MSCI Europe SRI**	0,91	0,81	0,97	1,00				
5	**iShares Dow Jones Eurozone Sustainability Screened**	0,85	0,76	0,94	0,95	1,00			
6	**iShares Dow Jones Global Sustainability Screened**	0,98	0,94	0,91	0,93	0,89	1s,00		
7	**UBS MSCI Pacific SRI**	0,90	0,82	0,82	0,82	0,76	0,89	1,00	
8	**Think Sustainable World**	0,97	0,93	0,91	0,92	0,89	0,98	0,89	1,00

4.5 Survivorship Bias

While evaluating the performance of both sustainable and conventional ETFs, it is essential to mention the effect of survivorship bias. This bias occurs when certain funds are getting liquidated or being merged due to a weak performance. Thus, all remaining funds in an observed spectrum show a biased result with regards to their returns. It might consequently affect the overall result of the study by being potentially skewed and distort the persistence of performance. (Carpenter & Lynch, 1998)

In recent elaborations, the survivorship bias has gained more attention and it has been considered in the data collection process by trying to exclude this effect. However, not all databases allow to adjust for this factor. This phenomenon is usually connected to an active investment style as well as to mutual funds since they investment manager tries to “beat”, i.e. outperform, the considered benchmark, also often referred to the overall market. ETFs or Index Funds, in contrast, usually follow a different, passive strategy so that those instruments are theoretically less influenced to survivorship bias. Nonetheless index funds and ETFs, especially sustainable-themed ETFs, are subject to the bias as those instruments are published in the German investor market recently. Thus, most of them do not have reached a certain level of fund size so that ETF providers might liquidate or merge some of them to ensure a lower cost level for managing those funds. (Elton, et al., 1996)

Therefore, survivorship bias-free were not available for this research and consequently are prone to this phenomenon. As mentioned above, however, this effect can be more seen to newly established indices such as the sustainable-themed ones compared to their conventional counterparts as those exist already a longer period on the market with a substantial fund size, providing a better cost-performance ratio to its providers than niche and newly issued investment products. Nonetheless one cannot deny that the conventional ETFs used in this research might be also exposed to the survivorship bias effect than their sustainable peers.

5 Methodology

5.1 Methodology

Before going into more detail about the actual outcome of the thesis, the methodology needs to be explained first in order to understand the underlying research design. The methodology is the theoretical fundament for applying it on the collected data in order to achieve scientifically profound results. The theoretical background above delivers insights about non-financial parameters that influence the performance of ETF investments concerning the topic of sustainability. This non-financial element might positively or negatively affect the performance, i.e. the return of a constructed portfolio. However, if sustainable-themed ETFs did not generate a similar return as their conventional counterparts or add any substantial value for the private investor, they would lose in attractivity and would not continue to grow exponentially.

Based on the status quo of current research, it is unable to provide substantial evidence on the distinctive performance of sustainable investments, may it be in favor for the investor or vice versa. This is especially true for Exchange Traded funds as sustainable ETFs are relatively new on the market, additionally having practical benefits for private investors that might also show a potential difference to other investment instruments such as mutual funds. Furthermore, the chosen sustainable ETFs are not limited to a certain sector or industry but use the best-in-class approach so that the performance cannot be derived from a sustainability-trending advantage only. However, due to the recent trend in investing in sustainable topics and related financial instruments, the research hypothesis is driven by the idea that they outperform their conventional counterparts.

For finding a proper answer to this research hypothesis, the thesis follows a quantitative approach. It is done by examining the performance of sustainable ETFs in comparison to their conventional peers. The methodology is based on theoretical profound models that are widely used and accepted in financial theory as it has been used in previous research studies as well. To round up the methodology, supplementary measurements for assessing the performance will be applied.

With regards to the proceeding, the sustainable ETFs that withstand the minimum criteria for this research have been chosen and being matched with conventional ETF instruments that cover the same scope of investment in terms of geography and/or industry. Based on those chosen instruments, the performance measurement techniques can be applied in order to

make a comparison between both sample groups. Those mentioned performance measurement techniques have been already introduced in the previous chapter and will be based on the same structure as above. To start with, the evaluation includes the one-factor model of the CAPM, followed by multi-dimensional models for collecting encompassing insights while acknowledging for the most prominent parameters that affect the overall return. Those multi-dimension models will firstly include the three-factor model of Fama-French as well as the Carhart four-factor model. Although the additional five-factor model of Fama-French has overlaps with their three-factor model, it will be still introduced and used as a basis to gain further understanding of the performance. For all models, the alpha and the Sharpe ratio will be taken into consideration as a more profound decision basis. Moreover, the underlying models and variables will be explained in the next chapter.

5.2 Econometric Models

Overall, this thesis applies linear regression models to compare the performance of conventional and sustainable exchange traded funds. The mentioned models have been chosen based on previous research as they have been applied across different studies and are consequently prominent and well-proofed instruments for performance measurement. In all models, the factor time, represented as T, will play an important role. In this research $T = 260$ as the observed time period is five years, reflecting 260 weeks to examine.

The Capital Asset Pricing Method is most probably the most fundamental model to evaluate the relationship between risk and return. The model has been introduced by individual researchers, i.e. Sharpe (1964), Lintner (1965) and Mossin (1966), who all have based their findings on Markowitz's (1952) Portfolio Theory. The main discovery of the model is that investors are not only rewarded by owning an asset over a certain time period, but they are also rewarded by the asset's riskiness. Thus, if risks are compensated accordingly, it makes sense to bear them. Otherwise, investors would avoid them as they do not add any value. With regards to the CAPM formula, the mentioned time value of money is represented by the risk-free rate and the asset's riskiness is denoted by its beta value as a measurement of systematic risk compared to the general market risk. The risk premium is consequently calculated as the product of beta and the market risk premium, representing the market return in excess of the risk-free rate. Consequently, the risk-return-relationship under the CAPM can be written as the following equation:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

where R_i is the return of the portfolio in excess of the risk-free rate at time t, the intercept α_i reflects the alpha, representing the risk-adjusted abnormal return. β_i is being interpreted as the systematic (market) risk that cannot be eliminated through any diversification, R_M reflects the related market return, R_f is the risk-free rate. $\left(R_{M,} - R_f\right)$ as a subtraction term can be interpreted as the excess market return of the risk-free rate. Finally, ε_i represents the error term covering the idiosyncratic return factor.

This model is still used as a comprehensive performance measurement instrument as it can be applied to different cases. However, the model does not withstand all empirical testing. For example, it assumes that the investment period for all investors is almost similar, and also that those investors aim for mean-variance optimal portfolios. Furthermore, the model does neither consider any transaction costs nor taxes; it assumes that borrowing, and lending can be done at the risk-free interest rate and that all risky assets are traded publicly.

Nonetheless, the CAPM reflects asset prices with respect to their underlying risk so that it provides crucial help for investment decisions. It also may be used to reflect prices of assets that are yet not traded to evaluate their expected returns. (Bodie, et al., 2011)

As the CAPM is a relatively simple model that only covers one explanatory factor, further attempts have been made to capture other factors, especially company-specific ones, to estimate the sensitivity towards systematic risk. The Fama-French (1993) three-factor model is one of the most recognized and widely used methods. In their model, they have not neglected the assumptions of CAPM, but have extended the model with two additional factors of which both have shown a substantial explanatory power on stock return as well as on risk premium estimates.

With regards to the Fama-French 3-factor model, the single-factor CAPM is extended by additional variables:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_1 \left(R_{M,t} - R_{f,t}\right) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

In this equation, β_2 and β_3 are factor-mimicking portfolios for size (SML) and value (HML), respectively. To recap, SML stands for small minus low, calculated as the delta of returns between a small stock and a large stock portfolio. Thus, it represents the effect the excess returns of small cap portfolios compared to large cap portfolios. Furthermore, HML stands for high minus low, reflecting the excess return of a value stock portfolio (i.e. a portfolio that consists of stocks with high book-to-market ratio) and a growth-stock portfolio (i.e. a portfolio that consists of stocks with low book-to-market ratio).

Within the Frama-French three-factor model, the first factor represents systematic risks from macroeconomic circumstances, whereas the additional two factors, SMB and HML, should be seen as estimations for further variation in the model. Thus, those two factors are not risk factors per se, but can be used as approximations for macroeconomic risk sensitivity.

As a third model, the Carhart (1997) four-factor model (also known as the Fama-French-Carhart-model or FFC) has been developed by expanding the already existing 3-factor model from Fama and French by an additional fourth factor to include the one-year momentum effect. The momentum was found by Jegadeesh and Titman (1993) who proofed that the recent past return of a stock (from 3 to 12 months) tends to continue for the months. Thus, higher returns will follow higher returns. Especially with regards to the short-term returns, neither the CAPM nor the three-factor model explain this phenomenon. In addition, the three-factor model is unable to capture the momentum effect. Consequently, the corresponding equation for the Carhart four-factor model looks as follows:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_1 \left(R_{M,t} - R_{f,t}\right) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WML_t + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

where β_2 and β_3 again represent factor loadings for the aforementioned variables SML and HML, and β_4 represents the loading on the one-year momentum anomaly. To put it in other words, the Momentum factor includes the phenomena that higher returns will follow higher returns and vice versa for lower returns for an observed time frame of 12 months. It represents the average return on the two high prior return portfolios minus the average return on the two low prior return portfolios,

Carhart (1997) concludes that the sensitivity towards momentum is the main factor that explains the risk-adjusted abnormal returns of mutual funds. Until its introduction of the model,

it has been commonly used in various empirical research on return performance. (Bodie, et al., 2011)

As an extension of the above explained model, the Fama-French five-factor model was published in 2015. It extended the 3-factor model by two additional company-specific factors with regards to profitability and investments. By adding those two factors, Fama and French revealed in their empirical studies that the new model outperforms the older one. However, they also found out that the value factor becomes redundant while adding the two new factors. (Fama & French, 2015), represented in the following equation:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_1 \left(R_{M,t} - R_{f,t}\right) + \beta_2 SMB_t + \beta_3 HML_t + \beta_5 RMW_t + \beta_6 CMA_t + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

The two factors additional to the three-factor model are used to increase the level of influencing factors on the performance. While the used variables in the three-factor model represent the same economic patterns, β_5 represents the factor loading for RMW. This term stands for robust minus weak, representing the return difference between the stocks of robust and weak profitability. β_6, as an additional factor loading, is used for the variable CMA, standing for conservative minus aggressive, and represents the return difference between the stocks of conservatively to aggressively investing firms.

For additional purposes, the Jensen measure, also known as Jensen's alpha, will be used for the analysis. It refers to the alpha of an investment, which represents the measurement of the investment's risk-adjusted abnormal return. To be more exact, it is the average that exceeds the return predicted by the pricing model. The measure has been introduced by Michael C. Jensen (1967) during his research on mutual fund performance. As mentioned earlier, the CAPM takes the riskiness of an asset into account and concludes that higher risks imply higher returns. If the return of an investment is higher than the actual model suggests, the investment has generated an abnormal return, resulting into a positive alpha. Originally, Jensen introduced this measure to evaluate the performance of portfolio managers; however it is still widely used as a general performance indicator of portfolio investments. (Bodie, et al., 2011)

The mathematical formulation of the Jensen Alpha can be described as follows:

$$\alpha_p = \bar{R}_p + \beta_p(\bar{R}_m - \bar{R}_f)$$

Another widely used measure is the Sharpe ratio that represents an alternative to risk-adjusted performance measurement. Unlike the Jensen alpha, the Sharpe ratio measures the excess return in relation to the total risk, measured by the standard deviation of the returns. To

rephrase it, the Sharpe ratio reflects the reward-to-risk-ratio. (Sharpe, 1994) (Bodie, et al., 2011)

The Sharpe ratio can be mathematically expressed as the following term:

$$SR_p = \frac{(\bar{R}_p - \bar{R}_f)}{\sigma_p}$$

Both the Jensen alpha and Sharpe ratio are measures that are typically applied to analyze the performance of an investment or portfolio. In practice, both are used to create performance rankings as it is also done in this research.

5.3 Variables

After describing and introducing the underlying econometric models, it is furthermore important to understand the used variables in those models. To start with, the dependent variable(s) are being examined. Afterwards, the more complex part of explanatory or independent variables will examined. This is especially essential as the variables mentioned in the previous chapter have been already used in the econometric models, but not explained how they get constructed.

At first, the dependent variable in the models represent the ETF return, $R_{i,t}$. This variable is based on the excess return of the risk-free return $R_{f,t}$, The risk-free return has been taken from the Fama-French database, where the other variables are also from. The risk-free rate is based on the weekly U.S. Treasury bill yields. Although the research examines ETFs across the globe as well as the fact that T-bills are no longer sincerely risk-free, this treasury rate is widely accepted as good proxy as it covers the biggest and most important financial market with regards to its market capitalization. The adjusted closing prices are used in order to determine the returns for further calculation, additionally ensuring that potential effect such as dividend payments are considered.

As a second part, different explanatory variables are used across the applied models. The market premium, denoted as R_M, is used in all models, reflecting the excess market return of the risk-free rate. In addition, further risk factors have been added to better understand the returns' sensitivity on certain market parameters within the models. With regards to the three-factor model, size and value factors have been added, while the four-factor model includes a momentum factor and the five-factor model incorporates for an additional profitability and

investment factor. All those factors have been extracted from the Fama-French database on a weekly basis in US Dollars, based on the research by Fama and French (1993) & (2015) and Carhart (1997)

Depending on the ETF and its regional dispersion, different market returns have been applied to reflect the different developments in different markets. For example, the North American dataset from Fama and French has been applied on the relevant ETFs that cover the North American markets. Likewise, the Europe-covering ETFs have been used with the Fama and Frech dataset for Europe. In case there could not be found a direct match between the ETF region and the Fama and French dataset, the global datset has been used.

While different market factors have been used as proxies for the returns of the corresponding markets, some circumstances need to be considered. At first, the coverage of the ETF with regards to their geographic dispersion might not match with the geographical span of the underlying market return factor. Furthermore, the considered ETFs might have a different weighting with regards to their investments into countries or industries, resulting into a country- or industry-bias, resulting into an influence on the overall performance. Both issues show that in theory they cover the same geographical area, but in practice some smaller differences might lead to a biased results. However, testing for those biases is not part of the thesis and will be therefore not considered any further.

Regarding the size factor, it is measured based on the market capitalization of the considered companies by multiplying the respective share price by the numbers of shares outstanding. The value factor, in contrast, refers to the book-to-market equity, reflected as the ratio between company's book value of stocks and the market value of those stocks. (Fama & French, 1993) Concerning their mathematical composition, those size and value factors, stated in the three- and four-factor model as SML and HML, are constructed in the following way (French, 2019b):

$$\text{“}SMB = 1/3\,(Small\,Value + Small\,Neutral + Small\,Growth) - 1/3\,(Big\,Value + Big\,Neutral + Big\,Growth)\text{”}$$

and

$$\text{“}HML = \frac{1}{2}\,(Small\,Value + Big\,Value) - \frac{1}{2}\,(Small\,Growth + Big\,Growth).$$

To interpret this, those factors consists out of weighted returns of either small/big or value/growth portfolios, summarizing to six portfolios for size and four portfolios for value.

Based on the assumptions of Fama and French (1993), the size factors should negatively correlate with the return as companies with a bigger market capitalization tend to have a lower historical performance than companies with smaller market capitalization. The value factor, in opposition, should have a positive relationship with regards to their return as value companies have a higher historical average return than growth companies.

In addition to the size and value factor, the five-factor model incorporates the profitability and investment factor, composed in the following way (French, 2019b):

$$"RMW = \frac{1}{2}(Small\ Robust + Big\ Robust) - \frac{1}{2}(Small\ Weak + Big\ Weak)"$$

and

$$"CMA = \frac{1}{2}(Small\ Conservative + Big\ Conservative) - \frac{1}{2}(Small\ Aggressive + Big\ Aggressive)"$$

The RMW, robust minus weak, is calculated as the average return on the two robust portfolios minus the average return on the two weak portfolios. The CMA, conservative minus aggressive, is calculated as the average return on the two conservative portfolios minus the average return of the two aggressive portfolios. Thus, companies with high operating profit have a superior performance, resulting into a positive factor effect, whereas for companies with high total asset growth, the factor effect will be negative due to their inferior performance.

Moreover, the five-factor model includes the following relationship for the size-factor:

$$"SMB = \frac{1}{3}(SMB_{(B2M)} + SMB_{(OP)} + SMB_{(INV)})"$$

Where the three terms for book to market (B2M), operating profitability (OP) and investments (INV) can be further drilled down into:

$$"SMB_{(B2M)} = \frac{1}{3}(Small\ Value + Small\ Neutral + Small\ Growth) - \frac{1}{3}(Big\ Value + Big\ Neutral + Big\ Growth)"$$

$$"SMB_{(OP)} = \frac{1}{3}(Small\ Robust + Small\ Neutral + Small\ Weak) - \frac{1}{3}(Big\ Robust + Big\ Neutral + Big\ Weak$$

$$"SMB_{(INV)} = \frac{1}{3}(Small\ Conservative + Small\ Neutral + Small\ Agressive) - \frac{1}{3}(Big\ Conservative + Big\ Neutral + Big\ Agressive$$

(French, 2019b)

To summarize those equations, the size portfolio consists out of the average return from nine small stock portfolios minus the average return of the nine big stock portfolios.

As the last part, the one-year momentum factor is put together based on the past 11-month returns lagged one month; the highest 30% returns minus the lowest 30% returns while using equal weights. (French, 2019b). Consequently, the portfolio using the momentum factor MOM can be reflected in the following mathematical term:

$$"WML = \frac{1}{2}(Small\ High + Big\ High) - \frac{1}{2}(Small\ Low + Big\ Low)"$$

(French, 2019b) Based on the studies of Carhart (1997), the momentum factor should correlate positively with the overall portfolio return.

5.4 Model Diagnostics

Before coming to the analysis of the results, the econometric models need be checked whether they fulfill certain criteria in order to ensure scientifically profound conclusions. Brooks (2002) has specified five assumptions to check the correctness of the models and to avoid biased or inaccurate results. Those assumptions will be introduced and applied on the observed data set to conclude about the usefulness of the constructed models.

Based on the already introduced research hypothesis, it is possible to formulate it as a statistical hypothesis that must be further elaborated based on the subchapters below:

H0: The alpha is zero, $\alpha = 0$

H1: The alpha is not zero: $\alpha \neq 0$

The technique of estimating the ordinary least points (OLS) is used to execute the regression analysis and to achieve projections for the error loads shown above. Performance can be evaluated by the fund alpha in the framework of equity funds, which is more precisely the intercept term in a regression of the excess returns of the portfolio on the returns of benchmark factors. OLS is built on the concept of minimizing the amount of vertical squared gaps between yields and yields forecast by regression. OLS is built on the concept of minimizing the amount of vertical squared gaps between yields and yields forecast by regression. When employing the OLS estimation technique, to achieve solid outcomes and achieve coefficient estimates that are best linear unbiased estimators (BLUE), it is necessary to fulfill certain criteria linked to the assessment procedure. Brooks (2002) points out the present basic linear regression statements whose infringement may result in partial or inaccurate correlation:

Goodness of Fit

The first diagnostic measure is goodness of fit, which can be mathematically expressed as:

$$E(\varepsilon_t) = 0$$

To put it in words, it means that the error terms have zero mean. If a constant term is included in the regression equation, this assumption will be never violated. With regards to our data, this is true for all observed ETFs both in the conventional as well as in the sustainable area. In addition to this measurement, the R^2 measure explains the model's suitability, i.e. how much the model can describe or reflect the underlying data. Thus, it shows how much variation of the explanatory variables can explain the variation in the dependent variables. (Brooks, 2002)

Concerning the observed data set, one can see that the R^2 measure is mainly ranging between 0,50 and 0,80. That means that the constructed models can explain between 50 and 80% of the underlying data. For the models with values ranging more to 50%, they still explain half of the regressions that have been performed. The values ranging more into the direction of 80% have a better fit with the underlying data and can be interpreted as good models for explaining the used data. However, this range also reflects that a 100% fit is almost unrealistic as there will be always factors that are not considered into a model and might influence the performance of the underlying data.

Heteroskedasticity

As a second diagnostic measure, the models are tested on heteroskedasticity that can be reflected as the following mathematical term:

$$var\,(\varepsilon_t) = \sigma^2 < \infty$$

The underlying data is heteroscedastic (or heteroskedastic) if sub-populations of the complete data set show different variabilities from others. Variability is usually measured by the variance of the data, as it can be also seen in the equation above. If the data is not heteroscedastic, it is called homoscedastic, i.e. the variability of the sub-populations is not different from others. (Brooks, 2002)

Testing for heteroscedasticity can be done with different methods: the first method can be done in a graphical way by analyzing the residuals vs. fitted values or by analyzing the standardized residuals on the Y-axis. If there is no heteroscedasticity, then the data points should be ordered completely random and equally distributed. (Brooks, 2002)

As a more sophisticated method, statistical tests can be applied to check for heteroscedasticity. Within this context, different tests exist to check the presence or absence of heteroscedasticity, for example the Breusch-Pagan test or the White Test. (Brooks, 2002)

In the case of this research, the statistical methods have been used. To be more specific, the Breusch-Pagan test has been applied to check for heteroskedasticity. Based on the test, it could be found out that the data is not homoscedastic, thus showing a heteroscedastic behavior.

Autocorrelation

As a third diagnostic measure, the normality of residuals will be checked. Again, the mathematical term looks as follows:

$$cov\left(\varepsilon_i, \varepsilon_j\right) = 0$$

To rephrase this, the error terms are statistically independent from each other, meaning that they are uncorrelated with each other. If they are not uncorrelated, they are autocorrelated.

The residuals are the differences between the fitted model and the data. In a signal-plus-white noise model, if you have a good fit for the signal, the residuals should be white noise.

Autocorrelation means that the model does not include all the significant data. The autocorrelation of residuals can be tested with plotting the residuals to see if they are random or not. If there is auto-correlation, then there should be a linear relationship between consecutive residuals. In addition to the graphical way, autocorrelation can be also tested with the Durbin-Watson method. Overall, the residuals should not be correlated. If you can predict the residuals, those residuals should be included in the model. Basically, if there is autocorrelation among residuals, we have to improve the original model. (Brooks, 2002)

Concerning our models and underlying data, they do suffer from autocorrelation so that the build models have to be transformed accordingly

Newey West-estimator

As both Heteroskedasticity and Autocorrelation occurs in the dataset, it has to be transformed. For this purpose, the Newey West estimator will overcome this circumstance.In statistics and econometrics, a Newey–West estimator is used to provide an approximation of the covariance matrix of the regression-type model parameters when this model is implemented in cases where the traditional regression analysis assumptions do not apply. The model has been introduced by Whitney K. Newey and Kenneth D. West in 1987, although there are a variety of later variants. The estimator is used to attempt to resolve autocorrelation (also known as serial correlation) and heteroskedasticity in model terms, mostly for regressions applied to time series results. (Newey & West, 1987)

The problem with autocorrelation, which is mostly seen in data from time series, is that the terms of error are correlated over time. This can be represented in the following equation

$$Q^* = \frac{1}{T}\sum_{t=1}^{T} e_t^2 x_t x_t' + \frac{1}{T}\sum_{\ell=1}^{L}\sum_{t=\ell+1}^{T} w_\ell e_t e_{t-\ell}(x_t x_{t-\ell}' + x_{t-\ell}x_t')$$

$$w_\ell = 1 - \frac{\ell}{L+1}$$

Where Q^* represents a matrix of sums of squares and cross products, involving $\sigma_{(ij)}$ and the rows of X. The least squares estimator b is a consistent estimator of β, implying that the least square residuals e_i reflect point-wise consistent estimators of their counterparts within the population of E_i.As a more general approach, X and e are then used to generate an estimator of Q^*. As an additional remark to the above equation, w_l can be seen as a weight factor. Thus, errors with a higher distance to each other have a lower weight, while those with equal

subscripts have a given weight of 1. (Greene, 1997) To translate those mathematical explanations, it would mean that as the time between the respected error terms increases, the correlation between the error terms decreases. As a consequence, the estimator is helpful to improve the OLS regression while the residuals are heteroscedastic and/or autocorrelated. While performing the regression with Newey-West standard errors, the maximum lag size has to be defined. For the purpose of this thesis, the maximum lag size has been set to 4. This is based on the rule of thumb, specifying an appropriate lag size is equal to $N^{\frac{1}{4}}$ or $\sqrt[4]{N}$.

Multicollinearity

The fourth diagnostic measure refers to multicollinearity. Statistically, it can be expressed as

$$cov\ (\varepsilon_t, x_t) = 0$$

or in other words: there is no relationship between the error term and the corresponding dependent variable(s).

Multicollinearity refers to the circumstance that explanatory (or independent) variables have a very high correlation with each other. However, it is impossible to create an absolute non-multicollinearity as a small degree of association will always exist.

With regards to testing for this diagnostic measure, it is relatively challenging, while there is no simple method or test to check for multicollinearity. However, different methods exist how to deal with this issue. One possible way would be to ignore multicollinearity, but only if the model is statistically adequate. As mentioned before, multicollinearity does not need to impact the interpretability of the used models. Another opportunity would be to drop certain variables out that have a high collinearity with each other. However, this is only possible if it does not disturb the overall model and its interpretability. (Brooks, 2002) Another way how to deal with it is to transform highly correlated variables into one single variable as a ratio so that only the ratio will be integrated in the regression model. However, this might also depend on the model and can be just used when the number of variables is considerably high.(Brooks, 2002)

Referring to the descriptive statistics that has been described before, the used data do show similar correlations to each other so that the data might suffer from multicollinearity. However, this high multicollinearity can be also explained by the fact that not each single region is independent from the other regions as those companies reflected in the ETFs are mostly active across regions. Thus, they naturally have a higher multicollinear relationship with each

other. Therefore, one can say that this inter-relationship of the ETFs does not refer to the theoretical issue of multicollinearity as a perfect non-multicollinearity can be almost excluded from this case. Thus, the ETF models can be further used for proper analysis.

Normality of Residuals

As the last diagnostic measure, the normality of the residuals will be checked. In a statistical term, it can be expressed as

$$\varepsilon_t \sim N\,(0, \sigma^2) = \ 0$$

which means that the Error Terms of the observed models are normally distributed

Again, different methods exist on how to test for normality. There are graphical methods, where histograms can be compared based on the sample data with a normal probability curve, while the ideal result should form a bell-curve. However, if the data set is relatively small, this might be challenging to see. Furthermore, a quantile-quantile plot (QQ plot) of the standardized data against the standard normal distribution can also help to detect normality. (Brooks, 2002)

As a second way, statistical tests can be used to determine the normality of the model. There are different tests available, among them the Shapiro–Wilk test or the Kolmogorov–Smirnov test as the most prominent examples. (Brooks, 2002)

For the purposes of this research, the Shapiro-Wild test will be used. With regards to the used data and models, one can see that the data is normally distributed and does not show any abundance of normality, while the p-Value is below 0,05 with a statistical significance of 95%.

6 Results

This section will finally present the results from this research study. It will follow the same logic as the above introduced performance measurement instruments, starting with the Capital Asset Pricing Method towards the Five-Factor model from Fama and French. For each model, the conventional ETFs will be compared with the sustainable counterparts in order to get an idea which of both has a better performance. For comparing the ETFs, the most relevant indicators will be taken into consideration. Each pair of ETFs, i.e. the sustainable ETF with its conventional counterpart, will be analyzed individually in order to increase the level of interpretable outcomes.

Overall, only the corresponding factors will be analyzed, while the constant factors will be ignored in further analysis. This is due to the fact that in all models, the p-value is above 0,05, leading to the non-rejection of the Null Hypothesis that states that there is no correlation between the variables. In other words, the constant is obvilusly not correlated with the underlying ETF data and will always have a value of 0 in the observed models. For the other factors, it will be carefully analyzed whether they obtain a p-value below or above 0.05. If the p-value in the models is below 0.05, the Null Hypothesis will be rejected and thus, the factor has a correlation with the observed data of the corresponding ETF. If the p-value is above 0,05, the Null Hypothesis will be accepted and thus, there is insufficient evidence to conclude that there is significant effect on the observed data and the population overall.

6.1 Performance under CAPM

Table 9: UBS MSCI World SRI under the CAPM (1S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	352.71
	Prob > F	=	0

	Newey-West					
ER 1S	Coef.	Std. Err.	t	p > |t|	[95% Conf.	Interval]
RMRF	0.948	0.050	18.780	0.000	0.849	1.048
_cons	0.001	0.001	1.110	0.270	-0.001	0.002

Table 10: UBS MSCI World under the CAPM (1C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	341.41
	Prob > F	=	0

ER 1C	Coef.	Newey-West Std. Err.	t	p > |t|	[95% Conf.	Interval]
RMRF	0.975	0.053	18.480	0.000	0.871	1.078
_cons	0.000	0.001	0.620	0.537	-0.001	0.002

Comparing the first pair of ETFs, they both have a similar outcome. For the market risk factor (RMRF), the p-value is below the threshold of 0.05 so that the Null Hypothesis can be rejected, meaning that there is a non-zero correlation between the independent variable of the respective ETF development and the market risk factor. Thus, the market factor has a strong positive correlation with the observed datasets. There is only a slight difference between the sustainable and the conventional model, where the conventional model has a slightly stronger trend towards the market factor than the sustainable model. However, the difference is very small with only 0.05. Thus, they both have the same tendency towards the market risk factor.

For the sustainable model, the equation can be reprented as:

$$1S = R_{i,t} - R_{f,t} = 0.001 + 0.948 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

For the conventional model, the equation can be represented as:

$$1C = R_{i,t} - R_{f,t} = 0.000 + 0.975 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 11: UBS MSCI USA SRI under the CAPM (2S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	461.56
	Prob > F	=	0

ER 2S	Coef.	Newey-West Std. Err.	t	p > |t|	[95% Conf.	Interval]
RMRF	0.927	0.043	21.480	0.000	0.842	1.012
_cons	0.001	0.001	1.030	0.303	-0.001	0.002

Table 12: iShares MSCI USA under the CAPM (2C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	425.37
	Prob > F	=	0

	Newey-West					
ER 2C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.927	0.045	20.620	0.000	0.839	1.016
_cons	0.001	0.001	1.480	0.141	0.000	0.002

Concerning the the second pair of ETFs, both have a p-value below the threshold of 0.05 so that the market risk factor does onviously have a correlation with the corresponding dataset. In this case, the market factor has even the same value equal to 0.927.

To put this into equations:

$$2S = R_{i,t} - R_{f,t} = 0.001 + 0.927 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$2C = R_{i,t} - R_{f,t} = 0.001 + 0.927 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

Table 13: UBS MSCI EMU SRI under the CAPM (3S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	317.32
	Prob > F	=	0

	Newey-West					
ER 3S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.897	0.050	17.810	0.000	0.798	0.997
_cons	0.001	0.001	1.770	0.078	0.000	0.003

Table 14: UBS MSCI EMU under the CAPM (3C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	312.61
	Prob > F	=	0

	Newey-West					
ER 3C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.969	0.055	17.680	0.000	0.861	1.077
_cons	0.000	0.001	0.200	0.842	-0.001	0.002

Regarding the third pair of ETFs, it shows the same tendency as the ETF pairs before. The p-value is below 0.05 and thus, the Null Hypothesis will be rejected, stating that there is a correlation between the market risk factor and the observed data sets. In this case, the market risk factor has a lower impact on the sustainable model than in the conventional model, represented by the following equations:

$$3S = R_{i,t} - R_{f,t} = 0.001 + 0.897 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$3C = R_{i,t} - R_{f,t} = 0.000 + 0.969 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 15: iShares MSCI Europe SRI under the CAPM (4S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	286.56
	Prob > F	=	0

		Newey-West				
ER 4S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.887	0.052	16.930	0.000	0.784	0.990
_cons	0.001	0.001	0.900	0.370	-0.001	0.002

Table 16: iShares MSCI Europe under the CAPM (4C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	312.61
	Prob > F	=	0

		Newey-West				
ER 4C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.969	0.055	17.680	0.000	0.861	1.077
_cons	0.000	0.001	0.200	0.842	-0.001	0.002

Concerning the fourth pair of ETFs, the tendency is in line with the other models, where the p-value is below 0.05, resulting into a correlation between the market risk factor and the observed data sets. Again, the conventional model has a stronger bias towards the market risk factor than its sustainable peer. The equations look as follows:

$$4S = R_{i,t} - R_{f,t} = 0.001 + 0.887 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$4C = R_{i,t} - R_{f,t} = 0.000 + 0.969 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2,\ldots,T$$

Table 17: iShares Dow Jones Eurozone Sustainability Screened under the CAPM (5S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	396.5
	Prob > F	=	0

	Newey-West					
ER 5S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	1.008	0.051	19.910	0.000	0.908	1.107
_cons	0.001	0.001	0.850	0.396	-0.001	0.002

Table 18: iShares MSCI Europe ex UK under the CAPM (5C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	320.87
	Prob > F	=	0

	Newey-West					
ER 5C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.916	0.051	17.910	0.000	0.815	1.016
_cons	0.000	0.001	0.350	0.726	-0.001	0.002

The fifth pair of ETFs show a slightly different picture. Altough the p-value is again below 0.05 and thus, the market risk factor has a strong correlation with the observed dataset, the sustainable model shows a stronger effect than the conventional model with a difference of approximately 0.1. To put it into equations, it looks as follows:

$$5S = R_{i,t} - R_{f,t} = 0.001 + 1.008 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$5C = R_{i,t} - R_{f,t} = 0.000 + 0.916 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2,\ldots,T$$

Table 19: iShares Dow Jones Global Sustainability Screened under the CAPM (6S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	417.65
	Prob > F	=	0

	Newey-West					
ER 6S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	1.017	0.050	20.440	0.000	0.919	1.115
_cons	0.000	0.001	0.690	0.490	-0.001	0.002

Table 20: iShares MSCI World under the CAPM (6C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	326.22
	Prob > F	=	0

	Newey-West					
ER 6C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.964	0.053	18.060	0.000	0.859	1.069
_cons	0.001	0.001	1.230	0.218	-0.001	0.002

For the sixth pair, it shares similarities with the fifth pair regarding the fact that the sustainable model has a slightly stronger stress on the market level than the conventional model, while the p-value is again below the threshold of 0.05. The sustainable model has even a slightly higher slope towards the market risk factor, altough this surplus is marginal. The equation can be expressed as:

$$6S = R_{i,t} - R_{f,t} = 0.000 + 1.017 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$6C = R_{i,t} - R_{f,t} = 0.001 + 0.964 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

Table 21: UBS MSCI World Pacific SRI under the CAPM (7S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	163.38
	Prob > F	=	0

	Newey-West					
ER 7S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.699	0.055	12.780	0.000	0.591	0.806
_cons	0.001	0.001	0.810	0.417	-0.001	0.002

Table 22: Comstage MSCI Pacific under the CAPM (7C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	165.68
	Prob > F	=	0

	Newey-West					
ER 7C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.696	0.054	12.870	0.000	0.589	0.802
_cons	0.001	0.001	0.650	0.516	-0.001	0.002

The seventh pair, focusing on the Pacific area, also shows similarities in their models, regardless of their conventional or sustainable label. While the p-value is below 0,05 for the market risk factor, it is interesting to see that both models firstly do not show such a strong connection to the market risk factors as the pairs above. They “only” have a coefficient of 0.699 and 0.696 respectively. This circumstance might be also explained with the fact that the underlying factor dataset is based on Asia Pacific, but excludes Japan from the analysis. Thus, a major economical power in this area has been neglected. This trend will probably also appear in the other models with regards to the Asian Pacfic area.

Nonetheless, the above insights can be put into equations as follows:

$$7S = R_{i,t} - R_{f,t} = 0.001 + 0.699 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$7C = R_{i,t} - R_{f,t} = 0.001 + 0.696 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

Table 23: Think Sustainable World under the CAPM (8S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258)	=	399.38
	Prob > F	=	0

ER 8S	Coef.	Newey-West Std. Err.	t	p > |t|	[95% Conf.	Interval]
RMRF	1.053	0.053	19.980	0.000	0.949	1.157
_cons	0.001	0.001	0.740	0.462	-0.001	0.002

Table 24: Think Global under the CAPM (8C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(1, 258) =	=	436.8
	Prob > F	=	0

ER 8C	Coef.	Newey-West Std. Err.	t	p > |t|	[95% Conf.	Interval]
RMRF	1.014	0.049	20.900	0.000	0.919	1.110
_cons	0.000	0.049	0.000	0.999	-0.001	0.001

Regarding the last pair under the CAPM, the sustainable model has a slightly stronger stress on the market risk factor that its conventional peer, while the p-value is below 0.05 for both models. They both also have a higher value than 1, showing that the respected ETF is slightly better performing than the underlying market development data. However, the effect is relatively small and does not show a significant evidence.

The equations for this pair look as follows:

$$8S = R_{i,t} - R_{f,t} = 0.001 + 1.053 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$8C = R_{i,t} - R_{f,t} = 0.000 + 1.014 \left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

Overall, the models under the CAPM have all a relatively similar outcome, while the sustainable models are slightly better in five cases compared to their conventional peers. However, as also mentioned before, this effect is not significantly high and can be thus neglected.

6.2 Performance under the three-factor model

Table 25: UBS MSCI World SRI under the 3-Factor Model (1S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3,256)	=	125.72
	Prob > F	=	0

	Newey-West					
ER 1S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.906	0.055	16.510	0.000	0.798	1.014
SMB	-0.587	0.115	-5.090	0.000	-0.814	-0.360
HML	-0.230	0.090	-2.560	0.011	-0.407	-0.053
_cons	0.001	0.001	0.940	0.349	-0.001	0.002

Table 26: UBS MSCI World under the 3-Factor Model (1C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3,256)	=	132.39
	Prob > F	=	0

	Newey-West					
ER 1C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.932	0.055	16.850	0.000	0.823	1.041
SMB	-0.575	0.120	-4.780	0.000	-0.811	-0.338
HML	-0.196	0.097	-2.010	0.045	-0.387	-0.004
_cons	0.000	0.001	0.460	0.643	-0.001	0.002

With regards to the first pair, the p-value for the market risk factor as well as the SMB factor is considerable below the threshold of 0.05, representing a correlation of these factors with the underlying datasets. For the HML factor, this is also true in the case of the sustainable model. However, for the conventional one, the value is also below the threshold, but with a value of 0.045 only. In thise case, it will be still regarded that the Null Hypothesis can be rejected and the the HML factors does have an impact on the overall performance. The values of the factors itself do not show a relatively big difference between the conventional and sustainable model that can be also seen in the following equations:

$$1S = R_{i,t} - R_{f,t} = 0.001 + 0.906\left(R_{M,t} - R_{f,t}\right) + (-0.587\ SMB_t) + (-0.230\ HML_t) + \varepsilon_{i,t}$$

$$1C = R_{i,t} - R_{f,t} = 0.000 + 0.932\left(R_{M,t} - R_{f,t}\right) + (-0.575\ SMB_t) + (-0.196\ HML_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 27: UBS MSCI USA SRI under the 3-Factor Model (2S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	150.38
	Prob > F	=	0

	Newey-West					
ER 2S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.931	0.045	20.780	0.000	0.843	1.020
SMB	-0.047	0.085	-0.550	0.584	-0.215	0.122
HML	-0.043	0.071	-0.600	0.547	-0.182	0.097
_cons	0.001	0.001	0.910	0.363	-0.001	0.002

Table 28: iShares MSCI USA under the 3-Factor Model (2C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	136.63
	Prob > F	=	0

	Newey-West					
ER 2C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.934	0.047	20.040	0.000	0.842	1.025
SMB	-0.075	0.093	-0.810	0.421	-0.258	0.108
HML	-0.089	0.075	-1.190	0.236	-0.236	0.059
_cons	0.001	0.001	1.290	0.199	0.000	0.002

Interestingly, the analysis of the second pair under the three-factor model comes to the result, that the newly added factors SMB and HML do not show a p-value below 0.05 and thus cannot be regard as statistically significant to the model. Thus, the models for both the sustainable and conventional ETF dataset are similar to the ones under the CAPM. The equations look as follows:

$$2S = R_{i,t} - R_{f,t} = 0.001 + 0.931\left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$2C = R_{i,t} - R_{f,t} = 0.001 + 0.934\left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 29: UBS MSCI EMU SRI under the 3-Factor Model (3S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	217.78
	Prob > F	=	0

	Newey-West					
ER 3S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.754	0.056	13.420	0.000	0.644	0.865
SMB	-0.906	0.104	-8.670	0.000	-1.111	-0.700
HML	-0.282	0.080	-3.540	0.000	-0.439	-0.125
_cons	0.002	0.001	2.840	0.005	0.001	0.003

Table 30: UBS MSCI EMU under the 3-Factor Model (3C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	191.47
	Prob > F	=	0

	Newey-West					
ER 3C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.779	0.058	13.360	0.000	0.664	0.894
SMB	-0.981	0.115	-8.500	0.000	-1.209	-0.754
HML	-0.050	0.086	-0.580	0.562	-0.219	0.119
_cons	0.001	0.001	1.120	0.262	-0.001	0.002

Concerning the third pair under the three-factor model, one can also find different statistical results. For the sustainable model, all included factors show a statistical significance with a p-value below 0.05, and thus will be regarded in the model. For the conventional model, however, the HML factor cannot be regarded as the p-value is above 0.05, showing that this factor does not have a statistical significant influence on the overall model. As a consequence, the equations can be expressed in the following way:

$$3S = R_{i,t} - R_{f,t} = 0.002 + 0.754\left(R_{M,t} - R_{f,t}\right) + (-0.906\ SMB_t) + (-0.050\ HML_t) + \varepsilon_{i,t}$$

$$3C = R_{i,t} - R_{f,t} = 0.001 + 0.779\left(R_{M,t} - R_{f,t}\right) + (-0.981\ SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 31: iShares MSCI Europe SRI under the 3-Factor Model (4S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	200.92
	Prob > F	=	0

	Newey-West					
ER 4S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.733	0.051	14.430	0.000	0.633	0.833
SMB	-0.936	0.101	-9.260	0.000	-1.136	-0.737
HML	-0.252	0.073	-3.450	0.001	-0.396	-0.108
_cons	0.001	0.001	1.910	0.057	0.000	0.002

Table 32: iShares MSCI Europe under the 3-Factor Model (4C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3,256)	=	191.47
	Prob > F	=	0

	Newey-West					
ER 4C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.779	0.058	13.360	0.000	0.664	0.894
SMB	-0.981	0.115	-8.500	0.000	-1.209	-0.754
HML	-0.050	0.086	-0.580	0.562	-0.219	0.119
_cons	0.001	0.001	1.120	0.262	-0.001	0.002

With regards to the fourth pair, the sustainable model includes all three factors since the p-value is below 0.05 and thus they show a statistical significance to the model. For the conventional model, however, the HML factor has a p-value that is above 0.05 so that it cannot be included in the regression analysis. For both models, the equations look as follows:

$$4S = R_{i,t} - R_{f,t} = 0.002 + 0.773\left(R_{M,t} - R_{f,t}\right) + (-0.936\ SMB_t) + (-0.252\ HML_t) + \varepsilon_{i,t}$$

$$4C = R_{i,t} - R_{f,t} = 0.001 + 0.779\left(R_{M,t} - R_{f,t}\right) + (-0.981\ SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 33: iShares Dow Jones Eurozone Sustainability Screened under the 3-Factor Model (5S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	184.51
	Prob > F	=	0

	Newey-West					
ER 5S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.810	0.058	13.990	0.000	0.696	0.924
SMB	-0.933	0.127	-7.350	0.000	-1.183	-0.683
HML	0.078	0.088	0.880	0.377	-0.096	0.252
_cons	0.001	0.001	1.940	0.054	0.000	0.003

Table 34: iShares MSCI Europe ex UK under the 3-Factor Model (5C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	192.55
	Prob > F	=	0

	Newey-West					
ER 5C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.768	0.055	14.000	0.000	0.660	0.875
SMB	-0.852	0.107	-7.970	0.000	-1.063	-0.642
HML	-0.168	0.079	-2.120	0.035	-0.324	-0.012
_cons	0.001	0.001	1.130	0.261	-0.001	0.002

For the fifth pair, it is the opposite case as in the latter one. Here, the sustainable model does not include the HML factor since the p-value is not below the threshold, while for the conventional model all three factors are includeded in the regression. Thus, the equation will look as follows:

$$5S = R_{i,t} - R_{f,t} = 0.001 + 0.810\left(R_{M,t} - R_{f,t}\right) + (-0.933\ SMB_t) + \varepsilon_{i,t}$$

$$5C = R_{i,t} - R_{f,t} = 0.001 + 0.768\left(R_{M,t} - R_{f,t}\right) + (-0.852\,SMB_t) + (-0.168\,HML_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 35: iShares Dow Jones Global Sustainability Screened under the 3-Factor Model (6S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	146.51
	Prob > F	=	0

	Newey-West					
ER 6S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.970	0.053	18.410	0.000	0.866	1.073
SMB	-0.582	0.104	-5.600	0.000	-0.787	-0.378
HML	-0.066	0.089	-0.740	0.460	-0.240	0.109
_cons	0.000	0.089	0.650	0.519	-0.001	0.002

Table 36: iShares MSCI World under the 3-Factor Model (6C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	122.03
	Prob > F	=	0

	Newey-West					
ER 6C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.919	0.055	16.720	0.000	0.811	1.028
SMB	-0.597	0.110	-5.430	0.000	-0.813	-0.380
HML	-0.191	0.094	-2.020	0.044	-0.376	-0.005
_cons	0.001	0.001	1.110	0.269	-0.001	0.002

Concerning the sixth pair, all three factors are included in the regression for the conventional model, while the sustainable model does not include the HML factor due to the lack of statistical significance of this factor. Thus, the equations for both models will look as follows:

$$6S = R_{i,t} - R_{f,t} = 0.000 + 0.970\left(R_{M,t} - R_{f,t}\right) + (-0.582\, SMB_t) + \varepsilon_{i,t}$$

$$6C = R_{i,t} - R_{f,t} = 0.001 + 0.919\left(R_{M,t} - R_{f,t}\right) + (-0.597\, SMB_t) + (-0.191\, HML_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 37: UBS MSCI Pacific SRI under the 3-Factor Model (7S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	65.68
	Prob > F	=	0

	Newey-West					
ER 7S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.647	0.053	12.150	0.000	0.542	0.752
SMB	-0.592	0.112	-5.290	0.000	-0.813	-0.372
HML	-0.125	0.100	-1.260	0.210	-0.322	0.071
_cons	0.001	0.001	1.520	0.130	0.000	0.003

Table 38: Comstage MSCI Pacific under the 3-Factor Model (7C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	67.66
	Prob > F	=	0

	Newey-West					
ER 7C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.648	0.054	11.910	0.000	0.541	0.755
SMB	-0.555	0.114	-4.890	0.000	-0.779	-0.332
HML	-0.044	0.097	-0.450	0.653	-0.234	0.147
_cons	0.001	0.001	1.360	0.176	0.000	0.003

Regarding the seventh pair, both do not include the HML factor in their regression as the p-value is below 0.05, indicating that there is no statistical significance that the HML factor has a correlating relation to the dependent variable. The other factors, though, are included in the regression equations that can be represented as follows:

$$7S = R_{i,t} - R_{f,t} = 0.001 + 0.647\left(R_{M,t} - R_{f,t}\right) + (-0.592\, SMB_t) + \varepsilon_{i,t}$$

$$7C = R_{i,t} - R_{f,t} = 0.001 + 0.648\left(R_{M,t} - R_{f,t}\right) + (-0.555\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 39: Think Sustainable World under the 3-Factor Model (8S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	132.81
	Prob > F	=	0

	Newey-West					
ER 8S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	1.012	0.057	17.720	0.000	0.900	1.125
SMB	-0.495	0.119	-4.150	0.000	-0.730	-0.260
HML	-0.038	0.105	-0.360	0.722	-0.245	0.170
_cons	0.000	0.001	0.700	0.484	-0.001	0.002

Table 40: Think Global under the 3-Factor Model (8C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(3, 256)	=	139.64
	Prob > F	=	0

	Newey-West					
ER 8C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.968	0.053	18.240	0.000	0.864	1.073
SMB	-0.575	0.115	-5.010	0.000	-0.801	-0.349
HML	-0.076	0.097	-0.780	0.436	-0.268	0.116
_cons	0.000	0.001	-0.070	0.945	-0.001	0.001

With regards to the last pair under the three-factor model, the also share a similar trend, where the HML factor will not be included in the regression analysis as the p-value is not below 0.05 and thus the factor is not statistically significant for the models. Consequently, the equations for both model will look as follows:

$$8S = R_{i,t} - R_{f,t} = 0.000 + 1.012\left(R_{M,t} - R_{f,t}\right) + (-0.495\, SMB_t) + \varepsilon_{i,t}$$

$$8C = R_{i,t} - R_{f,t} = 0.000 + 0.968\left(R_{M,t} - R_{f,t}\right) + (-0.575\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

To summarize, there is no clear evidence that the sustainable models have a better performance than their conventional peers. They do not have strong differences in their models, while some include the HML factor in their equation, and some do not due to the lack of statistical significance.

6.3 Performance under the four-factor model

Table 41: UBS MSCI World SRI under the 4-Factor Model (1S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	96.14
	Prob > F	=	0

	Newey-West					
ER 1S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.904	0.054	16.720	0.000	0.797	1.010
SMB	-0.587	0.115	-5.110	0.000	-0.814	-0.361
HML	-0.244	0.096	-2.530	0.012	-0.433	-0.054
WML	-0.018	0.069	-0.270	0.789	-0.154	0.117
_cons	0.001	0.001	0.960	0.339	-0.001	0.002

Table 42: UBS MSCI World under the 4-Factor Model (1C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	99.55
	Prob > F	=	0

	Newey-West					
ER 1C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.934	0.055	16.950	0.000	0.826	1.043
SMB	-0.574	0.121	-4.750	0.000	-0.812	-0.336
HML	-0.177	0.103	-1.720	0.087	-0.380	0.026
WML	0.025	0.079	0.310	0.758	-0.132	0.181
_cons	0.000	0.001	0.440	0.659	-0.001	0.002

Comparing both models under the four-factor model, one can see that the sustainable model includes the RMRF factor as well as the SMB and HML factor. However, the WML factor cannot be included as the p-value is above 0.05 and thus the factor does not have statistical significance to the overall model. Concerning the conventional model, the HML factor will be also not considered due to the lack of statistical significance. Thus, the equations for both look as follows:

$$1S = R_{i,t} - R_{f,t} = 0.001 + 0.904\left(R_{M,t} - R_{f,t}\right) + (-0.587\, SMB_t) + (-0.244\, HML_t) + \varepsilon_{i,t}$$

$$1C = R_{i,t} - R_{f,t} = 0.000 + 0.934\left(R_{M,t} - R_{f,t}\right) + (-0.574\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 43: UBS MSCI USA SRI under the 4-Factor Model (2S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	111.45
	Prob > F	=	0

	Newey-West					
ER 2S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.934	0.045	20.680	0.000	0.845	1.023
SMB	-0.039	0.088	-0.440	0.658	-0.212	0.134
HML	-0.024	0.073	-0.330	0.741	-0.167	0.119
WML	0.032	0.057	0.550	0.580	-0.081	0.144
_cons	0.001	0.001	0.900	0.368	-0.001	0.002

Table 44: iShares MSCI USA under the 4-Factor Model (2C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	101.18
	Prob > F	=	0

	Newey-West					
ER 2C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.940	0.047	19.920	0.000	0.847	1.032
SMB	-0.055	0.095	-0.580	0.564	-0.242	0.132
HML	-0.041	0.075	-0.550	0.586	-0.189	0.107
WML	0.081	0.060	1.340	0.181	-0.038	0.199
_cons	0.001	0.001	1.270	0.205	0.000	0.002

For the second pair, none of the additional factors have a statistical influence on both models as their p-value clearly exceeds the threshold of 0.05. Thus, only the market risk factor RMRF will be considered in the following equations:

$$2S = R_{i,t} - R_{f,t} = 0.001 + 0.934\left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$2C = R_{i,t} - R_{f,t} = 0.001 + 0.940\left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 45: UBS MSCI EMU SRI under the 4-Factor Model (3S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	167.56
	Prob > F	=	0

	Newey-West					
ER 3S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.757	0.057	13.210	0.000	0.644	0.869
SMB	-0.933	0.109	-8.570	0.000	-1.147	-0.718
HML	-0.212	0.080	-2.640	0.009	-0.370	-0.054
WML	0.126	0.067	1.880	0.062	-0.006	0.258
_cons	0.002	0.001	2.480	0.014	0.000	0.003

Table 46: UBS MSCI EMU under the 4-Factor Model (3C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	140.7
	Prob > F	=	0

	Newey-West					
ER 3C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.781	0.059	13.200	0.000	0.665	0.898
SMB	-1.010	0.119	-8.500	0.000	-1.244	-0.776
HML	0.024	0.089	0.270	0.787	-0.152	0.200
WML	0.133	0.070	1.900	0.058	-0.005	0.270
_cons	0.001	0.001	0.860	0.392	-0.001	0.002

Concerning the third pair, both models include the market risk factor and the SMB factor as the p-value is below 0.05, stating that those factors have a statistical significance on the overall model. However, the sustainable model additionally includes the HML factor, whereas the conventional model does not. In addition, the WML factor will not be regarded in both models as the threshold of the p-value is exceeded in both models. Consequently, the models will look as follows:

$$3S = R_{i,t} - R_{f,t} = 0.002 + 0.757\left(R_{M,t} - R_{f,t}\right) + (-0.933\, SMB_t) + (-0.212\, HML_t) + \varepsilon_{i,t}$$

$$3C = R_{i,t} - R_{f,t} = 0.001 + 0.781\left(R_{M,t} - R_{f,t}\right) + (-1.010\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 47: iShares MSCI Europe SRI under the 4-Factor Model (4S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	149.66
	Prob > F	=	0

	Newey-West					
ER 4S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.734	0.051	14.340	0.000	0.633	0.834
SMB	-0.940	0.100	-9.360	0.000	-1.137	-0.742
HML	-0.244	0.085	-2.880	0.004	-0.411	-0.077
WML	0.015	0.074	0.200	0.842	-0.130	0.160
_cons	0.001	0.001	1.830	0.069	0.000	0.002

Table 48: iShares MSCI Europe under the 4-Factor Model (4C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	140.7
	Prob > F	=	0

	Newey-West					
ER 4C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.781	0.059	13.200	0.000	0.665	0.898
SMB	-1.010	0.119	-8.500	0.000	-1.244	-0.776
HML	0.024	0.089	0.270	0.787	-0.152	0.200
WML	0.133	0.070	1.900	0.058	-0.005	0.270
_cons	0.001	0.001	0.860	0.392	-0.001	0.002

Regarding the fourth pair, they both do not contain the WML factor and are thus similar to the three-factor model. In addition to that, the sustainable model has no other restrictions concerning the statistical significance of the factors, whereas in the conventional model, the HML factor will be also not included due to its p-value above 0.05. Thus, the equations for both models will look as follows:

$$4S = R_{i,t} - R_{f,t} = 0.001 + 0.734\left(R_{M,t} - R_{f,t}\right) + (-0.940\, SMB_t) + (-0.244\, HML_t) + \varepsilon_{i,t}$$

$$4C = R_{i,t} - R_{f,t} = 0.001 + 0.781\left(R_{M,t} - R_{f,t}\right) + (-1.010\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 49: iShares Dow Jones Eurozone Sustainability Screened under the 4-Factor Model (5S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	136.85
	Prob > F	=	0

	Newey-West					
ER 5S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.812	0.058	13.990	0.000	0.698	0.926
SMB	-0.959	0.130	-7.370	0.000	-1.215	-0.703
HML	0.145	0.095	1.520	0.129	-0.043	0.332
WML	0.120	0.082	1.460	0.145	-0.042	0.282
_cons	0.001	0.001	1.650	0.101	0.000	0.003

Table 50: iShares MSCI Europe ex UK under the 4-Factor Model (5C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	139.36
	Prob > F	=	0

	Newey-West					
ER 5C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.770	0.056	13.790	0.000	0.660	0.880
SMB	-0.877	0.111	-7.920	0.000	-1.096	-0.659
HML	-0.103	0.081	-1.270	0.206	-0.262	0.057
WML	0.118	0.063	1.870	0.063	-0.006	0.242
_cons	0.001	0.001	0.870	0.387	-0.001	0.002

The fifth pair of models shows again similar features since the SMB as additional factor is only included into equation, while all other do not meet the criteria to be statistically significant. Consequently, the equations will look as follows:

$$5S = R_{i,t} - R_{f,t} = 0.001 + \ 0.812\ (R_{M,t} - R_{f,t}) + (-0.959\ SMB_t) + \varepsilon_{i,t}$$

$$5C = R_{i,t} - R_{f,t} = 0.001 + \ 0.770\ (R_{M,t} - R_{f,t}) + (-0.877\ SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

Table 51: iShares Dow Jones Global Sustainability Screened under the 4-Factor Model (6S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	115.86
	Prob > F	=	0

	Newey-West					
ER 6S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.965	0.051	18.930	0.000	0.865	1.065
SMB	-0.583	0.103	-5.670	0.000	-0.785	-0.380
HML	-0.099	0.093	-1.060	0.292	-0.282	0.085
WML	-0.044	0.069	-0.630	0.528	-0.180	0.092
_cons	0.000	0.001	0.690	0.491	-0.001	0.002

Table 52: iShares MSCI World under the 4-Factor Model (6C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	93.42
	Prob > F	=	0

	Newey-West					
ER 6C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.921	0.055	16.880	0.000	0.813	1.028
SMB	-0.596	0.110	-5.400	0.000	-0.814	-0.379
HML	-0.180	0.097	-1.860	0.064	-0.370	0.011
WML	0.015	0.073	0.200	0.842	-0.130	0.159
_cons	0.001	0.001	1.090	0.276	-0.001	0.002

The sixth pair represents the same characteristics as the pair before: only the SMB factor will be included as explanatory factor in addition to the market risk, while the other factors do not show a statistical significance with a p-value above 0.05. As a result, the equations for both the sustainable and the conventional model will look as follows:

$$6S = R_{i,t} - R_{f,t} = 0.000 + \ 0.965\left(R_{M,t} - R_{f,t}\right) + (-0.583\, SMB_t) + \ \varepsilon_{i,t}$$

$$6C = R_{i,t} - R_{f,t} = 0.001 + \ 0.921\left(R_{M,t} - R_{f,t}\right) + (-0.596\, SMB_t) + \ +\varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

Table 53: UBS MSCI Pacific SRI under the 4-Factor Model (7S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	49.43
	Prob > F	=	0

	Newey-West					
ER 7S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.646	0.053	12.190	0.000	0.542	0.751
SMB	-0.598	0.116	-5.170	0.000	-0.826	-0.370
HML	-0.114	0.104	-1.100	0.273	-0.318	0.090
WML	0.019	0.092	0.210	0.833	-0.162	0.200
_cons	0.001	0.001	1.540	0.125	0.000	0.003

Table 54: Comstage MSCI Pacific under the 4-Factor Model (7C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	52.81
	Prob > F	=	

	Newey-West					
ER 7C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.647	0.054	12.050	0.000	0.542	0.753
SMB	-0.563	0.119	-4.740	0.000	-0.797	-0.329
HML	-0.030	0.098	-0.300	0.764	-0.223	0.164
WML	0.023	0.089	0.260	0.794	-0.152	0.198
_cons	0.001	0.001	1.380	0.168	0.000	0.003

Interestingly, the seventh pair follows the same pattern as the fifth and sixth pair. Here, the SMB factor will be the only factor that is included in the regression next to the market risk factors. The other ones, though, represent values with high p-values so that those factors cannot be regarded as statistically significant. As a consequence, the equations look as follows:

$$7S = R_{i,t} - R_{f,t} = 0.001 + \ 0.646\left(R_{M,t} - R_{f,t}\right) + (-0.598\, SMB_t) + \varepsilon_{i,t}$$

$$7C = R_{i,t} - R_{f,t} = 0.001 + \ 0.647\left(R_{M,t} - R_{f,t}\right) + (-0.563\, SMB_t) + \ \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

Table 55:Think Sustainable World under the 4-Factor Model (8S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	103.3
	Prob > F	=	0

	Newey-West					
ER 8S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	1.013	0.057	17.740	0.000	0.901	1.126
SMB	-0.495	0.120	-4.130	0.000	-0.731	-0.259
HML	-0.032	0.108	-0.290	0.771	-0.245	0.182
WML	0.008	0.082	0.100	0.924	-0.153	0.169
_cons	0.000	0.001	0.690	0.489	-0.001	0.002

Table 56: Think Global under the 4-Factor Model (8C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(4, 255)	=	110.65
	Prob > F	=	0

	Newey-West					
ER 8C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.969	0.052	18.490	0.000	0.866	1.072
SMB	-0.575	0.115	-4.990	0.000	-0.802	-0.348
HML	-0.071	0.099	-0.710	0.475	-0.265	0.124
WML	0.007	0.078	0.090	0.926	-0.147	0.161
_cons	0.000	0.001	-0.080	0.940	-0.001	0.001

Concerning the last pair under the four-factor model, it also only includes the SMB factor as explanatory factor in the model, whereas the HML and WML factor are not considered in the model due to their lack of statistical significance. Thus, the model equations will look as follows:

$$8S = R_{i,t} - R_{f,t} = 0.000 + \ 1.013\ (R_{M,t} - R_{f,t}) + (-0.495\ SMB_t) + \varepsilon_{i,t}$$

$$8C = R_{i,t} - R_{f,t} = 0.000 + \ 0.969\ (R_{M,t} - R_{f,t}) + (-0.575\ SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2, \dots, T$$

6.4 Performance under the five-factor model

Table 57: UBS MSCI World SRI under the 5-Factor Model (1S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	88.56
	Prob > F	=	0

	Newey-West					
ER 1S	Coef.	Std. Err.	t	p > |t|	[95% Conf.	Interval]
RMRF	0.825	0.049	16.970	0.000	0.729	0.920
SMB	-0.700	0.112	-6.240	0.000	-0.921	-0.479
HML	-0.045	0.154	-0.290	0.771	-0.349	0.259
RMW	-0.259	0.159	-1.620	0.106	-0.573	0.055
CMA	-0.550	0.196	-2.810	0.005	-0.936	-0.165
_cons	0.001	0.001	1.220	0.222	-0.001	0.002

Table 58: UBS MSCI World under the 5-Factor Model (1C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	81.8
	Prob > F	=	0

	Newey-West					
ER 1C	Coef.	Std. Err.	t	p > |t|	[95% Conf.	Interval]
RMRF	0.835	0.055	15.110	0.000	0.727	0.944
SMB	-0.736	0.117	-6.270	0.000	-0.966	-0.505
HML	-0.097	0.156	-0.620	0.536	-0.405	0.211
RMW	-0.482	0.174	-2.770	0.006	-0.826	-0.139
CMA	-0.527	0.201	-2.620	0.009	-0.923	-0.131
_cons	0.001	0.001	0.870	0.386	-0.001	0.002

For the first pair under the five-factor model, one can see that the HML factor has a p-value above 0.05 so that it will be not included in both models due to the lack of statistical significance. For the sustainable one, the RMW will be also excluded due to the same reason. Otherwise, all other factors are regarded to have a statistical significant influence on the dependent variable, leading to the following equations:

$$1S = R_{i,t} - R_{f,t} = 0.001 + 0.825\left(R_{M,t} - R_{f,t}\right) + (-0.700\,SMB_t) + (-0.550\,CMA_t) + \varepsilon_{i,t}$$

$$1C = R_{i,t} - R_{f,t} = 0.001 + 0.835\left(R_{M,t} - R_{f,t}\right) + (-0.736\,SMB_t) + (-0.482\,RMW_t) + (-0.527\,CMA_t) + \varepsilon_{i,t}$$

$$t = 1,2,\ldots,T$$

Table 59: UBS MSCI USA SRI under the 5-Factor Model (2S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	94.18
	Prob > F	=	0

	Newey-West					
ER 2S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.914	0.045	20.130	0.000	0.825	1.004
SMB	-0.046	0.092	-0.500	0.617	-0.227	0.135
HML	0.069	0.113	0.610	0.544	-0.154	0.292
RMW	0.026	0.117	0.230	0.822	-0.204	0.257
CMA	-0.225	0.169	-1.330	0.184	-0.558	0.108
_cons	0.001	0.001	0.900	0.367	-0.001	0.002

Table 60: iShares MSCI USA under the 5-Factor Model (2C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	86.18
	Prob > F	=	0

	Newey-West					
ER 2C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.904	0.048	18.920	0.000	0.810	0.998
SMB	-0.104	0.100	-1.040	0.298	-0.301	0.093
HML	0.069	0.120	0.580	0.566	-0.168	0.306
RMW	-0.067	0.125	-0.540	0.591	-0.313	0.179
CMA	-0.347	0.167	-2.070	0.039	-0.676	-0.017
_cons	0.001	0.001	1.270	0.207	-0.001	0.002

For the second pair of ETFs, it is interesting to see that almost all factors are excluded from the regression models, except for the CMA factor in the conventional model. The other factors have all a higher p-value than 0.05, making them statistically insignificant for the overall models. In conclusion, the equation would look as follows:

$$2S = R_{i,t} - R_{f,t} = 0.001 + 0.914\left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t}$$

$$2C = R_{i,t} - R_{f,t} = 0.001 + 0.904\left(R_{M,t} - R_{f,t}\right) + (-0.347\, CMA_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 61: UBS MSCI EMU SRI under the 5-Factor Model (3S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	144.83
	Prob > F	=	0

	Newey-West					
ER 3S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.744	0.055	13.480	0.000	0.636	0.853
SMB	-0.946	0.103	-9.150	0.000	-1.149	-0.742
HML	-0.289	0.145	-1.990	0.048	-0.576	-0.003
RMW	-0.155	0.160	-0.970	0.333	-0.469	0.159
CMA	-0.160	0.151	-1.060	0.288	-0.457	0.137
_cons	0.002	0.001	3.010	0.003	0.001	0.003

Table 62: UBS MSCI EMU under the 5-Factor Model (3C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	137.65
	Prob > F	=	0

	Newey-West					
ER 3C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.772	0.055	13.910	0.000	0.662	0.881
SMB	-1.035	0.114	-9.110	0.000	-1.259	-0.811
HML	-0.134	0.146	-0.920	0.359	-0.421	0.153
RMW	-0.272	0.181	-1.510	0.133	-0.628	0.084
CMA	-0.136	0.179	-0.760	0.446	-0.488	0.216
_cons	0.001	0.001	1.400	0.163	0.000	0.002

Concerning the third pair under the five-factor model, both datasets, as in the previous ones under the four-factor and three-factor model, will only include the SMB factor as additional explanatory factor, whereas the other ones have a p-value that is above the threshold of 0.05, making them statistically insignificant. Thus, the equation for those models will look as follows:

$$3S = R_{i,t} - R_{f,t} = 0.002 + 0.744\left(R_{M,t} - R_{f,t}\right) + (-0.946\, SMB_t) + (-0.289\, HML_t) + \varepsilon_{i,t}$$

$$3C = R_{i,t} - R_{f,t} = 0.001 + 0.772\left(R_{M,t} - R_{f,t}\right) + (-1.035\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 63: iShares MSCI Europe SRI under the 5-Factor Model (4S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	137.57
	Prob > F	=	0

	Newey-West					
ER 4S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.725	0.049	14.780	0.000	0.629	0.822
SMB	-0.987	0.099	-10.010	0.000	-1.181	-0.793
HML	-0.325	0.136	-2.390	0.018	-0.593	-0.057
RMW	-0.272	0.172	-1.580	0.115	-0.610	0.066
CMA	-0.166	0.160	-1.040	0.299	-0.480	0.148
_cons	0.001	0.001	2.200	0.029	0.000	0.003

Table 64: iShares MSCI Europe under the 5-Factor Model (4C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	137.65
	Prob > F	=	0

	Newey-West					
ER 4C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.772	0.055	13.910	0.000	0.662	0.881
SMB	-1.035	0.114	-9.110	0.000	-1.259	-0.811
HML	-0.134	0.146	-0.920	0.359	-0.421	0.153
RMW	-0.272	0.181	-1.510	0.133	-0.628	0.084
CMA	-0.136	0.179	-0.760	0.446	-0.488	0.216
_cons	0.001	0.001	1.400	0.163	0.000	0.002

With regards to the fourth pair, one can see under the sustainable model that the market risk factor, the SMB as well as the HML factor are included in the regression equation. For the conventional model, however, it is ony the market risk factor as well as the SMB factor. Thus, the equations will look as follows:

$$4S = R_{i,t} - R_{f,t} = 0.001 + 0.725\left(R_{M,t} - R_{f,t}\right) + (-0.987\, SMB_t) + (-0.325\, HML_t) + \varepsilon_{i,t}$$

$$4C = R_{i,t} - R_{f,t} = 0.001 + 0.772\left(R_{M,t} - R_{f,t}\right) + (-1.035\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 65: iShares Dow Jones Eurozone Sustainability Screened under the 5-Factor Model (5S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	137.61
	Prob > F	=	0

	Newey-West					
ER 5S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.801	0.055	14.450	0.000	0.692	0.910
SMB	-0.998	0.121	-8.260	0.000	-1.236	-0.760
HML	-0.034	0.154	-0.220	0.824	-0.337	0.268
RMW	-0.385	0.175	-2.200	0.029	-0.730	-0.040
CMA	-0.236	0.197	-1.200	0.232	-0.623	0.152
_cons	0.002	0.001	2.320	0.021	0.000	0.003

Table 66: iShares MSCI Europe ex UK under the 5-Factor Model (5C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	139.34
	Prob > F	=	0

	Newey-West					
ER 5C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.761	0.052	14.690	0.000	0.659	0.863
SMB	-0.906	0.105	-8.610	0.000	-1.113	-0.698
HML	-0.260	0.135	-1.930	0.055	-0.526	0.006
RMW	-0.302	0.164	-1.840	0.066	-0.624	0.021
CMA	-0.167	0.148	-1.130	0.260	-0.459	0.124
_cons	0.001	0.001	1.430	0.154	0.000	0.002

The fifth pair shows a similar picture than the pairs before. For the sustainable model, the RMRF factor, the SMB factor and the RMW factor show a statistical significance to the model, whereas the others have a higher p-value than 0.05, meaning that the null hypothesis will be accepted and that they do not have a statistical significant influence on the dependent variable. For the conventional model, the RMRF factor as well as the SMB factor are included. The other ones do not have a p-value that is below 0.05, making them not statistically significant. Consequently, the equations for both models will look as follows:

$$5S = R_{i,t} - R_{f,t} = 0.002 + 0.801\left(R_{M,t} - R_{f,t}\right) + (-0.998\,SMB_t) + (-0.385\,RMW_t) + \varepsilon_{i,t}$$

$$5C = R_{i,t} - R_{f,t} = 0.001 + 0.761\left(R_{M,t} - R_{f,t}\right) + (-0.906\,SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 67: iShares Dow Jones Global Sustainability Screened under the 5-Factor Model (6S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	117.02
	Prob > F	=	0

	Newey-West					
ER 6S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.867	0.042	20.540	0.000	0.784	0.950
SMB	-0.729	0.103	-7.090	0.000	-0.932	-0.526
HML	0.140	0.139	1.010	0.314	-0.133	0.413
RMW	-0.360	0.153	-2.350	0.020	-0.662	-0.058
CMA	-0.687	0.177	-3.870	0.000	-1.037	-0.338
_cons	0.001	0.001	1.050	0.296	-0.001	0.002

Table 68: iShares MSCI World under the 5-Factor Model (6C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	87.67
	Prob > F	=	0

	Newey-West					
ER 6C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.821	0.049	16.900	0.000	0.725	0.917
SMB	-0.744	0.106	-6.990	0.000	-0.953	-0.534
HML	-0.020	0.153	-0.130	0.898	-0.322	0.283
RMW	-0.386	0.170	-2.260	0.025	-0.721	-0.050
CMA	-0.620	0.188	-3.290	0.001	-0.991	-0.249
_cons	0.001	0.001	1.490	0.138	0.000	0.002

The sixth pair also shows similarities between the conventional and the sustainable model. In both cases, the HML factor will be not regarded as statistically significant with a p-value above 0.05. The other factors, however, fulfill the criteria and will be included in the formula. Thus, the equations for both models look as follows:

$$6S = R_{i,t} - R_{f,t} = 0.001 + 0.867\left(R_{M,t} - R_{f,t}\right) + (-0.729\,SMB_t) + (-0.360\,RMW_t) + (-0.687\,CMA_t) + \varepsilon_{i,t}$$

$$6C = R_{i,t} - R_{f,t} = 0.001 + 0.821\left(R_{M,t} - R_{f,t}\right) + (-0.744\,SMB_t) + (-0.386\,RMW_t) + (-0.620\,CMA_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 69: UBS MSCI Pacific SRI under the 5-Factor Model (7S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	41.18
	Prob > F	=	0

	Newey-West					
ER 7S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.622	0.057	10.900	0.000	0.509	0.734
SMB	-0.592	0.117	-5.070	0.000	-0.822	-0.362
HML	-0.039	0.125	-0.310	0.756	-0.285	0.207
RMW	-0.038	0.235	-0.160	0.872	-0.501	0.425
CMA	-0.284	0.244	-1.160	0.245	-0.763	0.196
_cons	0.001	0.001	1.580	0.116	0.000	0.003

Table 70: Comstage MSCI Pacific under the 5-Factor Model (7C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	42.14
	Prob > F	=	0

	Newey-West					
ER 7C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.623	0.059	10.510	0.000	0.506	0.740
SMB	-0.553	0.118	-4.680	0.000	-0.786	-0.320
HML	0.010	0.124	0.080	0.936	-0.234	0.254
RMW	-0.102	0.227	-0.450	0.652	-0.549	0.344
CMA	-0.257	0.242	-1.060	0.289	-0.734	0.219
_cons	0.001	0.001	1.440	0.150	0.000	0.003

Regarding the seventh pair, it is interesting to see that all factors will not be included in the model for both the conventional and sustainable version, except for the market risk factor and the SMB factor. The p-values clearly exceed the threshold of 0.05 to be statistically significant. Thus, the equations look as follows:

$$7S = R_{i,t} - R_{f,t} = 0.001 + 0.622\left(R_{M,t} - R_{f,t}\right) + (-0.592\, SMB_t) + \varepsilon_{i,t}$$

$$7C = R_{i,t} - R_{f,t} = 0.001 + 0.623\left(R_{M,t} - R_{f,t}\right) + (-0.553\, SMB_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

Table 71: Think Sustainable World under the 5-Factor Model (8S)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	109.75
	Prob > F	=	0

	Newey-West					
ER 8S	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.872	0.049	17.950	0.000	0.776	0.967
SMB	-0.709	0.112	-6.320	0.000	-0.929	-0.488
HML	0.150	0.168	0.890	0.373	-0.181	0.482
RMW	-0.616	0.172	-3.580	0.000	-0.955	-0.278
CMA	-0.873	0.209	-4.180	0.000	-1.284	-0.461
_cons	0.001	0.001	1.290	0.197	0.000	0.002

Table 72: Think Global under the 5-Factor Model (8C)

Regression with Newey-West standard errors	N	=	260
max. lag: 4	F(5, 254)	=	103.33
	Prob > F	=	0

	Newey-West					
ER 8C	Coef.	Std. Err.	t	p > |t|	[95% Conf. Interval]	
RMRF	0.855	0.048	17.930	0.000	0.761	0.949
SMB	-0.749	0.112	-6.670	0.000	-0.970	-0.528
HML	0.093	0.160	0.580	0.560	-0.222	0.409
RMW	-0.480	0.178	-2.700	0.007	-0.830	-0.130
CMA	-0.480	0.199	-2.700	0.001	-1.091	-0.307
_cons	0.000	0.001	0.370	0.713	-0.001	0.002

Concerning the eight pair under the five-factor model, it can be seen that for the sustainable dataset all factors can be included in the regression equation, except for the HML factor that has a p-value of above 0-05. For the conventional model, the same case is true so that the HML factor will be disregarded in the model. Thus, the equations for both models will look like as follows:

$$8S = R_{i,t} - R_{f,t} = 0.001 + 0.872\left(R_{M,t} - R_{f,t}\right) + (-0.709\,SMB_t) + (-0.616\,RMW_t) + (-0.873\,CMA_t) + \varepsilon_{i,t}$$

$$8C = R_{i,t} - R_{f,t} = 0.000 + 0.855\left(R_{M,t} - R_{f,t}\right) + (-0.749\,SMB_t) + (-0.480\,RMW_t) + (-0.480\,CMA_t) + \varepsilon_{i,t}$$

$$t = 1,2,\dots,T$$

6.5 Sharpe Ratio

As an additional indicator to be analyzed is the introduced Sharpe Ratio. As it is independent from the different factor models, it will be also analyzed separately from the above chapters. The below figure delivers an overview about the Sharpe ratio for each ETF pair:

Table 73: Results of Sharpe Ratip for sustainable and conventional ETF pairs

	1S	2S	3S	4S	5S	6S	7S	8S
SR_p	0,83	0,98	0,66	0,42	0,40	0,71	0,56	0,72
	1C	2C	3C	4C	5C	6C	7C	8C
SR_p	0,68	1,12	0,23	0,25	0,28	0,86	0,51	0,52

To recap, the Sharp Ratio represents an alternative to risk-adjusted performance measurement. Unlike the Jensen alpha, the Sharpe ratio measures the excess return in relation to the total risk, measured by the standard deviation of the returns. To rephrase it, the Sharpe ratio reflects the reward-to-risk-ratio. It therefore takes into consideration that the investment into ETFs is always connected to risk, being set together from different risk components. The Sharpe ratio is therefore an indicator to represent how much risk an individual need to take in order to receive a certain return on his/her investment. The higher the Sharpe ratio, the better is the ratio between gained returns and involved risk, i.e. that a certain level of return can be achieved by a lower risk involved. Thus, it sets the whole investment into a different relation rather than just comparing the absolute annual return and risk indicators as described in the descriptive statistics.

The interpretation of the above table is therefore very insightful. Although the performance of the sustainable ETFs compared to their conventional counterparts is relatively mixed, the Sharpe ratio indicates that six from the eight chosen sustainable ETFs have a better ratio than their conventional peers. Thus, although they might deliver a slightly worse absolute performance, they also involve less risk in relative terms. Thus, the reward-to-risk ratio is better, and the earned results have been achieved with less risk involved. To put this into perspective of a private investor, this plays an important role as there are different types of risk level among the investors. In general, the fluctuation of the ETF is important for investors as this has also a psychological component in it. The less fluctuating the results seem, the more secure. Nonetheless, investing in ETFs cannot be compared with non-risky investments

in certain Government bonds, so the investor should be always aware that no return cannot be achieved with risks involved.

7 Conclusion and Discussion

In this research, two recent trends in the current financial word has been carefully observed and combined. On the one hand, sustainable and responsible investing and on the other hand investing into ETFs while following a passive investment approach. This section will conclude on the findings and will encourage to start a discussion about the results of the research. Finally, this section will summarize the major findings of the thesis by also pointing out where sustainable ETFs might over- or underperform compared to their conventional peers.

To start with, the thesis has shed light on the topic of sustainable and responsible investing per se. Here, the chapter has brought insights about the evolution historical development, stating that the principle of investing according to specific ethical or sustainable rules has been already established centuries ago. Nonetheless this topic is of big interest and urgency as society is constantly more concerned about the future development of ecological and social topics.

To structure this topic, the ESG framework has been introduced while emphasizing on the different aspects of investing in a sustainable and responsible manner. However, this framework only delivers the foundation that is meant to be as an outline. Thus, it is more important to reflect on sustainable and responsible investment principles as well as strategies for a practical application into the financial investment world. Here, one can identify that different methods are existent to follow a sustainable and responsible investment philosophy. On the one side, it is beneficial that general guidelines from the United Nations do exist and that the number of companies is constantly increasing who commit to those principles. On the other side, however, those principles are relatively wide, and are more a loose code of conduct rather strict rules that every company needs to follow. As a point of view from a private investor who seeks sustainable and responsible investment opportunities, those principles show too less commitment to be fully seen as a guideline for investing in a sustainable and responsible manner. However, there are also different practices how ESG factors can be practically implemented.

Thus, there are opportunities for each individual investor who seeks to invest his/her money into companies that really have a sustainable and responsible business model. This can be

seen also in the fact that the exclusion strategy is still the most prevalent method that is being used while implementing ESG factors into financial investment practices. As a last cornerstone of this aspect, theoretical considerations also state that having a sustainable and responsible mindset as a company is not only an invest and a cost-factor, but also generated additional value for the companies. Thus, the number of companies will also increase who integrate ESG factors into their operations since they see the strategic and long-lasting value of this investment. This change of the mindset will then hopefully lead not to a paradox where the private investor need to decide between “good”, i.e. sustainable and responsible investment, and “bad” ones, but where the majority of companies has already integrated ESG measures so that it will be natural to incorporate this in the corporate strategy and operations.

As a second building block of this research, Exchange Traded Funds have been carefully analyzed. Within this context, the evolution and historical development has been introduced to the reader. Furthermore, it is also important to understand the distinction of ETFs to other asset classes, such as Mutual Funds or Index Funds. The biggest difference here is that ETFs can be bought and sold on exchange, as the name suggests, and are openly traded on the commonly known exchange locations. This gives also the opportunity for private investors to freely choose about their own investment and they are not obliged to use asset management services that would charge extra fees. Thus, ETFs do share positive characteristics of stocks, but also the positive characteristics of Index Funds as they cover a broader scale than single stock investments.

Nonetheless it is noteworthy to mention that ETFs can be used for different investment strategies. They can be used like stocks and bought and sold to at the “optimum” prices for generating the highest return for each individual investor. As an alternative, ETFs are predestined to be used for a passive investment strategy, including a buy- and hold strategy and a diversification through investing into widespread stock ETFs. This approach is even supported by both theoretical and empirical results so that passive investment through ETFs seems superior above other investment strategies, especially the active trading of assets. Out from the point of view of the author, this passive approach seems to be a method where abnormal returns might be missed out due to recent trends or recent well-performing stocks are underrepresented in the individual’s portfolio. However, it is a rock-solid method in which the risk-return relationship is well-balanced without having negative impact on the general performance of this passive portfolio. Nevertheless, investing into stock ETFs do involve certain risks and costs than one cannot neglect. However, the underlying relationship between risk and return cannot be crossed out of the investment equation so that each individual investor should be aware of those risk, but not be afraid to still invest. Overall, ETFs are ideal investment vehicles for private individual investors, as they can participate in the global

economy by investing into only a few ETFs and can consequently mime the return performance of the chosen markets that are covered by the ETFs.

While referring about the performance, it is not only about the basic parameters of average return and risk, reflected by the standard deviation of the respected asset. Performance measurement also covers certain factor models that include relevant characteristics to reflect the performance while analyzing for performance-impacting indicators.

Transferring the above-mentioned aspects into the practice, it is important to choose the correct instruments, i.e. ETFs, for a sustainable and responsible investment. Despite the interest in ETFs has steadily increased during the last decade, the available data is yet relatively scarce with regards to sustainability-themed ETFs. In addition, certain criteria needed to be fulfilled in order to be empirically observed within this thesis. At the end, only eight sustainability themes ETFs could withstand the selection, including criteria about the fund size, issuing data and availability on the German market. Nonetheless, those chosen ETFs could be easily matched with conventional similar ETFs as the variety of those is much broader due to their longer existence on the market. In direct comparison of the most relevant indicators, the sustainable ETFs usually involve higher costs based on their total expense ratio (TER) which has a direct impact on the net return for each customer. Here, the conventional ETFs have a disadvantage as they can be managed with lower TER due to their higher fund volume and longer existence on the market. Regarding their annual average return and standard deviation, the direct comparison shows a mixed picture while some sustainable ETFs have a better return, while some also show a higher risk involved. Thus, a clear picture cannot be found when just looking on the general descriptive statistics.

But overall, the relatively small amount of available sustainable ETFs for German private investors is a serious issue as it limits the opportunity to invest in different regions and markets across the globe. For example, a sustainable ETF covering the emerging markets could be used for this research as the relevant ETFs have not fulfilled the above-mentioned criteria. Consequently, a private investor loses the chance to diversify over those markets, having a direct impact on the dependency of the performance within the developed markets only. Furthermore, six out of the eight sustainable ETFs use a best-in-class approach, and only two using the exclusion approach for building a sustainable index. In consequence, this would mean that certain companies are still represented in the index, although their business segment overall might be criticized with regards to a sustainable and responsible business model. Taking a MSCI World ETF as an example, Microsoft and Intel as two big IT companies are integrated in the sustainable version of this index, while Apple, Facebook or Amazon are not. ExxonMobil as an oil company would be also not integrated in the sustainable index, while

Total might seem to be a company for a sustainable and responsible investment. Taken only those two examples show that the underlying business model and their impact is identical, but the best-in-class approach has its limitations if a private investor would really like to invest the money into companies with a profound sustainable and responsible business model. Therefore, a passive investment strategy with ETFs is somehow limited with regards to a pure sustainable and responsible investment. This strategy is rather useful to take part in the global financial markets to achieve the market return, and not to invest in SRI-related companies only. A private investor might also choose certain sector ETFs that are more focused on SRI, but this would lead to a higher industry risk so that those considerations have been left out in this research.

Nonetheless, a private investor still can invest in the broad ETFs with a sustainability-themed aspect. With this regard, it is interesting to recap the performance comparison between the chosen conventional and sustainable ETFs. Different performance measurement techniques have been applied in order to assess it. The research started with the single-factor model of CAPM, while constantly increasing the number of factors, including the Fama-French 3 factor model, the Carhartt 4-factor model as well as the Fama-French 5-factor model. In all models, the Sharpe-Ratio and the Goodness of Fit, measured by R^2, has been additionally used to evaluate the performance.

To generally conclude, further research is needed in order to increase the available amount of data that is the basis for the analysis. Since sustainable ETFs are relatively new on the market, it is hard to generally draw a conclusion on their long-term performance compared to their conventional peers. This research showed that, for some sustainable ETFs, the performance seemed better. Nonetheless it is noteworthy to mention that the available data is still very limited when using ETFs that can be traded in Germany. Due to the increasing desire for sustainable and responsible investments as well as the increasing demand for ETFs, the offer for German private investors will be bigger, and thus a performance comparison on a broader scale will generate more valuable insights.

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