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Environmental Portfolios—Evidence from Screening and Passive Portfolio Management

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Abstract: Environmental portfolios via screening or optimization with respect to ecological criteria are not clear-cut concepts. Often, they urge investors to reduce the asset universe, which is accompanied by diversification losses. In this article, we show that a simple passive asset selection strategy based on environmental criteria allows ecological investors to adjust their portfolios without compromising or even reducing risk-adjusted financial performance. In detail, we show that screening does not lead to a significant financial performance reduction. Moreover, we propose an asset selection based on an environmental criteria that improves the portfolios' financial performance, and further improves its potential positive environmental impact. Our results suggest that a combination of a screening and an environmental-scoring-based asset allocation seems to be a viable option for environmentally responsible investors leveraging the advantages of both strategies. Furthermore, we construct a risk factor CMP (clean minus polluting) and document a significant factor loading when added to the Fama–French five-factor model, suggesting the existence of a risk premium based on a firm's environmental performance.

Keywords: asset selection; ecological investment; benchmarking; performance

JEL Classification: G0; G4

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1. Introduction

In recent years, many investors consider additional decision-making criteria besides risk and return, for example, environmental, social and governance (ESG) issues in their portfolio. According to Eurosif [1], there are several procedures available, whereas the most common are: exclusions, engagement and voting; norms-based screening; and ESG integration in asset selection. While exclusion strategies are the most predominant strategies given by the assets under management (AUM), in terms on Euros invested, ESG integration shows the largest increase over the last few years. These practices aim to express the investors' wish not to promote companies that fail to meet the investors' individual preferences. The criteria that lead to an exclusion from the asset selection process can be based either on the type of industry (e.g., tobacco, weapons, or pornography) or on global issues and controversies (e.g., environmental, social or corporate governance). Given that this exclusion procedure affects the number of assets available in such portfolios, how does this activism affect the financial performance of the remaining "clean" portfolio? This question is important for financial managers as it highlights the trade-offs between certain interests or social preferences and the financial performance and respective risk structure of the resulting portfolio. Richardson [2], for example, shows that the negative screening of controversial stocks by institutional investors may contradict their fiduciary duties whenever controversial assets show superior financial performance compared to a socially responsible alternative, which provides a positive environmental or social impact.

In this artcle, we contribute to the question whether investors divesting or screening their portfolios (with respect to certain environmental criteria) are willing to leave money on the table in order to improve the environmental impact of their portfolio. Based on Ziegler et al. [3], we expect that the environmental subscore included in the ESG scores from ESG rating providers seems to be a good starting point for constructing environmental portfolios based on firms with higher environmental performance and competitive financial performance. Herein, we distinguish between asset screening, i.e., excluding assets from the portfolio based on environmental criteria, and asset allocation, i.e., weighting the selected assets according to environmental criteria based on the environmental subscore (E-score) of the ESG score.

The aim of this article is to provide a simple passive strategy that does not require investors to have a deeper knowledge about the firm, its business operations or supply chain. Therefore, we analyze the question of whether environmentally responsible investors could be better off in terms of the overall environmental performance of their portfolios by following an environmental score weighting approach (abbreviated as E-weighting) without sacrificing financial performance. In this regard, we follow the procedure outlined in Trinks et al. [4] for screening with respect to (i) coal or (ii) oil and gas, or (iii) all fossil fuels. We refer to the constituents of the S&P 500 and the Eurostoxx 600 in order to compare the differences between the respective regions. For both, full and screened asset selection, we then construct portfolios based on value weighting, i.e., weighting by company size, and equal weighting (naive asset selection). For the investor focusing on environmental issues (environmentally responsible investor or ERI), we refer to the environmental subscore of the ESG score provided by ASSET4. This score serves as the basis for the environmental weighting approach, in which the asset allocation of the environmental portfolios is solely based on the E-score.

Overall, the contribution of this article is manifol Similar to Amon et al. [5] and Lee et al. [6], we contribute to the question of whether ESG-based investment strategies may lead to significant underperformance and diversification losses. First, we construct portfolios for both the US and Europe by applying a negative screening based on the exclusion of fossil fuel-related firms in combination with the most common asset allocation strategies, such as value-weighting and a naive allocation. We find that negative screening in Europe does not have a negative impact on the financial performance, but also has little effect on the overall environmental performance of the portfolios as measured by the E-score. For the US we observe an improvement in financial performance when excluding fossil fuel-related firms. Second, we follow Amon et al. [5] and implement a novel asset allocation strategy, where the weighting of the individual stocks in the portfolio is determined by the environmental subscore of the ESG score. We observe a significantly higher financial performance and competitive environmental performance. For the US, the results indicate a small, but insignificant trade-off between the financial performance of the E-weighting strategy and the naive allocation, while the environmental performance is significantly higher. These results suggest that an environmentally responsible investor in Europe is able to realize his preferences for both, financial and environmental performance together by following a combination of negative screening and E-weighting. In the US, however, a trade-off between financial and environmental performance has to be accepted, even with this combination strategy.

In a last step, a Fama–French five-factor model is applied to further identify the explanatory factors of the portfolio returns, and a sixth factor denoted CMP (clean minus polluting) is added to the model. The model results indicate a highly significant loading on the new factor, indicating the existence of a risk premium for environmental portfolios.

Therefore, the remainder of the paper is structured as follows. Section 2 gives an overview of the relevant literature. Section 3 describes the methodology, while Section 4 outlines the data used. Section 5 explains the results of the analysis and, finally, Section 6 presents the conclusion.

2. Literature and Hypothesis Development

In 2016, approximately USD 8 trillion assets were under management in socially responsible investment (SRI) strategies (see Farzana [7] and Flood [8]) in the US. According to the US SIF Foundation's 2020 Report on US Sustainable and Impact Investing Trends, this volume grew to USD 17.1 trillion by the end of 2019.

Following Dorfleitner et al. [9] we define socially responsible, ethical or sustainable investments as financial products that include all types of investments in which (additional to financial criteria) non-financial issues are taken into consideration for asset selection. This approach was already used several hundred years ago, when religious and/or ethical beliefs were considered for investment decisions (see Ballestero et al. [10]). A comprehensive overview on empirical studies until 2015 is provided in Friede et al. [11].

Most studies focus on the question of whether the extension of asset selection criteria towards non-financial dimension(s) has a positive or negative impact on the financial performance. Friede et al. [11], for example, show that approximately 90 percent of existing studies find a positive or at least no negative relationship between ESG criteria and financial performance. More recently, Camilleri [12] has presented an extensive descriptive analysis of the "foundations of SRI and a factual summary of its evolution".

With the following article, we address the question of whether a portfolio that screens assets from fossil fuel industries or a portfolio constructed based on the environmental subscore of a common ESG score provider comes at the expense of financial performance or additional risk. Therefore, in the following literature review, we first focus on articles that deal with screening activity.

In the second part of this section, we focus on ecological and environmental investment decisions.

2.1. Portfolios and Screening

Barnett and Salomon [13] showed that there is a curve-linear relationship between screening and performance. They conclude that there are at least two effects working in different effective directions, namely diversification losses and performance gains driven by strong stakeholder relationships that may outweigh each other. Renneboog et al. [14] demonstrated that the performance of SRI funds critically depends on the screening intensity. They further argued that any short-term loss in diversification could be offset by benefits due to better stakeholder relations, which in general implies stronger long-term performance.

Humphrey and Lee [15] find "little evidence of positive or negative screening impacting total return, but find weak evidence that funds with more screens overall provide better risk-adjusted performance, . . . as. . . positive screening significantly reduces funds' risk." They further showed that with respect to negative screening, diversification loss may increase risk and thus reduce risk-adjusted performance of these funds. In line with Langbein and Posner [16], Knoll [17] also mentions this shortcoming of diversification loss that goes along with the reduction of the asset universe for SRI investments (especially in the early years of ESG measurement). Fabozzi et al. [18] derive a conclusion about screening effects from looking at sin portfolios, i.e., portfolios based on sin stocks e.g., weapons, alcohol or tobacco. They show that these significantly outperform the market, but at the same time lead to a lower overall risk-adjusted performance due to the higher risk. Early evidence provided by Goldreyer and Diltz [19] shows that SRI funds with positive screening techniques outperform their counterparts. Statman and Glushkov [20] confirm this finding, but do not restrict their analysis to SRI funds. They find a positive relationship between positive screening and portfolio performance, but show also that negative screening decreases portfolio performance.

Edmans [21] analyzed the relationship between employee satisfaction and long-term stock returns and found that certain SRI activity may improve returns. For this, he forms a value-weighted portfolio composed of the "100 Best Companies to Work For in America" standard. He finds on average an annual outperformance of 3.5%, as measured by the four-factor model, over a period from 1984 to 2009 which is 2.1% above the industry benchmarks.

Humphrey and Lee [15] and Humphrey and Tan [22] also demonstrated "that a typical socially responsible fund will neither gain nor lose from screening its portfolio".

For a sample of French funds, Capelle-Blancard and Monjon [23] show that the quality and quantity of the screening process critically affects fund performance in a positive or negative manner.

More recently, Trinks and Scholtens [24] analyzed "the impact of negative screening on the investment universe as well as on financial performance" and show that controversial investments generally yield positive abnormal returns which implies a negative effect of screening on the financial performance. They investigated the impact of negative screening on the market portfolio with respect to certain sin stocks and derived clear cost associated with this personal preference in the asset selection.

Based on these prior studies, it becomes evident that screening activity is an ambiguous approach for portfolio manager who aim to optimize the financial performance on behalf of their investors. However, certain investors may aim to exclude certain assets from their portfolio. Hence, the question remains as to how this reduction in the asset universe which is generally accompanied by diversification loss could be compensated for by different asset allocation approaches applied to the selected assets of the portfolio. Moreover, it is still unclear how the findings discussed above could be classified from the risk management perspective, i.e., whether well-known risk factors can also explain the differences in good and bad (sin) stocks or whether additional factors are needed. In order to investigate these questions, we derive the following hypotheses.

Following Trinks et al. [4], we analyze the financial performance of investment portfolios with and without fossil fuel firms for two separate regions, the US and Europe. In line with Trinks et al. [4], we expect that fossil fuel screenings do not impair portfolio performance. We assume that one reason for this is that fossil fuel companies do not necessarily outperform other stocks. Another reason is that the diversification loss from the screening activity triggered by the investor's environmental preference to screen oil, gas or coal companies, is rather limited. Based on this prior evidence, we formulate the first hypothesis.

Hypothesis 1. *A negative screening of fossil fuel firms does not adversely affect the risk-adjusted financial performance of the portfolio.*

2.2. Environmental Factors and Financial Performance

In the second strand of literature, we focus on ecological or environmental investment decisions.

Early evidence is provided in Russo and Fouts [25] who showed that environmental ratings have a small, but statistically significant positive effect on a firm's return on assets for US stocks for the years 1991 and 1992. In a sample of multinational firms, Dowell et al. [26] found that firms with high environmental standards have higher firm value than others, measured by Tobin's Q. Wheat [27] showed that there may be a similar financial performance of social or environmental funds, but is often accompanied by higher risk. Derwall et al. [28] analyzed two different equity portfolios that differ in their eco-efficiency score. They find superior environmental and financial performance during 1995 to 2003 for the higher ranked portfolio. Ziegler et al. [3] focused on European data for the period from 1996 to 2001. They showed that for the corporations considered, "the average environmental performance of the industry has a significantly positive influence on the stock performance", which does not hold for social or governmental criteria. This underlines our expectation that the environmental subscore included in the ESG score seems to be a good starting point for the asset selection. Koellner et al. [29] showed that sustainable investment funds performed better between 2000 and 2004 with respect to environmental impact assessment but worse in their risk-adjusted economic performance. They concluded, that there is a clear tradeoff between the financial and environmental dimension. Sharfman and Fernando [30] exhibited for a sample of 267 U.S. firms that “improved environmental risk management” leads to lower cost of capital, with the possibility to increase debt financing and thus foster higher tax benefits. Climent and Soriano [31] showed that green funds are not significantly different from the rest of SRI and conventional mutual funds after adjusting for risk. Manescu [32] does not find a significant effect of environmental performance of value relevant environmental activities. More recently, Hunt and Weber [33] showed for the Canadian stock index TSX 260 higher risk-adjusted returns and lower carbon intensity of the divestment strategies compared to the benchmark and they concluded that this way it is also possible to address the financial risks inherent in climate change.

Yook and Hooke [34] showed that for the time horizon from 2004 to 2017, Solactive US Large Cap Index with fossil firms reports a significantly higher financial performance compared to its respective counterpart without fossil firms. In constrast, Lee et al. [6] show that the integration of environmental, social and governance analyses does not reduce risk-adjusted returns in Australia. They analyze the differences of the performance in terms of risk and returns with respect to portfolios classified being high- or low-ESG-rated. They find that “a simple ESG integration strategy may provide a natural hedge against the . . . ESG risks”.

Amon et al. [5] construct passive portfolio strategies, which are directly based on the ESG scores of individual firms and find that it is possible to outperform standard passive benchmark portfolios, such as a value-weighted or naive portfolio, with respect to financial and social performance. Our contribution in this article is the focus on an environmentally responsible investor and his decision making process following clear preferences towards environmentally responsible firms. On one hand, we investigate the possibility of an investor performing a screening prior to portfolio construction in order to exclude firms from polluting industries. On the other hand, the investor is also able express these preferences directly in the asset allocation process of the portfolio by allocating more funds towards firms with high environmental ratings given by the environmental subscore of the ESG score. Finally, the combination of these two approaches is examined as well, while Amon et al. [5] purely focus on the asset allocation process for socially responsible portfolios in general. While social and governance considerations are of utmost importance, the aspect of environmental responsibility is of particular relevance for firms, since environmental failures constitute a major source of risk due to substantial legal fines and reputation losses. However, our article leaves aside the ongoing debate about the integration of carbon (or climate) risk in portfolio decisions as for example provided in Focardi Sergio [35], or Görgen [36]. Based on this prior evidence we formulate Hypotheses 2 and 3.

Hypothesis 2. *A portfolio based on the environmental subscore of the ESG score (E-weighting) is not harmed in its financial performance compared to a portfolio based on naive weighting or a value-weigthed portfolio. It further shows a higher environmental performance and is thus strictly preferred.*

This hypothesis tests whether a clear focus or preference of a certain investor towards environmental performance (measured by the E-score) negatively impacts the financial performance of the portfolio (risk-adjusted performance). Furthermore, we expect that the clear focus on the E-score leads to a higher environmental performance and in turn to a higher satisfaction for the ERI.

However, this does not answer the question whether the financial performance of the portfolios constructed based on different asset allocation strategies is explainable by the same set of risk factors and to a similar extent. Therefore, we investigate the financial returns of the portfolio strategies using the the well-known Fama–French five-factor model and extend it further by another factor.

In general, it is assumed that the portfolio returns can be well explained by the five Fama–French (FF) factors (see Fama and French [37]). In line with Henriksson et al. [38], we add a sixth factor denoted as CMP (clean minus polluting) to the regression model, which aims to explain the difference in returns between clean and polluting stocks, which is not covered by the other FF factors (A detailed description on the calculation of this parameter is outlined in the methodology).

Hypothesis 3. *The financial performance of the portfolios constructed based on different weighting strategies are affected in different ways by the risk sources. We expect further that a risk factor based on the E-score holds significant explanation power for the portfolio returns in addition to the five Fama–French factors.*

3. Methodology

In Section 3.1, we focus in a first step on the asset selection and implement a number of portfolios based on sector screenings. In a second step, the portfolio weights are adjusted using a number of asset allocation strategies, such as value- weighting, E-weighting based on the environmental subscore of the ESG score and the naive allocation (1/N) . In Section 3.2, we describe the methodology for the financial performance assessment via the well known systematic risk factors as outlined in Fama and French [37].

3.1. Asset Selection—Screening and the Decision of the Environmentally Responsible Investor

We apply a number of negative screenings of stocks from polluting industries to establish the final asset selection reflecting an environmentally responsible investor's preferences. We test three screening options, which include the most common industries for ERI's to screen. Furthermore, we use the full and screened asset universe to construct the portfolios using an asset allocation strategy based on the weights of the environmental subscore (E-score) provided in the ESG score of ASSET4 (E-weighting). As mentioned in Gonenc and Scholtens [39], fossil fuel firms sometimes show a high E-score performance although the firms may not be environmentally-oriented at all. A pure focus on the environmental rating might therefore not be in line with an ERI's preference set. By combining a negative screening with E-weighting, the sole dependence on ESG scores can be reduced and this issue can be resolved. Such a portfolio excludes firms based on industry or topic affiliation, and shifts the asset allocation of the remaining asset selection towards strong environmental performance stocks at the same time, while also providing a signalling effect to the firms contained in the portfolio.

The screening of assets is based on their SIC codes and is in line with Trinks et al. [4] allowing a direct comparison of our results to these earlier findings. We focus on the exclusion of the fossil fuel part of the energy sector in multiple steps and conduct negative screenings based on the following sectors.

- screening of coal (sic 12 und 3532) (this screening strategy is further abbreviated as -c.)
- screening of oil and gas (sic 13, 291, 3533, 46, 492) (this screening strategy is further abbreviated as -og.)
- screening of coal, oil and gas i.e., exclude firms covered with sic 12, 13, 46, 291, 492, 3532, 3533 (this screening strategy is further abbreviated as -f.)

Hence, the asset universe from which the portfolios are constructed can (a) encompass all firms, i.e., the whole included universe, (b) the universe without coal, (c) without oil or gas, or (d) without coal, oil and gas.

Based on these screening scenarios, three different portfolios are formed, differing only in the weights put on the composites. Herein, we distinguish between value weighting, i.e., a firm's weight depends on its relative market capitalization, and a naive asset allocation, in which all assets receive the same weight. In addition, following Amon et al. [5] we construct a portfolio strategy that assigns a larger weight to firms with higher environmental performance. The portfolio weight of an individual firm i at a given time t is based on the environmental subscore E of the ESG score, where the sum of E-scores for an asset selection and region represents the total environmental value $V(E)$ of that portfolio's specific asset universe (In this study, we rely on the environmental subscore of the ESG score. We do not take scope emissions into consideration separately, as the E-score is already a composite of emissions, recourse use and innovation capacity to reduce environmental costs. This can result in firms with comparably higher emissions to show a high environmental score as well, if the other two dimensions outperform accordingly). It is given by

$$V(E)_t = \sum_{i=1}^{N} E_{it}. \tag{1}$$

A firm's portfolio weight $x_{E,it}$ is then calculated as the level of that firm's E-score E_{it} relative to the total environmental value of that portfolio $V(E)_t$ and is given by

$$x_{E,it} = \frac{E_{it}}{V(E)_t}. \tag{2}$$

This strategy allows an environmentally responsible investor to go beyond asset screening and put more emphasism on environmental performance in the asset allocation strategy while still being able to exclude assets in order to construct a portfolio that reflects his personal set of preferences for return, risk and environmental responsibility.

All screenings and asset allocation strategies are implemented and compared for the US and EU, respectively, and tracked throughout the whole observation period (The rebalancing of the portfolios takes place on a monthly basis, despite the adjustments of the E-scores are less frequent.).

3.2. Assessing the Financial Performance

After constructing the various portfolios based on different levels of screening and asset allocation strategies, we relate the portfolio returns to common risk factors via the Fama–French five-factor model (Fama and French [37]), and include an additional factor denoted CMP (Clean minus Polluting) with the following regression equation:

$$\begin{aligned} r_{i,t} = \alpha + \beta^{mkt}(R_{mkt,t} - R_{rf,t}) + \beta^{SMB} SMB_t + \beta_t^{HML} HML_t \\ + \beta^{RMW} RMW_t + \beta^{CMA} CMA_t + \beta^{GMB} CMP_t + \epsilon_t \end{aligned} \tag{3}$$

with $(R_{mkt,t} - R_{rf,t})$, denoting the market risk premium measured as the return difference of the value-weighted market portfolio of the full asset universe and the one-month treasury bill rate. SMB (small minus big) captures possible size effects, as companies with small market capitalization are expected to show higher returns compared to companies with a large market capitalization on average. It is given by the return on a diversified portfolio of small stocks (smallest 30%) minus the return on a diversified portfolio of big stocks (biggest 30%). High minus Low (HML) analyzes possible biases because of the book to market ratio, as companies with a high book to market ratio (value companies) are on average outperforming companies with a low book-to-market ratio (growth companies). It is calculated by subtracting the stocks with a low book-to-market ratio (lowest 50%) from the stocks with a high book-to-market ratio (highest 50%). Robust minus weak (RMW) is the average return of stocks from companies with a weak operating profitability minus the average return of stocks from companies with a robust operating profitability. Conservative minus aggressive (CMA) investment strategies, which is the difference between the returns on diversified portfolios of the stocks of low and high investment firms (see Fama and French [37]). The factors are determined based on stocks traded in the respective region, i.e., the universe is per definition larger than the universe used for the asset selection for the portfolio construction.

Over the last decade, several articles suggested that "good" firms and "bad" firms are subject to different sources of risk. Blitz and Fabozzi [40] showed that there exist factors beyond the well-known five Fama–French factors, which explain the difference between the financial performances of good and sin stocks. In line with Henriksson et al. [38], we add a sixth factor called CMP (clean minus polluting), which controls for the systematic differences in returns of clean and polluting firms. It is calculated as the return of the highest minus the lowest 50% of firms in terms of E-score (We also compute the CMP factor by considering only the top and bottom 30% to allow for a stronger distinction between clean and polluting firms. This variation does our regression results and overall findings).

This factor is determined based on the asset universe of the respective portfolio as it deals with the significant differences of the clean and polluting firms within the portfolio.

4. Data

We refer to daily stock price data for firms included in the S&P 500 as well as the Eurostoxx 600 provided by Bloomberg. We focus on a time period that ranges from 2005 until 2018. Firms with incomplete price information, mergers or major change in firm structure are removed (As we deal with large and rather stable stocks, we expect that also the inclusion of the firms that we excluded would not have changed our results significantly, as the number of firms that defaulted from these indices is rather low). The full sample consists of 414 firms for Europe and 473 firms for the US. For the Fama–French five-factor model we use data provided by the library of Kenneth R. French, based on the full asset universe of public equities in the US and Europe.

For the environmental score, we refer to the environmental subscore of the ESG score provided by ASSET4 (Thompson Reuters). Tables A1 and A2 provide the average return, standard deviation, and minimum, as well as maximum E-score for each 2-digit sic code classification which are given in the Appendix A (For a detailed overview on the two digit sic code classification see for example https://www.naics.com (accessed on 2 September 2021)).

The distribution of the average environmental scores is given in Figures 1 and 2, respectively. It can be observed that for European firms, environmental scores are on average higher with a distribution, that is heavily skewed to the left. For the US, the distribution is more uniform with a high number of firms showing very low environmental scores.

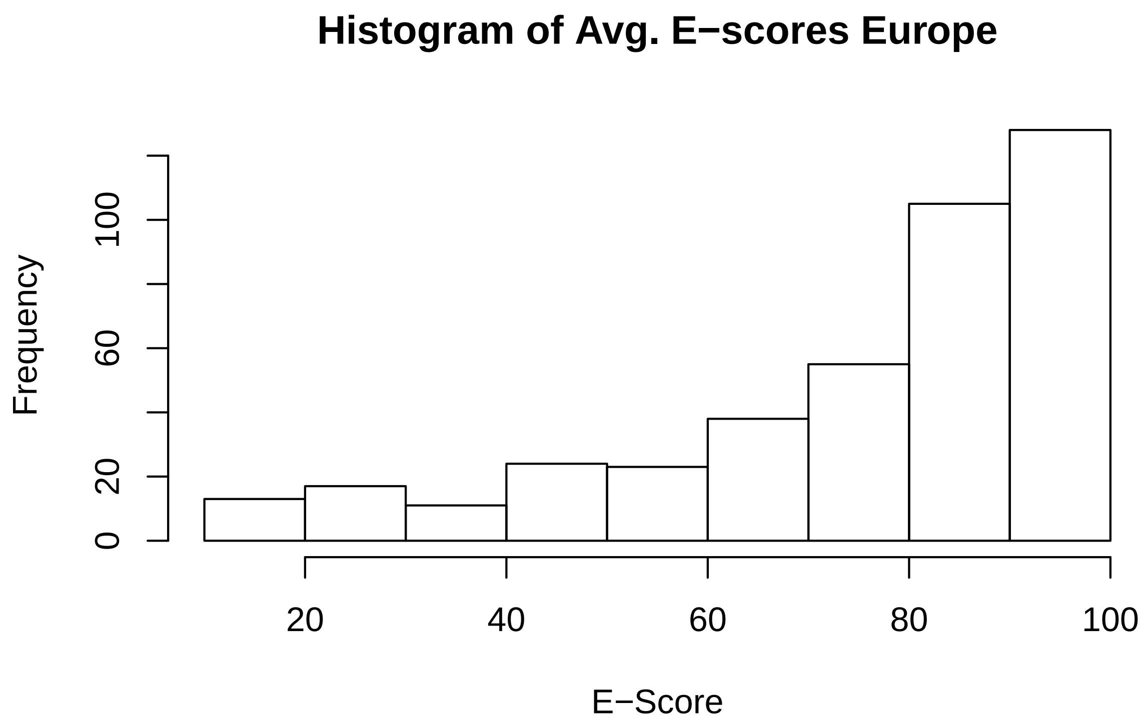

Figure 1. Histogram of E-scores in Europe. Note: This figure shows a histogram of average E-scores in Europe. Herein, the largest group is also the highest group of E-scores, i.e., for Europe, more firms have higher E-scores.

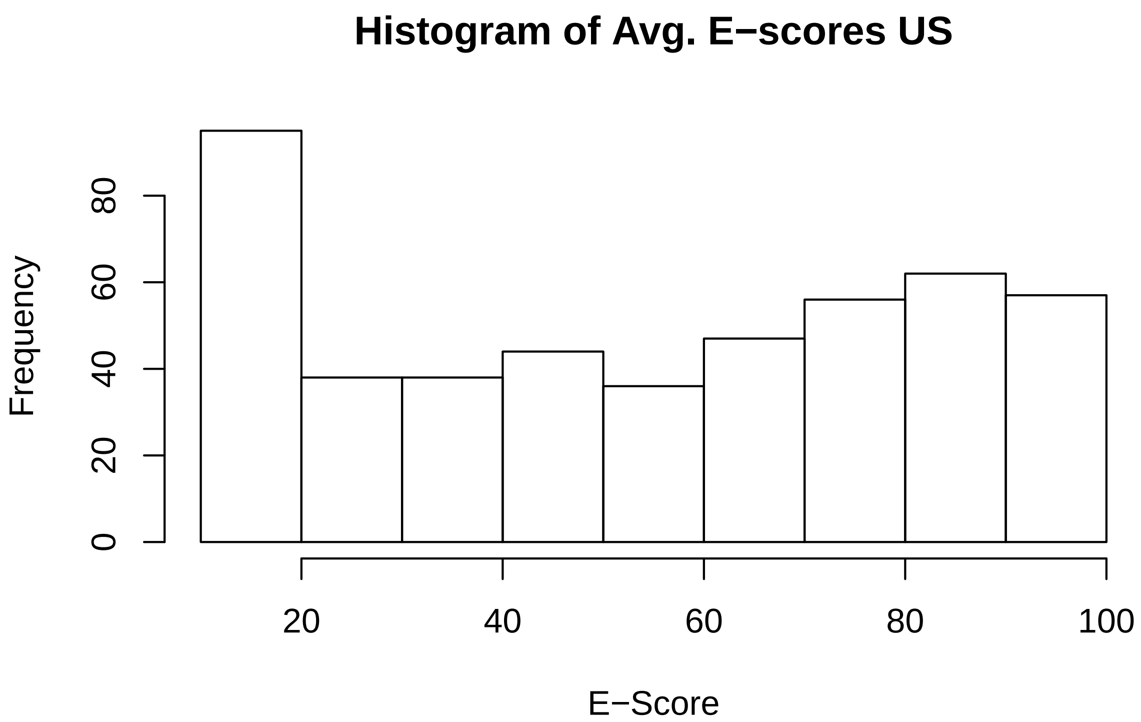

Figure 2. Histogram of E-scores in the US. Note: This figure shows a histogram of average E-scores in the US. Herein, the largest group is also the group with the lowest E-scores, i.e., for the US, more firms have lower E-scores. On total, the frequency seems quite balanced across the different ESG baskets.

Further, summarizing descriptives are provided in Table 1, which further confirm the results shown in the previous figures.

Table 1. E-Score Descriptives.

	Min	1st Quartile	Median	Mean	3rd Quartile	Max	Skewness
Europe	10.96	63.49	82.32	74.42	91.18	95.07	−1.26
US	10.32	26.87	54.70	53.71	80.00	94.86	−0.11

Note: This table gives descriptive statistics of E-scores for Europe and the US. Herein, mean, minimum, maximum, as well as the first and third quartile are given.

As mentioned before, we employ first a screening of polluting firms based on the association to fossil fuel sectors given by SIC codes. We summarize the descriptives of these sectors in Table 2. The screening strategy based on coal, oil and gas, or both, is a very narrow classification, as it does not cover the broader spectrum of possible negative effects of business operations or environmental impact of firms.

We only have one coal firm in Europe included in the sample which surprisingly has also a very high E-score. Interestingly, from the range of E-scores, it is not obvious that the firms considered to be divested are polluting firms, as the maximum value is perfectly in line with other sectors that are less polluting or not stigmatized (For the sake of this article, we focus on screening based on the SIC code only, as the aim of this article is to provide a very simple strategy without further knowledge on the firms). This finding further motivates a detailed analysis of a combination of screening and weighting via E-scores, as the E-score alone may not lead to the intended outcome as evidently non-clean firms may be able to reach rather high E-scores. A prior screening in combination with an E-weighting approach to further promote environmentally strong firms in clean sectors might be able to resolve this issue and be more in line with an environmentally responsible investor's preferences. This has the additional benefit of a signaling effect for firms in these industries, which may further stimulate the transformation towards more sustainable business practices.

Table 2. Analysis of polluting companies.

	N	Mean Return	SD Return	Mean E-Score	Min E-Score	Max E-Score
Europe—Coal	1	0.071%	2.505%	93.262	93.262	93.262
Europe—Oil/Gas	16	0.041%	1.988%	77.301	31.793	93.207
Europe—Fossil Fuels	17	0.043%	2.019%	78.240	31.793	93.262
US—Fossil Fuels	32	0.053%	2.465%	52.427	11.613	92.574

Note: This table provides descriptive statistics of the polluting companies for the US and Europe. Herein, average return, standard deviation (SD), minimum, maximum and average E-score are given. For the US, a deeper classification into coal and oil/gas is not possible, such that all firms are categorized under fossil fuels.

5. Results

Figures 3 and 4 give insights into the cumulative monthly returns resulting from each strategy.

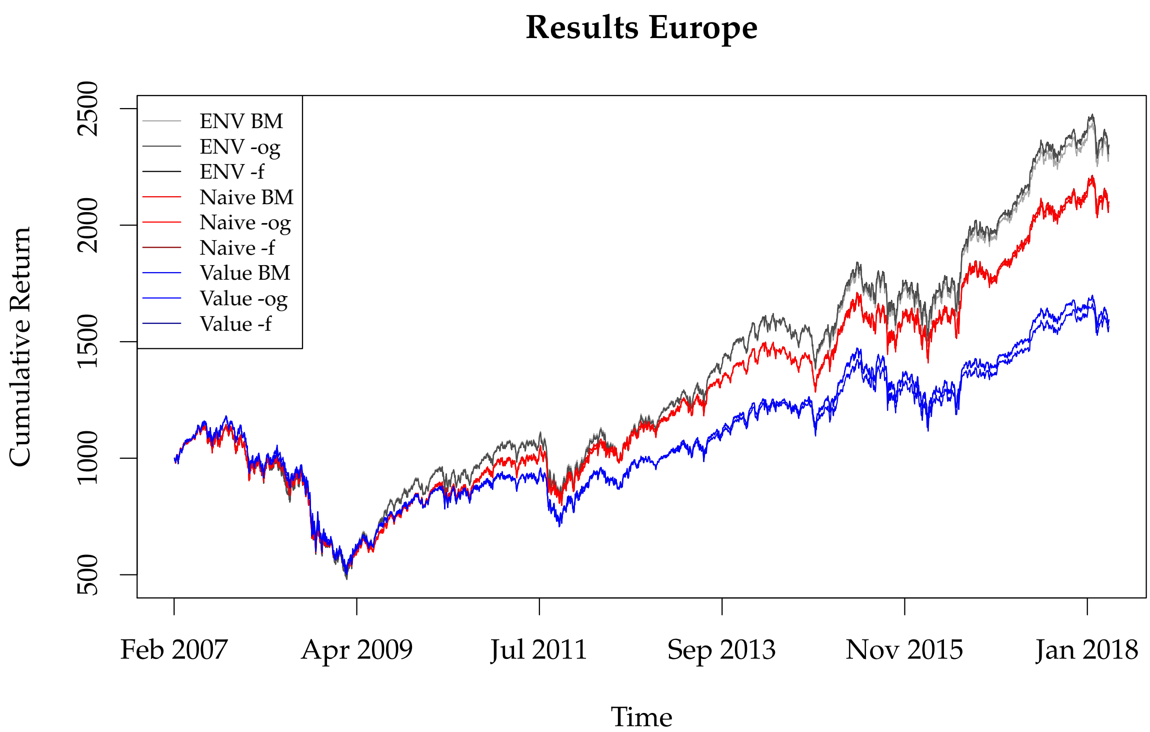

Figure 3. Cumulative returns on 1000 USD for Europe. Note: This figure gives the cumulative monthly returns based on an initial investment of 1000 $ for the nine proposed strategies in Europe. In grey, the ecological portfolios are given, whereas the naive portfolio is given in red, the value weighted one in blue. Herein, the grey graph shows a clear superior performance compared to the other strategies.

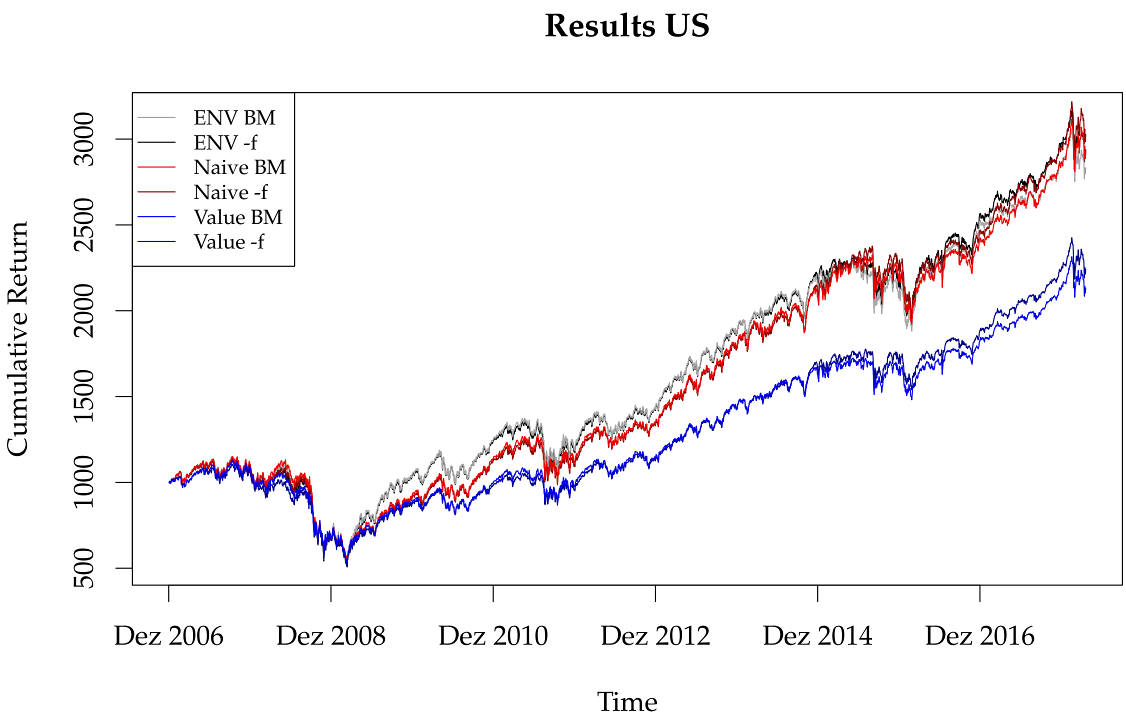

Figure 4. Cumulative returns on 1000 USD for the US. Note: This figure gives the cumulative monthly returns based on an initial investment of 1000 $ for the 6 proposed strategies in the US. In grey, the ecological portfolios are given, whereas the naive portfolio is given in red, the value weighted one in blue. Herein, the grey and red graphs show a clear superior performance compared to the value weighted strategy.

Each color visualizes a certain asset allocation strategy in which further screening activity is included, indicated by the variations in color. For expository convenience and in order to compare the figures for US and Europe, only the benchmark (without screening) and the strategies including screening based on oil and gas, and all fossil fuels are presented. Hence, we end up with two possible asset bases for the portfolio selection: first, the complete asset universe, and second, the universe after screening, i.e., without oil and gas, in which the latter is denoted as -f (without fossil fuel).

It can be seen that screening activity does not seem to affect the cumulative return significantly, i.e., the outcome available to the investor is not affected by screening activity with respect to coal, oil or gas. Nevertheless, we further observe that the different (passive) portfolio weighting strategies clearly lead to (significantly) different cumulative returns. The best performing strategy (in terms of returns) in Europe is given by E-score weighted portfolio, followed by the naive portfolio, and the value-weighted portfolio, which provides the lowest cumulative return. This ranking is mostly confirmed for the US, although here, the naive and E-weighted portfolios show similar returns, which are not significantly different from each other.

5.1. Portfolio Performance

For the portfolio performance, and in order to analyze hypotheses 1 and 2, we highlight the average monthly mean, standard-deviation, resulting portfolio E-score, as well as Sharpe ratio and Delta ratio (The Delta ratio traces back to Gasser [41] and shows, similar to the Sharpe ratio, the financial risk-adjusted environmental performance of the portfolio given by $\frac{\bar{E}_P}{\sigma_P}$.) for each strategy. In order to evaluate our hypotheses and compare the portfolio strategies with respect to any significant financial and environmental under-/overperformance, we employ a number of pairwise significance tests for the returns, variances, Sharpe ratios and E-scores (We use a T-test for returns and E-scores, an F-test for variances and the Sharpe Ratio equality test following Wright [42]. These findings are presented with the corresponding portfolio results. The detailed results of the significance tests are available upon request.). The benchmark within each specific strategy refers to the portfolio based on the whole data sample without screening. The results are given in Tables 3 and 4 for Europe and the US, respectively.

Table 3. Portfolio results Europe.

	Mean	Standard Deviation	Mean E-Score	Sharpe Ratio	Delta Ratio
Naive Benchmark	0.036%	1.190%	74.864	3.006%	62.905
Naive w/o coal	0.036%	1.189%	74.830	3.012%	62.941
Naive w/o oil/gas	0.036%	1.190%	74.956	3.030%	63.000
Naive w/o fossil fuels	0.036%	1.189%	74.921	3.036%	63.038
Value Benchmark	0.025%	1.248%	84.133	2.028%	67.429
Value w/o coal	0.025%	1.248%	84.130	2.029%	67.437
Value w/o oil/gas	0.026%	1.253%	84.119	2.082%	67.123
Value w/o fossil fuels	0.026%	1.253%	84.115	2.083%	67.132
E-Score Weighted	0.041%	1.288%	83.549	3.184%	64.865
E-Score Weighted w/o fossil fuels	0.042%	1.291%	83.528	3.224%	64.667

Note: This table shows the portfolio results for the monthly average returns, standard deviation, E-score, Sharpe ratio, and Delta ratio for Europe. The highest mean financial return is gathered by the E-score weighted strategy, but this also goes along with the highest risk. Referring to the Sharpe ratio instead, the E-weighted portfolio clearly again shows the highest value.

Table 4. Portfolio results US.

	Mean	Standard Deviation	Mean E-Score	Sharpe Ratio	Delta Ratio
Naive Benchmark	0.047%	1.340%	53.175	3.511%	39.689
Naive w/o fossil fuels	0.048%	1.322%	53.509	3.629%	40.468
Value Benchmark	0.035%	1.266%	75.425	2.750%	59.560
Value w/o fossil fuels	0.036%	1.249%	75.143	2.914%	60.181
E-Score Weighted	0.046%	1.382%	74.182	3.359%	53.678
E-Score Weighted w/o fossil fuels	0.048%	1.369%	74.617	3.473%	54.523

Note: This table shows the portfolio results for the monthly average returns, standard deviation, E-score, Sharpe ratio, and Delta ratio for the US. The highest financial return (mean) is gathered by the naive strategy and the e-weighted one with fossil fuel divestment. In terms of the Sharpe ratio, there are small differences between naive and e-weighted portfolio observable but these are not statistically significant.

For Europe, the highest mean financial return is generated by the E-score weighted strategy, and is also accompanied by the highest risk. In order to show the possible tradeoff between risk and return, we refer to the Sharpe ratio. Here again, the E-weighted portfolio clearly shows the highest value. Interestingly, the screening approaches go along with a reduction in risk. This is in line with the high industry risk expected with fossil fuels. This implies a reduction of risk if these firms are screened out (see for example Driesprong et al. [43], and Ansar et al. [44], but also Trinks et al. [4]). The second best strategy in terms of Sharpe ratio is given by the naive portfolios, in which the with and without screening portfolios are not statistically significantly different from each other. The worst financial performing strategy is given by the value-weighted portfolio.

This finding cannot be fully confirmed for the US. Here, the highest mean financial return is reported by the naive strategy and the E-weighted portfolio with fossil fuel screening. In terms of the Sharpe ratio, small differences between the naive and the E-weighted portfolios can be observed, but these are not statistically significant. Similar to Europe, also in the US, the value-weighted portfolios provide the worst performance.

A comparison of the environmental performance between Europe and the US reveals a clear outperformance of all strategies in Europe, which report 40% higher E-scores for the naive strategies and a 12% increase for the value-weighted and E-weighted strategies. These findings could be related to regulatory pressure resulting from stricter ESG disclosure regulation, e.g., the sustainable finance disclosure regulation issued in Europe in 2017.

Overall, we can conclude that screening does not seem to significantly alter the results. Even more important is the decision to which extent the selected assets are included in the portfolio. In addition, there are some differences in the results for the EU and the US, but the E-weighting approach seems to be beneficial in both regions. For Europe, a combination of screening and E-weighting seems to provide the best outcome. It ensures a clear exclusion of polluting stocks, an environmental performance on par with the value-weighting approach, and the highest financial performance. For the US, the combination of screening and E-weighting also provides the same benefits with respect to the environmental performance. However, a small, but insignificant tradeoff with respect to the financial performance in comparison to the naive strategy can be observed (The results show that the exclusion of companies from certain sic codes reduces the asset universe, but does not necessarily affect the financial performance in a positive or negative way. If the number of companies excluded by screening is very small, this effect is limited within a weighting regime. Nonetheless, the construction of portfolios based on different weighting regimes can lead to a significantly different financial performance of these portfolios with respect to portfolio returns and/or standard deviation).

With respect to our hypotheses, the following observations can be made. Screening does not adversely affect the risk-adjusted portfolio performance. We find that for both regions an insignificant increase in the Sharpe ratios can be observed for the screened portfolios within a certain asset allocation strategy. Consequently, hypothesis 1 can therefore be confirmed and our results verify the findings provided in Lee et al. [6].

Hypothesis 2 can not be confirmed for both regions. It holds for the US, where we find the same financial performance but increased environmental performance for the E-weighting strategy compared to the naive portfolio. For Europe, this is not the case. We observe a significantly higher financial performance but similar environmental performance as the value-weighted strategy. These results are also in line with Lee et al. [6], who show that the integration of environment, social and governance analyses does not reduce risk-adjusted returns in Australia but serves the needs of the individual investors' preferences.

5.2. Fama–French Regressions

In order to analyze possible excess returns, we conduct a regression analysis using the well-known five Fama–French risk factors. This subsection reports the factor loadings for each strategy with respect to the asset universe, separated by the regions.

5.2.1. Results—Europe

For Europe, the factor loadings with respect to the Fama–French factors as well as the CMP factor are given in Tables 5–7. In addition to the results presented and discussed in this section, we also provide the Fama–French regression results without the CMP factor in the Appendix A.

Table 5. Naive Fama–French regressions Europe.

	Dependent Variable:			
	Benchmark	**w/o Coal**	**w/o Oil/Gas**	**w/o Fossil Fuels**
	(1)	**(2)**	**(3)**	**(4)**
Mkt.RF	0.644 ***	0.643 ***	0.641 ***	0.641 ***
	(0.011)	(0.011)	(0.011)	(0.011)
SMB	−0.425 ***	−0.426 ***	−0.426 ***	−0.426 ***
	(0.026)	(0.026)	(0.026)	(0.026)
HML	−0.119 ***	−0.119 ***	−0.120 ***	−0.121 ***
	(0.027)	(0.027)	(0.028)	(0.028)
RMW	−0.244 ***	−0.244 ***	−0.259 ***	−0.259 ***
	(0.040)	(0.040)	(0.041)	(0.041)
CMA	−0.397 ***	−0.395 ***	−0.395 ***	−0.394 ***
	(0.036)	(0.036)	(0.036)	(0.036)
CMP	−0.200 ***	−0.199 ***	−0.211 ***	−0.210 ***
	(0.024)	(0.024)	(0.025)	(0.025)
Constant	0.0002 **	0.0002 **	0.0002 **	0.0002 **
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	2558	2558	2558	2558
R^2	0.842	0.842	0.837	0.837
Adjusted R^2	0.842	0.842	0.836	0.836

Note: This table gives the Fama–French results for the naive portfolio in Europe. Herein the significance levels are indicated by ** $p < 0.05$; *** $p < 0.01$; according t-statistics in brackets. All factor loadings are significant, and negative in sign, besides the market risk premium (positive sign).

Table 6. Value Fama–French regressions Europe.

	Dependent Variable:			
	Benchmark	**w/o Coal**	**w/o Oil/Gas**	**w/o Fossil Fuels**
	(1)	**(2)**	**(3)**	**(4)**
Mkt.RF	0.616 ***	0.616 ***	0.616 ***	0.615 ***
	(0.011)	(0.011)	(0.011)	(0.011)
SMB	−0.638 ***	−0.638 ***	−0.655 ***	−0.655 ***
	(0.025)	(0.025)	(0.025)	(0.025)
HML	−0.091 ***	−0.091 ***	−0.108 ***	−0.109 ***
	(0.026)	(0.026)	(0.027)	(0.027)
RMW	−0.308 ***	−0.308 ***	−0.376 ***	−0.376 ***
	(0.039)	(0.039)	(0.040)	(0.040)
CMA	−0.417 ***	−0.416 ***	−0.401 ***	−0.401 ***
	(0.035)	(0.035)	(0.035)	(0.035)
CMP	−0.249 ***	−0.249 ***	−0.317 ***	−0.317 ***
	(0.024)	(0.024)	(0.024)	(0.024)
Constant	0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	2558	2558	2558	2558
R^2	0.865	0.865	0.861	0.861
Adjusted R^2	0.865	0.865	0.860	0.860

Note: This table gives the Fama–French results for the value weighted portfolio in Europe. Herein the significance levels are indicated by *** $p < 0.01$; according t-statistics in brackets. It shows a slightly positive but insignificant alpha. All other Fama–French factors exert a significant impact on the risk and return of the portfolio.

For the naive strategy, screening activity does not change the results of the Fama–French regressions and the factor loadings. Based on the Fama–French factors, all loadings are significant, and negative in sign, except for the market risk premium with a positive coefficient. For the value-weighted approach we also see that screening activity does not alter the results of the factor loadings. For all E-weighted portfolios, similar results can be found with significantly negative loadings on SMB, RMW, CMA and CMP and a significantly positive loading on the market risk premium. A comparison to the value-weighted portfolio shows an increase in the coefficients of the SMB, HML and CMP factors, which could provide some explanation for the differences in returns between these two strategies. These findings suggest that the difference could be driven by small value stocks with strong environmental performance.

For all asset allocation strategies in the EU, the FF factors and CMP explain approximately 85% of the portfolios' return variation. It can also be observed that the CMP factor is sensitive to the screening process as its coefficient further decreases for the portfolios without oil and gas and without all fossil fuels, when compared to the benchmark.

Table 7. E-Score Fama–French regressions Europe.

	Dependent Variable:			
	Benchmark (1)	**w/o Coal** (2)	**w/o Oil/Gas** (3)	**w/o Fossil Fuels** (4)
Mkt.RF	0.656 ***	0.655 ***	0.657 ***	0.655 ***
	(0.012)	(0.012)	(0.012)	(0.012)
SMB	−0.502 ***	−0.504 ***	−0.502 ***	−0.503 ***
	(0.027)	(0.027)	(0.027)	(0.027)
HML	0.072 **	0.070 **	0.069 **	0.068 **
	(0.028)	(0.028)	(0.029)	(0.029)
RMW	−0.352 ***	−0.352 ***	−0.371 ***	−0.372 ***
	(0.042)	(0.042)	(0.043)	(0.043)
CMA	−0.441 ***	−0.438 ***	−0.452 ***	−0.450 ***
	(0.037)	(0.037)	(0.038)	(0.038)
CMP	−0.216 ***	−0.214 ***	−0.230 ***	−0.228 ***
	(0.025)	(0.025)	(0.026)	(0.026)
Constant	0.0003 ***	0.0003 ***	0.0003 ***	0.0003 ***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	2558	2558	2558	2558
R^2	0.854	0.854	0.850	0.850
Adjusted R^2	0.854	0.854	0.849	0.849

Note: This table gives the Fama–French results for the E-score weighted portfolio in Europe. Herein the significance levels are indicated by ** $p < 0.05$; *** $p < 0.01$; according t-statistics in brackets. It shows a slightly positive and significant alpha. All factors beside the market risk premium show a significant loading with negative sign.

5.2.2. Results—US

For the US, the regression results are given in Table 8.

Compared to Europe, the explanatory power of the models is larger and the systematic risk measured by the market risk premium is close to one. Overall, the results between Europe and the US differ significantly. The signs of the SMB and CMA coefficients switch from negative to positive for all portfolios except for the value-weighted strategies. The RMW factor turns positive for all portfolios. The HML factor turns negative only for the naive portfolios. The CMA factor also shows reduced explanatory power with insignificant loadings for the naive benchmark and screened value-weighted portfolio and low significance for the value-weighted benchmark. Although the signs of the coefficients remain the same after screening for the value-weighted strategy, the factors CMA, CMP and alpha lose their significance.

In Europe, the E-weighted strategies are explained by the factors with a mix of significantly positive (market, HML) and mostly negative loadings (SMB, RMW CMA and CMP). In the US, the return variation is mainly explained by significantly positive loadings (market, SMB, HML, RMW, CMA) and only one significantly negative loading on the CMP factor. This indicates, that the risk profiles of these strategies is very different depending on the region (Both the portfolio analysis and regression models have also been implemented for subperiods prior to and after the financial crisis for robustness checks. All results also hold true for these subperiods).

The regression analysis shows for the US and Europe that the CMP factor is a relevant risk factor in explaining the portfolio results. These findings confirm Hypothesis 3 and suggest the existence of a risk premium relating to the environmental performance of firms, which is also sensitive to the negative screening of fossil fuel stocks (Thus, our results are in line with Amon et al. [5]).

Table 8. Fama–French regressions US.

	Dependent Variable:					
	Naive BM	**Naive w/o Fossil**	**Value BM**	**Value w/o Fossil**	**E-Score BM**	**E-Score w/o Fossil**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Mkt.RF	1.040 ***	1.016 ***	1.011 ***	0.977 ***	1.058 ***	1.040 ***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
SMB	0.093 ***	0.108 ***	−0.115 ***	−0.100 ***	0.056 ***	0.064 ***
	(0.006)	(0.007)	(0.003)	(0.006)	(0.007)	(0.007)
HML	−0.050 ***	−0.044 ***	0.035 ***	0.064 ***	0.115 ***	0.126 ***
	(0.005)	(0.006)	(0.003)	(0.005)	(0.006)	(0.006)
RMW	0.100 ***	0.079 ***	0.052 ***	0.019 **	0.134 ***	0.139 ***
	(0.009)	(0.011)	(0.005)	(0.009)	(0.010)	(0.011)
CMA	0.009	0.046 ***	−0.011 *	−0.002	0.131 ***	0.133 ***
	(0.010)	(0.012)	(0.006)	(0.010)	(0.011)	(0.013)
CMP	−0.230 ***	−0.248 ***	0.050 ***	0.004	−0.133 ***	−0.156 ***
	(0.009)	(0.011)	(0.006)	(0.010)	(0.011)	(0.012)
Constant	0.00004	0.0001 *	−0.00003 *	0.00000	0.00005	0.0001 *
	(0.00003)	(0.00003)	(0.00002)	(0.00003)	(0.00003)	(0.00004)
Observations	2825	2825	2825	2825	2825	2825
R^2	0.988	0.983	0.995	0.985	0.985	0.982
Adjusted R^2	0.988	0.983	0.995	0.985	0.985	0.982

Note: This table gives the Fama–French results for the different portfolios in the US. Herein the significance levels are indicated by * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. The according T-statistics are given in brackets. For all models, the market risk premium is close to one, the other factor loadings on the FF factors are significant.

5.3. Portfolio Costs and Turnover

We further analyze the role of transaction costs and their implications for the overall performance of the strategies in comparison to the naive portfolio. Tables 9 and 10 report the turnover rates of the different portfolios. For the naive portfolio, no rebalancing takes place during the considered time horizon, whereas for the value-weighted and the E-weighted strategies regular adjustments are made on a monthly basis. The turnover rate gives insights into the level of transaction costs.

Table 9. Portfolio Turnovers—Europe.

E- Weighted	Value	Value -c	Value -og	Value -f
0.902	3.672	3.671	3.658	3.658

Note: This table reports the turnover rates for Europe with respect to the asset selection via screening and E-score weighting.

Table 10. Portfolio Turnovers—US.

E- Weighted	Value	Value -f
1.397	3.667	3.630

Note: This table reports the turnover rates for the US with respect to the asset selection via screening and E-score weighting.

For both, Europe and the US, the E-score weighting approach causes much lower rebalancing costs than the adjustments necessary for the value-weighted strategies, which further hightlights the usefulness of this strategy for environmentally responsible investors.

Overall, it can be concluded, that screening in general does not seem to affect the overall portfolio performance. However, the alternative strategy based on E-weighting provides an additional positive financial and environmental benefit. The combination of negative screening and E-weighting seems to be a viable option for environmentally responsible investors as it leverages the advantages of both strategies and does not purely rely on ESG ratings. It ensures an asset selection based on strict exclusion criteria, while still allowing for the asset allocation to be shifted towards firms with strong environmental performance. This significantly increases the overall environmental performance of the portfolio with no or only a small sacrifice in financial performance depending on the region, even after consideration of transaction costs. This approach would allow fund managers to construct environmental portfolios without worrying about a potential breach in fiduciary duty. It further enables the cost-efficient construction of environmentally responsible financial products as only readily available aggregated ESG rating information is required and no further resource-intensive analysis of the environmental impact of each firm in the portfolio is necessary. This passive strategy providing improved environmental performance at low transaction costs ensures, that such products can be offered at low management fees, which are also compliant according to Art. 8 of the recently issued Sustainable Finance Disclosure Regulation (see [45]). This makes such financial products attractive for a broad range of investors.

The regression analysis shows for the US and Europe that the CMP factor is a relevant risk factor in explaining the portfolio results, which indicates the existence of a risk premium relating to the environmental performance of the firm.

6. Conclusions

Screening activity is often seen as reducing the investors' asset universe and, thus, impacting the portfolios' financial performance in a negative way due to diversification considerations. In this paper, we investigate for both the US and Europe, simple passive portfolio strategies that rely on one hand on an sector-based negative screening of fossil fuel firms for the asset selection and on the other hand common on asset allocation strategies based on value-weighting and a naive allocation. We further introduce a novel asset allocation strategy based on the environmental performance of the firms included in the asset selection (E-weighting) given by the environmental subscore of the ESG score. We conduct a comparative analysis of these strategies and investigate their viability for environmentally responsible investors with respect to both financial and environmental performance. Furthermore, these strategies are analyzed with respect to the Fama–French five-factor model in order to gain a better understanding of the explanatory risk factors of the portfolio returns. The model explains the majority of the variation in the portfolio returns and the regression factors do not vary significantly with respect to the asset selection criteria but with respect to the region. Finally, we extend the Fama–French five-factor model by a sixth factor denoted as CMP (clean minus polluting). We find that there is a significant amount of risk that can be explained by the difference in returns of clean and polluting stocks covered by the CMP factor.

With this article, we show that a simple passive portfolio strategy based on environmental criteria allows environmentally responsible investors to adjust their portfolios without compromising risk-adjusted financial performance. In detail, we show that a negative screening of fossil fuel firms does not lead to a significant reduction in the financial performance at the portfolio level. Our results suggest further that a combination of negative screening and an environmental-scoring-based asset allocation seems to be a viable option for environmentally responsible investors leveraging the advantages of both strategies. The constructed risk factor CMP (clean minus polluting) documents a significant factor loading for both regions when added to the Fama–French five-factor model, which suggests the existence of a risk premium based on the environmental performance of firms.

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Appendix A

Appendix A.1. 2-Digit SIC Code Data Description

Table A1. Descriptives by Industry (2-digit SIC)—EU.

SIC Code	N	Mean Return	St. Dev Return	Mean E-Score	Min E-Score	Max E-Score
10	4	0.096	2.832	68.195	54.662	79.906
13	6	0.055	2.325	67.962	31.793	92.618
14	2	0.062	2.245	86.952	80.768	93.135
15	7	0.064	2.664	87.202	82.822	92.085
16	6	0.061	2.065	86.006	73.189	92.389
20	14	0.048	1.595	78.090	21.535	93.363
21	3	0.046	1.404	84.271	76.015	88.484
23	4	0.073	2.039	67.682	43.025	90.952
24	2	0.087	2.617	73.330	61.336	85.323
26	8	0.059	2.024	76.877	23.904	93.713
27	7	0.040	1.970	66.390	42.166	88.254
28	37	0.052	1.740	77.301	11.052	94.796
29	5	0.043	1.915	80.155	35.478	93.207
30	5	0.086	2.284	88.756	81.702	92.067
31	1	0.089	1.735	60.575	60.575	60.575
32	4	0.049	2.291	89.279	86.146	92.331
33	7	0.055	2.623	84.031	64.296	93.215
34	5	0.070	1.916	72.562	27.208	94.709
35	21	0.070	2.340	77.471	32.948	94.522
36	10	0.046	2.161	87.732	53.312	94.671
37	18	0.064	2.190	85.291	51.846	94.652
38	15	0.058	1.897	68.203	29.777	95.072
39	3	0.059	1.916	78.226	61.551	93.029
42	5	0.053	1.804	78.800	66.663	92.227
43	2	0.025	2.225	83.183	73.711	92.655
44	3	0.042	1.914	82.792	77.358	89.101
45	7	0.060	2.223	70.354	27.423	88.367
48	20	0.028	1.863	74.836	18.678	93.968
49	21	0.028	1.642	85.549	67.463	93.663
50	3	0.042	2.179	79.160	52.954	94.171
51	2	0.062	1.518	54.035	45.867	62.203
52	2	0.034	2.183	87.167	82.042	92.293
53	1	0.027	1.856	91.075	91.075	91.075
54	9	0.027	1.700	86.060	77.088	92.594
55	1	0.054	2.742	51.781	51.781	51.781
56	5	0.053	1.724	87.339	75.372	93.939

Table A1. *Cont.*

SIC Code	N	Mean Return	St. Dev Return	Mean E-Score	Min E-Score	Max E-Score
57	1	0.013	1.999	89.211	89.211	89.211
58	4	0.051	1.694	73.989	55.142	92.718
59	1	0.055	1.780	44.415	44.415	44.415
60	35	0.041	2.513	77.677	16.798	94.388
61	1	0.052	2.596	71.615	71.615	71.615
62	11	0.070	2.323	52.369	11.725	84.942
63	24	0.055	2.044	69.976	24.472	94.521
65	14	0.031	1.771	72.285	28.053	93.338
67	4	0.045	1.763	23.672	10.956	52.475
70	2	0.070	1.975	80.833	69.666	92.001
73	25	0.056	2.063	57.555	13.436	86.725
76	2	0.064	2.009	60.260	34.674	85.845
78	1	0.013	1.607	88.633	88.633	88.633
79	3	0.037	2.078	38.879	23.756	57.385
80	2	0.066	1.523	68.323	62.183	74.464
87	9	0.081	2.239	55.647	21.779	90.547

Notes: This table gives the average mean return, standard deviation, as well as minimum, average and maximum E-score for each two digit sic code included in our data sample for Europe. N stands for the numbers of firms in each sic code category.

Table A2. Descriptives by Industry (2-digit SIC)—US.

SIC	N	Mean Return	St. Dev Return	Mean E-Score	Min E-Score	Max E-Score
10	2	0.044	2.992	81.286	77.899	84.673
13	17	0.057	2.754	43.481	13.124	85.136
14	3	0.055	2.195	39.687	18.593	60.506
15	4	0.057	3.327	29.889	17.640	46.281
16	2	0.059	2.484	41.143	15.561	66.726
17	2	0.080	2.421	24.891	22.909	26.872
20	19	0.050	1.784	67.921	16.875	94.356
21	1	0.052	1.214	62.910	62.910	62.910
22	1	0.054	2.233	81.153	81.153	81.153
23	3	0.066	2.088	64.355	46.064	79.782
24	2	0.032	2.271	88.664	85.482	91.846
25	3	0.048	2.733	49.789	13.092	92.591
26	6	0.037	2.151	79.506	58.550	90.692
27	5	0.022	2.157	49.851	16.632	72.073
28	32	0.057	1.963	70.415	14.315	94.696
29	7	0.054	2.343	80.304	55.712	92.574
30	4	0.063	2.346	77.527	65.434	92.245
31	1	0.050	2.036	33.133	33.133	33.133
33	3	0.052	2.634	67.304	42.839	89.505
34	5	0.048	1.758	73.044	54.294	94.838
35	14	0.062	2.305	77.133	53.088	94.623
36	20	0.059	2.234	69.765	14.320	94.864
37	13	0.054	2.304	71.716	13.627	94.139
38	33	0.066	1.969	57.509	10.318	94.758
40	5	0.076	2.119	59.446	12.929	81.724
42	5	0.051	2.273	37.788	11.997	92.752
44	2	0.047	2.530	78.480	69.183	87.777
45	3	0.069	2.258	60.392	28.085	78.523
47	2	0.050	1.910	31.252	26.298	36.206
48	11	0.046	2.044	51.768	11.540	91.568
49	35	0.034	1.550	66.516	11.613	91.704
50	6	0.063	1.846	28.209	10.924	53.268
51	6	0.046	1.677	47.688	17.291	93.547
52	5	0.065	1.860	58.128	30.068	83.091
53	6	0.042	1.909	67.559	24.078	93.025
54	1	0.043	1.596	85.470	85.470	85.470
55	4	0.074	1.989	18.883	12.010	26.141
56	8	0.058	2.380	46.849	12.142	80.398
57	2	0.047	2.574	49.030	15.833	82.228
58	5	0.062	1.845	58.434	11.889	85.641
59	6	0.076	2.772	45.676	12.912	84.165

Table A2. *Cont.*

SIC	N	Mean Return	St. Dev Return	Mean E-Score	Min E-Score	Max E-Score
60	27	0.042	2.700	42.781	10.460	92.524
61	1	0.044	2.249	76.415	76.415	76.415
62	13	0.065	2.532	39.266	12.028	91.292
63	24	0.055	2.555	43.925	10.460	85.048
64	4	0.040	1.493	35.676	18.396	52.098
65	3	0.080	3.288	64.598	35.537	84.948
67	25	0.047	2.418	35.659	10.969	74.973
70	3	0.062	2.683	50.054	17.531	80.273
72	2	0.038	1.826	42.098	10.729	73.467
73	40	0.061	2.109	39.942	11.084	94.398
75	1	0.119	4.680	39.738	39.738	39.738
78	2	0.127	2.682	33.280	11.858	54.702
79	1	0.096	2.310	27.838	27.838	27.838
80	6	0.047	1.691	18.193	11.165	31.734
87	7	0.068	2.384	26.464	10.488	81.132

Notes: This table gives the average mean return, standard deviation, as well as minimum, average and maximum E-score for each two digit sic code included in our data sample for the US. N stands for the numbers of firms in each sic code category.

Appendix A.2. Fama–French Regressions without GMB

Table A3. Naive Fama–French regressions without CMP factor—Europe.

	Dependent Variable:			
	Benchmark (1)	w/o Coal (2)	w/o Oil/Gas (3)	w/o Fossil Fuels (4)
Mkt.RF	0.656 ***	0.655 ***	0.654 ***	0.653 ***
	(0.011)	(0.011)	(0.011)	(0.011)
SMB	−0.347 ***	−0.348 ***	−0.343 ***	−0.344 ***
	(0.024)	(0.024)	(0.024)	(0.024)
HML	−0.149 ***	−0.150 ***	−0.152 ***	−0.153 ***
	(0.027)	(0.027)	(0.028)	(0.028)
RMW	−0.275 ***	−0.274 ***	−0.292 ***	−0.291 ***
	(0.041)	(0.041)	(0.041)	(0.041)
CMA	−0.425 ***	−0.424 ***	−0.425 ***	−0.424 ***
	(0.036)	(0.036)	(0.037)	(0.037)
Constant	0.0002 **	0.0002 **	0.0002 **	0.0002 **
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	2558	2558	2558	2558
R^2	0.838	0.838	0.832	0.832
Adjusted R^2	0.837	0.838	0.832	0.832

Notes: This table gives the Fama–French results for the naive portfolio in Europe. Herein the significance levels are indicated by ** $p < 0.05$; *** $p < 0.01$. According t-statistics in brackets. All factor loadings are significant, and negative in sign, besides the market risk premium (positive sign).

Table A4. Value Fama–French regressions without CMP factor—Europe.

	Dependent Variable:			
	Benchmark (1)	w/o Coal (2)	w/o Oil/Gas (3)	w/o Fossil Fuels (4)
Mkt.RF	0.632 ***	0.631 ***	0.635 ***	0.635 ***
	(0.011)	(0.011)	(0.011)	(0.011)
SMB	−0.541 ***	−0.541 ***	−0.531 ***	−0.531 ***
	(0.024)	(0.024)	(0.024)	(0.024)
HML	−0.129 ***	−0.129 ***	−0.157 ***	−0.157 ***
	(0.027)	(0.027)	(0.028)	(0.028)
RMW	−0.346 ***	−0.346 ***	−0.425 ***	−0.425 ***
	(0.040)	(0.040)	(0.041)	(0.041)
CMA	−0.452 ***	−0.452 ***	−0.447 ***	−0.446 ***
	(0.035)	(0.035)	(0.036)	(0.036)
Constant	0.0001	0.0001	0.0002	0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)

Table A4. *Cont.*

	Dependent Variable:			
	Benchmark (1)	**w/o Coal (2)**	**w/o Oil/Gas (3)**	**w/o Fossil Fuels (4)**
Observations	2558	2558	2558	2558
R^2	0.859	0.859	0.851	0.851
Adjusted R^2	0.859	0.859	0.851	0.851

Note: this table gives the Fama–French results for the value weighted portfolio in Europe. Herein the significance levels are indicated by *** $p < 0.01$; according t-statistics in brackets. It shows a slightly positive but insignificant alpha. All other Fama–French factors exert a significant impact on the risk and return of the portfolio.

Table A5. E-Score Fama–French regressions without CMP factor—Europe.

	Dependent Variable:			
	Benchmark (1)	**w/o Coal (2)**	**w/o Oil/Gas (3)**	**w/o Fossil Fuels (4)**
Mkt.RF	0.670 ***	0.668 ***	0.671 ***	0.669 ***
	(0.012)	(0.012)	(0.012)	(0.012)
SMB	−0.418 ***	−0.420 ***	−0.412 ***	−0.414 ***
	(0.025)	(0.025)	(0.026)	(0.026)
HML	0.039	0.037	0.034	0.033
	(0.029)	(0.029)	(0.029)	(0.029)
RMW	−0.385 ***	−0.385 ***	−0.407 ***	−0.407 ***
	(0.042)	(0.042)	(0.043)	(0.043)
CMA	−0.471 ***	−0.469 ***	−0.485 ***	−0.482 ***
	(0.038)	(0.038)	(0.038)	(0.038)
Constant	0.0003 ***	0.0003 ***	0.0003 ***	0.0003 ***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Observations	2558	2558	2558	2558
R^2	0.850	0.850	0.845	0.845
Adjusted R^2	0.850	0.850	0.845	0.845

Note: this table gives the Fama–French results for the E-score weighted portfolio in Europe. Herein the significance levels are indicated by *** $p < 0.01$; according t-statistics in brackets. It shows a slightly positive and significant alpha. All factors beside the market risk premium show a significant loading with negative sign.

Table A6. Fama–French regressions without CMP factor—US.

	Dependent Variable:					
	Naive BM (1)	**Naive w/o Fossil (2)**	**Value BM (3)**	**Value w/o Fossil (4)**	**E-Score BM (5)**	**E-Score w/o Fossil (6)**
Mkt.RF	1.044 ***	1.021 ***	1.010 ***	0.977 ***	1.060 ***	1.043 ***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)
SMB	0.157 ***	0.177 ***	−0.129 ***	−0.101 ***	0.093 ***	0.108 ***
	(0.005)	(0.006)	(0.003)	(0.005)	(0.006)	(0.007)
HML	−0.049 ***	−0.043 ***	0.035 ***	0.064 ***	0.115 ***	0.127 ***
	(0.005)	(0.006)	(0.003)	(0.005)	(0.006)	(0.006)
RMW	0.055 ***	0.030 ***	0.061 ***	0.020 **	0.108 ***	0.109 ***
	(0.010)	(0.011)	(0.005)	(0.009)	(0.010)	(0.012)
CMA	−0.051 ***	−0.019	0.002	−0.001	0.096 ***	0.092 ***
	(0.010)	(0.012)	(0.006)	(0.010)	(0.011)	(0.013)
Constant	0.0001 **	0.0001 **	−0.00003 *	0.00000	0.0001 *	0.0001 **
	(0.00003)	(0.00004)	(0.00002)	(0.00003)	(0.00003)	(0.00004)
Observations	2825	2825	2825	2825	2825	2825
R^2	0.986	0.980	0.995	0.985	0.985	0.980
Adjusted R^2	0.986	0.980	0.995	0.985	0.985	0.980

Note: This table gives the Fama–French results for the different portfolios in the US. Herein the significance levels are indicated by * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. The according T-statistics are given in brackets. For all models, the market risk premium is close to one, the other factor loadings on the FF factors are significant.

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