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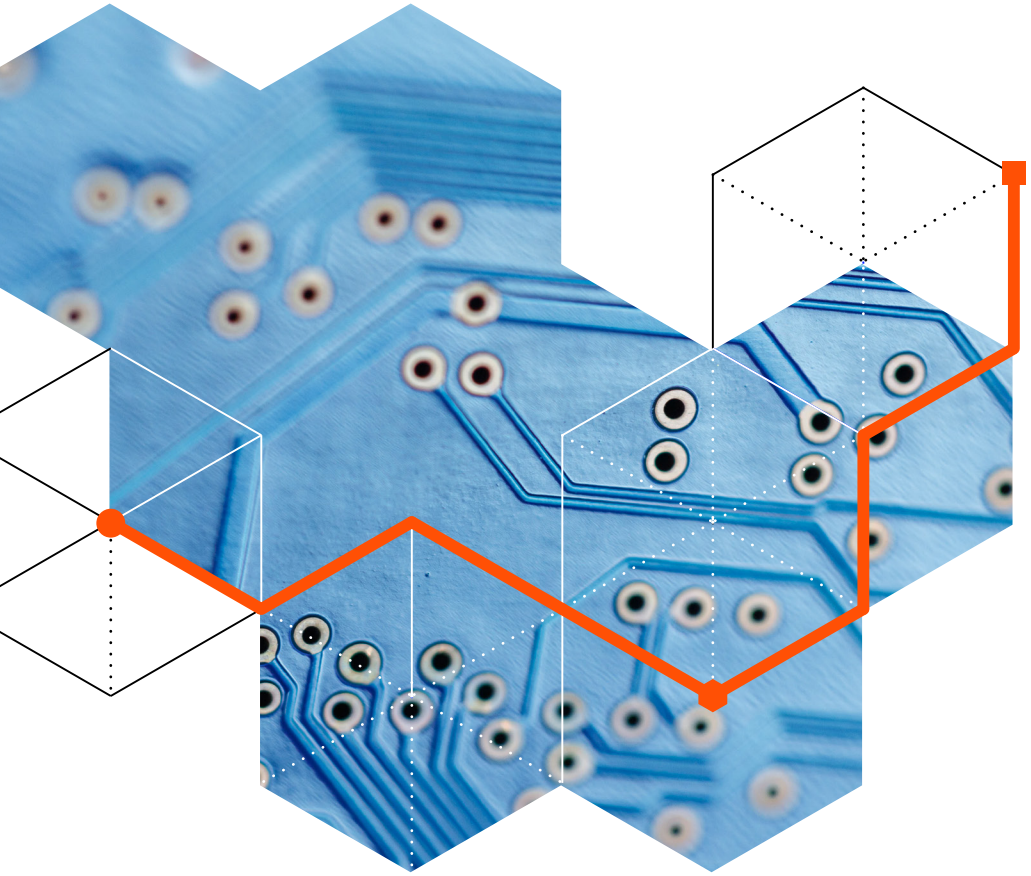

SUSTAINABLE FACTOR INVESTING:
ESG considerations in your factor strategies

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1 Summary and main findings

Investing in a sustainable way is currently the main investment trend. Sustainable investing appeals to the new generation of investors – millennials – and sustainability transparency and disclosure is increasingly enforced by regulators.

Factor investing, the modern investment workhorse, is another ongoing investment theme, with new factor-based investment products appearing almost daily. Many asset managers incorporate factor investing into their overall investment strategies. Multifactor investment strategies have shown their consistently superior performance over the past decade.

The goal of this paper is to combine these two investment trends: to show how sustainability considerations can be combined with multifactor investment strategies, and to demonstrate that adding sustainability considerations to these strategies does not diminish their performance.

Numerous papers have investigated the relationship between sustainability and corporate financial performance; most of them found that either sustainability has a negative impact on stock return (at least the short-term return), or the impact is insignificant (Borovkova & Wu, 2020).

In this research, we propose investment strategies based on factor model (Fama & French, 2016) and α-momentum (Hühn & Scholz, 2018), and incorporating sustainability (i.e., ESG) metrics. Instead of considering ESG as a separate investment factor, we propose to use sustainability as a screening overlay in multifactor strategies and as an aid in sector rotation. We show that our strategies incorporate sustainability at a low cost of financial performance, and that the resulting portfolios still significantly outperform the benchmark, just like traditional multifactor strategies do.

Specifically, we address the following questions in this research:

- Can sustainability be treated as an investment factor?
- What is the impact of sustainability, as a screening overlay and as the weighting criterion in sector rotation, on portfolio financial performance?

In what follows, we will go into more detail about our research; but firstly, we summarise our main findings:

- In both the S&P 500 and STOXX 600, sustainability cannot be considered as a traditional investment factor. Consequently, adding sustainability as a factor does not make a difference in portfolio performance – there is no significant negative difference
- Applying sustainability as an overlay and/or in sector rotation to multifactor strategies in the S&P 500 universe leads to a higher Sharpe Ratio compared to the unscreened factor strategies. Differently in STOXX 600 universe, it results in a slightly lower Sharpe Ratio. However, the tradeoff is acceptable, since the ESG-based screening scenario still results in at least 12.88% annualized return over the last decade
- Using the environmental (E) pillar score as the overlay or in sector rotation is a less attractive alternative than using ESG score as a whole, especially in STOXX 600 universe

2 Methodology

The data we used in this research is comprised of the returns of S&P 500 and the STOXX 600 historical constituents during the period July 2007 to December 2020. For sustainability metrics, we employ Refinitiv Combined Environment, Social and Governance (ESGC) scores, for the same companies and historical period. The ESGC scores are generated annually. The risk-free rate in our research is we use is three-month Treasury Bill rate for S&P 500 stocks, and three-month euro yield for STOXX 600 stocks.

ESGC scores provide a rounded and comprehensive scoring of a company's ESG performance, based on reported information pertaining to the ESG pillars, with the ESG controversies overlay captured from global media sources. The main objective of this score is to discount the ESG performance score based on negative media stories. This is done by incorporating the impact of significant, material ESG controversies into the overall ESGC score. Find more details on how the ESGC scores is calculated in the Refinitiv ESG Scores Methodology.

The following well-known factor model is estimated using 13-week rolling regressions with a two-year lookback window:

$$R_t = \alpha + \beta_1(Mrkt_t - rf_{,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WML_t + \beta_5 SMV_t + \varepsilon_t \qquad (1)$$

In this model, the well-known investment factors are: the market, size, growth, momentum and volatility. We construct factor portfolios following the Fama French approach (Fama & French, 2016). Size and value factors (SMB and HML) are formed at the end of June of each year ***t***. Momentum and volatility factors positively correlated to market cap (WML and SMV) are constructed at the beginning of each month ***t***.

To test whether sustainability (as measured by ESG score) can be considered as a factor, we also consider the following extended model,

$$R_t = \alpha + \beta_1(Mrkt_t - rf_{,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WML_t + \beta_5 SMV_t + \beta_6 ESG_t + \varepsilon_t, \qquad (2)$$

where the long-short sustainability factor (ESG) is formed, in a way similar to other factors, at the beginning of each year, using the previous December's ESG scores. It is well known that larger companies have higher sustainability scores. So, to avoid a tilt towards large companies when also including the ESG factor, in the factors construction we employ double sorting with market cap and ESG scores.

ESG metrics can be incorporated into multifactor strategies in many ways. Adding a specific factor based on ESG scores is one possibility; the question then is whether this enhances the returns of the strategy - we will answer this in the next section. However, it might be that sustainability considerations are incorporated into factor portfolio construction, not to enhance returns (not short-term anyway), but to improve the ESG (or other sustainability metrics) of the entire portfolio, hopefully not at the cost of financial performance. In this case, it might be more appropriate to consider ESG scores as a risk overlay, and perform screening of stocks by their ESG scores before including them into multifactor portfolios. This is the second strategy we will evaluate. Finally, we can invest preferentially into those sectors that have higher overall ESG metrics. This additional sector tilt will be investigated in our third strategy.

All investment strategies we consider are based on the so-called α-momentum strategy by Hühn and Scholz (2018), currently widely used by factor investors. We evaluate the performance of the following three options.

Factor portfolio

Step 1: Every 13 weeks, the model is estimated on weekly returns for each of the S&P 500 (or STOXX 600) constituents, with a two-year lookback window of historical data.

Step 2: The estimated αs from Step 1 are ranked to construct the portfolio for the next 13-week period. The top 10 stocks in each sector (in terms of their αs) are selected.

Step 3: Stocks within each sector are equally weighted.

Step 4: The sectors receive the same weights as in the underlying index, to prevent sector tilts.

Factor portfolio with ESG as a risk overlay

Steps 1 and 2 are the same as in the Factor Portfolio strategy above.

We then exclude the bottom q% stocks within each sector according to the previous year's ESG score.

Three scenarios are considered: 'Subtle' with q = 10%; 'Medium' with q = 30% and 'Aggressive' with q = 50%.

As above, the remaining stocks are equally weighted within each sector, and the sectors receive the same weights as in the index.

Factor portfolio with ESG as a risk overlay and sector rotation

This portfolio is equivalent to the previous one, with one significant difference: in the last step, we overweight (resp. underweight) sectors with the best (resp. worst) average ESG scores from the previous year. This is done as follows:

Stocks that are not excluded by the ESG overlay are aggregated using market cap weights. This results in sector-average ESGC scores. In the S&P 500, the top five of the 11 GICS sectors are overweighted, while the bottom five sectors are underweighted. The scheme is fixed as: 5,4,3,2,1,0,−1,−2,−3,−4,−5. For the top five sectors, there are three scenarios: subtle, medium and aggressive, which have 10%, 30% and 50% total weight, respectively. Meanwhile, the bottom five sectors are underweighted in the same proportions.

Note that the combination three different ESG risk overlay strategies (subtle, medium and agressive) and three sector rotation strategies results in total of nine strategies to be evaluated. For the STOXX 600, we map ICB classification into GICS and apply the same sector rotation scheme as described above.

3 Results

Table 1 presents the statistics of weekly returns of factor portfolios. The averaged weekly return of the volatility factor (SMV) and the sustainability (ESG) factor is negative (but not significantly so) for the S&P 500, indicating that more stable stocks tend to underperform volatile stocks, and similarly, sustainable stocks seem to underperform less sustainable stocks. On the other hand, the size and momentum factors exhibit positive returns, in agreement with the factor investing theory.

Table 2 shows the correlations between factor returns. The correlations between the size factor and the sustainability factor is relatively low, indicating that the double sorting with market cap indeed limits a possible size bias in other factors.

Table 1: Summary statistics July 2007 to December 2020

	Mean	Std. dev
	S&P 500	
MKT-rf	0,203	2,729
ESG	-0,057	1,080
SMV	-0,101	3,299
WML	0,073	3,126
HML	-0,070	2,466
SMB	0,039	2,234
	STOXX 600	
MKT-rf	0,190	2,810
ESG	0,083	1,142
SMV	0,020	2,537
WML	0,109	2,854
HML	-0,025	1,432
SMB	-0,020	1,496

Table 2: Correlation matrix: July 2007 to December 2020

	Mrkt-rf	ESG	SMV	WML	HML	SMB
			S&P 500			
MKT-rf	1,000					
ESG	0,098	1,000				
SMV	-0,620	-0,138	1,000			
WML	-0,479	-0,259	0,706	1,000		
HML	0,263	0,064	-0,386	-0,441	1,000	
SMB	0,202	-0,005	-0,389	-0,212	-0,308	1,000
			STOXX 600			
MKT-rf	1					
ESG	0,015	1,000				
SMV	-0,592	-0,005	1,000			
WML	-0,432	0,021	0,716	1,000		
HML	0,115	0,088	-0,272	-0,324	1,000	
SMB	-0,282	-0,215	-0,176	-0,136	0,073	1,000

3.1 Is sustainability an individual factor?

For each constituent in the S&P 500 and STOXX 600, we performed the 13-week rolling factor model estimation with and without the sustainability factor. The estimated betas are aggregated over all stocks and all estimation dates.

Table 3 provides an overview of the aggregated results for both models, along with the robust ***t***-values. The aggregated coefficient of sustainability factor is not significant in either the S&P 500 and STOXX 600 universe. This rejects the hypothesis of sustainability as an independent factor in the S&P 500 or STOXX 600. Moreover, we observe in Table 4 that the performance of portfolios based on the five-factor model is the same as the performance of portfolios formed by the factor model with the sustainability factor. This means that, with or without the sustainability factor, the portfolio constituents selected by the factor model are predominantly the same.

Table 3: Rolling robust factor model estimation aggregated results July 2009 to December 2020

(a) S&P 500					(b) STOXX 600				
	Five-factor		Five-factor + ESGC			Five-factor		Five-factor + ESGC	
	Coeff.	***t***-value	Coeff.	t-value		Coeff.	***t***-value	Coeff.	***t***-value
α	0.001	0.311	0.001	0.316	α	0.000	0.130	0.000	0.121
Mrkt-rf	1.032	6.359	1.032	6.388	Mrkt-rf	1.086	5.544	1.086	5.535
SMB	0.225	0.909	0.226	0.914	SMB	0.325	0.951	0.327	0.953
HML	0.061	0.339	0.063	0.345	HML	0.072	0.167	0.069	0.162
WML	-0.015	-0.015	-0.016	-0.019	WML	-0.018	0.058	-0.019	0.047
SMV	0.012	0.377	0.008	0.342	SMV	0.000	0.150	0.000	0.151
ESG			0.037	0.114	ESG			-0.003	0.020
adjusted R^2	0.433	0.441	adjusted R^2	0.400	0.404				

t-values are calculated by HAC covariance estimation if auto-correlation or heteroskedasticity is detected.

Table 4: Investment results based on factor model with and without sustainability factor, annualised over 2010 to 2020

	S&P 500			STOXX 600		
	Benchmark	S&P 500	S&P 500 + ESGC	Benchmark	Five-factor*	Five-factor + ESG
Return (%)	13.992	14.299	14.299	7.766	17.075	14.075
Std. dev (%)	16.320	17.786	17.786	17.165	16.040	16.040
Information Ratio	\	0.200	0.200	\	0.663	0.663
Sharpe Ratio	0.672	0.542	0.542	0.510	0.705	0.705

3.2 Performance of multifactor strategies with and without ESG overlay

Our above results indicate that sustainability is a redundant factor, which does not contribute to the traditional multifactor model. So, we consider it more appropriate to apply the ESG scores as a risk overlay and in sector tilts. These two options by definition will lead to a higher sustainability score of the resulting portfolio; the question is whether this happens at the cost of financial performance – this is what we investigate.

Table 5 shows the annualised return, the standard deviation, the Sharpe Ratio and the Information Ratio of S&P 500 portfolios constructed by all the strategies we described.

The combination of five-factor model and α-momentum strategy produces a 14.3% annualised return from 2010 to 2020, with the Sharpe ratio 0.542, outperforming the S&P 500 benchmark.

When we incorporate ESG as a risk overlay, the financial performance in terms of the return and the Sharpe Ratio increases slightly. Moreover, the higher the screening aggressiveness, the higher the return and the Sharpe Ratio. When 50% stocks are excluded according to their ESG rating, the annualised return increases by 1.1%. As we over/underweight sectors based on their ESG scores, we observe a further increase in the return and the Sharpe Ratio. The strategy 'aggressive' on both risk overlay and sector rotation results in a 4.2% increase in return. Moreover, we also notice that the ESG risk overlay and sector rotation contribute to the reduction in portfolio volatility. Screening stocks by ESG excludes some volatile stocks, thus we observe that, even with fewer stocks, portfolios constructed with the ESG risk overlay have lower volatility than five-factor portfolios. Furthermore, sector rotation also underweights volatile sectors to a certain extent. The joint improvement in return and volatility leads to a Sharpe Ratio of 0.93 in the most aggressive scenario.

Table 6 reports the portfolio performance in the STOXX 600. Differently from S&P 500 portfolios, the ESG risk overlay and sector rotation produce lower return and Sharpe Ratio compared to the five-factor portfolio. The volatility slightly increases, along with the aggressiveness of screening and sector rotation. One possible explanation is that the relationship between a stock's volatility and the ESG score is relatively weak. Consequently, the portfolio variance is dominated by the number of stocks included and not the type of stocks.

This, however, says nothing about the long-term performance of a more sustainable portfolio. By including highly sustainable stocks, we might be immunising the portfolio against shocks in the medium and long term, which may adversely affect less sustainable companies to a higher extent than their more sustainable peers.

In all, although we make a tradeoff between financial performance and sustainability, the sustainable factor portfolio still yields at least an extra 5% return annually over the benchmark (recall that the annualized return of the STOXX 600 index is 7.766% over the same time period).

Table 5: Portfolio performance (annualised over the period 2010 to 2020), S&P 500

		Return (%)	Std. Dev (%)	Information Ratio	Sharpe Ratio
Five-factor model portfolios		14.299	17.786	0.227	0.646
ESGC as risk overlay					
Screening					
Subtle		14.733	17.611	0.330	0.679
Medium		14.876	17.375	0.346	0.694
Aggressive		15.440	17.235	0.446	0.731
ESGC as risk overlay and with sector rotation					
Screening	**Sector rotation**				
Subtle	Subtle	15.091	17.371	0.379	0.706
Subtle	Medium	15.703	17.040	0.409	0.755
Subtle	Aggressive	16.279	16.919	0.391	0.794
Medium	Subtle	15.250	17.153	0.407	0.724
Medium	Medium	15.972	16.867	0.452	0.778
Medium	Aggressive	16.658	16.798	0.440	0.821
Aggressive	Subtle	16.078	17.025	0.557	0.777
Aggressive	Medium	17.329	16.789	0.660	0.861
Aggressive	Aggressive	18.547	16.808	0.667	0.930

Table 6: Portfolio performance (annualised over the period 2010 to 2020), STOXX 600

		Return (%)	Std. Dev (%)	Information Ratio	Sharpe Ratio
Five-factor model portfolios		14.075	16.040	0.725	0.935
ESGC as risk overlay					
Screening					
Subtle		13.180	16.510	0.586	0.854
Medium		12.882	16.632	0.543	0.830
Aggressive		13.267	16.625	0.600	0.853
ESGC as risk overlay and with sector rotation					
Screening	**Sector rotation**				
Subtle	Subtle	13.260	16.490	0.614	0.860
Subtle	Medium	13.485	16.655	0.636	0.865
Subtle	Aggressive	13.667	17.062	0.603	0.855
Medium	Subtle	13.103	16.551	0.597	0.847
Medium	Medium	13.612	16.595	0.676	0.876
Medium	Aggressive	14.078	16.891	0.686	0.888
Aggressive	Subtle	13.655	16.592	0.676	0.879
Aggressive	Medium	14.501	16.737	0.790	0.922
Aggressive	Aggressive	15.307	17.137	0.822	0.948

3.3 Performance of multifactor strategies with environmental pillar score

Often sustainability considerations are dominated by environmental issues. So we also investigated what happens to multifactor portfolios if only the E (environmental) pillar is considered for risk overlay or sector rotation.

Tables 7 and 8 report the portfolio performance when using the environmental pillar score as the risk overlay and/or in sector rotation. We observe similar results as in Section 3.2. Applying the E score individually does not take the full advantage of sustainability, as in S&P 500 portfolios, so the benefit in terms of financial performance improvement is lower. Moreover, in the STOXX 600, the return and the Sharpe Ratio decrease further compared to portfolios constructed by using full ESG score. It suggests that the environment pillar is not the dominant component in sustainability, and that the social and governance pillar also play an important role.

Table 7: Portfolio performance (annualised over the period 2010 to 2020) with environmental score, S&P 500

		Return (%)	Std. Dev (%)	Information Ratio	Sharpe Ratio
Five-factor model portfolios		14.299	17.786	0.227	0.646
ESGC as risk overlay					
Screening					
Subtle		14.435	17.751	0.261	0.655
Medium		14.314	17.675	0.236	0.651
Aggressive		14.420	17.531	0.243	0.663
ESGC as risk overlay and with sector rotation					
Screening	**Sector rotation**				
Subtle	Subtle	17.704	17.268	0.309	0.689
Subtle	Medium	15.215	16.431	0.344	0.754
Subtle	Aggressive	15.687	15.786	0.318	0.814
Medium	Subtle	14.741	17.202	0.322	0.693
Medium	Medium	15.569	16.394	0.418	0.777
Medium	Aggressive	16.361	15.792	0.425	0.856
Aggressive	Subtle	14.889	17.075	0.311	0.707
Aggressive	Medium	15.798	16.324	0.424	0.794
Aggressive	Aggressive	16.667	15.815	0.430	0.874

Table 8: Portfolio performance (annualized over the period 2010-2020) with Environment score, STOXX 600

		Return (%)	Std Dev (%)	Information Ratio	Sharpe Ratio
5-factor model portfolios		14.075	16.040	0.725	0.935
ESGC as risk overlay					
Screening					
Subtle		13.394	16.510	0.627	0.867
Medium		13.245	16.836	0.625	0.841
Aggressive		11.864	16.957	0.429	0.753
ESGC as risk overlay and with sector rotation					
Screening	**Sector rotation**				
Subtle	Subtle	13.254	16.370	0.620	0.866
Subtle	Medium	13.043	16.271	0.576	0.858
Subtle	Aggressive	12.796	16.394	0.493	0.836
Medium	Subtle	12.897	16.712	0.582	0.827
Medium	Medium	12.274	16.644	0.471	0.792
Medium	Aggressive	11.617	16.796	0.340	0.746
Aggressive	Subtle	11.437	16.840	0.373	0.733
Aggressive	Medium	10.657	16.794	0.249	0.688
Aggressive	Aggressive	9.842	16.979	0.120	0.632

4 Concluding remarks

The aim of sustainable investment strategies is to achieve a higher sustainability profile of portfolios without sacrificing on other, more traditional performance measures such as return and risk. Although sustainability is not considered as a driver of returns, there is evidence that it mitigates investments' risk, especially in the long term. Sustainable companies may produce lower returns, but they are less vulnerable to various market shocks. A sustainable investment process should seek balance between improving the sustainability metrics of portfolios and the impact on return and risk, which is what we explored in this research.

Rather than considering sustainability as a 'traditional' investment factor, we think of it as a screening overlay in investment strategies. Apart from improving sustainability metrics, by screening stocks for sustainability we preferentially leave aside more volatile stocks (due to a proven negative relationship between ESG metrics and a stock's volatility), and decrease portfolio risk. Furthermore, by assigning more weight to sectors that scored highly on ESG, we further decrease portfolio volatility as we tilt the portfolio towards relatively less volatile sectors.

These applications of ESG screening result in higher performance metrics, such as Information and Sharpe Ratios in the S&P 500 universe. In the STOXX 600 universe, the ESG scores are generally quite high (and higher than for companies in the US), so the incorporation of ESG does not improve the portfolio performance, but the strategies we suggested still have an acceptable tradeoff between improving ESG even further and potential loss of performance.

Ours is just one possible approach to incorporating ESG in factor investing strategies. Other variants are possible, depending on investment philosophy, sustainability goals or other considerations. We believe that, overall, incorporating sustainability considerations in your investment decisions does not have to lead to significantly inferior financial performance of your investment portfolios.

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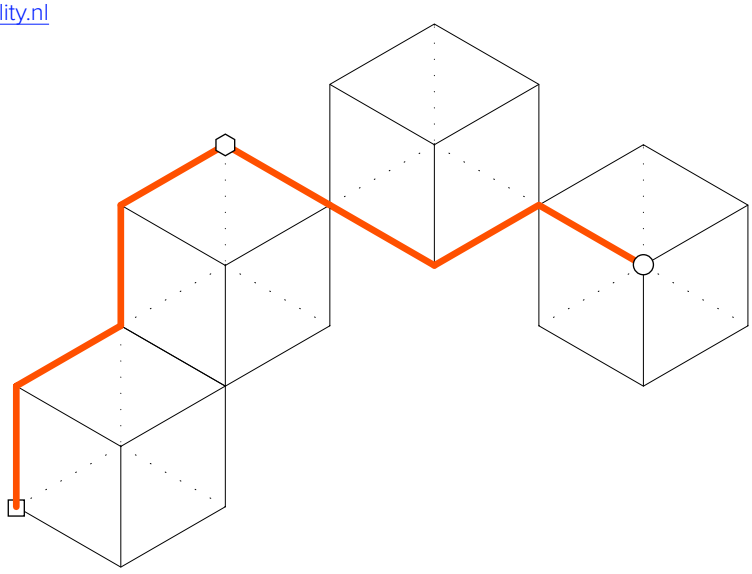

Appendix

Factor portfolios construction method

For factor portfolios that are formed at time (year or month) ***t***, we use the following variables to sort stocks:

- **Market return:** the market cap-weighted return of the index constituents using market cap at the end of December of lagged year ***t*** −1
- **Size:** the market cap at the end of December of year ***t*** −1
- **Value:** the book-to-price ratio is at the end of June of year ***t*** −1
- **Momentum:** the cumulative return from month ***t*** −12 to month ***t*** −2
- **Volatility:** the variance is calculated using 60 days of lagged daily returns
- **ESGC:** the combined ESG score is the last valid value in year ***t***-1, mostly in December

Factor portfolios

Every year, the independent 2×3 sorts on size and B/P to produce six value-weight portfolios: SG, SN, SV, BG, B, where S and B indicate small or big (bottom 10% and top 10% of market cap) and G, N and V indicate growth, neutral and value (bottom 30%, middle 40%, and top 30% of B/P).

- Size factor: SMB $= \frac{1}{3}(SG+SN+SV) - \frac{1}{3}(BG+BN+BV)$
- Value factor: HML $= \frac{1}{2}(SV-SG) + \frac{1}{2}(BV-BG)$

Every month, the independent 2×3 sorts on size and momentum to produce six value-weight portfolios: SL, SN, SW, BL, BN and BW, where S and B indicate small or big and L, N, and W indicate losers, neutral, and winners. The same breakpoint conventions and the size-B/P sorts are used here.

- Momentum factor: WML $= \frac{1}{2}(SW-SL) + \frac{1}{2}(BW-BL)$

Every month, the independent 2×3 sorts on size and volatility to produce six value-weight portfolios: SS, SN, SV, BS, BN and BV, where S and B indicate small or big and S, N, and V indicate stable, neutral, and volatile. Due to the fact that with unconditional breakpoints, the highest volatility quintiles are mostly micro-caps, and the mega-cap portfolios in the highest volatility quintiles are thin, sometimes empty (Fama & French, 2016), we set the breakpoints for volatility separately for big and small stocks. For big stocks, the breakpoints of volatile and stable are the upper 50% and bottom 20%, respectively. For small stocks, the breakpoints are the upper 80% for volatile and bottom 50% for stable.

- Volatility factor: SMV $= \frac{1}{2}(SS-SV) + \frac{1}{2}(BS-BV)$

Every year, the independent 2×3 sorts on size and ESGC to produce six value-weight portfolios: SL, SN, SS, BL, BN and BS where the first S and B indicate small or big and the second L, N and S indicate less-sustainable, neutral and sustainable (bottom 30%, middle 40%, and top 30% of ESGC score). Since the ESGC score is positively correlated to market cap, using unconditional breakpoints again leads to a problem that high ESGC-scored portfolios are mostly maga-caps, and low ESGC-scored portfolios are mostly micro-caps. Therefore, we set the breakpoints for size separately for sustainable and less-sustainable stocks. For sustainable stocks, the breakpoints of big and small are the upper 90% and the bottom 30%, respectively. For less-sustainable stocks, the breakpoints are upper 70% for big and bottom 20% for small.

- Sustainability factor: ESG $= \frac{1}{2}(SS-LS) + \frac{1}{2}(SB-LB)$

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