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ABSTRACT

This study sheds light on a new type of sustainable investment approach, namely environmental, social, and governance (ESG) momentum. We provide both a theoretical discussion and an empirical comparison of this new approach and put it in perspective to traditional weighting schemes considered by sustainable portfolio managers. In order to provide a clear basis for our argumentation and avoid any conflicting effects, we solely focus on the environmental aspect of ESG ratings in Europe and pay particular attention to strategies' carbon footprint as a central measure of a portfolio's environmental friendliness. Although the empirical results demonstrate inferior environmental ratings for ESG-momentum portfolios and mixed results in respect to risk-adjusted returns across alternative rating components, there might still be a case for investing in sustainable momentum stocks.

INTRODUCTION

Over the past decade, both institutional and retail investors have grown substantially more interested in sustainable investments. For asset managers today, the incorporation of ESG factors into the investment decision-making process is a necessary prerequisite to generate business, especially with institutional investors. However, from an academic perspective, the literature on sustainable investments yields mixed results and does not provide a clear picture about whether it pays to invest sustainably from the perspective of risk-adjusted return (Renneboog et al. 2008; Friede et al. 2015). The reasons for the mixed results are multifold and include offsetting effects caused by different screening techniques and individual measures that conflict with each other, as well as different effects or impact across industries and regions (Galema et al. 2008; Statman and Glushkov 2016; Auer 2016).

The objective of this paper is to shed light on the financial and sustainability performance of five portfolio-formation strategies in a European setting. We are particularly interested in the benefits of considering changes in environmental sustainability ratings compared with considering absolute ratings. Although the financial services industry has picked up on the potential for building portfolios on the basis of changes in ESG ratings—"ESG momentum"—the academic literature analyzing the underlying characteristics of these portfolios is limited. This study analyzes characteristics of ESG momentum in comparison to more commonly applied screening and tilt approaches to gain insight about whether strategies based on sustainability data result in sustainable portfolios.

To avoid any offsetting effects, we restrict our empirical analysis to the environmental pillar of the ESG rating; we consider the aggregated environmental score and three subcategory scores—emissions reduction, product innovation, and resource reduction—to identify the drivers of environmentally triggered portfolio performance. We base our research on the work of Auer (2016) with regard to exclusion and inclusion strategies and Nagy et al. (2016) concerning the ESG momentum approach. For performance measurement we build on the Fama and French (1993) three-factor model, albeit applying alternative index-based factors as introduced by Cremers et al. (2012).

Furthermore, we explicitly include a portfolio's carbon footprint as a central measure of success in implementing environmentally friendly portfolios. Due to a general increase in public awareness about carbon dioxide (CO_2) emissions and media coverage of the Paris climate accord in April 2016, more money managers are disclosing the carbon footprints of their portfolios. This shift, due predominantly to regulatory and stakeholder pressure, has made the carbon footprint of a publicly traded fund a central factor of its success potential. As such, the appropriateness of the underlying investment strategy must be evaluated on the basis of risk-adjusted return, the aggregated environmental rating, and the carbon footprint.

DATA AND METHODOLOGY

Our initial sample comprises all European firms with annual ESG ratings included in the Asset4 database provided by Thomson Reuters between January 2002 and December 2015, which corresponds to 1,072 firms and is consistent with the dataset of Sassen et al. (2016). This includes firms for which sustainability ratings are available over the full period, as well as joiners and leavers. Thereby we avoid potential survivorship bias, which is well-documented in the mutual fund literature.

Table 1

DESCRIPTIVE STATISTICS

TYPE	ABBR.	MEAN	STD	MIN	MAX	SKEW	KURT	DISP
(A): Level of Sustainability Performance (sustainability rating)								
Environmental	ENVSCORE	56.00	11.29	36.81	69.85	-0.37	3.04	29.25
Emission Reduction	ENER	55.92	12.72	34.48	71.16	-0.39	3.04	29.40
Product Innovation	ENPI	50.80	13.09	30.44	67.74	-0.12	3.02	31.13
Resource Reduction	ENRR	57.32	12.79	35.67	72.87	-0.39	3.09	29.47
(B): Change in Sustainability Performance (change in sustainability rating)								
Environmental	ENVSCORE	0.14	0.36	-0.22	0.97	1.01	4.28	0.49
Emission Reduction	ENER	0.15	0.42	-0.26	1.15	1.14	4.49	0.55
Product Innovation	ENPI	0.13	0.45	-0.33	1.27	1.08	4.94	0.61
Resource Reduction	ENRR	0.17	0.48	-0.27	1.37	1.19	4.76	0.67

Table 1 presents the descriptive statistics for absolute sustainability ratings (A) and changes in environmental sustainability ratings (B), according to Asset4 from Thomson Reuters. We report averages (mean), standard deviation (std), minimum (min) and maximum (max) values, skewness (skew), kurtosis (kurt), and the degree of cross-sectional dispersion of sustainability ratings. The observation period is July 2005–June 2016 and corresponds to 132 monthly returns.

The sample consists of 10,379 annual ratings for each of the ESG pillars. To avoid the possibility that our results are driven by outliers, we trim our sample at the 1-percent level with respect to considered variables. This reduces our sample by 108 firms and results in a final sample size of 965 European firms. As for the representation of firms by country, the three largest countries in Europe—Germany (eighty-seven firms), France (ninety-six firms), and the United Kingdom (388 firms)—account for 53.3 percent of our sample and the ten countries best represented in our sample account for 82.5 percent of the firms. The final out-of-sample observation period is from July 2005 to June 2016 and corresponds to 132 monthly returns.

For this analysis, we concentrate on the environmental layer of the Asset4 sustainability ratings. In addition to the aggregated score of the environmental pillar, we focus on three second-level subcategories in our analysis: emission reduction, product innovation, and resource reduction (see table 1). The aggregate environmental rating (ENVSCORE) for each firm consists of more than 300 individual data points and evaluates a firm's impact on Earth's ecosystem as a whole. A high score indicates that a company is capable of actively avoiding or reducing environmental risks and generating long-term profits from environmental opportunities.

The emission reduction (ENER) score sheds light on a firm's production and operational processes. ENER evaluates a firm's ability to reduce emissions that lead to atmospheric pollution, water contamination, (hazardous) waste, noise, etc. Furthermore, ENER measures a firm's willingness to work with local environmental organizations to reduce its direct community impact.

The product innovation (ENPI) score measures a firm's efforts to create eco-efficiency through its research and development. ENPI measures the firm's ability to lower its environmental impact and create new business opportunities by using the latest industry-specific environmental technologies in the product innovation process.

The resource reduction (ENRR) score measures a firm's capacity to effectively and efficiently use natural resources in production processes and along its supply chain. These natural resources include everything from production materials to water and energy. The ENRR also includes a firm's efforts to develop more eco-efficient materials.

PORTFOLIO CONSTRUCTION

We pay particular attention to so-called ESG momentum strategies, which provide a variation to the common application of ESG ratings in portfolio management. To provide a robust comparison between strategies, we consider simple implementations of the following sustainability-related portfolio schemes: (1) worst-in-class exclusion, (2) best-in-class inclusion, (3) simple ESG tilt, and (4 and 5) two variations of the ESG momentum approach. Furthermore, we deviate from Nagy et al. (2016) and do not only consider the aggregated ESG score; rather we focus solely on the environmental component because the three ESG aspects can show confounding effects (Galema et al. 2008; Auer 2016).

Every year in June, we rebalance our portfolios based on lagged six-month sustainability data to ensure data availability to investors at the time of revising the portfolio composition, which is a common approach for the application of firms' financial-statement information (Asness et al. 2013). Therefore, our results are conservative throughout and in particular with respect to sustainability information. This is particularly relevant, as Nagy et al. (2016, p. 114) state, because "an improvement in ESG scores signals that a company is better

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equipped to avoid ESG-related risks; this reduction in potential future liabilities is quickly discounted by market participants and built into the share price." Consequently, accounting for this lag is essential in terms of strategies' practical implementation and the respective performance analysis when timely release of the sustainability rating is not guaranteed.

The standard setting, for all but tilt portfolios, assigns an equal weight to all stocks in the respective smaller investment subset. Furthermore, we consider two alternative approaches: (1) we weight stocks according to their market capitalization, and (2) we weight stocks according to their sustainability rating. This provides a second source of adjusting sustainability strategies to potentially enhance their risk-adjusted and sustainability performance.

INVESTMENT STRATEGIES

Here we introduce the investment strategies, which build on the application of ESG ratings in portfolio formation.

Tilt portfolio: We replace a firm's market capitalization with sustainability level to derive portfolio weights to achieve this tilt strategy. Tilt portfolios are fully invested across the investment universe and not reduced to a smaller, more concentrated, subset of stocks that fulfill predefined sustainability criteria. Thereon, stocks with high sustainability ratings are overweight and stocks with low sustainability ratings are underweight. Given the full replication approach of this strategy, it closely aligns with the benchmark portfolio and is likely to show lower levels of tracking error and active share compared to sampling approaches.

Exclusion and inclusion strategies: These strategies invest in subsets of the stock universe by either excluding firms with the lowest sustainability ratings or including those with the highest sustainability ratings. Every year, we exclude (include) stocks that are in the bottom (top) twentieth percentile of the ratings. These approaches are in accordance with Auer (2016), who tests for the impact of excluding the bottom x-percent of stocks according to ESG ratings. Auer (2016) makes two central observations: First, at cut-off rates above the thirtieth percentile, portfolios' risk-adjusted returns decrease. Second, the impact of socially and environmentally based negative exclusionary screens is negligible, but corporate governance screens increase performance significantly. Auer (2016, p. 381) concludes that investors "can do (financially) well while doing (socially) good."

ESG momentum approach: This approach builds on changes in sustainability ratings rather than their absolute levels. As such, stocks that have increased their ratings over the past year receive a higher weight in the portfolio. More specifically, we consider two versions of the ESG momentum strategy: (1) all stocks with a positive change (>0) in sustainability ratings over the previous year, and (2) the top twenty-fifth percentile of stocks with the greatest increase in sustainability ratings. Intuitively the potential to increase a rating is higher when the level of sustainability is still low. Consequently, it is questionable whether an ESG momentum strategy results in a sustainable portfolio or just takes a perverse twist on the application of ESG ratings. In this light, Nagy et al. (2016) base their study on investors' concern that "the inclusion of ESG factors in their investment process comes at the cost of weaker risk-adjusted returns" and conclude that such a "performance trade-off does not always necessarily occur." However, the simple fact that ESG data is considered in the portfolio construction does not necessarily mean the resulting portfolio will be sustainable.

The Performance Measurement section provides an analysis of these ESG-based portfolio models from the perspective of an investor who is interested in holding a set of sustainable assets rather than just utilizing such information for financial gain.

PERFORMANCE MEASUREMENT

We conduct our performance attribution according to commonly applied market (MKT), size (SMB), and value (HML) factors. In contrast to the factors provided on Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html), we consider index-based factors as suggested by Cremers et al. (2012). The basic concept underlying index-based factors—which aim to capitalize on the same equity risk exposures—is to apply popular indexes that are commonly considered for benchmarking purposes and derive corresponding systematic risk exposures. The common application of these index-based factors as performance benchmarks indicates that they are more appropriate than the broader Fama-French risk premiums.

We derive our factors as follows: market factor (STOXX EUROPE 600), size premium (EURO STOXX Small minus EURO STOXX Large), and value premium (EURO STOXX TMI Value minus EURO STOXX TMI Growth). Our outlined measurement framework translates into the following monthly time-series factor regression equation:

$$R_i - R_f = \alpha_i + \beta_{1,i}MKT + \beta_{2,i}SMB + \beta_{3,i}HML + e_i \quad (1)$$

Initial tests, not reported in this study, document a better fit for index-based factors compared to broader Fama-French factors, based on the extensive cross-section of Center for Research in Security Prices (CRSP) stocks. In this respect, we observe a market beta of 0.98 (0.69) and annualized alpha of 0.26 percent (2.51 percent) for the STOXX EUROPE 600 index (Fama-French market factor) against the value-weighted portfolio based on our sample. The good fit of the STOXX Europe 600 for the case of the European Asset4 sample was reported previously by Sassen et al. (2016).

EMPIRICAL RESULTS

PORTFOLIO CHARACTERISTICS

The key portfolio characteristics used in our performance analysis of alternative ESG-based investment strategies are summarized in table 2. We report the mean and standard deviation of the excess returns of our value and equally weighted benchmark portfolios and the various strategies. Additionally, we present Sharpe and Sortino ratios, as well as the portfolio average weighted sustainability scores for the respective category, average firm size (f_size) of firms included in the portfolios, and average number of stocks (p_size) for each investment strategy. The final two columns show the size-adjusted CO_2 emission and absolute CO_2 of the portfolios. On a general note, we make the following three central observations:

1. The majority of strategies yield favorable portfolio performance characteristics relative to the benchmark indexes when based on the aggregated environmental score and product innovation.
2. The inclusion approach and the two momentum approaches perform poorly based on emission reduction and resource reduction ratings.
3. All strategies—based on all rating variables—yield favorable sustainability ratings on an aggregated portfolio level as well as on reduction of portfolio CO_2 emission exposure.

Next, we discuss previously mentioned findings in more detail. First, we provide evidence about the performance of alternative strategies that is driven predominantly by the underlying sus-

Table 2

PORTFOLIO CHARACTERISTICS

	MEAN	STD	SR	T(SR)	SO	RATING	F_SIZE	P_SIZE	CO_2ADJ	CO_2ABS
(A): Benchmark Indexes										
Value-weighted	5.49	14.51	0.11	0.00	0.15	81.71	46,177	518	16.49	11.93
Equal-weighted	8.37	18.44	0.13	0.00	0.20	63.5 7	10,379	518	24.07	6.35
(B): Environmental Score (ENV)										
Tilt	8.40	18.21	0.13	0.43	0.20	76.76	13,312	518	16.02	4.37
Exclusion	8.69	18.29	0.14	1.51	0.21	74.85	12,131	415	16.21	3.97
Inclusion	8.41	18.09	0.13	0.16	0.20	94.10	22,943	104	17.28	6.60
$Momentum_{pos}$	8.42	18.19	0.13	0.34	0.20	69.50	10,123	255	13.80	2.96
$Momentum_{top}$	6.97	18.26	0.11	-1.20	0.16	60.34	5,552	104	12.09	1.16
(C): Emission Reduction (ENER)										
Tilt	8.25	18.17	0.13	0.03	0.20	76.70	13,306	518	17.13	4.41
Exclusion	8.63	18.32	0.14	1.28	0.21	74.36	12,086	413	16.35	4.01
Inclusion	6.94	18.44	0.11	-1.29	0.16	94.15	22,281	103	19.38	7.20
$Momentum_{pos}$	7.83	18.17	0.12	-0.91	0.19	71.68	10,766	250	14.66	3.27
$Momentum_{top}$	6.94	18.45	0.11	-1.48	0.16	63.91	5,544	104	9.55	1.35
(D): Product Innovation (ENPI)										
Tilt	8.48	18.35	0.13	0.39	0.20	73.80	13,467	518	14.47	4.50
Exclusion	8.65	18.44	0.14	0.94	0.21	66.56	11,921	413	13.95	3.83
Inclusion	8.47	18.45	0.13	0.08	0.20	95.90	18,768	103	15.42	7.09
$Momentum_{pos}$	8.80	18.94	0.13	0.34	0.21	67.06	10,726	238	13.91	3.19
$Momentum_{top}$	8.67	18.19	0.14	0.44	0.21	69.62	10,661	103	15.35	2.69
(E): Resource Reduction (ENRR)										
Tilt	8.46	18.17	0.13	0.72	0.20	77.54	13,099	518	15.42	4.10
Exclusion	8.64	18.13	0.14	1.62	0.21	76.30	12,306	410	16.12	4.03
Inclusion	8.24	18.51	0.13	-0.14	0.20	93.70	22,714	104	12.32	4.83
$Momentum_{pos}$	8.13	18.65	0.13	-0.63	0.19	72.63	10,510	237	13.80	3.45
$Momentum_{top}$	7.80	18.52	0.12	-0.64	0.18	67.60	6,206	104	12.51	2.20

Table 2 presents the performance characteristics of considered investment strategies. (A) presents the sample-based equal- and value-weighted (market-capitalization) benchmark portfolios and (B) to (E) report the results for portfolios formed on the basis of the respective environmental sustainability component. We state the annualized average return (mean) and standard deviation (std) in percentage terms. Sharpe ratios (sr) are provided with corresponding t-statistics on the difference relative to the equal-weighted benchmark, according to Jobson and Korkie (1981). As a downside deviation measure we include the Sortino ratio. Besides, we provide the weighted portfolio sustainability rating (rating), average market-capitalization of firms in the portfolio (f_size), average number of stocks in the portfolio (p_size), and the absolute (in million tons) and size-adjusted CO_2 emission (Scopes 1 + 2) on a weighted portfolio level. The observation period is July 2005–June 2016 and corresponds to 132 monthly returns.

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tainability components. This should not come as a surprise, because a model can be only as good as the information plugged into it. Thereon, we argue that the findings by Nagy et al. (2016) on the good performance of ESG momentum portfolios based on an aggregated ESG level are not easily transferable to alternative measures (scores) of sustainability performance. As we show, this consistency is lacking even when solely maneuvering within the sphere of environmental aspects. In this respect, we find both inclusion and momentum portfolios to yield lower risk-adjusted returns against the benchmarks when constructed on the basis of ENER and ENRR, whereas all strategies outperform the two benchmarks for the case of ENPI. This observation is positive with respect to the informational value and relevance of sustainability scores in that they capture different aspects of varying relevance to market participants, but it raises doubts about the performance transferability of the respective portfolio approaches.

Recall, that both ENER and ENPR are related to the reduction of environmental emissions and the use of natural resources in production and operations. As such, both variables are concerned with reducing existing environmental inefficiencies as part of firms' business operations. In contrast, product innovation (ENPI) is related to research and development of eco-efficient products and services and consequently relates to innovative capacity to reduce environmental costs and burdens. Alternatively, we can also view these three components in terms of their financial relevance to a firm and—taking the perspective of an income statement—we find that ENPI would be categorized as a revenue-relevant sustainability issue, whereas ENER and ENPR are more likely to be related to material costs. Thereon, investments in firms that are frontrunners in terms of research and development are rewarded for their innovative drive, as reflected by all portfolio strategies yielding positive characteristics based on ENPI. However, investors expect firms' production and operations to fulfill a certain environmental standard. Consequently, investors do not reward firms for fulfilling this standard, as indicated by the underperformance of inclusion and momentum strategies; instead they shun firms that do not meet these standards, as reflected by the good performance of the exclusion approach.

For robustness we also test for alternative observation periods and find generally consistent results. Interestingly, we identify the exclusion approach to be the only one to consistently, across all three classes of environmental performance, outperform both the equal- and market-capitalization benchmark in terms of risk-adjusted returns. Once more, this suggests that market participants are more concerned with the exclusion of firms that show weak management practices—in terms of avoiding environmental risks and identifying opportunities—than they are with rewarding firms for their good management of environmental issues.

With respect to the resulting aggregated sustainability ratings of portfolios, we confirm the well-known entanglement of firm size (f_size) and sustainability performance, in that large firms show on average higher ratings, which becomes clear when comparing the resulting portfolio ratings of the equal-weighted (64) and value-weighted (82) portfolios. To our surprise, the high sustainability rating of the market-capitalization-weighted portfolio dominates all other strategies with the exception of the inclusion approach, which picks only the 20 percent of stocks with the highest sustainability ratings. Especially in a direct comparison with the tilt strategy—which is identical in its construction but replaces a firm's market-capitalization by its sustainability score—we document a difference in absolute ratings of up to 7 percent. We reason this observation on the basis of a lower degree of cross-sectional dispersion among ratings compared to firm size, which results in a relatively lower level of overweighting of high-rated firms compared to large firms, although the latter are on average also highly rated firms. In this respect, the market-capitalization-weighted market portfolio is a reasonable and theoretically grounded benchmark in the context of modern portfolio theory, and it also is a good point of reference for benchmarking the performance of alternative ESG strategies.

For the specific case of the two considered sustainable momentum strategies, we observe a strong tilt toward small-cap stocks—as indicated by f_size—accompanied by the lowest portfolio sustainability ratings across tested investment approaches. However, this should not come as a surprise given that a larger increase in sustainability performance is more likely for firms with low levels of absolute sustainability (i.e., they have more upward potential), whereas firms with already high levels of absolute ratings have less upward potential. We will discuss this concept, as well as the implications for sustainable investors, in more detail below.

Finally, we consider the CO_2 footprint of a strategy as a core concept of sustainability. CO_2 emissions have received increased attention since the Paris climate accord was signed in April 2016. The far-right two columns of table 2 report the aggregated direct CO_2 emissions (Scope 1 + Scope 2) for portfolio strategies based on firms' absolute emissions (CO_{2abs}) and adjusted for firm size (CO_{2adj}) according to book value of assets.[1] Indeed, we find all portfolios based on alternative categories of the environmental score (ENER, ENPI, and ENRR) to yield favorable outcomes in terms of reducing a portfolio's CO_2 exposure relative to both the equal- and value-weighted benchmark, with the exception of the inclusion strategy, which yields mixed results. Most prominently, we observe the lowest emission exposure for both momentum strategies with respect to absolute and size-adjusted CO_2 emissions. Although the low level of absolute carbon emissions for momentum portfolios can be explained by their small-cap tilt, the positive outcome for size-adjusted CO_2 emissions is not as straightforward,

Table 3

FAMA-FRENCH THREE-FACTOR PERFORMANCE ATTRIBUTION

	ALPHA		MKT		SMB		HML		R^2
(A): Benchmark Indexes									
Value-weighted	-0.54	(-1.23)	0.96	(80.63)	-0.01	(-0.38)	-0.01	(-0.57)	0.99
Equal-weighted	0.83	(0.74)	1.10	(40.52)	0.58	(9.32)	0.15	(2.39)	0.95
(B): Environmental Score (ENV)									
Tilt	1.01	(0.98)	1.11	(45.16)	0.48	(8.38)	0.14	(2.38)	0.96
Exclusion	1.18	(1.10)	1.11	(42.86)	0.52	(8.93)	0.13	(2.17)	0.96
Inclusion	1.50	(1.09)	1.12	(36.74)	0.21	(3.96)	0.13	(2.07)	0.94
$Momentum_{pos}$	0.88	(0.73)	1.08	(40.42)	0.60	(11.45)	0.14	(2.49)	0.95
$Momentum_{top}$	-0.77	(-0.47)	1.06	(27.98)	0.69	(9.94)	0.10	(1.66)	0.92
(C): Emission Reduction (ENER)									
Tilt	0.87	(0.86)	1.10	(45.77)	0.49	(8.53)	0.14	(2.47)	0.96
Exclusion	1.12	(1.04)	1.11	(41.96)	0.53	(8.43)	0.13	(2.10)	0.96
Inclusion	0.21	(0.16)	1.11	(37.71)	0.30	(4.39)	0.23	(3.55)	0.94
$Momentum_{pos}$	0.36	(0.30)	1.09	(36.01)	0.56	(9.01)	0.13	(2.15)	0.95
$Momentum_{top}$	-0.82	(-0.54)	1.08	(28.51)	0.66	(9.63)	0.11	(1.60)	0.93
(D): Product Innovation (ENPI)									
Tilt	1.00	(0.96)	1.12	(44.88)	0.49	(8.70)	0.14	(2.25)	0.96
Exclusion	1.15	(1.00)	1.11	(39.72)	0.54	(8.14)	0.15	(2.10)	0.95
Inclusion	1.21	(0.85)	1.13	(33.41)	0.34	(5.52)	0.11	(1.83)	0.93
$Momentum_{pos}$	1.19	(0.89)	1.13	(33.88)	0.54	(7.20)	0.16	(1.88)	0.94
$Momentum_{top}$	1.24	(0.91)	1.07	(29.64)	0.58	(8.04)	0.15	(2.07)	0.94
(E): Resource Reduction (ENRR)									
Tilt	1.11	(1.02)	1.10	(43.39)	0.48	(8.05)	0.14	(2.37)	0.96
Exclusion	1.25	(1.18)	1.09	(43.51)	0.52	(9.01)	0.15	(2.48)	0.96
Inclusion	1.42	(1.04)	1.12	(34.40)	0.27	(4.12)	0.20	(3.04)	0.94
$Momentum_{pos}$	0.70	(0.52)	1.10	(33.94)	0.57	(7.52)	0.18	(2.33)	0.94
$Momentum_{top}$	0.22	(0.13)	1.08	(27.52)	0.65	(9.82)	0.15	(2.16)	0.92

Table 3 presents the multivariate regression results for ESG-based portfolios regressed on a market factor, size, and value premium. We derive our factors as follows: market factor (STOXX EUROPE 600), size premium (EURO STOXX Small minus EURO STOXX Large), and value premium (EURO STOXX TMI Value minus EURO STOXX TMI Growth). (A) presents the sample-based equal- and value-weighted (market-capitalization) benchmark portfolios and (B) to (E) report the results for portfolios formed on the basis of the respective environmental sustainability component. We state regression coefficients and t-statistics in parenthesis. The observation period is July 2005–June 2016 and corresponds to 132 monthly returns.

especially because the higher levels of CO_{2adj} for the equal-weighted portfolio, compared to the value-weighted portfolio, indicate that small firms are not necessarily more carbon-efficient. Similarly, the inclusion strategy based on ENER, which focuses on the best-rated 20 percent of firms and is reflected by the highest aggregated portfolio rating of 94, shows the best scores for absolute and adjusted CO_2 emissions.

FACTOR EXPOSURES IN PORTFOLIOS

We analyze the factor exposures of considered strategies by using the Fama and French (1993) three-factor methodology and considering the industry-based index factors proposed by Cremers et al. (2012). We expect a more accurate and representative exposure analysis of the market factor, size, and value premium given the better fit of the STOXX Europe 600 universe for our investment universe. This notion is confirmed by an insignificant intercept of −0.54 percent per annum (p.a.) for the value-weighted sample portfolio, alongside a market beta of 0.96, a size and value factor exposure of −0.01, and an explained variance of 0.99 (see table 3). In contrast, the equal-weighted portfolio yields a positive, but insignificant, intercept of 0.83 percent p.a., as well as a significant positive exposure toward size and value, which is consistent with previous findings (Plyakha et al. 2012).

With respect to the tested environmentally sustainable investment strategies, we make the following five central observations:

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1. All approaches but $momentum_{top}$ yield positive alphas against the STOXX Europe 600 and outperform the value-weighted sample benchmark.
2. The exclusion strategy is the only one to consistently—across all four environmental sustainability measures—outperform the equal-weighted sample benchmark.
3. All strategies result in high market betas given their underlying equal-weighting approach.
4. Portfolios show size exposures below the 1/N benchmark with the exception of the two momentum approaches.
5. The value tilt is near the 1/N benchmark.

These initial findings show that, for each strategy, the weighting scheme has a stark impact on the portfolio outcome, as indicated by the close alignment with the 1/N benchmark. We further analyze the impact of weighting scheme on strategy performance in the Alternative Portfolio Weighting Schemes section.

A closer look at single components results in some interesting observations. First, we once more observe differences between ENPI and the ENER and ENRR components: The inclusion strategy shows high degrees of value tilt for ENER and ENRR of 0.23 and 0.20, respectively, whereas for ENPI the value exposure is relatively low at 0.11. This makes sense when considering that value generally is associated with a tilt toward energy, financial services, telecoms, and utilities; whereas growth investors focus more on the technology sector. The relevance of environmental aspects is more dominant for the energy and utility sectors given their greater exposure on these issues; as such it is reasonable to observe that firms in these industries put more effort into reducing emissions and the efficient use of natural resources. Consequently, we observe a higher value exposure for the firms scoring highest on emission reduction (ENER) and resource reduction (ENRR).

Secondly, the generally lower size exposure of strategies that focus on environmentally sustainable firms—vis-à-vis the stronger small-cap tilt of momentum-based approaches—once more confirms our previous observations of firms showing strong increases in their sustainability performance to be on average small-cap stocks and thereon associated with lower current levels of absolute sustainability ratings. Besides the sustainability aspects, where momentum-based ESG strategies are likely to fall short, the small-cap tilt also has potential implications in terms of transaction costs and liquidity risk. The values for fourth quarter 2016 provided by the Investment Technology Group's Global Cost Review on the difference between total trading costs associated with small- and large-cap stocks—100.5 basis points (bps) and 32.9 bps, respectively—indicate a strong net performance impact at the cost of ESG momentum strategies.[2] Furthermore, although not explicitly tested in this study, the small-cap tilt also may come alongside a higher degree of liquidity risk and as such the strong performance of ESG momentum portfolios, reported by Nagy et al. (2016), is potentially compensation for liquidity risk rather than a source of active performance.

ALTERNATIVE PORTFOLIO WEIGHTING SCHEMES

The standard setting, for all but tilt portfolios, assigns an equal weight to all stocks in the respective smaller investment subset of each strategy. In this section we consider two alternative approaches: (1) we weight stocks according to their market capitalization, and (2) we weight stocks according to their sustainability rating. This provides a second source of adjusting sustainability strategies to potentially enhance their risk-adjusted returns and sustainability ratings on an aggregated portfolio level.

Figure 1 presents the outcomes for the three categories of environmental sustainability (ENER, ENPI, and ENRR) in columns and the corresponding changes related to risk-adjusted returns (Sharpe ratio), portfolio sustainability rating for each respective category, and size-adjusted CO_2 emission in rows. Although the tilt strategy is not affected by a change in the underlying weighting scheme, because it is always constructed on the basis of firms' underlying environmental sustainability ratings, we include it for the benefit of comparability across investment strategies. Based on the graphical analysis we document five main findings:

1. Both tilt and exclusion strategies exhibit stable performance across the three components of environmental sustainability, whereas inclusion and momentum strategies vary more.
2. Value-weighting has a negative impact on risk-adjusted returns.
3. Inclusion strategies result in the highest sustainability ratings (90+) across the three categories and weighting schemes.
4. Equal-weighting results in the lowest sustainability ratings.
5. Value-weighting results in the highest size-adjusted CO_2 exposure in portfolio .

Next we examine more closely some of the influences of alternative weighting schemes on certain environmentally sustainable investment strategies. In addition to the previously mentioned points, we also observe a situation where portfolios show on average highest size-adjusted CO_2 emissions when based on the emission reduction (ENER) component, which is counterintuitive at first glance. However, this confirms our earlier conclusion that firms with high absolute carbon emissions tend to score well on emissions reduction, given their large potential for improvement. In this respect, a closer look at the industry allocation of alternative strategies across environmental components supports our argument; e.g., both ENER-based tilt and inclusion strategies increased their relative allocation to utilities, which is a carbon intensive industry, by 32 percent and 107 percent compared to the equal-weighted benchmark,

Figure 1

EFFECTS OF ALTERNATIVE PORTFOLIO WEIGHTING SCHEMES

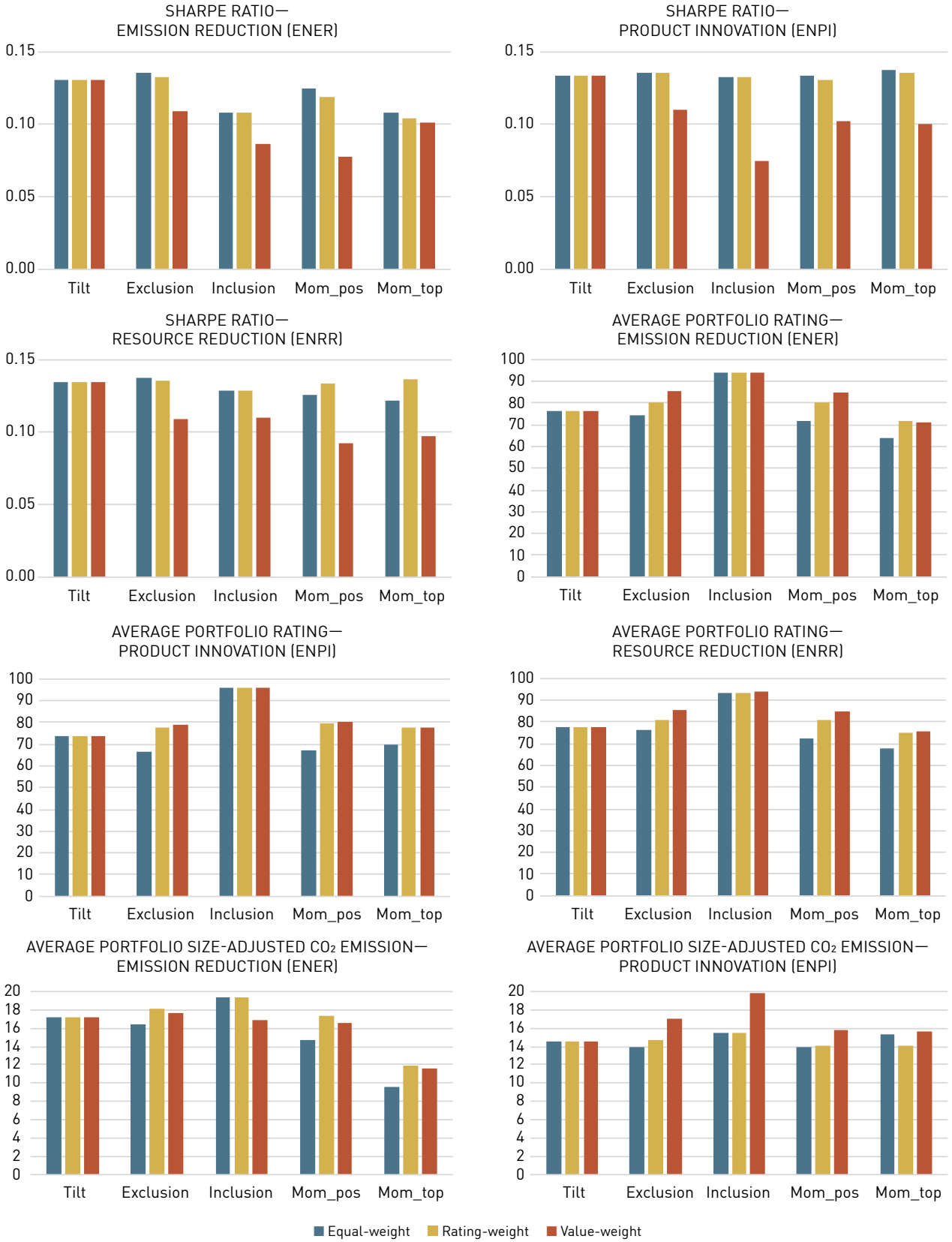

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FIGURE 1, CONTINUED

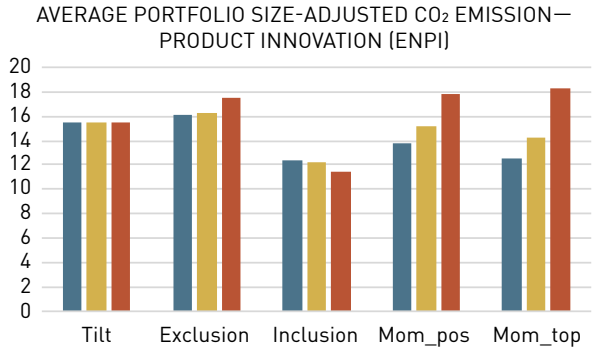

Figure 1 presents the effects of alternative weighting schemes on sustainability portfolios. We consider three approaches: (1) equal-weighted portfolios, (2) portfolios weighted by sustainability rating, and (3) portfolios value-weighted by market-capitalization. We report the impact on portfolios' Sharpe ratios, aggregated portfolio category sustainability ratings, and the weighted size-adjusted CO_2 emission of a portfolio. Note that tilt strategies are not affected by changes in the weighting scheme, because they are always based on the respective sustainability rating. The observation period is July 2005–June 2016 and corresponds to 132 monthly returns.

compared to 15 percent and 9 percent for the ENPI-based portfolios.[3]

Regarding the three alternative weighting schemes, we show that both the equal- and rating-based weighting closely align across the weighting approaches and the three types of environmental sustainability. In contrast, the application of a market-capitalization-weighted approach yields consistently lower risk-adjusted returns and higher size-adjusted CO_2 emissions portfolio values, whereas the portfolio sustainability ratings do not considerably benefit from the implicit overweighting of large-caps. Going forward, we recommend the use of a ratings-based approach, although differences toward an equal-weighting are little, we do observe some favorable characteristics for the case of exclusion and momentum strategies in terms of their resulting environmental ratings. With respect to alternative investment strategies, we document overall advantageous characteristics for tilt and exclusion strategies because they:

1. are broadly diversified;
2. are the most consistent in terms of risk-adjusted returns, portfolio ratings, and carbon emissions across alternative specifications of weighting schemes and environmental sustainability components; and
3. yield positive three-factor alphas while staying within the limits of an equal- and value-weighted benchmark in terms of their size and value exposure.

DISCUSSION

Numerous empirical studies have analyzed the connection between a firm's sustainable and financial performance, including total shareholder return. This research is inconclusive and offers various explanations for under- or outperformance of sustainable firms versus nonsustainable firms. The most popular hypothesis appears to be based on the risk perspective: Firms with an on average higher sustainability rating entail lower business risk and as such also reduce financial risk to shareholders. In this paper we argue that risk and return are two sides of the same coin when it comes to a firm's sustainability performance.

From an investment perspective the concept rests on the classical Markowitz framework, where the investment decision can be broken down into two components: mean and variance. An investor deciding to engage in sustainable investing faces a choice: (1) reduce the overall portfolio risk or (2) enhance the portfolio in terms of increasing expected returns. The underlying intuition is straightforward. A stock fulfilling a high standard in terms of sustainability performance has lower operational risk with respect to social or environmental factors. This, most likely, is based on management's decision to invest in becoming more sustainable and working to retain this high sustainability standard in the future. As such, investors who construct portfolios on the basis of firms' high absolute sustainability ratings demand a lower rate of return alongside a lower level in risk.

On the contrary, another set of firms may be at an early stage of their sustainability cycles. Management of these firms has decided to become more sustainable in the future, but the firms likely show low absolute sustainability levels at this time. Thereon, investors will be more interested in progress over time rather than whether these firms can retain current levels of sustainability; they will be concerned with the changes in a firm's rating over consecutive periods to track the progress made. These firms are still exposed to certain risks not fully accounted for in their business models and therefore investors require a higher rate of return. Consequently, one can think of firms with these characteristics—a low absolute sustainability performance and a positive trend—as climbers.

As we have shown, sustainability performance must be separated into absolute and relative sustainability performance, and each type appeals to a different set of investors. This is conceptually similar to value investing, where investors buy stocks that are out of fashion (low absolute level of sustainability) yet show potential to grow in market value (increase in sustainability performance). Nevertheless, the question remains: Can an investment in a firm with low sustainability performance but potential for improvement be considered a sustainable investment? Essentially, each investor must answer this question on an individual basis. As long as portfolio sustainability is measured solely on the basis of absolute ratings, short-term focused strategies based on changes in sustainability scores will have a hard time penetrating the market of sustainable products for predominantly long-term orientated investors.

CONCLUDING REMARKS

The aim of the study at hand is to shed light on a new type of sustainable investment approach, namely ESG momentum. Although existing studies and practical implementations of ESG-based investment strategies have built on the use of absolute (level of) ESG ratings for the benefit of deriving more-sustainable portfolios, Nagy et al. (2016) have suggested the use of changes in ratings as a new basis of deriving sustainable portfolios. We provide both a theoretical discussion and empirical comparison with respect to traditional weighting schemes considered by sustainable portfolio managers and the newly introduced ESG momentum approach. To provide a clear basis for our argumentation and avoid any conflicting effects, we focus solely on the environmental aspect of ESG ratings in Europe and pay particular attention to strategies' carbon footprints as a central measure of a portfolio's environmental friendliness.

Our empirical findings document that all strategies yield in general improved sustainability ratings as well as reduced carbon emissions exposures relative to the equal-weighted benchmark, while providing identical or higher risk-adjusted returns. This is especially the case when derived on the basis of the aggregated environmental rating and with respect to product innovation (ENPI), whereas the momentum portfolios disappoint on the basis of emission reduction (ENER) and resource reduction (ENRR) ratings. Surprisingly, the exclusion approach is the only method that outperforms both the equal- and market-capitalization benchmarks across all rating approaches, thereby indicating that investors prefer to shun firms with high environmental risks and try to identify environmental opportunities rather than rewarding firms for good management of environmental issues.

As for the relevance of ESG momentum approaches on theoretical grounds, we struggle to offer a clear-cut answer about whether this strategy should find support on behalf of environmentally sustainable investors. The empirical results demonstrate inferior environmental ratings throughout and mixed results with respect to risk-adjusted returns across alternative rating components, but there may be a case for investing in sustainable momentum stocks. This is because firms can be in the early stage of sustainability cycles. That is, management may have decided to become more sustainable, but these firms are likely to show low absolute sustainability levels at this point in time. Consequently, investors will be concerned with the change in a firm's rating over consecutive periods, to track the progress made. At the same time, these firms are still exposed to certain risks not fully accounted for in their business models and investors will require a higher rate of return. Investors in such firms essentially help to fund the firm's sustainability progress and therefore improve the overall level of environmental sustainability in the market.

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ENDNOTES

1. Scope 1 emissions are direct emissions owned or controlled by the organization. Scope 2 emissions are energy indirect emissions resulting from purchased energy in order to operate the firm. Scope 3 emissions are all indirect emissions that occur along the value chain of the reporting company and are not already accounted for under Scope 2.
2. According to the definitions provided by the Investment Technology Group's Global Cost Review, Total Cost (bps) is defined as the sum of Average Commission (bps) and IS Cost (bps), where the latter refers to the difference, or slippage, between the arrival price and the execution price for a trade.
3. Results regarding the industry allocation of portfolios are based on the Industrial Classification Benchmark (ICB) provided by WorldScope (WC07040).

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