Environmental fund performance compared to conventional funds

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ABSTRACT,
The goal of this thesis was determining whether there is a difference in performance between environmental and conventional funds. For that a group of low-carbon emitting funds in Europe were identified and paired with appropriate conventional funds of the same size and location. Historical data for 10 years was then collected for each fund and their daily raw returns, Jensen's alphas, Sharpe, and Treynor ratios calculated. Those ratios were then combined into equally weighted portfolios and compared using the non-parametric Mann-Whitney U mean rank test. Additionally, Jensen's alpha, Sharpe ratio and the Treynor ratio were calculated for each fund in order to get more insight.
Unfortunately, there were a number of constraints regarding the data availability and collection, as the current situation in Europe is characterized by a large amount of heterogeneity in the definitions and reporting of environmental sustainability.
This study did not find any significant difference between the two groups neither through the statistical tests nor through the annualized performance of each fund.
The conclusion therefore is, according to the data at hand, there is no distinguishable difference between the performances of our identified environmental (low-carbon emitting) funds and their conventional counterparts.

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Keywords
Environmental sustainability, fund performance, Exchange Traded Funds, Conventional Funds.

1. INTRODUCTION

In Finance, appropriate risk assessment is key to every investment and portfolio strategy both on a personal and an institutional level. Concepts such as the risk-reward relationship, the CAPM, and the efficient frontier all not only improve the decision-making process when investing but are arguably key to minimising downsides and controlling the impact of the market's volatility on the portfolio.

Portfolio theory was first introduced by Markowitz in this 1952 publication "Portfolio Selection", in which he argued in favour of the superiority of proper diversification and therein the balancing of the expected return with the involved risk (Markowitz, 1952). This maxim of combining only weakly or inversely correlated equities in order to minimise risk exposure (diversification) is as alive today as it ever was and is a core principal used by most if not all institutional asset management firms worldwide.

However, the occurrence of climate change is introducing an immense shift in many aspects of the globe and will therein also shift many ways of conducting business and the logic behind it. There is no denying that climate change will have far reaching implications and that humankind has to innovate and change a vast variety of different practices and policies, including many traditional ways of producing and shipping goods and bringing utilities to the people.

According to the EPA, in 2010 25% of all global CO2 emissions are produced through Electricity & Heat Production, 24% through Agriculture, and 21% through Industry alone (EPA, n.d.). Therefore, in order not to cause a climate catastrophe, all these industries will either have to completely innovate themselves or have to be phased out sooner or later.

Nonetheless, this will not be as simple as restricting people from buying three iPhones a year but needs to entail a change in some of the most fundamental practices in all societies worldwide. Electricity cannot simple be shut off but needs to be innovated to run on carbon-free techniques that are viable for the future. The production of concrete is absolutely vital for infrastructure, but it is contributing 8% of total CO2 emission per annum (Chatham house, 2018). No matter where one is looking, the transition to a sustainable economy will entail many complex challenges that will introduce a lot of uncertainty into the world economy for the foreseeable future.

This will naturally have immense implications for the ease of assessing risk and running an efficient and effective portfolio. Many of the large asset management firms and funds have existed for some time and their strategies are based on traditional ways of evaluating business opportunities. However, the level of uncertainty only ten years into the future is much higher than it was at any point during the last two decades at least. Hence, being able to appropriately estimate and forecast the impact climate change will have on the risk controllability and thus long-term performance is one of the key questions facing the asset management industry now (Rayner, n.d.).

Accordingly, the scientific interest in the financial aspects have been part of financial literature since the 90s with the emergence of Socially Responsible Investing (SRI) as a field of research around that time. Nowadays the amount of research into the field has grown substantially, however there has been little to no consensus on any results yet wherefore the topic and its insight still have a lot of room for improvement. This study will try do contribute empirical evidence, in the form that it will only concentrate on a single SRI dimension in order to keep confounding influences as low as possible. By doing this this study tries to contribute a piece of empirical evidence about the impact of the environmental dimension on financial performance.

Therefore, the proposed research question for my bachelor is formulated as follows:

In asset management, can a "environmental" investment strategy achieve better risk-adjusted returns than a conventional (non-SRI) strategy?

2. LITERATURE REVIEW

2.1 History

The practice of using ethical concerns in order to rate investment opportunities is an ancient concept and has its roots in ancient Jewish religion. One example is Jews being forbidden from taking interest on loans to another Jew (Ahmad, 1981). According to George (1957), the Christian west implemented similar ruling during the middle ages and the Christian church tries to this day to invest their money according to a number of moral and ethical principles.

During the 17th Century the practice found interest in North America, with the Quakers refusing to participate in the weapons and slave trade and the Methodist movement, a protestant religious movement forbidding the exploitation of others, being founded (Renneboog, 2008; Behrens, 2015).

Nonetheless, the practice of including ethical concerns into one's investment strategy has had a renaissance during the second half of the 20th century when a number of major events and catastrophes led to a re-evaluation of many individuals sense for ethical behaviour. In most academic work on Socially responsible investing (SRI) the Vietnam War, the Exxon tanker crash, anti-racist movements in South Africa, and the Chernobyl disaster are mentioned as early causes for this shift in sentiment (Renneboog, 2008; von Wallis & Klein, 2014). Whereas the typical investment strategy prior to that time was simply based on maximising financial gain/growth, from that point on the inclusion of ethical concerns into one's strategy slowly moved into the foreground.

Generally from that time on, the palette of investment opportunities got expanded by new funds working on this new split financial and ethical approach. To this day there is a huge industry for "halal investing", funds who do not invest their client's money into what Islamic tradition would view as sinful products, such as pork, alcohol and gambling (Yusof et al., 2010). The Vietnam war and Exxon disaster specifically were also the breeding grounds for a number of ethical funds that tried to appeal to

investors wishing to not give their money to companies seen as unethical in the public eye (Renneboog, 2008).

During the 1980s and 90s this culminated in the creation of a new academic field that was working on understanding this shift in strategy: the field of socially responsible investing (SRI).

2.2 Terminology

The field of socially responsible investing (SRI) has grown substantially since its inception (14025 results on jstor.org for the term "socially responsible investing"), however even so it is still showing a large amount of heterogeneity in its definition and focus (von Wallis & Klein, 2015; Berry & Junkus, 2012). Even though the older term ethical investing is slowly being phased out in favour of SRI, none of the two can be attributed a single accepted definition.

Sandberg et al. (2009) define SRI to be the act of integrating "certain kinds of non-financial concerns – variously called ethical, social, environmental, or corporate governance criteria – in the otherwise strictly financials-driven investment process". Whereas Shkura (2019) defines it as "an investment [in] tangible and intangible form focused on creating long-term value taking into account the impact on the environment, social sphere, quality control, and ethical obligations".

When looking at similarities of the many definitions available, notwithstanding any heterogeneity, some patterns and similarities can be identified. Generally, most if not all definitions are based on the fundamental principle of adapting one's investment strategy by including both financial goals and ethical and sustainability concerns/ screenings, instead of just the former one (shareholder-view).

On a different note, Dorfleitner & Utz (2012) argue the inherent heterogeneity in SRI should not be seen negatively or worked towards changing. Instead, in their view the nature of acting ethical and sustainable has such different implications for every individual that trying to capture the concept with a single definition would lead to the certain exclusion of some viewpoints. To give an example, no matter how ethical and sustainable an alcohol or tobacco-producing company is to become, an investor opposed to the availability of drugs and addicting substances will never rate such a company high on his list and would most likely exclude it with a negative screen.

Therefore, for the remainder of this paper SRI will be defined as "the implementation of additional non-financial screening methods – based on ethical, environmental, societal, or corporate governance concerns – into an investment strategy in order to contribute to sustainable practices in business."

Most of the time, SRI funds operate by implementing a so-called "positive or negative screening" into their company vetting process. A negative screen works by identifying variables that disqualify a company from further examination, such as the removal of pork and alcohol producers from a halal fund's investment universe. A positive screen on the other hand is identifying positive features in a company and ranking them according to their effect. A positive screen would for example entail checking companies for their way of treating employees or their annual carbon emissions and include that as a factor in their investment decision or even simply choosing the best of a certain category.

2.3 Theoretical discussion

Since its inception in the 90s the field of SRI has seen continuous academic interest and especially in the beginning many scholars have built cognitive models and concepts and tried to predict how a SRI strategy would perform compared to one purely based on financial variables, which will be called conventional strategy in the remainder of this paper.

One of the early inferences created was the application of Merton's (1987) work on how incomplete information affects performance. If the exclusion of companies based on SRI concerns can be seen similar to not having information about those companies, it should infer that a SRI-based strategy should underperform due to its potential investment universe being smaller and therefore the optimal efficient frontier being smaller as well. A similar argument is made by Hamilton et al. (1993). This notion of SRI underperformance is also supported by Cowton (1998), who argues that SRI should always underperform the mainstream, since the latter is able to copy the former, whereas the former is bound to its smaller horizon.

Luther et al. (1992) find that the additional monitoring costs of implementing extensive screening methods will decrease potential returns, another argument for underperformance. Michelsen et al (2004) & Tippet (2001) go as far as to call the phenomenon of underperformance the "ethical penalty"

Nonetheless, there are also some logical arguments in favour of overperformance of SRI stock. Technically, if the process of screening companies is showing some information that was not available otherwise, Merton (1987) would be applicable again, only that this time the conventional strategy is missing information and is therefore positioned worse. Hamilton et al. (1993) also not only features negative scenarios with SRI performance. Hamilton argues that the impact of negative news due to negligence are likely underestimated by conventional strategies and the implementation of some screening process would secure a portfolio against this kind of downside. Similar arguments are made by Moskowitz (1972), who discovered that good environmental screens could protect a portfolio against high liabilities in case of an environmental disaster.

2.4 Empirical findings in academic field

Even though the theoretical section of SRI is arguably sided towards underperformance, the empirical studies trying to verify that notion over the years have failed to do so. While there have been a large number of empirical studies investigating the performance effect of SRI on mutual funds, there has been little to no consensus on the results and their implications. In the following I will give a brief summary of conducted empirical studies mostly

based on two literature reviews, by Renneboog et al. (2008) and von Wallis & Klein (2015).

2.4.1 SRI has no difference in performance to conventional strategy

Hamilton et al. (1993) compared 32 SRI mutual funds to NYSE returns and did not find either to outperform the other. Guerard (1997) finds that ethical screening as a process does not yield any outperformance compared to conventional means. Sauer (1997) creates his own portfolios and compares them to the Domini Social Index 400, which is made up of the highest ESG score company of each sector with similar weights to its parent index the MSCI USA IMI Index (MSCI, n.d.), and again does not manage to create an outperformance scenario. Statman (2000) takes the Domini Social Index from 1990 to 1998 and compares it with the S&P500, again finding no difference in performance.

Later both Schroeder (2004), who compared US, German, and Swiss SRI funds with individual benchmarks, and Bello (2005), comparing 1994 to 2001 ethical funds to conventional counterparts, did not manage to find any significant difference in performance. Other studies such as Kreander et al. (2005) and Mill (2006), also are using similar methodologies and even larger data sets but still fail to identify any significant difference.

2.4.2 SRI is underperforming conventional strategy

Even though the theoretical work described above identified SRI underperformance to be the most likely effect to be found, according to von Wallis & Klein (2015), only 6 studies have managed to do so.

Teper (1992) compared the Domini Social Index with the S&P500 from 1985 to 1989 and found significant underperformance of the SRI side. Kahn et al. (1997) find that S&P500 portfolios containing tobacco and sin stocks outperform portfolios without those stocks. Similarly, Gregory et al. (1997) finds SRI mutual funds underperformance when using a matched-pair analysis. Tippet (2001) finds substantial underperformance of three Australian mutual funds compared to their benchmarks and argues he identified higher management cost and transaction fees in the ethical funds to be the reason. The last identified study finding underperformance was Geczy et al. (2005). They compared self-built SRI portfolios with conventional ones (ones picked from a broader universe) and found the SRI portfolios to have lower Sharpe ratios than their conventional counterparts.

2.4.3 SRI is outperforming conventional strategy

Surprisingly, more than twice that many studies have managed to find some kind of significant outperformance of their SRI unit of analysis. The earliest identified study is Grossmann & Sharpe (1986) who identified South-Africa-free portfolios to outperform their counterparts. Even though Luther et al. (1992) do find statistical evidence for SRI outperformance, they make clear that the effect is probably too diversified and weak to be used as definitive proof. Similar problems occur with D'Antonio et al. (1997), who found an outperformance of the SRI approach, however, mention in their paper the effect is likely only due to differences in credit risk between the unit of analysis and the benchmarks.

Mallin et al. (1995) are also comparing ethical mutual funds to their conventional counterparts during the period 1986-1993 and found the SRI ones performing better. Similar results have been achieved by Travers (1997) who compared ethical funds with the MSCI EAFA benchmark for 1992-1997 and found the ethical funds to perform better.

In the 2000s, the main studies finding SRI outperformance were: Bragdon & Karash (2002), Derwall et al. (2005), Hill et al. (2007), Kemp and Osthoff (2007) and Shank et al. (2005).

3. HYPOTHESIS

In order to not contribute to the confusing and confounding nature of the subject, this study will try to only focus on one of the largest types of screenings applied: environmental screenings. This way only a single influence of the rooster of social responsibility is being analysed. "Environmental" in the remainder of this research will refer to environmental sustainability, or "the investment necessary to reduce greenhouse gas and air pollutant emissions" (Inderst et al., 2012).

Therefore the hypothesis of this research is:

- *H0: European environmental funds perform the same as their conventional (non-SRI) counterparts in terms of risk-adjusted returns*
- *H1: European environmental funds perform significantly differently than their conventional counterparts in terms of risk-adjusted returns*

4. METHODOLOGY & DATA

4.1 Methodology

According to von Wallis & Klein (2014), a majority of their 53 identified empirical studies have used Jensen's alpha (31) as their main measure with Sharpe ratio (14) and average returns (14), as well as Treynor ratio (6) completing the four main measures used in empirical SRI studies.

Hence this study is complying with the convention and uses Jensen's Alpha, the Sharpe ratio, and the Treynor ratio as its measures.

Additionally, in order to keep confounding influences as low as possible, this study is following Mallin et al. (1995), Gregory et al. (1997), Statman (2000), and Kreander et al. (2005), in that it will use a matched-pair analysis. This entails choosing the conventional sample in a way that is matching the environmental sample in a number of characteristics. In the abovementioned studies the main characteristics featured are size (net asset value), age, and location of the funds.

However, due to data constraints explained later, this study only uses size and location as the characteristics both samples are matched upon.

Afterwards, the three measures are calculated for each fund on an annualised basis similar to Kreander

et al. (2005), which should create a singular overview over the samples and funds. Additionally, the samples are combined into equally weighted portfolios to reduce the effect of outliers and create a more stable picture. The raw return plus the three ratios (α, S, T) will then be calculated for those portfolios on a daily basis and each will be tested.

Hence the following ratios are calculated on an annualised basis for the individual returns and on a daily basis for the combined samples.

Jensen's alpha $\alpha = R(i) - (R(f) + \beta * (R(m) - R(f)))$ is a method of risk-adjusting excess return, by subtracting the risk-free rate and the return of the market relative to the investments beta in order to establish how much better/worse an individual return was compared to the market and risk-free rate. Here α is the achieved excess return, R(i) is the realized return, R(f) is the risk-free rate, β is the beta of the portfolio, and R(m) is the return of the market.

The Sharpe ratio $S = \frac{R(i)-R(f)}{\sigma(i)}$ compares an investment's performance to the risk-free rate adjusted for the investments risk. It can therefore help to evaluate how much outperformance an investment achieved relative to the risk it took. S is the Sharpe ratio, R(i) the investment's return, R(f) the risk-free rate, and σ(i) is the investment's standard deviation or risk.

Lastly, the Treynor ratio $T = \frac{R(i)-R(f)}{\beta(i)}$ is swapping the standard deviation for the investment's beta. Therefore this measure is not looking at the investment's risk solely based on its own volatility, but rather is involving the market's movements into the measure. Again, T is the Treynor ratio, R(i) the investment's return, R(f) the risk-free rate, and β(i) is the investment's beta.

As mentioned, the three ratios plus the raw return will additionally be calculated on a daily basis for equally weighted portfolios made up of the two groups.

These four are then individually compared via a Mann-Whitney U mean rank test in SPSS. This test was chosen since a test for normality yielded a non-normal distribution for each, as well as them being continuous in nature.

4.2 Data

In order to offer comparable results with as little ambiguity as possible, a quantitative measure for whether a fund is environmentally friendly is used.

YourSRI is a project by the Centre for Social and Sustainable Products AG (CSSP) in which they are tracking company carbon emissions and extrapolate the emissions each share "owns" which can then be combined for funds in order to estimate their carbon footprint coming from their investments (CSSP, yoursri.com, n.d.).

Their website offers access to different categories of funds, however the only one compatible with the ECB databank was the class of Exchange Traded Funds (ETF), hence why they are chosen.

For ETFs with under a rating under 200, yourSRI was offering the data for 48 different environmental funds, which were chosen as the environmental sample for this study. This should only include highly sustainable funds and offer a good sample basis.

Those 48 were then categorised according to size and location via the ECB database of all active funds in Europe and appropriately matching conventional funds were randomly chosen from the fitting population, based again on the ECB database.

During this step 7 funds and their counterparts had to be eliminated leaving 41 funds per sample. This was due to four of the environmental funds being too young, two could not get matched appropriately, and one environmental fund had faulty data.

Since a number of the environmental funds are quite young a minimum amount of data of 12 months was set as the boundary.

In total, data from the 1st of January 2010 until the 31st December 2019 was collected in order to achieve a time frame of 10 years.

Lastly, the daily risk-free rate and the market return for Europe were obtained from Kenneth French's website (Kenneth French website).

5. FINDINGS

When looking at the ratios for each fund it is immediately obvious that the performances of the funds differ substantially in the groups themselves.

Three environmental as well as three conventional funds achieved an excess return upwards of 20% with two of each also achieving an alpha that high. This seems like something relating to the data as such a performance would be record breaking.

On average the performances were much lower but still positive with an average alpha of 4.57% and 3.48% for the environmental and conventional funds, respectively (table 1). However, it must be noted here that the inability to control for the funds ages certainly has an impact on the comparability of the individual funds.

Nonetheless, in this sample the environmental funds did indeed manage to achieve slightly higher ratios on average. Not only the mean alpha is higher but also both the conventional mean Sharpe and Treynor ratio are trailing behind the environmental ratios. Even though the environmental mean Sharpe ratio is 0.54 and with that considerably higher than the conventional sample's 0.23, their medians are much closer with 0.53 for the environmental sample and 0.50 for the conventional one. In the same time the market achieved an annualised Sharpe ratio of 0.32. Therefore, based on the average and with the outliers in mind, it can be stated that both samples did slightly better than the overall market.

A similar picture is happening with the Treynor ratio. Again, the environmental fund achieved a higher mean T with 0.14 than the -0.04 from the conventional sample. However, when looking at their medians the environmental (0.12) is only slightly higher than the conventional one (0.09).

Jensen's alpha is the only measure where the median is not as close together with the environmental funds

Table 1

Descriptive statistics for both groups of funds

Environmental						*Conventional*					
Name	ISIN	Sharpe ratio	Treynor	Beta	Jensen's	Name	ISIN	Sharpe ratio	Treynor	Beta	Jensen's
ComStage STOXX Europe 600 Banks UCITS ETF	LU0378435399	1.76	0.28	0.64	14.80%	AMUNDI INDEX SOLUTIONS - AMUNDI INDEX MSC	LU0389812008	-8.91	-2.23	0.01	-2.25%
ComStage STOXX Europe 600 RE UCITS ETF	LU0378436793	2.29	0.33	0.65	18.18%	AMUNDI INDEX SOLUTIONS - AMUNDI STOXX EUI	LU1681040223	1.24	0.22	1.19	20.28%
ComStage STOXX Europe 600 Tlcom UCITS ETF	LU0378437171	0.52	0.11	0.61	3.74%	COMSTAGE - COMSTAGE BLOOMBERG EQUAL-WE	LU1275255799	0.57	1.34	0.01	1.84%
Deka MSCI Europe ex EMU UCITS ETF	DE000ETFL458	0.76	0.42	0.05	1.75%	COMSTAGE - IBOXX EURO SOVEREIGNS GERMAN'	LU0444606700	0.80	-3.86	-0.01	2.50%
Deka MSCI Europe LC UCITS ETF	DE000ETFL086	0.75	0.16	0.28	3.19%	COMSTAGE - LEVDAX® X2 UCITS ETF	LU1104579369	1.84	0.25	0.99	19.91%
Deka MSCI Europe UCITS ETF	DE000ETFL284	0.56	0.10	0.74	3.30%	ComStage 1 TecDAX(R) UCITS ETF	DE000ETF9082	0.37	0.08	0.78	2.24%
Deka STOXX Europe 50® UCITS ETF	DE000ETFL250	-3.52	-1.55	0.00	-0.72%	ComStage Alpha Deutschland Dividende Plus UCITS ETF	DE000ETF7516	0.63	0.12	0.46	3.03%
Deka STOXX® Europe Strong Growth 20 UCITS ETF	DE000ETFL037	0.58	0.12	0.60	4.36%	ComStage Vermoegensstrategie Offensiv UCITS ETF	DE000ETF7037	1.07	0.31	0.43	11.21%
Deka STOXX® Europe Strong Style Comp 40 UCITS ETF	DE000ETFL052	0.68	0.18	0.51	6.76%	Deka DAX(R) UCITS ETF	DE000ETFL011	0.63	0.10	0.97	4.68%
Deka STOXX® Europe Strong Value 20 UCITS ETF	DE000ETFL045	0.64	0.13	0.69	5.52%	Deka Dt Börse EUROGOV Germany 5-10 U ETF	DE000ETFL201	-0.20	-0.10	0.48	-7.24%
Fidelity Europe Quality Income UCITS ETF EUR Acc	IE00BYSX4283	0.72	0.17	0.69	8.18%	Deka EURO STOXX Select Dividend 30 U ETF	DE000ETFL078	0.42	0.09	0.64	2.66%
Invesco MSCI EU ESG Lds Cath Princpl UCITS ETF Dis	IE00BG0NY640	0.55	0.12	0.59	4.11%	Deka Eurozone Rendite Plus 1-10 UCITS ETF	DE000ETFL490	0.67	-0.28	-0.12	3.97%
Invesco MSCI Europe ex-UK UCITS ETF	IE00BYX5K108	-0.12	-0.02	0.97	-6.98%	Deka MSCI Europe MC UCITS ETF	DE000ETFL292	1.68	0.24	1.04	20.16%
Invesco STOXX Europe 600 Opt Food & Beverage ETF	IE00B5MTYL84	0.67	0.18	0.54	6.92%	First Trust Germany AlphaDex® UCITS ETF	IE00BWTNM966	0.40	0.29	0.07	1.77%
Invesco STOXX Europe 600 Opt Health Care ETF	IE00B5MJYY16	3.08	1.47	0.17	23.97%	HAN-GINS Cloud Technology UCITS ETF	IE00BDDRF924	0.69	0.12	0.81	5.81%
Invesco STOXX Europe 600 Opt Media ETF	IE00B5MTZ488	0.28	0.05	0.82	-0.46%	Invesco EURO STOXX High Dividend Low Volatility UCI	IE00BZ4BMM98	0.43	0.07	0.82	1.35%
Invesco STOXX Europe 600 Opt Telecommunications ETF	IE00B5MJYB88	0.45	0.10	0.67	3.48%	Invesco STOXX Europe 600 Optimised Automobiles & Part	IE00B5NLX835	-0.08	-0.01	0.68	-4.03%
Invesco STOXX Europe 600 Optimised Banks ETF	IE00B5MTWD60	0.75	0.17	0.58	6.62%	Invesco STOXX Europe 600 Optimised Industrial Goods &	IE00B5MJYX09	0.33	0.07	0.72	1.49%
Invesco STOXX Europe Small 200 ETF	IE00B60SWZ49	0.53	0.12	0.58	3.85%	iShares € Covered Bond UCITS ETF	IE00B3B8Q275	0.62	0.11	0.73	3.87%
iShares € Corp Bond 1-5 yr UCITS ETF EUR (Dist)	IE00B4L60045	0.45	0.11	0.55	3.10%	iShares € Govt Bond 3-5yr UCITS ETF	IE00B1FZS681	0.90	0.20	0.35	5.07%
iShares € High Yield Corp Bond UCITS ETF EUR(Dist)	IE00B66F4759	0.17	0.04	0.65	-0.92%	iShares Core EURO STOXX 50 UCITS ETF	IE00B53L3W79	0.68	0.15	0.62	5.82%
iShares Core MSCI Europe UCITS ETF EUR(Dist)	IE00B1YZSC51	0.12	0.05	0.45	-0.17%	iShares DivDAX® UCITS ETF (DE)	DE0002635273	-0.15	-0.22	-0.01	0.29%
iShares STOXX Europe 600 Banks UCITS ETF (DE)	DE000A0F5UJ7	0.92	0.40	0.28	9.67%	iShares Edge MSCI Europe Minimum Volatility UCITS ETF	IE00B86MWN23	-0.07	-0.01	0.96	-5.53%
iShares STOXX Europe 600 Health Care (DE)	DE000A0Q4R36	0.73	0.19	0.65	8.74%	iShares EURO Dividend UCITS ETF	IE00B0M62S72	0.18	0.04	0.83	-0.81%
iShares STOXX Europe 600 Real Estate (DE)	DE000A0Q4R44	0.21	0.08	0.43	1.12%	iShares EURO Total Market Value Large UCITS ETF	IE00B0M62T89	0.20	0.04	1.21	-0.87%
iShares STOXX Europe 600 Technology UCITS ETF (DE)	DE000A0H08Q4	0.44	0.08	0.68	1.62%	iShares FTSE MIB UCITS ETF EUR (Dist)	IE00B1XNH568	0.55	0.11	0.72	4.31%
iShares STOXX Europe 600 Telecommunications (DE)	DE000A0H08R2	0.37	0.06	0.78	0.57%	iShares FTSEurofirst 80 UCITS ETF	IE0004855221	0.50	0.08	0.75	2.44%
iShares€Ultrashort Bond UCITS ETF EUR (Dist)	IE00BCRY6557	0.21	0.08	0.42	1.22%	iShares MSCI France UCITS ETF	IE00BP3QZJ36	0.71	0.18	0.64	8.40%
Lyxor 1 Stoxx Europe 600 UCITS ETF	DE000ETF9603	-0.10	-0.02	0.95	-6.41%	iShares Pfandbriefe UCITS ETF (DE)	DE0002635265	-2.35	0.60	-0.01	-0.66%
Lyxor STOXX Europe 600 Healthcare UCITS ETF - Acc	LU1834986900	0.56	0.15	0.57	5.79%	iShares S&P 500 EUR Hedged UCITS ETF (Acc)	IE00B3ZW0K18	-0.06	0.06	0.07	0.02%
Lyxor Stoxx Europe 600 Real Estate UCITS ETF SX86R	LU1812091194	0.22	0.09	0.40	1.44%	iShares STOXX Europe Large 200 UCITS ETF	DE0005933980	0.02	0.01	1.87	-8.41%
Lyxor STOXX Europe 600 Technology UCITS ETF - Acc	LU1834988518	0.49	0.16	0.46	5.00%	JPMorgan ETFs (Ireland) ICAV - Managed Futures UCITS	IE00BF2SYS28	0.39	0.07	0.94	1.43%
SPDR MSCI Europe Communication Services UCITS ETF	IE00BKWQ0N82	0.50	0.14	0.57	4.75%	JPMorgan ETFs (Ireland) ICAV EUR Ultra-Short Income U	IE00BD9MMF62	0.57	0.13	0.58	4.31%
SPDR MSCI Europe Financials UCITS ETF	IE00BKWQ0G16	0.90	0.24	0.50	9.46%	Managed ETFplus - Portfolio Opportunity	DE000A0NEBL8	1.02	0.21	0.82	12.76%
SPDR MSCI Europe Technology UCITS ETF	IE00BKWQ0K51	0.88	0.45	0.25	10.06%	Nomura JPX-Nikkei 400 Net Total Return Daily EUR Hedg	IE00BVVSZ262	0.51	0.10	0.80	4.08%
Vanguard FTSE Developed Europe UCITS ETF	IE00B945VV12	-0.12	-0.02	1.02	-7.34%	OSSIAM LUX - OSSIAM SOLACTIVE MOODY'S ANA	LU1093307442	0.07	-0.07	-0.13	1.60%
Xtrackers FTSE Develpd Europe Restate UCITS ETF 1C	LU0489337690	2.07	0.32	0.95	25.39%	PRIVACON ETF-Dachfonds Anlagechancen global (I)	DE000A2DL4E9	0.60	0.10	0.83	4.36%
Xtrackers S&P Europe ex UK UCITS ETF	IE00BGV5VM45	-0.03	-0.00	1.03	-5.42%	SPDR Bloomberg Barclays 5-7 Year Euro Government Bor	IE00BYSZ5Y35	0.61	-0.55	-0.03	1.67%
Xtrackers Stoxx Europe 600 Banks Swap UCITS ETF 1C	LU0292103651	0.19	0.07	0.46	0.76%	UBS ETF - FACTOR MSCI EMU PRIME VALUE UCIT	LU1215452928	0.41	0.10	0.73	3.53%
Xtrackers Stoxx Europe 600 UCITS ETF 1C	LU0328475792	0.93	0.35	0.34	9.97%	XTRACKERS - STOXX EUROPE 600 TECHNOLOGY S	LU0292104469	0.42	0.09	0.83	3.26%
Xtrackers Stxx Europe 600 Telecom Swp UCITS ETF 1C	LU0292104030	0.15	0.04	0.90	-1.38%	XTRACKERS II - EUROZONE INFLATION-LINKED E	LU0290358224	0.41	0.09	0.66	2.50%
All ratios are calculated on an annualised basis	Mean	0.54	0.14	0.58	0.05		Mean	0.23	-0.04	0.60	3.48%
	Median	0.53	0.12	0.58	0.04		Median	0.50	0.09	0.72	2.50%

achieving a median alpha of 3.74% while the conventional only managed to achieve a median of 2.5%.

This is again supporting the picture that the environmental funds slightly outperformed the conventional ones; however it is important to keep in mind the limitations.

Nonetheless, in order to further test this notion, all the funds in each group are combined into equally weighted portfolios and their daily raw return, alpha, Sharpe, and Treynor ratio are compared individually via the non-parametric Mann-Whitney U test. This way the average performance over the whole ten years can be measured for the data that is available.

In the following the results for each will be discussed individually and then combined in the results section.

Table 2

Daily Jensen's alphas

	Environmental	Conventional
Mean	0.010%	0.011%
Median	0.004%	0.013%
Max	2.57%	1.89%
Min	-3.56%	-2.80%
St Deviation	0.52%	0.41%
Mann-Whitney U test statistic		0.463

The results for the test statistic show similar means for the daily alphas for both groups (table 2). The environmental portfolio achieved 0.010% per day and the conventional managed to get 0.011% per day. However, the environmental portfolio only managed a median daily alpha of 0.004%, while the conventional one achieved 0.013%. This shows an outperformance of the conventional portfolio based on the median that was however not captured by the mean. One potential reason could be a number of strong performers in the environmental group being rather young, leading to this distortion.

Another noticeable thing is the higher volatility of the environmental portfolio. Both the standard deviation (environmental: 0.52%; conventional: 0.41%) and the minimum and maximum show the environmental portfolio producing larger daily jumps than their conventional counterpart.

In total, the MW U test for daily alphas did not capture any significant difference and yielded the non-significant P-value of 0.463 (P-value > 5%).

The comparison of the raw returns (table 3) yields a similar picture, with the difference in standard deviation, or volatility, of the environmental portfolio showing again. Whereas the conventional portfolio features a daily standard deviation of 0.73%, the environmental raw returns have one of 0.93%. Again, the same thing can be said about the minimum and maximum with the environmental

Table 3

Daily Raw Returns

	Environmental	Conventional
Mean	0.037%	0.032%
Median	0.057%	0.052%
Max	7.30%	4.70%
Min	-6.80%	-4.70%
St Deviation	0.93%	0.73%
Mann-Whitney U test statistic		0.446

portfolio having a max of 7.3% and a min of -6.8% while the conventional one reached 4.7% and -4.7% respectively.

Nonetheless, via the raw returns the environmental portfolio yielded a slightly higher mean and median with 0.037% and 0.057% respectively, while the conventional reached 0.032% and 0.052%.

Still, the MW U test did not find any significant difference between the two raw return samples and yielded a P-value of 0.446 (P-value > 5%).

Table 4

Daily Sharpe ratio

	Environmental	Conventional
Mean	0.04	0.67
Median	0.06	-0.02
Max	7.80	1.37
Min	-7.30	-1.17
St Deviation	1.01	0.64
Mann-Whitney U test statistic		0.670

The daily Sharpe ratios for both portfolios (table 4) shows an extremely high mean of 0.67 for the conventional one compared to the 0.04 for the environmental. However, this does absolutely not show in the median where both portfolios are much closer together (environmental: 0.06; conventional: -0.02). This is likely due to issues related to the data as the median of the conventional portfolio shows completely different pictures depending on the ratio.

Still the standard deviation shows a similar outcome to the alpha and raw returns. Again, the

environmental sample seems to have a much larger volatility with both its standard deviation (E: 1.01; C: 0.64) and the min and max being much larger.

However, using the MW U test no statistically significant differences were discovered with the test delivering a P-value of 0.670 (P-value > 5%).

Table 5

Daily Treynor ratio

	Environmental	Conventional
Mean	0.04	0.02
Median	0.06	0.03
Max	8.54	3.17
Min	-7.97	-3.20
St Deviation	1.09	0.50
Mann-Whitney U test statistic		0.085

Lastly is the Treynor ratio (table 5). Here the environmental portfolio reached a mean T ratio of 0.04 and a median of 0.06. The conventional on the other hand only managed a daily T ratio mean of 0.02 and a median of 0.03. This is considerable difference even if not large in absolute terms and shows an outperformance of the environmental fund in terms of performance per beta, or in other words performance per market risk taken.

Nonetheless, the MW U test was not able to identify any significant difference and yielded a P-Value of 0.085 (P-value > 5%).

However, it is mirroring the other test in that it also shows a much higher standard deviation of the environmental portfolio compared to the conventional one.

6. LIMITATIONS

Before summarizing and analysing the results a number of constraints and limitations impacting said results have to be discussed.

As already mentioned throughout this text, the field of SRI has a high degree of heterogeneity and the same can be said about the situation in Europe regarding the definition and measurement of concepts such as environmental sustainability. All throughout the literature different definitions are used which impacts the way methodologies are chosen and built.

Even though this study tried to eliminate some of that heterogeneity by only focusing on the dimension of environmental sustainability in form of low-carbon emitting funds, the methodology used here is only exactly that. A comparison of low-carbon emitting funds with conventional ones.

It is an ongoing debate about how to accurately measure even only the carbon footprint of complex entities such as companies or funds (Loman, 2014). The one chosen in this study (tonne CO2/ million Euro revenue) is only one of those, however the investigation into which one is the best would entail a whole piece of research in in itself and was not feasible in this study.

Hence the aforementioned measurement being used.

Furthermore, apart from deciding on an appropriate measure, this study also has to rely on the accuracy of CSSP's own dataset and the fact that there are no funds missing in their data.

After collecting the names and ISINs of the environmental funds the ECB database has been used in order to correctly identify and categorise each fund and match them properly. This in conjunction with the usage of ariva.de for the collection of historical data by hand is introducing a large area for potential mistakes and a number of funds were excluded based on missing data. Therefore, all results can only be as good as those sources. Additionally, since the environmental funds were taken from yourSRI the total number available was 48 even though there certainly were more fitting the same parameters.

Lastly, since the ECB database had no measurement of the age of the funds, matching them accordingly was not possible. Even though effort was put into checking at least a minimum amount of data and a certain similarity between the age profiles a complete match was not feasible.

7. CONCLUSION

When combining the findings from **5**. there is a number of interesting findings.

First and foremost, none of the test conducted with this data have resulted in a statistically significant difference based on the Mann-Whitney U test.

The four measures, raw return, Jensen's alpha, Sharpe ratio, and Treynor ratio mainly delivered similar results for both portfolios. Whereas there are only few concise results for the return-side of the performance, according to the data at hand, environmental funds seem to have considerably higher standard deviations than their conventional counterparts. Generally, it seems to be the case that the environmental funds are getting a slightly higher return than their conventional counterparts but do so with higher risk. This in turn leads to the risk-adjusted measures used in this research not showing a difference in performance.

Hence, according to this research it can be stated that environmental funds do indeed have higher standard deviations than their conventional matches, however this difference does not show in the risk-adjusted measures.

Generally, according to the data and measures used here there seems to be no significant difference in performance between environmental (as in low-carbon emitting) and conventional funds in Europe.

Nonetheless, since most studies conducted so far on this topic mainly focus on risk-adjusted results, it would be interesting to investigate whether the risk-profiles found in this samples fund can be replicated

and whether this higher average risk for environmental funds is true for the total population. Additionally, as mentioned in the limitations, this study had a number of restrictions concerning data availability as well as the heterogeneity of definitions in the European finance world. Hence this study was only able to look at one specific definition and it should be mentioned again that there is an ongoing debate about what definition for sustainability is accurately covering its true reality. This again opens up many possibilities for future research as a comparison between different definition in the individual SRI dimension should definitely be useful for understanding the topic thoroughly.

To summarize, this study was not able to identify any significant difference in performance between the two types of funds and did therefore not find any evidence that implementing environmental screenings improves financial results.

This however is not necessarily bad for environmentally conscious investors. As discussed in the literature review, many scholars argue that imposing those restrictions on one's investment strategy would result in worse performance. This study was not able to replicate this notion, even if it only did so for the restriction of low-carbon emissions.

In total, notwithstanding the mentioned limitations in data availability and the heterogeneity in this topic, this study did find no difference in performance between environmental, as in low-carbon emitting, and conventional funds. If supported by future literature, this would imply that there indeed is no penalty for investing ethically which would be great news for every investor trying to combine financial performance and environmental consciousness.

However it is important to acknowledge that there is a lot of room for further research in the environmental dimension of SRI and many pieces of research will be necessary to fully understand all the different aspects to environmental sustainability and how it affects financial performance.

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