ESG AND STOCK RETURNS: THE CRITICAL ROLE OF ANALYSIS PARAMETERS

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Abstract: In the wake of increasing global emphasis on sustainability, understanding the financial implications of ESG performance has become crucial. This study aims to investigate the relationship between ESG performance and stock performance among STOXX Europe 600 companies from 2010 to 2022. Our baseline analysis finds no significant effect of ESG ratings on stock performance when controlling for the Five Fama-French Factors and Momentum. However, a meta-regression of 864 parameter combinations reveals substantial sensitivity to analysis parameters, with varying results favoring either "brown" or "green" companies. Using multiple linear regression analyses, we assess various parameters such as portfolio weighting, score calculation, and return lag. These findings highlight the need for more rigorous robustness tests and parameter comparisons in ESG performance studies.

***Keywords*:** ESG, SRI, financial performance, meta-regression

INTRODUCTION

Sustainable finance, particularly sustainable investing, has gained prominence over the past decade (GSIA, 2023). This growth is encouraging, given the substantial capital required to achieve international climate targets (IPCC, 2022; UNFCC, 2024). Nevertheless, current investment levels significantly lag behind estimates necessary to meet the 1.5°C or even 2°C goals of the Paris Agreement (IPCC, 2022). If society aims to meet these crucial climate objectives, it is imperative to mobilize significantly more capital towards sustainable companies and projects.

Investors cite various reasons for incorporating environmental, social, and governance (ESG) factors into their investment decisions, including moral considerations, client demand, and financial incentives (Amel-Zadeh and Serafeim, 2018; Krueger et al., 2020; Giglio et al., 2023). Among these, financial performance has emerged as a critical factor (Amel-Zadeh and Serafeim, 2018; Giglio et al., 2023). However, it remains uncertain whether more sustainable companies will indeed outperform others in the future. Therefore, this study aims to investigate the relationship between ESG and stock performance of European companies and explore the reasons behind varying results in existing studies.

Given the practitioners interest in this topic and the ongoing debate about whether it is beneficial for companies to engage in socially responsible behavior (e.g., Friedman, 1970; Moskowitz, 1972), researchers have sought to determine whether sustainability is good business and whether investing in companies with higher ESG efforts is financially rewarding. Despite extensive empirical literature, evidence remains inconclusive. While many studies suggest a positive relationship between ESG and financial performance (e.g., Eccles et al., 2011; Friede et al., 2015; Garvey et al., 2018; Huang, 2021; Pastor et al., 2022), others find no significant relationship (e.g., Görgen et al., 2020; Aswani et al., 2021) or even a negative relationship (e.g., Delmas et al., 2015; Bolton and Kacperzyk, 2021; Busch et al., 2022; Hsu et al., 2023).

From a theoretical perspective, most studies predict a negative relationship between ESG factors and stock performance in equilibrium (Pástor et al., 2021; Pedersen et al., 2021; Zerbib, 2022). The rationale for this premium varies across studies but generally includes higher risk, exclusion of "brown" companies, and a preference for "green" companies. However, some arguments in the literature support the potential for overperformance of more sustainable companies, particularly in the short term, due to mispricing of risks (Pedersen et al., 2021; Bolton and Kacperzyk, 2021) or short-term trends driven by stronger investor flows influenced by climate change news (Pástor et al., 2022)

Additionally, it is important to acknowledge that much existing research focuses on U.S. financial markets (von Wallis and Klein, 2015). The extent to which these findings generalize to other regions remains underexplored in comparison. Europe, in particular, is of significant interest due to the EU's legislative efforts towards sustainable finance. Beyond this regulatory perspective, geographic differences in market behavior, investor attitudes, and information availability may contribute to different ESG/stock-performance relationships. These factors, along with increasing climate-related catastrophes and regulatory and public pressure towards more sustainability, have the potential to influence these relationships.

In conclusion, we identify two critical avenues for further research. First, despite many studies investigating the relationship between ESG performance and stock performance, results remain inconclusive. Conditions are rapidly evolving, and certain regions remain underexplored. More studies focusing on diverse regions, up-to-date data, and rigorous documentation are needed to enhance comparability and reproducibility.

Second, greater effort is required to understand the underlying causes of varying study results. This includes investigating whether differences stem from methodological disparities such as parameter choices or variations in sample characteristics, such as companies analyzed, regional contexts, time periods, and data providers.

In this paper, we contribute to the sustainable finance literature by examining the relationship between ESG performance and stock performance for STOXX Europe 600 companies from 2010 to 2022 using multiple linear regression analysis. We repeat the analysis on the same sample with various parameter combinations, such as value and equally weighted portfolios, E, S, or G as individual factors, and different time frames. We then conduct a meta-regression on the results of over 800 regressions to explore the impact of different analysis parameters on the results**.**

Our baseline regression finds no significant effects of ESG ratings on stock performance in our European sample when controlling for the Five Fama-French Factors (FFFF) (Fama and French, 2015) and Momentum (Carhart, 1997). The meta-regression reveals that significant results can occur depending on the choice of analysis parameters, highlighting the need for robustness tests and p-value adjustments (Menkveld, 2024). Furthermore, we demonstrate that certain factors may lead to results favoring the overperformance of brown companies, while others favor the overperformance of more sustainable companies.

METHODOLOGY

We retrieve financial and ESG data from Refinitiv (now called LSEG). For our portfolio analysis, we use stock prices, market capitalization, ESG rating scores, the E, S, and G pillar scores, and the corresponding category weights that Refinitiv uses to calculate their industry-adjusted scores. Additionally, we download the monthly FFFF and Momentum factor loadings for Europe from Kenneth French's data library (Fama and French, 2015; Carhart, 1993). The Refinitiv sustainability scores range from 0 to 100, with 100 being the highest score. Similar to other data providers, Refinitiv assesses a company's sustainability performance relative to its industry peers for the environmental and social factors, and relative to its country's peers for the governance factor (Refinitiv, 2022). Since we are also interested in the effects of industry unadjusted scorings, we calculate the unadjusted pillar scores by following the approach of Pástor et al. (2022). After adapting their formula to the Refinitiv scoring system, the greenness *g* of company *i* at the end of month *t* is given by the following formula:

$$g_{it} = -\left(100 - score_{i,t}\right) * (weight\_score_i) - \bar{g}_t$$

Where $score_{i,t}$ is company *i*'s pillar rating for month *t* and $weight\_score_i$ the respective weighting calculated by summing the underlying categories' weights for each score and pillar (e.g., Emissions, Innovations and Resource Use for the environmental factor). $\bar{g}_t$ is the value-weighted mean of all companies' scores in month *t*, and thus g_i represents the relative greenness of a company to the market

portfolio's greenness (Pástor et al., 2022). Additionally, we create an "unadjusted" score that is equal to the score given by Refinitiv times one minus the respective pillar weight. It is thus very similar to the PST greenness score but is not relative to the market.

Loosely following the procedure of Pástor et al. (2022), we perform our baseline analysis by creating a zero-investment portfolio. We sort the companies by their PST greenness scores and select the top and bottom third for the "green" and "brown" portfolios, respectively. We then go long on the brown portfolio while shorting the green portfolio, resulting in our brown minus green portfolio (BMG). For the baseline analysis, we also choose the period from the beginning of 2010 to 2022 and set a return lag of one month. Using this configuration, we run regression analyses with the monthly returns of BMG as the dependent variable and different subsets of the FFFF and momentum factors as control variables. The coefficient of the intercept then represents the alpha of the BMG strategy.

Table 1. Analysis parameter specifications

Paramter	**Values**
Time period	2010-2022, 2010-2016, 2017-2022
Portfolio weighting	Value weighted, equally weighted
Portfolio fraction	1/3, 1/5, 1/10
Score calculation	PST, unadjusted, Refinitiv
Return lag in months	1, 6, 12, 18
ESG Factor	E, ESG, S, G

Other researchers might, however, choose different parameters when conducting a similar analysis (Menkveld, 2024), for example, they might opt for equally-weighted portfolios or only include the top and bottom 20% of companies. Therefore, in the second part of our analysis we repeat the regression for every combination of the different specifications of the analysis parameters that are shown in Table 1. By saving the results of each regression, we can then conduct a meta-regression on these results by one-hot encoding the parameter specifications of the underlying regressions and using their resulting alpha as the dependent variable. By examining the coefficients of this regression, we can determine the direction and statistical significance of changes in the different parameters on the observed overperformance of brown or green companies.

Kommentiert [MM1]: Add that we only use the results of the „best performing" regression, i.e. Fama French 4 Factors or something

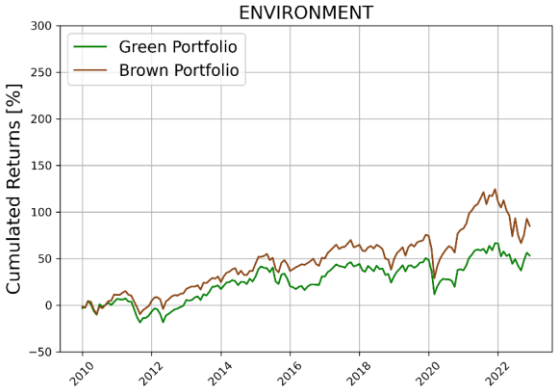

Figure 1. Cumulated returns of brown and green portfolio sorted by environmental greeness score.

FINDINGS

Creating the brown and green portfolios using the parameters of the baseline analysis results in the cumulative returns shown in Figure 1. This figure demonstrates that, for our sample and this specific configuration of analysis parameters, the brown portfolio outperformed the green portfolio over the period of 2010 to 2022. To investigate statistical significance and to control for known risk factors, we run our baseline regression on the same portfolio sorts. Table 2 shows an overperformance of 12.8 basis points (bps) per month for the BMG portfolio, however, the results indicate that this overperformance is not statistically significant. Moreover, when controlling for the FFFF and Momentum, the overperformance, although still statistically insignificant, reverses, showing a higher return for the green portfolio of 12.0 bps per month. This finding already suggests that even when using the same data, the results of analyses can vary substantially based on the setup of the analysis.

In the second part of our study, we further investigate this phenomenon. By combining each of the parameter specifications from Table 1, we generate 864 possible combinations, for which we run separate regressions. Given that the regressions using the FFFF and Momentum as control variables delivered the highest adjusted R^2 on average, we use this regression model for the analysis of different parameter combinations.

The results show that out of the 864 regressions 84 return a statistically significant alpha at the 5% level. Of those, 30 indicate a positive overperformance for the brown portfolio, ranging between 21.5 bps and 60.8 bps per month, while 54 attest a green overperformance, ranging between 21.4 bps and 69.0 bps per month. This again underscores the significant impact that different choices of analysis parameters can have on analysis results.

Dependent variable: BMG

	(1)	(2)	(3)	(4)	(5)	(6)
const	0.128	0.116	-0.027	0.007	-0.161	-0.120
	(0.156)	(0.158)	(0.122)	(0.132)	(0.116)	(0.125)
mkt-rf		0.023	0.089***	0.082***	0.094***	0.088***
		(0.036)	(0.030)	(0.029)	(0.028)	(0.028)
smb			0.316***	0.316***	0.350***	0.354***
			(0.075)	(0.075)	(0.064)	(0.064)
hml			-0.396***	-0.414***	-0.217***	-0.253***
			(0.049)	(0.060)	(0.074)	(0.084)
wml				-0.038		-0.046
				(0.047)		(0.044)
rmw					0.459***	0.457***
					(0.117)	(0.119)
cma					0.088	0.120
					(0.128)	(0.131)
Observations	156	156	156	156	156	156
Adjusted R^2	0.000	-0.003	0.404	0.402	0.452	0.452
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 2. Regression results baseline regression

By running a meta regression on the results of the 864 single regressions, using their alphas as the new dependent variable and the one-hot encoded analysis parameter specifications as independent variables, we can also observe which parameters tend to influence the results in either direction. This regression yields an adjusted R^2 of 0.53. Compared to the baseline regression, only the specification of the greenness score (i.e., unadjusted, Refinitiv) and the 12-month lag have no statistically significant coefficients. Parameters with a positive coefficient, which lead to higher returns for the BMG portfolio, include ESG factors (i.e., ESG, G, S), return lags (i.e., 6, 18 months), and the period (2017-2022). Conversely, smaller portfolio fractions (i.e., 0.1, 0.2), equally weighted portfolios, and an earlier period (2010-2016) have negative coefficients, generally leading to higher returns for the green portfolios.

CONCLUSIONS

In this study, we investigate the relationship between ESG performance and stock performance among STOXX Europe 600 companies from 2010 to 2022. Our baseline analysis finds no significant relationship between ESG ratings and stock performance when controlling for the five Fama-French factors and Momentum. However, a meta-regression of 864 parameter combinations reveals that results are highly sensitive to the chosen parameters, indicating that ESG performance can impact stock performance differently based on the analytical approach.

This study is limited to European companies and the period studied, which included varying market conditions and regulatory environments. Additionally, we only tested a subset of possible parameters, which may vary between different studies and only used linear models. These findings highlight the necessity for robust methodological approaches and caution in interpreting ESG performance studies.

The sensitivity to parameters suggests that studies should incorporate a range of scenarios to accurately capture ESG impacts on financial performance. Practically, investors and policymakers should ensure that investment strategies based on ESG criteria are rigorously tested across multiple settings. Future research could expand this study by investigating other parameters, such as different regions and ESG data providers, or by examining the influence of regulatory changes and market dynamics on the ESG/stock performance relationship.

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