



Sustainability Alpha in the Real World: Evidence from Exchange-Traded Funds

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Table of Contents

Executive Summary	5
1. Introduction.....	7
2. Data	13
3. Real-World Sustainable Investment Performance	17
4. Conclusions.....	24
Appendix	26
References	31
About Scientific Beta.....	34
Scientific Beta Publications	37

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Abstract

We assess the performance of sustainable investing from a value-weighted portfolio of exchange-traded funds that follow systematic ESG investing strategies in the US equity market. We find that sustainable investing did not deliver higher returns than standard index funds. Widely commented periods of outperformance, such as the year 2020, can be explained in large part by industry effects, such as a tilt towards technology stocks. Over the past decade, such periods of outperformance are offset by corresponding periods of underperformance, leaving ESG investors with returns of -0.2% compared with the market index and -0.7% compared with a benchmark with matching industry exposure.

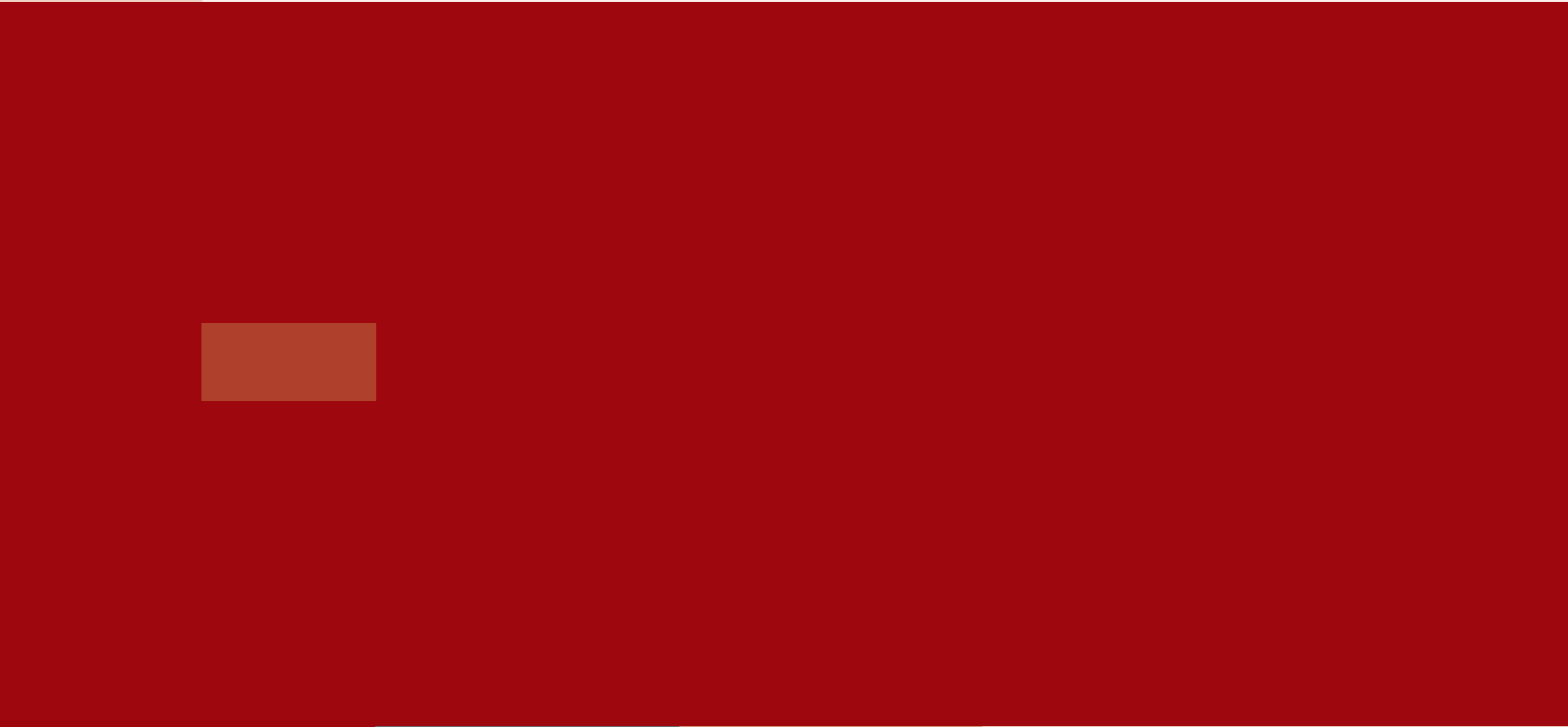
Executive Summary

Executive Summary

In recent years, there has been a growing interest in sustainable investing, which integrates non-financial considerations such as environmental, social, and governance (ESG) criteria in investment decisions. A key concern for all investors is whether integrating non-financial considerations has an impact on financial performance. However, assessing the realised impact on performance is difficult due to the existence of disparate approaches to define and capture sustainability. We address this problem by constructing a monthly rebalanced portfolio, the Sustainable Investing Portfolio, composed of sustainable ETFs that invest in the US equity market. This portfolio reflects real ESG approaches available on the market, weighted by their popularity. Therefore, it provides a more representative and less arbitrary assessment of the impact of sustainability on performance than stylised strategies. In addition, this portfolio only invests in products that adopt systematic approaches to tilt toward ESG. This gives us results that are not polluted by confounding effects, such as fund managers' skill in picking stocks or in timing the market.

Our results show that, over the past decade, the Sustainable Investing Portfolio did not outperform its benchmarks. If anything, realised returns of the Sustainable Investing Portfolio were marginally lower than its benchmarks. Indeed, average annual returns were 0.2% lower than the proxy for the US equity market, and 0.1% lower when we account for the portfolio's market risk exposure. Removing industry factors' contributions reduces performance even more – annualised industry-adjusted returns are -0.7% on average. Breaking down the performance in shorter time periods (the last ten calendar years), we identify one year (2020) characterised by a large outperformance over the market (+4.2% in relative returns and CAPM alpha). However, this short-term extra-performance represents just a statistical outlier. In addition, even this outlier is mostly due to sector-biases rather than to the ESG-tilt of the sustainable ETFs.

Overall, the evidence from real-world investment products shows that sustainability did not generate "sustainability alpha" over the past decade. We encourage investors to consider such 'real-world' results and be aware of the limitations of analyses that select particular funds or create stylised strategies that may not reflect options actually available to sustainable investors.



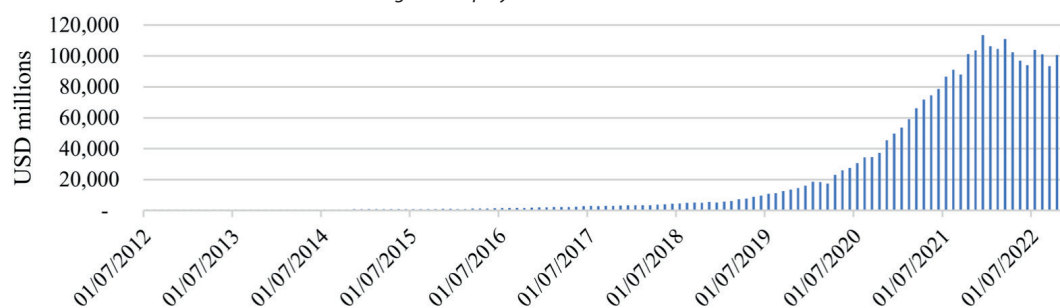
Introduction

1. Introduction

In recent years, investors have shown a growing interest in sustainable investing, an approach that integrates non-financial considerations, such as environmental, social, and governance (ESG) criteria in investment decisions. This growth in demand may have several drivers, such as achieving social impact, aligning portfolio holdings with investors' ethical preferences, or hedging ESG-related risks (e.g., climate transition risk). For some investors, however, the motivation may be the belief that sustainable portfolios can help to improve financial performance. In particular, these investors expect that integrating non-financial information can be used to generate "sustainability alpha", i.e. abnormal returns in excess of benchmarks that reflect risk exposures.¹

Whether integrating non-financial considerations has an impact on financial performance is a key concern for investors, whatever the main driver of their demand for sustainable investing may be. In this paper we investigate this question empirically. In particular, our objective is to properly assess the 'real-world' impact of sustainability on performance. In other words, we want to analyse the performance of investment products actually available to investors. For this we focus on the market for exchange-traded funds (ETFs) that invest in the US equity markets. Some ETFs integrate ESG criteria in a transparent and systematic fashion. We refer to these funds as sustainable ETFs. This market has experienced a remarkable growth in popularity among investors over the last 10 years, as shown in Figure 1. The market value of sustainable ETFs grew to almost USD100 billion at the end of 2022 from about USD350 million in 2012.

Figure 1: Total market value of Sustainable ETFs investing in US equity



The bars in this figure represent the total market value (in USD millions) of the sustainable ETFs invested in the US equity market included in our database².

To analyse the aggregate performance of these products, we construct a monthly rebalanced portfolio that invests in all sustainable ETFs that existed on the rebalancing day. Weights are allocated to funds in proportion to their market value³. This Sustainable Investing Portfolio reflects the full set of ESG approaches available in this market, weighted by their popularity. Our analysis does not involve arbitrary choices on what is the most material ESG information or what are the most suitable ways of integrating it into portfolios. Instead, our proxy for the performance of sustainable investing reflects the approaches used by investors in this market⁴.

1 - Several papers provide empirical evidence on the drivers of the demand for sustainable investing. For instance, Riedl and Smeets (2017) show with evidence from surveys that some investors have nonpecuniary motives, such as the desire to contribute to a social impact or to align portfolios' holdings with ethical preferences, while Hartzmark and Sussman (2019) provide experimental evidence suggesting that some investors expect sustainability to reduce risk but also to improve future returns, although they find no evidence that sustainable funds outperform.

2 - In the computation of the total market value, we include all the ETFs that are in our base-case list and also the ETFs that have less than three years of observations as well as those that have a smart-beta tilt. We clarify the composition of the list of ETFs in Section 2.

3 - However, the choice to value-weight the sustainable ETFs is not crucial to our results. Indeed, in the Appendix we show that a portfolio constructed assigning equal weights to the sustainable ETFs generate similar returns.

4 - Notice that our sustainable ETFs market portfolio tilts towards sustainability incorporating ESG information from different sources, because the sustainable ETFs obtain ESG information from different providers and follow different methodologies.

1. Introduction

We argue that using a market portfolio of ‘real-world’ products enables us to provide a more representative and less arbitrary assessment of the impact of sustainability on performance⁵ than looking at stylised strategies. Such strategies reflect neither how ESG information is actually used in investment products, nor the implementation challenges faced by investors, such as potentially higher fees linked to the ESG data. Our Sustainable Investing Portfolio instead reflects the methods used in actual investment products and their implementation costs. When assessing the performance of ESG investing against benchmarks (or factors), we similarly construct real world proxies. These performance benchmarks draw on ETFs that do not follow ESG objectives. Our analysis thus produces a relevant estimate of the value-added of integrating ESG information that investors can access in the real world. Moreover, the ETFs that compose our portfolio integrate ESG information following systematic and transparent methodologies without relying on discretionary decisions of an active manager. Unlike studies of mutual fund performance, our results are not polluted by confounding effects, such as fund managers’ skill in picking stocks or in timing the market. Overall, we argue that the Sustainable Investing Portfolio can provide a representative picture of the average performance available to investors who adopted systematic ESG investing.

To identify the impact of sustainability we need to adjust the performance of our Sustainable Investing Portfolio for the effects of non-ESG factors. We focus on three measures of adjusted performance. The first, Relative Return, is the simple returns of the Sustainable Investing Portfolio relative to the returns of a proxy of the US equity market. The other two measures take risk exposures into account. The second, CAPM alpha, takes into account the risk exposure of the Sustainable Investing Portfolio to the US equity market and adjust returns accordingly. The third, Industry Adjusted Return, take exposure to a series of nine industry-factors into account, as well as exposure to the US equity market. The first measure is just a way to assess whether the returns of the Sustainable Investing Portfolio differ from the returns of the US equity market benchmark. The second measure tells us whether the Sustainable Investing Portfolio outperformed a portfolio with equal exposure to the market, and the third whether it outperformed a portfolio with equal exposure to the market and to the industry factors.

We find that, over the past decade, the Sustainable Investing Portfolio *did not* outperform its benchmarks. If anything, realised returns of the Sustainable Investing Portfolio were marginally lower than its benchmarks. Indeed, on average, returns on an annual basis were 0.2% lower than the proxy for the US equity market. Once we account for the portfolio’s market risk exposure, returns are still 0.1% lower. This means that integrating ESG information in the investment decisions did not add value from a purely financial perspective. Adjusting for the exposure to industry factors reduces performance even more. The annualised industry-adjusted returns were -0.7% on average. This means that part of the returns of the Sustainable Investing Portfolio were driven by industry exposures, and once we remove these contributions, the value of using ESG information is even lower. We also study the performance of the Sustainable Investing Portfolio over shorter time periods – each of the last 10 calendar years. This enables us to identify one period (the year 2020) characterised by a large outperformance over the market (+4.2% in relative returns and CAPM

5 - To clarify, we do not claim that this portfolio encompasses all the ESG metrics and ratings available but only those that have been actually used with systematic approaches by ETFs that have been selected by market investors.

1. Introduction

alpha). However, this short-term extra-performance represents just a statistical outlier. In addition, even this outlier is mostly due to sector-biases rather than to the ESG-tilt of the sustainable ETFs.

Overall, our evidence from real-world investment products shows that sustainability did not have a noteworthy effect on financial performance. Of course, the time period we study is far too short to draw conclusions on the long-term premium associated with sustainable investing⁶. Instead, our conclusions apply to realised performance of sustainable investing over the past decade.

This is, however, no trivial matter; indeed, it has been the object of discussion over recent years both among practitioners and in the academic literature. Many press articles and product providers have presented results suggesting that tilting towards sustainability has generated outsized risk-adjusted returns (alpha)⁷, while the academic literature has documented more contrasted findings⁸. Indeed, three recent literature reviews (Gerard 2019, Matos 2020, Liang and Renneboog 2021) point out that there is no consensus in the academic literature on a positive alpha of virtuous companies or ESG funds.

This paper contributes to the understanding of sustainable investing performance, by assessing the performance of ‘real-world’ investment products that provide a realistic perspective on what investors achieve when they invest in ESG. This is in contrast with studies that use stylised investment strategies such as Edmans (2011), Giese et al. (2019), Giese, Nagy, and Lee (2020), Bruno, Esakia, and Goltz (2022), Naffa and Fain (2022). There are three advantages of our approach over the use of stylised strategies.

First, our approach accurately reflects the choices available to investors in practice. This contrasts with the lack of representativeness of stylised strategies. For instance, an influential study by Edmans (2011) documents outperformance of companies with high employees’ satisfaction that is measured by belonging to the best 500 companies to work for. However, ‘real-world’ ESG products rarely draw on such simple and publicly available categorisations. Similarly, in an earlier paper (Bruno, Esakia, and Goltz, 2022), we analysed stylised ESG-strategies proposed in the literature constructed using the ESG ratings of a single provider⁹. Clearly, limiting the analysis to such strategies does not do justice to the large variety of ESG information used in the practice of sustainable investment.

Second, stylised strategies offer substantial flexibility that raises the risk of datamining. Indeed, one can create an almost infinite number of ESG ‘factors’ by making choices about the ESG information retained (ratings, scores, activities, controversies, etc.) and about the portfolio construction mechanism (weighting scheme, rebalancing rules, etc.). Of course, using different types of ESG scores and ratings would be a lesser problem if they were all capturing the same source of fundamental

6 - The difficulty of deriving implications for the performance of sustainable investments is due to the fact that the theory suggests that it can have several possible drivers (a summary can be found in Amenc, Bruno, and Goltz, 2021). Some of these drivers, like investors preference for sustainability, and hedging demand for ESG-related risks (e.g., climate transition risk, or litigation risk), introduce a drag on the long-term performance of sustainable investment strategies (see Pastor, Stambaugh, and Taylor, 2021). On the other hand, a positive extra-performance may originate because of mispricing. In particular, if companies with high (low) ESG ratings were underpriced (overpriced), investors could boost their performance tilting their portfolios towards higher sustainability (see Pedersen, Fitzgibbons, and Pomorski, 2021). Our findings of close to zero extra-performance have different possible interpretations. One possibility is that the impact of all the drivers of sustainable performance are close to zero. Another possibility is that the channels that generate a negative and positive pressure on performance compensate each other. Finally, the reader should keep in mind that we are looking at a relatively short period of time, and it is possible that over such a short period a shift in preferences for sustainability may have happened. As explained in Pastor, Stambaugh, and Taylor (2022), a shift in preferences may generate a temporary impact on the performance of ESG strategies that may counterbalance the impact of drivers of the long-term premium.

7 - See for instance, Riding (2020), Hale (2022), Horton and Jessop (2022), and Wang, Giese, and Naly (2023).

8 - See Bruno, Esakia, and Goltz (2022) and Naffa and Fain (2022) amongst those that find no evidence of outperformance, and Edmans (2011), Giese et al. (2019), and Giese, Nagy and Lee (2020) amongst those that find evidence of a positive relationship between ESG and outperformance.

9 - In this paper we use MSCI ESG ratings and transformations of these ratings (e.g., ESG momentum).

1. Introduction

information¹⁰. However, Avramov et al. (2022) show that there is significant heterogeneity between ESG-ratings, which is consistent with the mixed evidence on ESG performance found using stylised strategies. By relying on the market to identify the relevant approaches to build sustainable portfolios, we avoid arbitrary choices.

Third, returns from stylised strategies do not account for real world performance effects, since their results do not include transaction costs, costs for ESG data and other management fees. Instead, the returns of the ETFs automatically embed these real-life performance effects, and because we use ETFs to construct both sustainable portfolios and their benchmarks, we can provide an assessment of the sustainability ‘alpha’ that includes such effects.

By using ETFs, our approach also differs from studies that analyse the link between sustainability and mutual fund performance¹¹ such as Hartzmark and Sussman (2019), Geczy, Stambaugh, and Levin (2021), Madhavan, Sobczyk, and Ang (2021), and Pastor and Vorsatz (2021). Studies of mutual fund performance face the difficulty of separating the impact on performance of using ESG information from the confounding effect of managers’ skills¹². Hypothetically, managers of ESG funds may be more skilled in market timing or stock picking without needing to use ESG information, hence, the performance of these funds does not reflect just systematic tilts to ESG (e.g., some funds may outperform because their managers are skilled at identifying mispriced companies among ESG leaders). This means that without separating the impact of ESG-tilts from the impact of decisions of managers it is not possible to assess the value added for investors from using ESG-information. This issue is further exacerbated by the fact that some of the mutual funds classified as sustainable may not even use ESG information. This is due to the system of classification used in these studies that often comes from ratings¹³ assigned on the base of the sustainability of the holdings, which in some cases may be high even though the fund does not have explicit ESG-objectives (e.g., technology funds tend to have high sustainability ratings because technology stocks tend to have high ESG scores). In contrast, we make sure through an analysis of official documentation¹⁴ that the ETFs included in our study not only use ESG information intentionally, but that they use it in a systematic¹⁵ way. This sharpens our identification of the value of using ESG information, ensuring that the performance that we measure is not due to managerial skills but to the application of strict systematic rules that leverage on ESG information.

An additional distinctive element of our methodology is how we adjust the performance of the Sustainable Investing Portfolio. Firstly, following the advice of Berk and van Binsbergen (2017), to adjust the performance we use comparable benchmarks constructed from investable ETFs, instead of non-investable mimicking portfolios. This gives us a fair comparison because both the performance of the Sustainable Investing Portfolio and the one of its benchmarks include real-life costs¹⁶.

10 - Indeed, it is important to highlight that we are not trying to suggest that stylised strategies cannot be used in general for empirical analyses in asset pricing. Stylised strategies provide perfectly representative results when they are used to analyse factors that are well defined (e.g., Size, Value, Momentum) because they are constructed with clearly identified characteristics. In contrast, sustainability is not a well-defined concept, and indeed, researchers and ESG data providers have developed over the years a disparate set of methodologies and ratings to capture sustainability.

11 - Renneboog, Horst, and Zhang (2008) provide a literature review of earlier studies on this topic.

12 - This problem is even pronounced in studies that look at hedge funds (e.g. Liang, Sun, and Teo, 2022) because they are characterised by an even lower level of transparency than mutual funds, which gives hedge funds’ managers more flexibility.

13 - For instance, the Morningstar’s Sustainability Rating is very popular in studies of the performance of sustainable mutual funds.

14 - We provide more details on this in the next section.

15 - Indeed, our list is almost entirely composed by passive ETFs (33 out of 35) that replicate ESG-indices with systematic rules, and they also represent more than 97% of the market value of the ETFs in our selection (as of 31 December 2022). We only have two ETFs classified as active, however, they also claim in their prospectuses that they follow systematic rules to integrate ESG-information in the construction process of their portfolios. Focusing on funds that use systematic rules allows us to limit the problem of the confounding effect of the skills of the funds’ managers.

16 - Using comparable benchmarks is an important issue for the analysis of funds’ performance to such an extent that Berk and van Binsbergen (2017) define benchmarking as the Achilles’ heel of the mutual fund literature.

1. Introduction

In addition, because we focus on ETFs invested in the same homogeneous geographical region (US), we avoid geographical biases linked to sustainability¹⁷. Finally, we estimate factors' exposures at ETF level rather than a portfolio level, which allows us to control for the time-variation in the factors' exposure of the portfolio due to the changes in its composition. These features distinguish our paper from Kanuri (2020), which also studies the adjusted performance of a portfolio of sustainable ETFs but without accounting for investability of the factors, geographical biases, and time-variation in the factors' exposures¹⁸.

To summarise, our work has the following advantages over previous studies:

- We extract ESG performance that is representative of market practice and allows us to estimate real-world investment outcomes rather than making arbitrary choices on what ESG integration should look like.
- This approach also circumvents the data mining risks related to the specification of stylised strategies.
- We consider products that integrate ESG information in a systematic and intentional manner, which provides us with a measure of the value added of using ESG information which is not polluted by effects of manager skill.

In the rest of the document, we first describe our data, providing details on the composition of the market of sustainable ETFs; we then explain how we assess the aggregate performance of the sustainable ETFs and present our results. A final section presents our conclusions.

17 - For instance, ESG ratings tend to be higher amongst developed countries than in emerging markets. Therefore, including ETFs from different regions, without correcting for geographical biases, as in Kanuri (2020), does not allow to distinguish performance effects due to ESG from geographical ones.

18 - Indeed, Kanuri (2020) uses non-investable equity factors, it does not control for geographical biases, even though, his portfolio includes ETFs that invest in different regions, and he estimates factors' exposures at portfolio instead of ETF level, meaning that he does not control for changes in factors' exposures due to changes in the composition of the portfolio.

2. Data

2. Data

In this section we describe the list of the sustainable ETFs and their benchmarks.

The Market of Sustainable ETFs

Our objective is to analyse the aggregate performance of the market of sustainable ETFs, for this we need to define a list of ETFs that is representative of this market.

First, we delimit our scope to ETFs tracking US equities because it is the largest equity market¹⁹.

We ensure that the funds' investment focus is limited to the US equity universe by checking official documents linked to the ETFs²⁰.

Then, we impose three requirements to include an ETF in our list of ETFs that compose the Sustainable Investing Portfolio.

The first and main requirement is that the construction of the ETF portfolio should reflect a sustainable investing approach, thus we require a self-declared ESG objective.²¹ This is better than considering an external ESG label, like article 9 or a fund rating, because ESG labels can be assigned also to ETFs that do not actually integrate ESG information in their construction's process but that nevertheless scores well in terms of ESG because they use information that is correlated with ESG²². In addition, looking at ETFs' objectives is more stable and reliable than using 'official' labels because they are continuously subject to unpredictable variations²³. Therefore, we manually check the description of the ETFs and retain only the funds that mention explicitly the integration of ESG information in their portfolio construction process²⁴. We also check for benchmark changes, because ETFs that are currently tracking an ESG index may have been tracking a non-ESG index in the past. Indeed, we find seven ETFs that switched from a non-ESG to an ESG index over the course of our sample, and in these cases, we include the ETFs in the Sustainable Investing Portfolio only after the switch.

As a second requirement, we want the sustainable ETFs not to be polluted by explicit tilts unrelated to ESG, thus, we exclude the ETFs with explicit smart beta or industry tilts. Finally, we require ETFs to have a minimum of 148.2 weeks of return history (95% of three years of observations) because we estimate factors' exposure at ETF level. To estimate portfolio exposures reliably, we need the exposures of its components. Estimating factors' exposure at portfolio level would be misleading because the composition of the portfolio is time-varying (more below in the methodology section). This brings the market for sustainable ETFs to a list of 35 ETFs, which we use as the base case composition of our Sustainable Investing Portfolio.

Notice that while we need to include the last two requirements to facilitate our analysis and the interpretation of the results, they do not materially affect the performance of the Sustainable

19 - Delimiting our analysis to the ETFs that invest in a well-defined geographic region has also the advantage that it allows us to avoid the contamination of geographical biases linked to ESG ratings. For instance, developed markets tend to fare better in terms of ESG relative to developing and emerging markets. This is a distinguishing feature of our work relative to Kanuri (2020), which also studies the performance of sustainable ETFs, but his list includes also ETFs investing in large regions (e.g., Global), and there is no control for geographical biases. By restricting our analysis to ETFs that invest only in US equity we avoid this problem altogether. In ongoing work, we plan to extend the analysis to ETFs investing in other regions, taking properly into account the issue of geographical bias.

20 - For each ETF, we conduct our checks looking at fact sheets, the prospectus or the website of the ETF provider or the provider of the index tracked by the ETF. 21 - To identify the ETFs, we search the internet for ETFs with an explicit ESG objective in their name or prospectus. To narrow down our search, we use several websites that provide ETF data (e.g. Trackinsight.com and justETF.com) and then check each ETF's prospectus on the providers' websites

22 - For instance, technology ETFs achieve high ESG scores even though they do not actually use any ESG information.

23 - See for instance Bryant (2023).

24 - We check the prospectus from the website of the ETF provider, or from the website of the provider of the underlying index.

2. Data

Investing Portfolio. Indeed, in the Appendix, we show that keeping the ETFs with smart-beta tilts and with less than three years of returns in the composition generates Sustainable Investing Portfolios with similar performance, and returns' correlations close to 1.

Table 1 shows the descriptive statistics on the composition of the market of sustainable ETFs. We report the distribution of the market value (in USD millions) at the end of our sample (31 December 2022), the distribution of the total expense ratio (also at the end of our sample), the distribution of their age, and the distribution of the annualised tracking errors relative to the US equity market²⁵. Although our final list is quite narrow, it gives us a good dispersion in the characteristics of the ETFs. The market value ranges from USD23 million to more than USD19 billion (as of 31 December 2022). The cheapest ETF has a total expense ratio of 5bp per year, while for the most expensive the total expense ratio is 75bp²⁵. The age since inception ranges from almost three years for the youngest ETFs, due to our restriction on the minimum amount of return observations, to almost 18 years for the oldest ETF. Finally, we highlight that the sustainable ETFs tend to have non-negligible tracking errors. Indeed, for 80% of them the tracking error is above 2.57% and for 50% of them it is above 3.52%, with a full range that goes from a minimum of 1.02% to a maximum of almost 14%. This is worth emphasising because it tells us that within this list of ETFs there is enough potential to substantially deviate from the benchmark. In other words, there is nothing in our list of ETFs that would bias the relative performance of the Sustainable Investing Portfolio towards zero.

Table 1: Descriptive statistics sustainable ETFs invested in US equity.

	Market Value (USD millions)	Total Expense Ratio (per year)	Age since Inception (years)	Tracking Error (annualised)
Min	23	0.05%	2.95	1.02%
20th Percentile	161	0.10%	3.55	2.57%
50th Percentile	700	0.20%	4.27	3.52%
80th Percentile	3,618	0.29%	6.47	5.37%
Max	19,581	0.75%	17.93	13.99%

The table shows descriptive statistics of the 35 Sustainable ETFs in our list. We report the distribution (minimum, 20th percentile, 50th percentile, 80th percentile, and maximum) of the market value of the ETFs in USD millions (as of 31 December 2022), of the total expense ratio (as of 31 December 2022), of the age (from inception to 31 December 2022) expressed in years, and of the annualised tracking error of each ETF relative to the proxy of the US equity market, which we compute using weekly returns over the entire period for which the returns of the ETF are available.

To have a more refined view on the composition of the market of Sustainable ETFs, we also obtain information on the index providers and on the country of incorporation of the ETFs²⁷. The country of incorporation is an important information for us because we use it to assign the proper set of factors as explained below. In Figure 2 we report the decomposition by index provider and region of the country of incorporation based on the market values of the ETFs at the end of our sample. We find that the Sustainable ETFs market is composed of ETFs tracking indices from different index providers, although the lion's share (83%) is taken by MSCI. We can also see that the sustainable ETFs are almost evenly split between those incorporated in North America (56%) and those incorporated in Europe (44%).

25 - We use an ETF on the S&P 500 as market benchmark, as explained better in the next section.

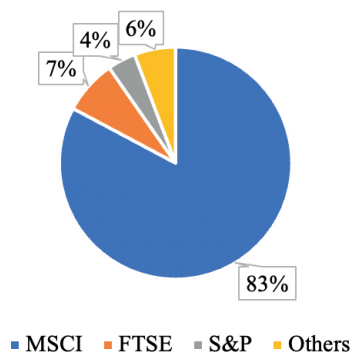
26 - We report total expense ratio as of 31 December 2022.

27 - We obtain information looking at the official documents (e.g., fact sheet and prospectus) of the ETFs.

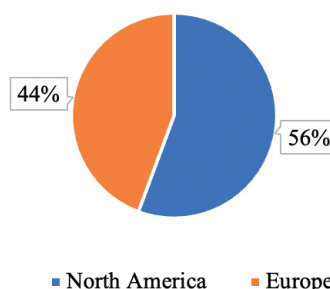
2. Data

Figure 2: Market Share

A. Market Share by Index Provider



B. Market Share by Region of the Country of Incorporation



The pie chart A shows the market share by index provider of the ETFs in our list. Market share of each index provider is computed as the sum of the market values of the ETFs that track an index from that index provider over the total of the market values of the ETFs in the list. The pie chart B shows the market share by region of the country of incorporation of the ETFs in our list. In the North America region, we include ETFs incorporated in Canada and in the US, while in the Europe region we include ETFs incorporated in Ireland and in Luxembourg. Market share of each region is computed as the sum of the market values of the ETFs incorporated in that region over the total of the market values of the ETFs in the list. Market values of the ETFs are taken at the end of our sample (31 December 2022).

Benchmark ETFs

To adjust the performance of our sustainable ETFs, we need to use the proper benchmarks/factors. For our main set of analyses, we use as market and industry benchmarks a collection of SPDR ETFs managed by State Street Global Advisors (SSGA). We use ETFs as benchmarks to remain consistent with our aim to analyse real-world performances, as opposed to using stylised strategies, such as academic factors, that may be difficult to replicate and whose performance does not include fees and transaction costs. As market benchmark we use the SPDR ETFs that replicate the performance of the S&P 500, and as industry benchmarks we use a set of SPDR ETFs that replicate the performance of nine industry portfolios: Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Financials, Health Care, Technology, and Utilities.

Because we estimate exposures at ETF level, to account for the non-synchronicity of the returns due to the difference in trading hours between North America and Europe, we use two different sets of benchmarks. For the ETFs traded in North America we use the SPDR ETFs traded on the Nyse-Arca exchange, while for the ETFs that trade on European exchanges we use the SPDR ETFs traded on the Xetra exchange.

3. Real-World Sustainable Investment Performance

3. Real-World Sustainable Investment Performance

In this section we analyse the aggregate adjusted performance of the sustainable ETFs, which we represent using a value-weighted portfolio of the sustainable ETFs – the Sustainable Investing Portfolio. The objective is to understand whether integrating ESG-related information in the portfolio's construction process of real-world investment products has generated an extra-performance relative to standard benchmarks.

We first explain how we construct the Sustainable Investing Portfolio and how we compute its adjusted performance. Then we discuss the results of our analysis of the adjusted performance.

Adjusting the aggregate performance of the Sustainable ETFs

To represent the aggregate performance of the market of sustainable ETFs we create a monthly rebalanced portfolio, the Sustainable Investing Portfolio, that allocates its weights to the sustainable ETFs in proportion to their market values²⁸ as they come to existence²⁹.

Because we want our portfolio to reflect the broad Sustainable ETFs market, we wait to have at least three ETFs to start our analysis, which gives us a time-sample of roughly 10 years – from 27 July 2012 to 31 December 2022.

We analyse the performance of the Sustainable Investing Portfolio relative to different benchmark-portfolios. The first benchmark-portfolio is a proxy of the US equity market. The second is a combination of the risk-free asset and of the proxy of the US equity market whose weights are such that the portfolio replicates the CAPM market exposure of the Sustainable Investing Portfolio, hence the returns of this portfolio represent the CAPM-explained returns of the Sustainable Investing Portfolio. The third benchmark-portfolio is a combination of the risk-free asset, of the proxy of the US equity market, and of nine industry factors, and the returns of this portfolio represent the returns of the Sustainable Investing Portfolio explained by its exposure to the US equity market plus its exposures to the nine industry-factors³⁰.

All the benchmark-portfolios³¹ are formed using the benchmark ETFs reported in the previous section. This means that just like the aggregate performance of the market of Sustainable ETFs, the performance of the benchmark-portfolios is also formed using real-world investment products. We focus on the differences between the returns of the Sustainable Investing Portfolio and its benchmark-portfolios, and we refer to these differences as adjusted returns, that we define as

28 - For one ETF we do not have the history of its market values. We keep the ETF in the Sustainable Investing Portfolio; however, given the uncertainty surrounding its information, we want to limit its impact on our results. For this, at each rebalancing date we assign to the concerned ETF the lowest market value across the other ETFs, so that we always allocate to it the lowest weight in the portfolio. We also highlight that this ETF is one of the last to enter the Sustainable Investing Portfolio (it appears for the first time in the composition of portfolio in January 2020) so its contribution to the overall results is in any case limited.

29 - As explained above, sustainable ETFs that switched from a non-sustainable benchmark to a sustainable one are added only after the switch.

30 - We focus on industry-factors, rather than equity-style factors (e.g., Size, Value, Momentum, etc.) because, for the sake of comparability, we want to use 'real-world investment products like ETFs also to construct the factors, and while there is a large availability and a long history for the industry ETFs and homogeneity in the construction process across the different industries, for the equity-style factors it is more difficult to find ETFs with a consistency in terms of history and construction methods for all the factors in the factor model. However, we have run some analyses using a set of academic equity-style factors rather than ETFs, and we have found that using equity factors does not affect the conclusions that can be drawn from our results (see Appendix A4).

31 - To account for the change in the composition of the Sustainable Investing Portfolio, we first compute the returns of the benchmark-portfolios of each individual sustainable ETF, and then we aggregate them at portfolio level using the weights in the Sustainable Investing Portfolio at each point in time. This means that we estimate factor exposures at ETF level, rather than at portfolio level. Therefore, we consider factors' exposures constant at ETF level. However, they change at portfolio level because of the changes in the composition of the portfolio. In addition, as mentioned in the previous section, to account for differences in trading hours between North America and Europe, we use a different set of benchmark ETFs depending on the region where the ETF is traded. For instance, the returns of the benchmark-portfolio that represents the proxy of the US equity market are a weighted average of the returns of the SPDR S&P 500 ETF traded on the Nyse-Arca and of the one traded on the Xetra exchange with weights assigned based on the weights in the Sustainable Investing Portfolio.

3. Real-World Sustainable Investment Performance

follows³²:

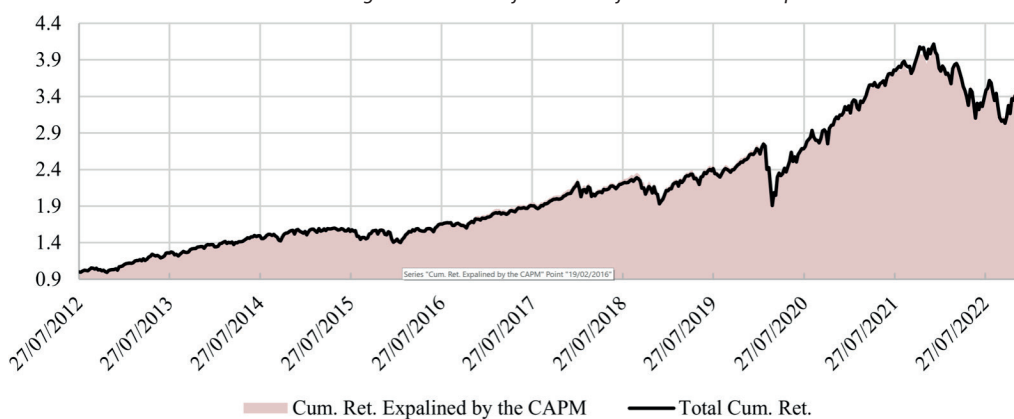
- Relative returns: Returns of the Sustainable Investing Portfolio minus the returns of the proxy of the US equity market.
- CAPM alpha: Returns of the Sustainable Investing Portfolio minus the returns of the portfolio that accounts for the CAPM exposure of the Sustainable Investing Portfolio.
- Industry adjusted returns: Returns of the Sustainable Investing Portfolio minus the returns of the benchmark-portfolio that represents the returns of the Sustainable Investing Portfolio explained by its exposure to the market plus its exposures to nine industry-factors.

We study the adjusted returns over periods of multiple years, with the longest being just above ten years, which tells us whether integrating ESG-information has had a persistent impact on performance. We also analyse performance over individual calendar years, which tells us if there has been any remarkable temporary deviation in returns linked to sustainability.

Performance over Multiple Years' Periods

We start our analysis looking at the cumulative returns of the Sustainable Investing Portfolio vis-à-vis the cumulative returns of the benchmark portfolio that accounts for its CAPM exposure over the longest time-sample that we have available. We can clearly see from Figure 3 that there is no discernible difference between the two time-series, which means that the returns of the Sustainable Investing Portfolio are almost perfectly explained by its market exposure. In other words, the average sustainable ETF did not generate a CAPM alpha for its investors.

Figure 3: Cumulative returns of the Sustainable Investing Portfolio - Unadjusted VS Adjusted for market exposure.



The plot above shows the time-series of the cumulative returns of our Sustainable Investing Portfolio (black solid line), and the part of the cumulative returns of the ESG portfolio explained by the market exposure (pink area), which we obtain cumulating the part of the returns that is explained by the CAPM exposure $- r f_t + \beta * R_t^{e,M}$, in which $r f_t$ is the risk-free rate, β is the market exposure of the Sustainable Investing Portfolio and $R_t^{e,M}$ the excess return of the market benchmark. We use weekly returns observations. The time period is from 27 July 2012 to 30 December 2022.

We can try to put under the microscope the differences between the two portfolios above to understand if there is anything worth noticing. Figure 4 shows the time-series of the cumulative CAPM alpha over the entire period, which can be interpreted as the cumulative return of a long/

32 - We provide in the appendix a full account of the computational details for the benchmark-portfolios and for the adjusted returns, including details on the estimation of the factor exposures and on the construction of the factors.

3. Real-World Sustainable Investment Performance

short strategy that is long the Sustainable Investing Portfolio and short the benchmark-portfolio that invests in the risk-free asset and in the US equity market portfolio and that matches the market exposure of the Sustainable Investing Portfolio. Over the whole time-sample such a long/short strategy would have generated a slightly negative return (USD99 if 100 USD were invested at the beginning of the period). Note that between October 2018 and November 2021 this strategy went through a period of growth, which may have attracted attention from investors³³. However, this growth was short-lived.

Figure 4: Cumulative CAPM alpha of the Sustainable Investing Portfolio.



The plot shows the cumulative CAPM alpha, which we obtain cumulating the difference between the return of the Sustainable Investing Portfolio and the returns explained by the CAPM exposure. We use weekly returns observations. The time period is from 27 of July 2012 to 30 of December 2022.

Table 2 provides overview on the annualised adjusted performance of the Sustainable Investing Portfolio over the full time-sample and over its two halves. All the adjusted returns are slightly negative (and statistically insignificant) both over the full sample and over its first half. For instance, over the full sample, an investor in the Sustainable Investing Portfolio would have lost on average 0.2% on an annual base relative to the US equity market, or 0.1% controlling for the market exposure, and 0.7% if both market and industry-factors contributions are taken into account. Over the second half, relative returns and CAPM alphas rise slightly above zero, but they revert to the negative sign once industry contributions are accounted for. Indeed, adjusting for industry contributions tend to reduce the already low returns in all three the time samples.

The annualised tracking error relative to the US equity market index remains at 1.7% in the different samples. This value is of course lower than the median tracking error reported in Table 1, as deviations with respect to the market of one fund might be cancelled by those of another fund. Despite these offsetting effects of deviations at the individual fund level, the tracking error does not go to zero at an aggregate level. Instead, the ESG-tilts in real-world products create substantial deviations from the US equity market index in the Sustainable Investing Portfolio.

Once again, these results tell us that tilting towards ESG did not help the Sustainable Investing Portfolio to generate an outperformance. If anything, we see slightly negative adjusted returns, especially when industry-factors' contributions are taken in consideration.

³³ - Indeed, it is worth noticing that in some of the articles and studies that report a positive link between ESG ratings and performance – such as Wang, Giese, and Nagy (2023), and Hale (2022) – this period represents the larger portion of their time-sample.

3. Real-World Sustainable Investment Performance

Table 2: Performance summary of Sustainable Investing Portfolio.

	Full Sample From 27/07/2012 to 31/12/2022	First Half From 27/07/2012 to 31/12/2017	Second Half From 01/01/2018 to 31/12/2022
Ann. Relative Return	-0.25% (-0.53)	-0.71% (-1.08)	0.26% -0.37
Ann. CAPM Alpha	-0.14% (-0.31)	-0.50% (-0.77)	0.25% -0.35
Ann. Industry Adjusted Return	-0.74% (-1.68)	-1.32% (-1.99)	-0.11% (-0.18)
Ann. Tracking Error	1.71%	1.70%	1.73%

The table reports the annualised relative returns, the annualised CAPM alpha, the annualised industry adjusted return, with corresponding *t*-stats in brackets, and tracking errors of the Sustainable Investing Portfolio for the three periods indicated in the second row of the headline. Results are obtained using weekly return observations. Relative return is the average difference between weekly returns of the Sustainable Investing Portfolio and of the market benchmark. CAPM alpha is the average of the difference between weekly returns of the Sustainable Investing Portfolio and the return explained by the CAPM exposure $-rf_t + \beta * R_t^{e,M}$, in which $-rf_t$ is the risk-free rate, β is the CAPM exposure of the Sustainable Investing Portfolio and $R_t^{e,M}$ the excess return of the market benchmark. We compute industry adjusted returns as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns explained by a model that accounts for the exposure to the market benchmark as well as nine industry factors $-rf_t + \sum_k \beta^k * R_t^k$, in which $-rf_t$ is the risk-free rate, β^k is the exposure of the Sustainable Investing Portfolio to the *k*th factor of the model and R_t^k is the factor return. To annualise relative returns, CAPM alphas, and industry adjusted returns, we multiply them by 52. *T*-stats are computed accounting for heteroskedasticity and serial correlation. Tracking error is taken relative to the proxy of the US equity market.

Performance over Individual Calendar Years

We also look at the adjusted returns over single calendar years, which helps us to understand whether the Sustainable Investing Portfolio generated any deviation in performance worth of notice at least over short time periods³⁴. Figure 5 shows the adjusted returns of the Sustainable Investing Portfolio over the full ten calendar years that we have in our time-sample³⁵. Most of the deviations over the single calendar years are below 1% in absolute value. Two years (2015 and 2022) are characterised by a stronger than usual negative performance, and only the year 2020 seems really to be characterised by a strong outperformance.

Indeed, in 2020, the Sustainable Investing Portfolio achieves an outperformance of 4.2% both in terms of relative returns and of CAPM alpha. These results are consistent with the narrative of an ESG-outperformance in 2020, which some press articles and industry reports³⁶ have strongly emphasised. In particular, these articles highlighted the link between high ESG ratings capture long-term business sustainability to argue that good levels of sustainability help to shield companies' value during periods of generalised market downturns like the one experienced during the Covid-19 crisis³⁷.

This short-term outperformance has even led some to make strong claims on the ability of these products to outperform over the long-term³⁸. However, investors should know that the 2020 outperformance represents an outlier. Indeed, the CAPM alpha over 2020 is more than seven times the standard deviation of the CAPM alpha over the full sample³⁹, and so it can hardly be used to form expectations over the long-term.

34 - By short time-periods we mean short relative to those analysed in the previous sub-section.

35 - We have checked whether our choice of removing the ETFs that have less than three years of returns may have somehow affected these results, and we found no relevant impact. Indeed, over the last three years (the only ones affected by the choice) by including the ETFs that have less than three years of returns, the returns of the Sustainable Investing Portfolio would have been 0.26% higher in 2020, 0.23% lower in 2021, and 0.001% higher in 2022.

36 - See for instance Hale (2021) and Feuer (2021).

37 - However, Demers et al. (2021) show that controlling for non-ESG characteristics, such as asset intangibility, ESG did not provide any extra protection from the Covid-19 downturn.

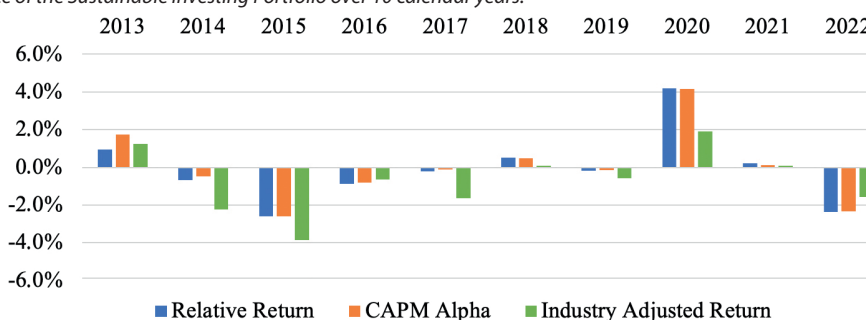
38 - For instance, in Feuer (2021) we find claims of industry practitioners such as: "I think that more and more research, [...] are showing that sustainable investing can in fact, perform and deliver stronger risk-adjusted returns."

39 - We compute standard deviation with weekly CAPM alpha from 27 July 2012 to 31 December 2022 and correcting for autocorrelation and heteroskedasticity.

3. Real-World Sustainable Investment Performance

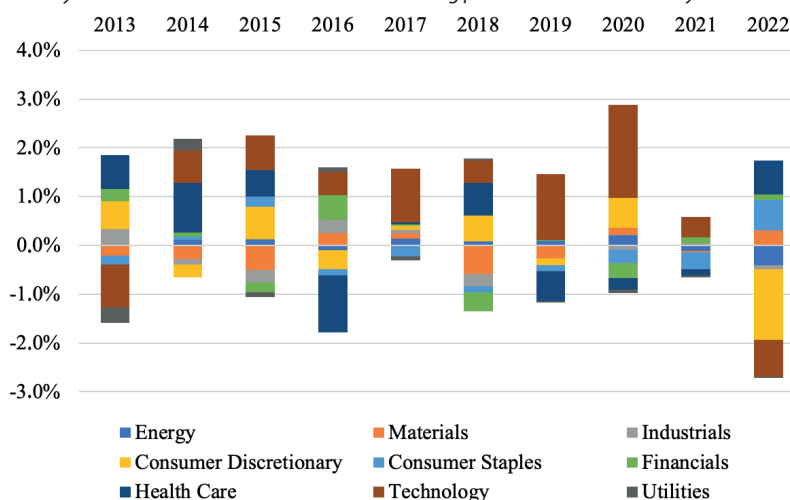
In addition, more than 50% of the positive CAPM alpha in 2020 is explained once industry-factors' exposures are taken into account⁴⁰. Indeed, the 2020 industry adjusted returns are 1.9%, and, as shown in Figure 6, most of the contribution to the 2020 outperformance came from the exposure to the technology sector, whose performance alone provided a 1.9% boost to the returns of the Sustainable Investing Portfolio. We can also notice from Figure 6 that industry-factors contributions over the single calendar years can be quite substantial (from -1.4% for the Consumer Discretionary sector in 2022 to 1.9% of the technology sector in 2020), and that although they mostly offset each other, on average they provide a positive contribution of 0.57% to the returns of the Sustainable Investing Portfolio.

Figure 5: Performance of the Sustainable Investing Portfolio over 10 calendar years.



The bar chart reports the relative returns, the CAPM alphas, and the industry adjusted returns of the Sustainable Investing Portfolio over the most recent 10 calendar years. For each calendar year, we compute relative returns of the Sustainable Investing Portfolio as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns of the market benchmark. We compute CAPM alphas as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns explained by the CAPM exposure $-rf_t + \beta * R_t^{e,M}$, in which rf_t is the risk-free rate, β is the CAPM exposure of the Sustainable Investing Portfolio and $R_t^{e,M}$ the excess return of the market benchmark. We compute industry adjusted returns as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns explained by a model that accounts for the exposure to the market benchmark and nine industry-factors $-rf_t + \sum_k \beta^k * R_t^k$, in which rf_t is the risk-free rate, β^k is the exposure of the Sustainable Investing Portfolio to the k th factor of the model and R_t^k is the factor return. We compute the results using daily return observations within each calendar year.

Figure 6: Contributions of industry factors to returns of the Sustainable Investing portfolio in each calendar year



The bar chart reports the industry factor-exposures' contributions to the return of the Sustainable Investing Portfolio over each selected calendar year from 2013 to 2022. Industry-factors contributions are computed in each day of the calendar year multiplying the industry-factor exposures of the Sustainability ETFs portfolio for the daily returns of the industry-factors, and to obtain the industry-factor contribution over the calendar year we sum the daily contributions of industry factor over each day in the calendar year. We compute the industry factors' exposures of the Sustainability ETFs portfolio as the weighted average of the industry-factor exposures of each ETFs in the portfolio. Industry-factor exposures of each ETF in the portfolio are estimated using weekly returns observations using the entire period for which the ETF has been available.

40 - Attention shifts to the ESG topic may also have played a role, but an analysis of this is beyond the scope of this study.

3. Real-World Sustainable Investment Performance

Overall, the results presented in this section show that real-world sustainable investment products did not outperform their benchmark-portfolios, except for a very short-term period (the year 2020), whose outperformance represents an outlier, and that appears far less remarkable once we subtract the strong boost to the returns given by the exposure to technology sector. Indeed, when adjusting performance for industry exposure, the performance of the sustainable investing portfolio over the full period of our analysis was slightly negative.

4. Conclusions

4. Conclusions

In conclusion, for investors looking to integrate ESG objectives in their investment process, it is crucial to question which impact this would have on their portfolio's financial performance. The existence of numerous methodologies to integrate sustainability, which may not be representative of actual practice, has made it challenging to assess this impact empirically. Our study provides an assessment of the 'real world' performance of sustainable investing, drawing on information from the market of exchange-traded funds.

Our findings show that 'real-world' ESG performance is unremarkable, with no evidence of sustainable ETFs outperforming. On an annual basis, both average relative returns and CAPM alpha are close to zero over the past decade. Removing the contribution from industry-factors reduces the performance even further, bringing the annualised average industry-adjusted returns to -0.7%. Outperformance is limited to the year 2020, which is just a statistical outlier. Furthermore, more than 50% of the outperformance in 2020 is attributed to exposure to industry-factors, which do not require ESG information.

We encourage investors to consider such 'real-world' results and be aware of the limitations of analysis that selects particular funds or creates stylised strategies that may not reflect the real world of sustainable investing.

Appendix

Appendix

A1. Alternative Sustainable ETFs' Lists

Table A.1 shows the performance of sustainable portfolios of ETFs constructed with different lists. The Base Case portfolio is the one used for the results reported in the main part of the paper, in which we use a value-weighting scheme, and apply the exclusion based on the age of ETFs (exclude those with less than three years of data) as well as the one based on the presence of smart-beta tilts. The portfolio named Alternative 1 is also value-weighted but adds the ETFs with smart-beta tilts to the list of the Base Case portfolio. Alternative 2 is value-weighted adds the ETFs with smart-beta tilts and those with less than three years of history to the list used for the Base Case portfolio. Finally, Alternative 3 keeps the same list of the Base Case portfolio but is formed equally weighting the ETFs.

The results shown in Table A.1 show that our exclusions and our choice of the weighting scheme do not generate important deviations in the returns that we obtain. The average returns of the alternative portfolios are close to the one of the Base Case as well as their volatilities and Sharpe ratios, and the returns of each portfolio are strongly correlated with the returns of the other portfolios.

Table A.1: Alternative Sustainable Investing Portfolios.

From 27/07/2012 to 31/12/2022		Sustainable Portfolios			
		Base case	Alternative 1: Adding smart-beta ETFs	Alternative 2: Adding smart-beta and ETFs with short history	Alternative 3: Same list as Base Case but EW
Analytics:	Ann. Return	12.04%	12.04%	11.85%	11.86%
	Ann. Volatility	15.91%	15.90%	15.85%	15.84%
	Sharpe Ratio	0.72	0.72	0.71	0.71
	Avg. Pair-Wise Corr.	99.84%	99.85%	99.85%	99.60%
Addition to the list of the Base Case portfolio:	ETFs with Smart-Beta Tilts	-	YES	YES	NO
	ETFs with less than 3 years of observations	-	NO	YES	NO
Weighting Scheme:		CW	CW	CW	EW

The first four rows show the returns analytics of four portfolios of Sustainable ETFs formed from three different lists of ETFs that are in our universe of sustainable US-equity ETFs. The return analytics are the annualised returns, volatilities, Sharpe Ratio, and average pair-wise correlation, which is the average of the correlations of the returns of each portfolio with the returns of the other three portfolios. The fifth and the sixth rows indicate whether the list used to form the portfolios adds ETFs with smart-beta tilts (row five) and with less than three years (148.2 weeks) of observations (row six) to the list used for the Base Case portfolio. The last row indicates whether the portfolio is formed value-weighting (CW) or equally-weighting (EW) the ETFs in available in the list at the rebalancing day. All the portfolios are formed with monthly rebalancing. For the three portfolios formed with a value-weighting (CW) scheme the weights are based on the market value of the ETFs at the closing of the last day of the previous month. We use weekly returns' observations at portfolio level to obtain all the results. The time sample is from 27 July 2012 to 31 December 2022.

A2. Details on Returns' Adjustments

To evaluate the performance of the Sustainable Investing Portfolio we look at three types of adjusted returns.

- **Relative returns:** returns of the Sustainable ETFs minus the returns of the representative market benchmark R_t^B which we construct as the weighted average of the returns of the ETFs of the market

Appendix

benchmarks of the ETFs in the Sustainable Investing Portfolio

$$R_t^B = \sum_i^N w_t^i R_t^{B,i}$$

In which, w_t^i is the proportion of the Sustainable Investing Portfolio invested in the ETF 'i', and $R_t^{B,i}$ represents the returns of the SPDR S&P 500 ETF if the ETF 'i' is traded on a North American market, and the returns of the SPDR S&P 500 UCITS ETF if the ETF 'i' is traded on a European market.

- CAPM alpha: returns of the Sustainable ETFs minus the returns explained by the market exposure R_t^M

$$R_t^M = \sum_i^N w_t^i R_t^{M,i}$$

In which, $R_t^{M,i}$ represents the returns of the ETF 'i' explained by its market exposure $R_t^{M,i} = R_t^F + \beta_i^M (R_t^{B,i} - R_t^F)$, in which R_t^F is the risk-free rate, β_i^M is the exposure of the ETF 'i' to the same market benchmark used to compute the relative returns and whose returns are whose returns are represented by $R_t^{B,i}$.

- Industry adjusted returns: returns of the Sustainable ETFs minus the returns explained by the returns of a model that includes exposures to the market and nine industry factors R_t^I

$$R_t^I = \sum_i^N w_t^i R_t^{I,i}$$

In which, $R_t^{I,i}$ represents the returns of the ETF 'i' explained by a model that includes exposures to the market and nine industry factors – $R_t^{I,i} = R_t^F + \sum_k^K \beta_{i,k} R_t^k$, in which $\beta_{i,k}$ is the exposure of the ETF 'i' to the kth factor of the model and R_t^k is the return of the kth factor of the model.

A3. Estimating Market and Industry-Factor Exposures

To compute CAPM alphas and industry adjusted returns of each ETF we need to estimate exposures to the factors included in the two factor-models. For both models, we estimate exposures separately for each ETF using OLS regressions with weekly returns over the entire period for which the returns of the ETF are available⁴¹. To run the estimation of the exposures, we require the ETFs to have at least 148 weekly observations (95% of three years of weekly observations).

To construct factors' returns we use returns of the benchmark ETFs reported in Section 2, because they are more comparable to the universe of assets that we are testing and because they include real world performance effects (e.g., fees and transaction costs). In addition, to account for the non-synchronicity problem, for each ETF we only use ETFs traded in the same region.

In particular, in the first model we only have the market as a factor, and for each sustainable ETF we obtain the market coefficient regressing their excess returns on the excess returns of ETF of the

41 - This means that we assume that factors' exposures of each individual ETF are constant over time.

Appendix

market benchmark traded in the same region. We use the excess returns of the SPDR S&P 500 ETF for the ETFs traded in the North America region, and the excess returns of the SPDR S&P 500 UCITS ETF for the ETFs traded in the European region.

In the second factor model, beside the market factor, we have the returns of nine industry-factors, and we estimate coefficients regressing the excess returns of the sustainable ETFs on the returns of the factors in the model. The first factor is the excess returns of the same market benchmark used in the first model, and the other nine factors are long/short portfolios that are long one of the Industry ETFs and short the ETFs representing the market benchmark in the model. As for the ETF representing the proxy of the market, as industry ETF we use SPDR ETFs managed by SSGA, and we assign them based on the region in which the sustainable ETF is traded.

For the industry ETFs traded in the European region returns are only available starting from July 2015. To extend the time-series of these ETFs to the beginning of our sample (July 2012) we create a proxy for each of them and use the returns of these proxy in the period that goes from the start of our sample to their inception. For each industry ETFs traded in the European region, we compute the returns of the proxy as follows:

$$R_t^{I,EP,j} = \gamma_0 + \gamma_1 R_t^{I,US,j} + \gamma_2 R_{t-1}^{I,US,j}$$

in which, $R_t^{I,EP,j}$ is the proxy at time 't' of the returns of the Industry ETF 'j' traded in the European region, $R_s^{I,US,j}$ is the return at time 's' of the industry ETF 'j' traded in the US region, and the coefficients γ_0 , γ_1 , and γ_2 are estimated with OLS regressions, in which the dependent variables the returns of the industry ETFs traded in the European region and the independent variables are the contemporaneous and lagged returns of the corresponding industry ETFs traded in the US market (we use weekly returns for the estimations).

A4. Accounting for Exposure to Equity-Style Factors

As a robustness check of our results, we have also computed the returns of the Sustainable Investing Portfolios adjusting for a set of academic equity-style factors. We refer to this adjusted performance as multi-factor alpha, and we compute with the same approach that we have used to obtain the adjusted industry returns but using six US equity style factors instead of the nine industry-factors⁴².

42 - The academic US equity-style factors are all long/short strategies and represent the SMB, the HML, the RMW, and the CMA factors, the Momentum factor, as in the model of Fama and French (2018) plus the Betting-Against-Beta (BAB) from Frazzini and Pedersen (2014). We obtain the returns of the first five factors from https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html and the returns for the BAB from the AQR library (<https://www.aqr.com/Insights/Datasets/Betting-Against-Beta-Equity-Factors-Daily>). As the market factor we keep on using the same one constructed from our proxy based on the ETFs of the S&P 500.

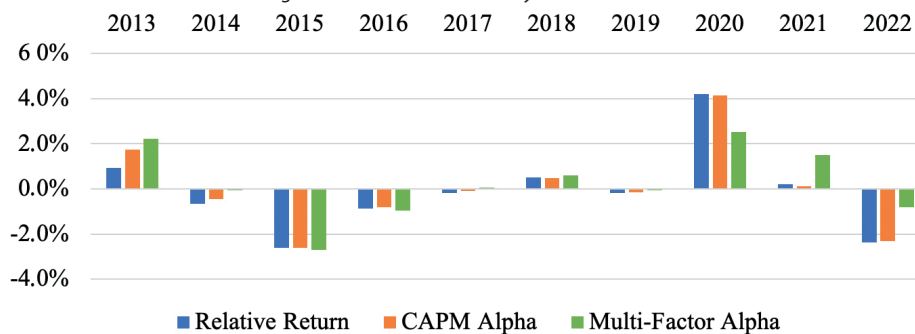
Appendix

Table A.2: Performance summary of the Sustainable Investing Portfolio

	Full Sample From 27/07/2012 to 31/12/2022	First Half From 27/07/2012 to 31/12/2017	Second Half From 01/01/2018 to 31/12/2022
Annualised Relative Returns	-0.2%	-0.7%	0.3%
t-stat	-0.53	-1.08	0.37
Annualised CAPM Alpha	-0.1%	-0.5%	0.2%
t-stat	-0.31	-0.77	0.35
Annualised Multi Factor Alpha	0.1%	-0.3%	0.6%
t-stat	0.27	-0.47	1.02

The table shows the annualised relative returns, the annualised CAPM alpha, and the annualised multifactor adjusted return, with corresponding t-stats in brackets of the Sustainable Investing Portfolio for the three periods indicated in the second row of the headline. Results are obtained using weekly return observations. Relative return is the average difference between weekly returns of the Sustainable Investing Portfolio and of the market benchmark. CAPM alpha is the average of the difference between weekly returns of the Sustainable Investing Portfolio and the return explained by the CAPM exposure $-r_{f_t} + \beta * R_t^{e,M}$, in which r_{f_t} is the risk-free rate, β is the CAPM exposure of the Sustainable Investing Portfolio and $R_t^{e,M}$ the excess return of the market benchmark. We compute multi factor adjusted returns as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns explained by a model that accounts for the exposure to the market benchmark as well as six equity-style factors (size, the value, the high profitability the low investment, the momentum, and the Betting-Against-Beta factor) $-r_{f_t} + \sum_k \beta^k * R_t^k$, in which r_{f_t} is the risk-free rate, β^k is the exposure of the Sustainable Investing Portfolio to the kth factor of the model and R_t^k is the factor return. To annualise relative returns, CAPM alphas, and industry adjusted returns, we multiply them by 52. T-stats are computed accounting for heteroskedasticity and serial correlation.

Figure A.1: Performance of the Sustainable Investing Portfolio over ten calendar years



The bar chart reports the relative returns, the CAPM alphas, and the multi-factor alphas of the Sustainable Investing Portfolio over the latest 10 full calendar years. We use daily return observations within each calendar year. For each calendar year, we compute relative returns of the Sustainable Investing Portfolio as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns of the market benchmark. We compute CAPM alphas as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns explained by the CAPM exposure $-r_{f_t} + \beta * R_t^{e,M}$, in which r_{f_t} is the risk-free rate, β is the CAPM exposure of the Sustainable Investing Portfolio and $R_t^{e,M}$ the excess return of the market benchmark. We compute multi-factor alphas as the difference between the cumulative returns of the Sustainable Investing Portfolio and the cumulative returns explained by the multi-factor exposures $-r_{f_t} + \sum_k \beta^k * R_t^k$, in which r_{f_t} is the risk-free rate, β^k is the exposure of the Sustainable Investing Portfolio to the kth factor of the model and R_t^k is the factor return.

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About Scientific Beta

About Scientific Beta

Scientific Beta's aim is to encourage the entire investment industry to adopt the latest advances in smart factor and ESG/climate index design and implementation. Our institution was established in December 2012 by EDHEC-Risk Institute, one of the top academic institutions in the field of fundamental and applied research for the investment industry, as part of its mission to transfer academic know-how to the financial industry. Scientific Beta brings the same concern for scientific rigour and veracity to all the services that it provides to investors and asset managers. We offer the smart factor and ESG/Climate solutions that are most proven scientifically, with full transparency of both methods and associated risks.

On 31 January 2020, Singapore Exchange (SGX) acquired a majority stake in Scientific Beta. SGX continues to support our strong collaboration with EDHEC Business School, and the principles of independent, empirical-based academic research that have benefited our development to date.

Scientific Beta has developed two types of expertise over the years, responding to two of the major challenges that investors face:

- Smart Beta and, more particularly, factor investing.
- ESG, in particular climate investing.

To date, Scientific Beta has made offerings with two major types of climate objective available to investors:

Since 2015, we have offered products with financial objectives that respect ESG and carbon constraints. These correspond to the application of exclusion filters, the design of which allows the financial characteristics of the index to be conserved. This involves reconciling financial objectives and compliance with ESG norms and climate obligations. As such, our Core ESG, Extended ESG and Low Carbon filters can be integrated into smart beta or cap-weighted offerings in line with the financial objectives targeted by the investor.

Since 2021, Scientific Beta has also offered indices with pure climate objectives (Climate Impact Consistent Indices) that enable climate exclusions and weightings to be combined in order to translate companies' climate alignment engagement into portfolio decisions.

Since it was acquired by SGX in January 2020, Scientific Beta has accelerated its investments in the area of Climate Investing as part of the SGX Sustainable Exchange strategy, which is mobilising an investment of SGD20 million. In addition, EDHEC and Scientific Beta have set up a EUR1 million/year ESG Research Chair at EDHEC Business School.

With the aim of providing worldwide client servicing, Scientific Beta has a presence in Boston, London, Nice, Singapore and Tokyo. As of 31 July 2022, our indices had USD52.47bn in assets under replication. Scientific Beta has a dedicated team of 55 people who cover not only client support from Nice, Singapore and Boston, but also the development, production and promotion of our index offering. Scientific Beta signed the United Nations-supported Principles for Responsible Investment on 27 September 2016. We became an associate member of the Institutional Investor Group on Climate Change on 9 April 2021.

About Scientific Beta

Today, Scientific Beta devotes more than 40% of its R&D investment to climate investing and more than 45% of its assets under replication refer to indices with an ESG or climate focus. As a complement to its own research, Scientific Beta supports an important research initiative developed by EDHEC on ESG and climate investing and cooperates with Moody's ESG and ISS ESG for the construction of its ESG and climate indices.

On 27 November 2018, Scientific Beta was presented with the Risk Award for Indexing Firm of the Year 2019 by the prestigious professional publication Risk Magazine. On 31 October 2019, Scientific Beta received the Professional Pensions Investment Award for "Equity Factor Index Provider of the Year 2019." On 2 February 2022, Scientific Beta was named "Best Specialist ESG Index Provider" at the ESG Investing Awards 2022.



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