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ESG SCORES AND STOCK RETURNS: EMPIRICAL EVIDENCE FROM THE EUROPEAN EQUITY MARKET

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ESG scores and stock returns:

Empirical evidence from the European equity market

Abstract

In this thesis, I aim to provide an empirical analysis of the relationship between ESG ratings by MSCI and stock returns of companies listed within the EU. I analyze over 1200 stocks covering approximately 80% of the EU market capitalization in 2023. I use a large number of control variables to account for other known characteristics that influence stock price. I find evidence that supports some of the empirical literature on the subject, even though the views between scholars are split and not homogeneous. Overall, my analysis suggests that ESG scores, in the period from 2018 to 2024, are not related to stock returns, in fact, they exhibit an extremely small negative correlation not statistically significant.

1. INTRODUCTION

Recent times have seen a remarkable growth in "Environmental, Social and Governance" (ESG) investing, currently measuring just under 20% of all global assets under management and forecasted to reach 21.5% (or 33.6 trillion USD) by 2026[1], growing at a higher CAGR than that of the wider industry.

The ESG investing sector experienced this strong growth due to increasing ESG concerns[2] and the consequent shift in investors' tastes. In fact, according to Starks (2023) and Pastor (2020), investors derive non-pecuniary payoffs by holding 'green' firms, and at the same time hedge against climate risk, thus leading to increased investments in 'green' firms. Moreover, a significant part of investors, circa 70%, according to Morgan Stanley's 2024 'Sustainable Signals' Report, believe that firms with strong ESG performance can lead to higher returns in the future. This trend, of course, is followed by individual investors and institutional investors who increase the share of their green investments every year to accommodate customers' demands. According to PwC's 2022 'wealth and asset management study', 86% of institutional investors would consider stopping investments with an asset manager due to shortcomings on their ESG promises.

Given the magnitude of this phenomenon, it is imperative to understand the underlying relationship between ESG scores, the most widely used measure of 'sustainability' by investors, and stock returns. Understanding this is key, especially given the fiduciary duties of asset owners and managers to act in the best interest of their beneficiaries[3].

In my analysis, I aim to empirically test the relationship between ESG scores and stock returns, to see if there is a correlation between the two. I use a large dataset made

[1] PwC Asset and wealth management revolution, 2022

[2] Ardia, D., Bluteau, K., Boudt, K., Inghelbrecht, K. (2023). Climate change concerns and the performance of green versus brown stocks. Management Science.

[3] In the US a recent department of Labour a proposal regarding the use of ESG risk factors in Employee Retirement Incomes Security Act accounts (ERISA, 1974) is consistent with this view of a conflict. The new proposal states that "private employer-sponsored retirement plans are not vehicles for furthering social goals or policy objectives that are not in the financial interest of the plan.

up of over 1200 firms, and their respective monthly returns, control variables, and ESG scores. The database covers the period from 2018 to 2024 and includes only companies listed on stock exchanges within the EU, and it accounted for about 80% of the total EU market capitalization in 2023.

While the relationship between the two has been studied by many researchers for many years, a uniform consensus on the effect of ESG scores on stock returns has not been reached. As we will see later, many studies come to clashing conclusions, and others highlight the importance of external factors, such as temporal dynamics, geographic region, and climate concern, in determining the effects of ESG investing. That's why I focus my analysis on a smaller geographic region (EU) and a shorter time frame, to test the relationship in a more controlled space, hoping to obtain clearer results and to see the results in current times.

In a first step of my analysis, I inspect the 'plain' relationship of ESG scores and stock returns, by running monthly cross-sectional Fama-MacBeth regressions on the whole database. I do this to check the overall relation in recent years. In a second step, I also conduct the same analysis on two subsamples, one pre-2023 and the other post-2023. I do this, following the model of *Pastor et al (2020)* to account for increases in climate concerns as per the MCCC index[4]. While this analysis yields statistically significant results on the post-2023 sample, the number of observations remains too small, and the statistical significance can be due to trend picking of the regression.

Overall, I find a small positive but statistically insignificant coefficient between the two variables, which once again shows the complexity of the relationship, especially when accounting for a large number of control variables. While, according to Morgan Stanley (2024), 70% of investors believe companies with high ESG scores will lead to higher stock returns, my results don't support this argument and don't find a significant correlation between ESG scores and future stock returns. However, the findings should still be comforting because they show that it's possible to "*do good*

[4] Ardia, D., Bluteau, K., Boudt, K., Inghelbrecht, K. (2023). Climate change concerns and the performance of green versus brown stocks. Management Science.

while doing good", or in other words, to not sacrifice financial performance while also fostering positive externalities by supporting greener firms.

Finally, my analysis doesn't rule out that there may be more subtle empirical patterns that this study doesn't uncover. In fact, the relationship between ESG scores (or ESG factors more in general) and returns could exist for more specific ESG metrics or maybe in even more defined geographical regions (such as at the national level). However, it highlights the complex and time shifting characteristics of this relationship, especially when we compare results with other recent studies that come to clashing conclusions.

The remainder of the paper is structured as follows: Section 2 presents the literature review; Section 3 describes the dataset used in the analysis; Section 4 outlines the methodology; Section 5 reports the empirical results; Section 6 discusses these findings in light of relevant theory; and Section 7 concludes.

2. LITERATURE REVIEW

In this section, I'll review the current state of the art in research on this topic, focusing especially on the latest findings. Being aware of recent trends and developments regarding the topic is important to understand how my analysis fits in the current literature and on which theoretical principles it's based on.

2.1 ESG INVESTING AND RETURNS

A prominent body of literature explores the mechanisms through which ESG scores, or more broadly ESG awareness, can influence firms, their stock prices, and the expected returns priced by the market. Understanding these mechanisms is fundamental for identifying the conditions under which ESG may or may not have a financial impact on equity markets.

In *Pastor et al.* (2020), the authors develop an equilibrium model in which investors have heterogeneous ESG preferences, which influence their propensity to hold certain

stocks with certain ESG characteristics. If ESG tastes were uniform, all investors would hold the same portfolio, the market portfolio. Instead, some investors are willing to pay a premium for 'green' stocks, even if it means accepting lower financial returns, because they derive non-pecuniary utility from aligning their portfolios with their social values (as described in the work of Pedersen et al 2021). This results in higher market valuations and lower costs of capital for green firms, a phenomenon the authors refer to as the "greenium"[5]. In their framework, this preference-driven investment strategy yields satisfactory outcomes for ESG-oriented investors, who vary in their strength of ESG conviction but all desire positive social impact, through two key transmission channels. First, firms are incentivized to become greener, as greener firms enjoy higher valuations. Second, investment flows shift from brown to green firms because of differences in cost of capital, which is rising for brown firms and falling for green ones. Consequently, green investment not only leads to social impact but also alters financial decision-making within firms, even in the absence of direct shareholder pressure, since managers aim to maximize firm value.

In a subsequent extension of their work (Pastor et al 2025), the same authors recognize that ESG preferences lie on a spectrum. They introduce the concept of *non-consequentialist investors*, those who do not necessarily aim to influence real-world outcomes but instead seek alignment with their ethical principles. These investors differ from those described in their previous paper because they do not seek real social impact, nonetheless, they can still influence financial markets through mechanisms like divestment from brown firms, which, although limited in effect, still increases the cost of capital for those firms since the market demands to pay less for those firms now. Thus, even passive ethical preferences can have measurable consequences in equilibrium.

Starks (2023) explores these concepts in a similar way but offers a different classification and interpretation of investor behavior. She distinguishes between two types of ESG investors: those driven by "*value*" and those driven by "*values*". Value-oriented investors are financially motivated and use ESG data as a signal of risk or

[5] In particular, the 'Greenium' refers to the amount by which the expected yield on the green instrument is lower than that of the conventional, or brown, instrument.

performance, expecting to obtain risk-adjusted returns at least equal to the market. These investors may view ESG information as a way to enhance their portfolios by identifying firms with better governance, management, risk control, or sustainability practices. On the other hand, values-driven investors aim to generate a positive social or environmental impact through their investment decisions. These investors engage in screening mechanisms, which can be either *positive screening* (including firms with desirable ESG characteristics) or *negative screening* (excluding companies with low ESG scores or negative social impact). While Starks outlines some convincing mechanisms behind ESG investing and more in particular demand for high ESG score firms, she remains agnostic on whether ESG strategies lead to higher or lower expected returns. She cites a range of studies with conflicting findings and suggests that this divergence often stems from differences in assumptions and objectives between *value* and *values*-based frameworks. From a *values* perspective- as highlighted in the work of Geczy, Stambaugh, and Levin (2021) - ESG investing can be viewed as a constrained optimization problem, thus, ESG portfolios cannot be expected to outperform traditional ones and, on the contrary, must have lower expected returns. From a value perspective, however, ESG scores may lead to better risk-adjusted outcomes through improved downside protection (like in the work of Hoepner et al. (2022)) or enhanced long-term profitability driven by reputational strength and increased consumer demand for product and services coming from greener firms (See Albuquerque et al. (2019)).

Another important paper, *Pedersen et al.* (2021), contributes to the debate by integrating both views into a unified equilibrium asset pricing model. In their framework, ESG affects asset prices through two central channels: the demand channel and the profitability channel. The demand channel arises from investors' ESG preferences, which increases their demand for high ESG scores companies and pushes up prices for their stocks, thereby lowering their expected returns, a mechanism that, as we will see, is also described by *Pastor et al.* (2022). The profitability channel, on the other hand, reflects the belief that high ESG scores are correlated with higher future profitability, either due to superior management quality, better risk controls, or increased consumer demand for sustainable goods and services. The overall effect of ESG on returns depends on the relative strength of these two forces. While the authors

do not explicitly quantify the magnitude of each channel, they expect the demand effect to dominate in equilibrium, resulting in lower expected returns for ESG assets overall. As we can see, this model reconciles the findings of pastor et al. (2020) and Starks (2023), creating an equilibrium model in which the mechanisms described in both papers coexist and the final outcome depends on the relative strength of both.

As we will see later, *Darolles et al.* (2024) build on this theoretical foundation and attempt to empirically disentangle these two channels using mediation theory. Their study emphasizes the dynamic and time-varying nature of the ESG-return relationship, driven by shifts in investor sentiment and macroeconomic trends that affect the relative dominance of the demand and profitability mechanisms.

The key insight from this section is that the relationship between ESG scores and stock returns is not straightforward. It is shaped by a complex interplay between investor preferences and firm fundamentals, with ESG awareness influencing the pricing process through demand-based and profitability-based channels. The net effect depends on the strength and direction of these forces which in turn depend on a number of external factors (such as geography and time, as highlighted by Karyoli et al, 2023) which we will explore more in detail in the next section.

2.2 MAIN EMPIRICAL STUDIES

When we shift from theoretical models to empirical evidence, the relationship between ESG scores and stock returns becomes even more ambiguous, as highlighted in the work of Williams and Apollonio (2024). There is no clear consensus in the literature, in fact, some studies report a positive correlation, others negative, and many find no statistically significant relationship at all (see Berg et al (2023), Krueger et al (2024) and Darolles et al (2024)). This inconsistency is often attributed to a number of external factors such as region, time period, methodology, and investor sentiment. Moreover, as noted by *Starks* (2023), cognitive biases may also shape how researchers and investors interpret evidence, reinforcing preconceived beliefs (Nickerson, 1998).

A number of empirical studies have found positive associations between ESG scores and realized returns, seemingly in contrast with theories that suggest ESG stocks

should offer lower expected returns. For instance, *Krueger, Alves, and Van Dijk* (2020) use Fama-MacBeth regressions on a global stock sample and apply a robust set of control variables, including both firm-level financial factors and country-level institutional and political variables. Despite this detailed approach, they find no strong or consistent relationship between ESG scores and stock returns, highlighting how once we control in a robust manner for both firm-level (all the main financial factors known to influence stock prices according to relevant financial literature) and external factors, the relationship tends to disappear. Their results remain insignificant even after conducting analysis on smaller subsamples based on temporal period and geographical location, reinforcing the conclusion that the ESG-return link is weak or unstable when controlling for broader market dynamics.

Similarly, *Aswani, Raghunandan, and Rajgopal* (2023) challenge prior claims of carbon efficient firms outperformance described in other studies (like Monk et al, 2017), by carefully analyzing firm-reported emissions data (not data provided by third-parties), adjusting for firm size and properly scaling emission metrics. Once these methodological precautions are applied, the previously observed outperformance of green stocks disappears, and the relationship between carbon intensity and returns becomes statistically insignificant. Their study emphasizes the importance of using clean, consistent data and controlling for confounding firm characteristics to avoid overstating ESG-related effects.

Finally, *Darolles et al.* (2024) conduct an innovative study by applying mediation theory to disentangle the effect of ESG on returns into two channels, mirroring the theoretical model of *Pedersen et al.* (2021). In their two-step analysis they aim to decompose the effects of the direct (*profitability*) and indirect (*demand*) channels using a large sample of U.S. stocks. In the first step, they find that ESG scores have a negative and statistically significant impact on returns. In the second step, they attempt to determine whether this effect is driven by profitability or demand trough mediation theory[6]. The results suggest that the direct profitability channel is generally

[6] Darolles et al. (2024) use a single mediator approach, where the direct channel is captured trough the effect of ESG on future profitability. Since only one mediator is used, the residual effect (the difference between the total and the direct effect) is attributed to the indirect effect.

weak and often statistically insignificant, except for the environmental (E) component, which shows a modest and statistically relevant negative association with future stock returns. Conversely, the indirect demand channel consistently exerts a negative and statistically significant effect on stock returns, implying that investor preferences, rather than superior firm performance, are the primary driver behind ESG pricing effects. Moreover, they also find that the overall impact of ESG scores on stock returns are negative and significant, in accordance with the more theoretical model of *Pedersen et al (2020).*

At the same time, other studies present compelling evidence for a positive link between ESG scores and returns. *Park and Monk* (2017), for example, examine carbon efficiency, a key environmental measure, and find that firms with lower emissions tend to outperform. Although their analysis centers on environmental metrics, the E component of ESG scores is often the most influential, and their findings are highly relevant for ESG investing more broadly[7]. Using Fama-French factor models and constructing long-short portfolios (based on an "EMI" factor: efficient minus inefficient), they show that carbon-efficient firms consistently earn higher returns and generate alpha unexplained by other factors.

Berg et al. (2023) take a different approach by addressing the issue of ESG rating divergence, which was largely discussed in a previous paper of the same author (Berg et al, 2022). They aggregate scores from six major providers using advanced techniques such as Principal Component Analysis (PCA), Mahalanobis Distance, and Voting Averages to reduce noise and improve signal quality. Once these composite scores are used to sort firms into deciles and construct long-short portfolios, they observe both a positive correlation between ESG scores and returns at the cross sectional level, as well as statistically significant alpha generation under Fama-French 5 factors model, suggesting that noise reduction improves the signaling quality of ESG scores and that by constructing the ESG scores in this way, we obtain higher returns not explained by the other known factors in the financial literature.

[7] According to Blackrock, Global Client Sustainable Investing Survey, 2020, the 'E' factor in ESG is often considered the predominant and most impactful one.

Similarly, *Bekaert et al.* (2023) test the alpha-generation capability of ESG portfolios using Fama-French models. They find that ESG portfolios do indeed generate higher returns, however, the authors also find that this outperformance does not necessarily align with broader sustainability metrics such as the UN's Sustainable Development Goals (SDGs), suggesting that not all ESG ratings capture meaningful real-world impact and that thus ESG investing is not always as impactful as we hope.

Some studies aim to reconcile the apparent contradiction between theory and empirical findings, giving explanations for the apparent inconsistencies between different studies. *Pástor, Stambaugh, and Taylor* (2022) find a significant outperformance and alpha generation of green portfolios over brown ones in recent years. In accordance with their previously developed theory (Pastor et al, 2020), they provide a critical empirical contribution by showing that the strong cumulative returns of green portfolios observed in recent years can be explained entirely by unexpected increases in climate concern (or positive climate shocks), as measured by the MCCC (Media Climate Change Concern) Index[8]. When a factor capturing ESG-related sentiment shocks is included in the regression, the alpha generated by green portfolios disappears. Moreover, the authors argue that it is not uncommon in asset pricing for stocks with low expected returns to deliver high realized returns over a period of time, particularly when those returns are driven by unanticipated sentiment shifts. Therefore, the high performance of green stocks during the sample period does not imply that they had higher expected returns, but on the other hand, it aligns with the theory that green assets carry lower expected returns**.**

Similarly, *Karoly et al.* (2023) investigates the time and region dependence of ESG returns. In their model, they construct a Green Minus Brown (GMB) factor and find that ESG outperformance was pronounced before 2021 but has since reversed in many markets. Their results show that ESG premiums are highly sensitive to macroeconomic context and investor sentiment. Interestingly, while the 'greenium' has faded globally, the U.S. and Japan remain exceptions, highlighting the importance of political and institutional factors in ESG pricing. *Darolles et al.* (2024) reinforce

[8] Ardia, D., Bluteau, K., Boudt, K., Inghelbrecht, K. (2023). Climate change concerns and the performance of green versus brown stocks. Management Science.

this view by showing that the relationship between ESG scores and returns is not stable over time, reflecting the changing balance between the demand and profitability channels.

2.3 OTHER INFLUENCE FACTORS FOR THE RELATIONSHIP

In this last section, I'll briefly introduce some factors that have been discussed in the literature as causes of noise in ESG investing. The first factor is the divergence and lack of uniformity amongst ESG ratings and its providers, according to Berg et al (2022) this divergence is mainly due to three factors: measurement divergence, scope and weight[9]. According to the authors this divergence causes investors to be less confident in the actual ESG performance of a firm and thus creates noise in ESG signals.

In another important paper, Starks (2023), discusses the lack of standardization of ESG definitions and how different investors and researchers interpret the concept of ESG investing differently. In her own words, *"the terminology related to sustainable finance is a central issue—what terms should be used to describe these types of approaches to manager or investor decision making? Some people prefer sustainability, while others prefer responsible investing, ESG, or CSR, yet, there is no clear understanding of how these terms differ or even what a given term means. For example, the term "sustainability" has a variety of meanings depending on the context. To some, the term's principal focus corresponds to the environment. To others, the term refers to the broader idea of sustainability for people, planet, and profit. To still others, the term's meaning encompasses not only people and planet, but also prosperity, peace, and partnerships."(Starks, 2023, Presidential Edition p.1838).* This leads to confusion both for the investors who aren't sure what green portfolios actually are and how they're built, and for researchers who use different screening mechanisms when constructing portfolios and testing the relationship between ESG scores and returns.

[9] From Berg et al (2022). Measurement divergence relates to how raters measure differently the same attributes, accounting for 56% of total discrepancy. Scope divergence relates to the different aspects raters include when building the score for a ESG category (38% of discrepancy). Finally weighting divergence relates to differences in how impactful is one of the three pillar scores within a firm (6% of discrepancy).

Finally, a large group of papers discusses the importance of geographical location (Iannone et al, 2025) and timing (Jacob et al, 2025) when testing the relationship, highlighting the complex nature of capturing the actual effects of ESG scores.

2.4 EMPIRICAL HYPOTHESIS

Based on the reviewed literature and the aim of this study to test the relationship between ESG scores (and related metrics) and stock returns I expect to find a very small and potentially insignificant relationship between the two. In fact, while some of the more theoretical studies expect a negative relationship between the two, other more empirical studies come to clashing conclusions, finding that companies with high ESG scores earn higher, lower or even unrelated returns, moreover, other studies explain the influence of external factors such as climate concerns and geographic region on the relationship. Given these contrasting findings therefore, I don't expect to find a clear and stable relationship. On the other hand, when I take into account external factors in the analysis, like when accounting for shifts in overall climate concerns, I expect the relationship to change and yield different results.

3. DATA

The analysis was performed using a database that contains monthly stock returns, ESG scores and related variables, and accounting control variables covering the period from 2018 to 2024. The data was obtained from Compustat Global, MSCI, and ORBIS. The database is made up of over 1200 companies, all listed on stock exchanges within the European Union, and as of December 2023, they covered about 80% of the total EU stock markets' capitalization. I obtained ESG overall scores, industry adjusted scores and ESG pillar scores[10] with their relative weights from MSCI, which has a broad coverage and is often used in academic work, thanks to its reliability and robust construction (See Berg, Kölbel, and Rigobon (2022)). The ESG scores were also used to compute ESG momentum, which is used in one of the

[10] ESG overall scores are constructed by summing the weighted pillar scores for each of the three ESG categories. Moreover, I also obtained ESG industry adjusted scores which account for the firm's relative performance within its industry.

specifications of the analysis. I then obtained yearly accounting variables and monthly stock prices from Compustat Global, moreover, I obtained data regarding market capitalization, Beta, and Volatility from ORBIS. Finally, I also obtained data regarding climate concerns from the MCCC index.

The three sub-datasets were joined based on ISIN codes and lagged accordingly to the periodicity of the control variables and ESG scores. The control variables included: market capitalization, book to market ratio, profitability, leverage, momentum, tangibility, investment, research and development expenses, volatility and market beta[11] (In accordance with: *Hou, Kho, and Karolyi 2011, Fama and French 2015, Bolton and Kacperczyk 2021*). I matched stock return data between January and December of year t + 1 to accounting data and control variables from year t. The whole database was winsorized at the 99% and 1% levels based on the whole sample distribution, in accordance with Kreuger, Alvarez and Van Dijk (2024). The final database contains 45140 stock-month observations which are all used in the baseline specification of the Fama-Macbeth regression analysis.

The dataset contains companies from all over the EU, and figure 1A in the appendix shows how stocks are distributed amongst European countries. The highest concentration of stocks is in Germany (31% of observations), followed by France (14,5%), Sweden (14,3%) and Italy (6,5%).

In order to check for proper construction of variables and absence of extreme observations, summary statistics have been computed and manually analyzed (see appendix A table 1A for summary statistics on the database). It's also important to note that the distribution of scores changes significantly between the industry adjusted scores and the raw overall scores, check figure 2A in appendix B.

All in all, the dataset used in the analysis has a solid number of stock month observations and covers a significant part of the European Union's total market capitalization. The extensive set of control variables used ensures that the relationship between ESG metrics and returns is pure and not influenced by other known price-moving factors in the financial literature.

[11] For full explanation on variables construction see appendix E Table 5A.

4. METHODOLOGY

This section outlines the empirical framework used to analyze the relationship between ESG scores and stock returns. I describe the implementation of the Fama-MacBeth regression approach, explain how the statistical analysis is conducted, and present the two main model specifications used in the study to ensure robustness and capture potential time-dependent effects.

4.1 REGRESSION MODEL

To assess the relationship between ESG performance and stock returns, I apply the Fama-MacBeth two-step regression methodology (Fama & MacBeth, 1973), which is widely used in empirical asset pricing to study the cross-section of expected returns. This method is particularly useful when working with panel data, as it allows estimation of time-averaged relationships while correcting for autocorrelation in the resulting coefficient series.

In the first step, I estimate a cross-sectional regression for each month *t* across all the firms, of the form:

$$R_{\{i,t\}} = \alpha_{\{t\}} + \beta_{\{1,t\}} \cdot ESG_{\{i,t-1\}} + \sum_{\{k=2\}}^{\{K\}\beta_{\{k,t\}}} \beta_{k,t} \cdot X_{\{i,t-1\}}^{\{(k)\}} + \varepsilon_{\{i,t\}}$$

Where $R_{i,t}$ is the return of firm *i* in month *t*, $ESG_{i,1-t}$ is the ESG score or related measure for the firm in the previous month, and $X_{\{i,t-1\}}^{\{(k)\}}$ denotes a set of control variables such as market capitalization, book-to-market ratio, profitability, leverage, momentum, and others. This step is repeated for every month in the sample across all companies, yielding a time series of estimated coefficients for each explanatory variable.

In the second step, I compute the average coefficient over time for each variable, in order to obtain the overall coefficients for each of the explanatory variables. These coefficients represent the overall relationship between the specific variable and the stock's returns, ensuring that the relationship is valid over the whole sample period and not just in parts of it. The average of the coefficients is calculated with the following formula:

$$\overline{\{\beta\}}_k = \left(\frac{1}{T}\right) \cdot \sum_{\{t=1\}}^{\{T\}\beta} \beta_t$$

To assess statistical significance, I calculate Newey-West adjusted standard errors (Newey & West, 1987), which correct for both heteroskedasticity and autocorrelation in the time series of monthly coefficients. The lag length for the correction is set following the standard rule:

$$L = \left(4 \cdot \left(\frac{T}{100}\right)^{\frac{2}{9}} \right)$$

This adjustment is needed in cross sectional analysis due to the high possibility of autocorrelation being present because of temporal effects, to obtain more accurate t-statistics and to avoid overstating the significance of a coefficient.

4.2 MODEL SPECIFICATIONS

The empirical analysis is structured around two main specifications. The first specification uses the full dataset covering the 2018–2024 period and is intended to assess the baseline relationship between ESG scores and stock returns, this approach is in line with Krueger et al. (2020)[12] and follows their methodology closely. I estimate

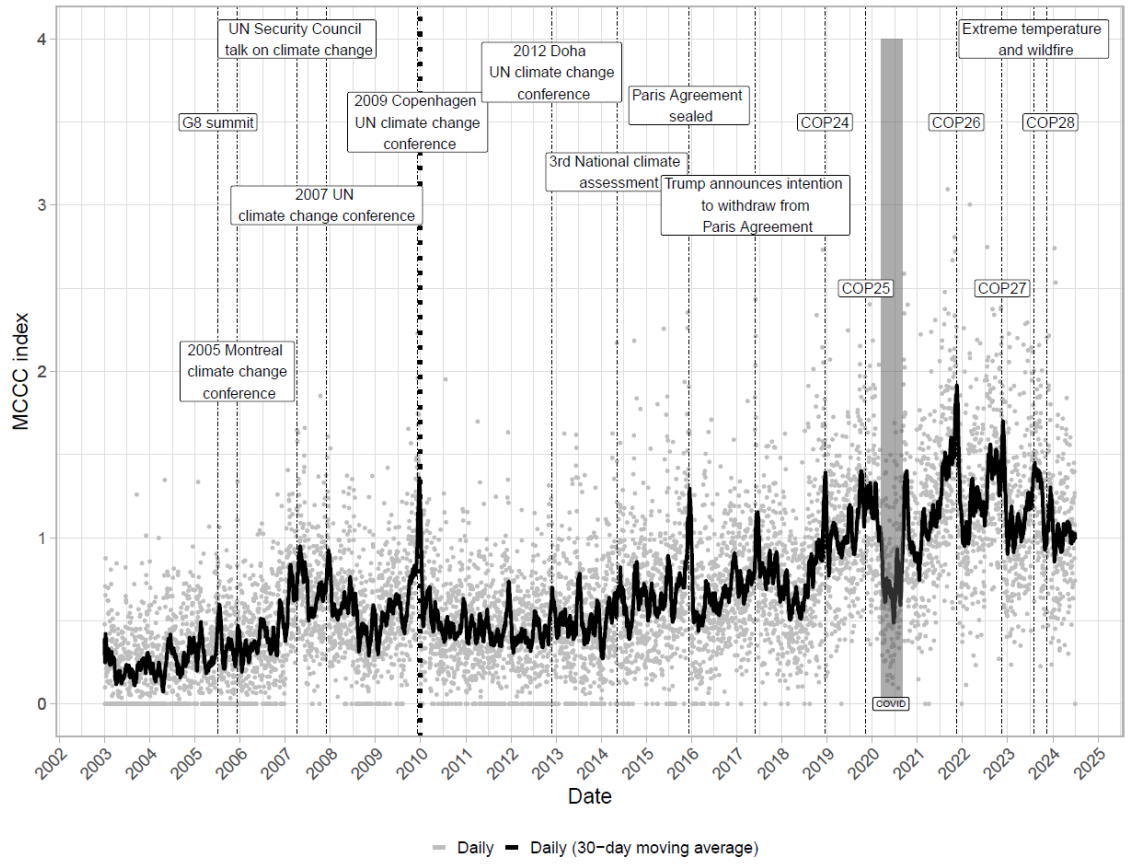
[12] Like in the Krueger et al (2024) paper the analysis is performed with pure ESG scores or related metrics, without taking into account growing climate concerns.

the Fama-MacBeth regressions three times using alternative ESG proxies: the firm's raw ESG score, the industry-adjusted ESG score and an ESG momentum (which in the study is considered a standalone specification given the smaller size of the subsample) measure that captures recent improvements in ESG performance. This multi-variable design helps ensure that results are not driven by the choice of ESG input and that the results are robust across different ESG measures.

The **s**econd specification introduces a time-based split, closer to the work of Pastor et al. (2020, 2022), who show that climate concern shocks can affect the relative valuation of green and brown firms. Using the MCCC Index (See Fig. 2 below) as a proxy for public climate concern, I divide the sample into two periods: one characterized by rising concern (pre-2023) and one by stable or declining concern (post-2023). Running regressions separately on each subsample allows me to test whether the ESG-return relationship shifts in response to changes in investor sentiment and test the relationship in two subperiods characterized by different climate concern trends.

Fig 1. MCCC index

The figure reports the growth and decline of climate concerns over the period from 2002 to 2024, showing the increasing concerns from 2018 to 2023 and the decline afterwards. The figure is retrieved from "Ardia, D., Bluteau, K., Boudt, K., Inghelbrecht, K. (2023). Climate change concerns the performance of green versus brown stocks. Management Science. MCCC Index 2025."



5. EMPIRICAL RESULTS

This section presents the results of the empirical analysis conducted using the Fama-MacBeth regression framework. The primary objective is to evaluate the relationship between ESG scores (and related variables) and stock returns, while controlling for a comprehensive set of financial characteristics. The section is structured in two parts: first, I present the main results from the baseline regression using the full dataset; second, I briefly summarize the results from additional model specifications designed to test the relationship under different assumptions.

5.1 MAIN REGRESSION RESULTS

The baseline analysis examines the relationship between ESG scores and stock returns across a sample of 45,140 firm-month observations. As discussed in the methodology, I use monthly cross-sectional regressions where the dependent variable is stock returns, and the explanatory variables include an ESG metric along with a full set of control variables. To account for differences in how ESG performance is measured, I estimate two versions of the model, one using the industry-adjusted ESG scores and the other using raw overall ESG scores.

While the results differ slightly between the two specifications, the overall meaning and interpretation remain the same. In the first regression using the industry-adjusted scores[13], I find a small negative coefficient (-0.0004), which is statistically insignificant. Moreover, the coefficients on a number of control variables are statistically insignificant, these include: momentum, volatility, investment, profitability, tangibility, and beta. This may be due to firm-specific noise, reduced power from the relatively short time horizon, or a broader issue of factor decay observed in recent asset pricing literature. On the other hand, several control variables show statistically significant results, including market capitalization, book-to-market

[13] Industry adjusted scores are computed, directly by MSCI, by adjusting the overall scores based on a firm's relative position and ESG performance within its group of peers or industry group.

ratio, leverage, and R&D expenses, possibly highlighting that during the sample periods these were better predictors of returns.

In the second regression, using the overall weighted ESG scores[14], the results are similar. I find a slightly larger negative coefficient (0.0008), which remains statistically insignificant. Again, the same control variables are statistically insignificant, while market cap, book-to-market, leverage, and R&D remain statistically significant.

Overall, these results suggest that there is no meaningful or relevant relationship between ESG scores, either industry-adjusted or raw, and stock returns for firms in the European Union over the 2018–2024 period. It's also important to mention that the R^2 of both regressions is relatively low (around 9%), but this is typical for cross-sectional asset pricing models, where a large proportion of return variation remains unexplained due to firm-level idiosyncrasies or broader market noise. The objective here is not to maximize explanatory power, but rather to test the significance of ESG variables after controlling for known return predictors. The results are shown in the following Table 1 and Table 2 for the industry-adjusted and raw ESG scores, respectively:

[14] Raw overall scores are obtained directly by MSCI, simply by calculating the weighted average of the three pillar scores based on how impactful they are within that company.

Table 1: Fama-MacBeth Regression - Industry-Adjusted ESG Score

Table 1. Shows the results of the Fama-MacBeth regression using Industry adjusted scores as the ESG variable. Data is retrieved from 'Compustat Global', 'MSCI' and 'Orbis', the sample period goes from 2018 to 2024. Coefficients marked with '*', '**' and '***' are significant respectively at the 0.10, 0.05 and 0.01 levels of p-values.

Variable	Coefficient	NW Std. Error	t-Statistic	p-Value
Intercept	-0.0084	0.0083	-1.0135	0.3148
ESG adj. Score	-0.0004	0.0004	-0.9904	0.3259
Volatility	0.0194	0.0409	0.4738	0.6373
Momentum	0.0004	0.0026	0.1519	0.8797
Market Cap	0.0024***	0.0008	2.8514	0.0059
Book to Market	-0.0033***	0.0010	-3.2156	0.0021
Investment	0.7199	0.7629	0.9435	0.3491
Profitability (ROA)	0.0007	0.0060	0.1233	0.9023
Leverage	-0.0158**	0.0063	-2.5339	0.0139
Tangibility	-0.0020	0.0075	-0.2601	0.7957
R&D	-0.0464*	0.0250	-1.8522	0.0688
Beta	-0.0001	0.0053	-0.0136	0.9892
Average R^2	**0.0906**			
Observations	**45,140**			

Table 2: Fama-MacBeth Regression - Weighted Average ESG Score

Table 2. Shows the results of the Fama-MacBeth regression using Overall Industry scores as the ESG variable. Data is retrieved from 'Compustat Global', 'MSCI' and 'Orbis', the sample period goes from 2018 to 2024. Coefficients marked with '*', '**' and '***' are significant respectively at the 0.10, 0.05 and 0.01 levels of p-values

Variable	Coefficient	NW Std. Error	t-Statistic	p-Value
Intercept	-0.0067	0.0082	-0.8203	0.4153
ESG Overall Score	-0.0008	0.0010	-0.7798	0.4385
volatility	0.0203	0.0408	0.4984	0.6200
momentum	0.0001	0.0026	0.0574	0.9544
Market Cap	0.0024***	0.0008	2.7885	0.0071
Book to Market	-0.0034***	0.0010	-3.3396	0.0014
Investment	0.7131	0.7437	0.9588	0.3414
Profitability (ROA)	-0.0002	0.0059	-0.0395	0.9686
Leverage	-0.0161**	0.0064	-2.5126	0.0146
Tangibility	-0.0016	0.0076	-0.2093	0.8349
R&D	-0.0467*	0.0249	-1.8749	0.0656
Beta	-0.0001	0.0053	-0.0136	0.9892
Average R^2	**0.0911**			
Observations	**45,140**			

5.2 OTHER SPECIFICATIONS RESULTS

To explore whether the relationship between ESG scores and returns is influenced by recent ESG-related changes or by recent shifts in climate concerns sentiment, I conduct additional Fama-MacBeth regressions using alternative ESG proxies (ESG momentum) and subsamples (temporal division). While some of these models yield statistically significant coefficients, they are estimated on smaller datasets and should be interpreted with caution.

First, I test the relationship using ESG momentum, which is computed as the change in a firm's ESG score over a 12 months trailing window. This aims to capture whether improvements or deteriorations in ESG performance predict future returns. The results are similar to the baseline specification, the coefficient is positive (0.0008) but statistically insignificant. The control variables, once again, behave similarly to the baseline model. While this specification provides a slightly different perspective, the findings suggest that ESG upgrades do not lead to higher returns, nor do downgrades predict underperformance. It should also be noted that using momentum results in the loss of 12 months of data for each firm, leading to a significant drop in overall observations, which may reduce statistical reliability. Full results table available in appendix C table 2A.

Subsequently, another analysis was performed by dividing the dataset into pre-2023 and post-2023 subsamples to test for the impact of climate concern shocks, as proposed by Pastor et al. (2020, 2022). As explained in the methodology and later in the results discussion, the MCCC index shows that climate concern increased steadily up to 2023 and then remained stable or declined slightly after that. According to Pastor et al., in times of increasing climate concern, green stocks may outperform brown ones, driven by heightened investor preferences or shifts in risk perception.

In the pre-2023 subsample, a small positive relationship (0.000917) is observed between ESG scores and returns, however, it is not statistically significant. On the other hand, in the post-2023 subsample, the coefficient turns negative (-0.0046) and statistically significant, indicating that green firms underperform during periods of

stable or declining climate concern. These findings are consistent with the theoretical framework that links green stock performance to shifts in climate sentiment.

That said, these subsample results are based on smaller datasets, especially the post-2023 one, and thus are more susceptible to noise and short-term fluctuations, possibly leading the regression to only pick up some isolated temporal trends. The significance in the post-2023 period, while in line with other studies, should not be overinterpreted without replication in broader time frames.

Full regression results for these specifications are presented in Appendix D Tables 3A for the post-2023 results and table 4A for the pre-2023 results.

6. RESULTS DISCUSSION

This section discusses and gives an economical interpretation to the empirical findings presented above, while linking them to the existing literature. The aim is to assess whether the results are consistent with other theoretical frameworks and empirical studies, and to understand how they contribute to the ongoing debate about ESG performance and stock returns.

6.1 INTERPRETATION OF THE RESULTS

As discussed in the previous section, the main findings of this thesis indicate that there is no statistically significant relationship between ESG scores, both raw and industry-adjusted, and stock returns. Similarly, the ESG momentum measure, intended to capture recent upgrades or downgrades in ESG performance, is also statistically insignificant. These results suggest that ESG-related variables[15], at least in this sample and during this period, do not predict future stock returns in the European equity market. Moreover, it's also important to evaluate the economic significance of the results; in the baseline model the economic significance is small and not very relevant. The coefficients of -0.0004 and -0.0008 for the industry adjusted and raw overall score

[15] ESG related variables as in different types of ESG scores and ESG momentum.

indicates that even a large change in ESG score would translate to small and negligible changes in monthly returns (less than 0.1% for a 5-point ESG difference), which even if annualized would still remain small.

Contrary to popular belief[16], these findings imply that firms with higher ESG scores do not necessarily earn higher returns, and vice versa, that brown firms do not underperform purely due to lower ESG ratings. While some may interpret this negatively (i.e., that firms pursuing sustainability are not being "rewarded" in the market), I would argue the opposite. These findings suggest that companies can adopt more sustainable practices and attempt to become 'greener' without sacrificing financial performance, which is ultimately a positive outcome. In other words, firms can "*do well by doing good*" maintaining profitability while reducing negative ESG externalities.

In the second model specification, where the sample is split into pre-2023 and post-2023 periods to account for climate concern shocks (as captured by the MCCC index), I observe a slightly positive but insignificant ESG-return relationship in the pre-2023 period, which is also economically significant and a negative, statistically significant relationship post-2023. Moreover, the coefficients in the post-2023 is also economically significant, given its magnitude. The results show that during stable climate concern times firms with high ESG scores earn lower returns, like predicted in the more theoretical studies. Moreover, these results are in line with the framework proposed by Pastor et al. (2020, 2022), who argue that green stocks can earn higher returns during periods of rising climate concern (positive shocks) and underperform during periods of stable or declining concern. Even though the post-2023 sample is small and limited in time, the significant negative coefficient provides a meaningful signal consistent with this theory. The economic significance of these results is larger than that of the baseline model in the post 2023 sample and instead similar in the pre-2023 sample. A coefficient of -0.0.34 implies that a firm with a 5 point higher ESG score would earn 1.7% lower returns per month, which when annualized becomes even more substantial. While this economic significance suggests the presence of a

[16] In the Morgan Stanley 2024 study it is reported that over 70% of investors believe that firms with good ESG performance will earn higher returns.

strong relationship, we must keep in mind that the results are obtained in a very small sample, and not enough observations are present to obtain meaningful findings.

Finally, I observe that a large number of control variables, amongst which momentum, investment, profitability, and beta, are statistically insignificant in both baseline and alternative models. This could be the result of firm-specific noise, the relatively short time horizon of the dataset, or the broader phenomenon of factor decay. In modern empirical asset pricing, it has been shown that many previously established predictive signals lose power over time due to arbitrage, structural market shifts, or data-mining concerns.

6.2 LINKS TO RELEVANT STUDIES

The results of this analysis align with several important contributions in ESG-finance literature. Notably, Krueger et al. (2020) find no significant relationship between ESG scores and stock returns in their global sample, when using an extensive set of control variables, all of which are also used in this study. Similarly, Aswani et al. (2023) re-examine the so-called carbon premium[17] and find that when firm-reported emissions[18] are adjusted properly and scaled appropriately, the carbon premium largely disappears. Their findings further support the view that ESG-related signals often lose significance when data quality and firm characteristics are appropriately controlled for.

In contrast, some studies report a clear positive relationship between ESG scores and returns. For example, Park and Monk (2017) find that carbon-efficient firms tend to earn higher returns, even after accounting for common risk factors. They construct EMI (Efficient Minus Inefficient) portfolios and observe returns that cannot be explained by standard Fama-French models (Fama-French 1992, 2015). These findings diverge from mine, but the difference may stem from variation in the dataset

[17] Carbon intensity closely relates to overall ESG, as carbon intensity is one of the main components of the ‘E’ pillar score.
[18] Firm reported instead of obtained by third parties.

(U.S. vs. European stocks), methodology (portfolio construction vs. regressions), sample period and set of control variables.

Another potential reason for the lack of significance in my results is the divergence of ESG ratings across providers which weakens ESG scores signaling power. Berg et al. (2022) show that ESG ratings vary widely across agencies due to differences in measurement, scope, and weighting. This inconsistency weakens the signal that ESG scores send to the market and reduces their predictive power. In a follow-up paper, Berg et al. (2023) aggregate ratings from six major providers using techniques like PCA and Mahalanobis distance to build a more robust composite ESG measure. Their adjusted scores do show a statistically significant relationship with returns, suggesting that the noise in raw ESG ratings may be a key barrier to establishing stronger links between ESG and financial performance. Finally, also Lindsay et al (2024) finds no alpha generation by ESG portfolios when constructing them based on the optimal tangency condition.

In line with my findings, Karoly et al. (2023) highlight the importance of temporal and geographical variation in determining ESG premium. They observe that green stocks outperformed brown stocks primarily before 2021, and that the 'greenium' has since weakened or even reversed in most markets, except for the U.S. and Japan. Their results support the idea that ESG-return relationships are highly sensitive to external macroeconomic factors, climate sentiment, and region-specific investor preferences.

As mentioned, the results from the split-sample regressions are broadly consistent with the frameworks of Pastor et al. (2020, 2022). In their model, green stocks earn abnormally high returns during periods of increasing climate concern but otherwise tend to underperform due to higher investor demand and the climate risk hedge they provide, increasing investors' propensity to pay more for them. My finding of a statistically significant negative coefficient post-2023, when the MCCC index stabilizes, is in line with this logic. Moreover, the mediation analysis by Darolles et al. (2024) also supports this interpretation: they find that most of the ESG impact on returns flows through the demand channel, which tends to lower expected returns for green firms, especially in the absence of new climate-related shocks. In fact, in the

absence of those shocks the price increases related to greater demand are already priced in, and what's left is lower future returns.

Finally, the lack of significance in many control variables aligns with results from broader asset pricing literature[19]. Hou, Xue, and Zhang (2015) show that many known anomalies fail to survive when tested under rigorous conditions, including Fama-MacBeth regressions. Similarly, Green, Hand, and Zhang (2020) find that while firm characteristics can be predictive, most lack consistent out-of-sample significance, particularly in short samples or noisy environments. These results help contextualize why traditional predictors may underperform in modern datasets, including mine.

In summary, my analysis contributes to the literature by providing new evidence from European equities over a recent time window. The results suggest that ESG scores, at least in their current form, do not provide strong or consistent signals about future stock returns. The findings are supported by several studies but contrast with others, underlining the complexity of this relationship and the need for further research, especially around the role of external shocks, rating divergence, and investor preferences.

7. CONCLUSION

In conclusion, this thesis set out to explore whether ESG scores are related to stock returns in the European equity market over the 2018-2024 period. The results show that statistically there is no clear relationship between the two and that companies with higher (lower) ESG scores do not earn higher (lower) returns. Whether we check for the relationship using industry adjusted ESG scores, overall scores, or ESG momentum the results don't change highlighting that the ESG scores by themselves don't have enough signaling power to increase future returns.

[19] By asset pricing studies I mean studies that check the relationship between classic factors in the asset pricing literature and not ESG ones.

This thesis also looked at a different specification where the results found a negative relationship between the ESG scores and stock returns in the post-2023 period - a period characterized by stable or slightly declining climate concerns. This finding supports the results of other relevant studies (Pastor et al 2022), but the analysis is conducted on too small of a sample and despite producing statistically relevant results the findings are not very meaningful. In order to obtain more meaningful results, further analysis on the subject should be carried out over longer time periods and with more sample data.

The findings of the baseline specification are in line with those of other relevant studies, such as Krueger et al (2024) and Aswani et al (2023), but differ from others like Monk et al (2017) and Berg et al (2023). The clashing conclusions may be reconducted to differences in methodology, sample and hypothesis formulation, which highlight the complex nature of the relationship. It's also important to remember that my analysis is limited to the European union equity markets and the 2018 to 2024 time-period. The results do not exclude the possibility that a relationship between the two exists outside of the geographical region analyzed, the time-period, or even in more constrained geographical regions (i.e. at the singular nation level[20]). In fact, numerous studies show that the relations between sustainability and returns varies greatly across geographical regions, time periods and due to external factors and macroeconomics trends (Karyoly et al (202?), Daroless et al (2024), Pedersen et al (2022)). This analysis also used ratings from only one provider, MSCI, which could be a limitation, in fact, by integrating ratings from different providers, as done by Krueger et al (2024) and Berg et al (2023), more robust results would be obtained, better testing the signaling power of ESG scores.

Finally, further analysis should be carried out on the topic in order to obtain clearer views on the subject. A more rigorous definition of ESG investing terminology is needed to make sure there is a clearer understanding of the topic for investors and even clearer definitions for researchers[21], as highlighted by Starks (2023). Moreover,

[20] It is possible for example that the relationship is not meaningful at the European level, but when looking at the single national level it may be present in some countries.
[21] Clearer definitions would help researchers formulate more uniform and defined research questions and structure the studies accordingly.

a more in depth analysis should be also performed on the relationship while taking into consideration the effects of positive climate concern shocks. A similar study has already been conducted by Pastor et al (2022), which used a fabricated factor to capture the effects of climate concern shocks, based on the MCCC index. It would be better to conduct such studies over a longer period of time in which the shocks are not present, so a fabricated factor is not needed. Using a broader index that doesn't only capture climate concerns but also measures these concerns related to all the ESG[22] factors would also be more appropriate in order to obtain clearer results.

Overall, the analysis shows that the level of sustainability of a firm does not impact its returns and should be viewed as a positive finding as it highlights that firms can pursue more sustainable practices without having to give up returns. This has important implications both for personal investment and also for institutional investors and asset managers. In fact, it could highlight that the fiduciary duties of institutional investors and pension funds wouldn't be breached by pursuing sustainable investing strategies.

This thesis also contributes to the growing body of empirical ESG research by providing updated evidence on the relationship between ESG scores and stock returns in the European equity market. By using a robust Fama-MacBeth regression framework across multiple score specifications, it also only takes into consideration only the European Union unlike other studies that cover a greater global sample or only a US one. This focus on the European Union provides a clear picture of how ESG factors play out within a unified regulatory and economic environment. Furthermore, by incorporating recent data and splitting the analysis around 2023, the thesis captured potential changes in the market sentiment and policy attention toward sustainability. The findings - which suggest that ESG scores do not lead to significantly higher or lower returns - show that sustainable investing does not come at the expense of performance. This finding is especially relevant as investors increasingly seek to align values and ethics with financial goals. Overall, the study adds to existing literature,

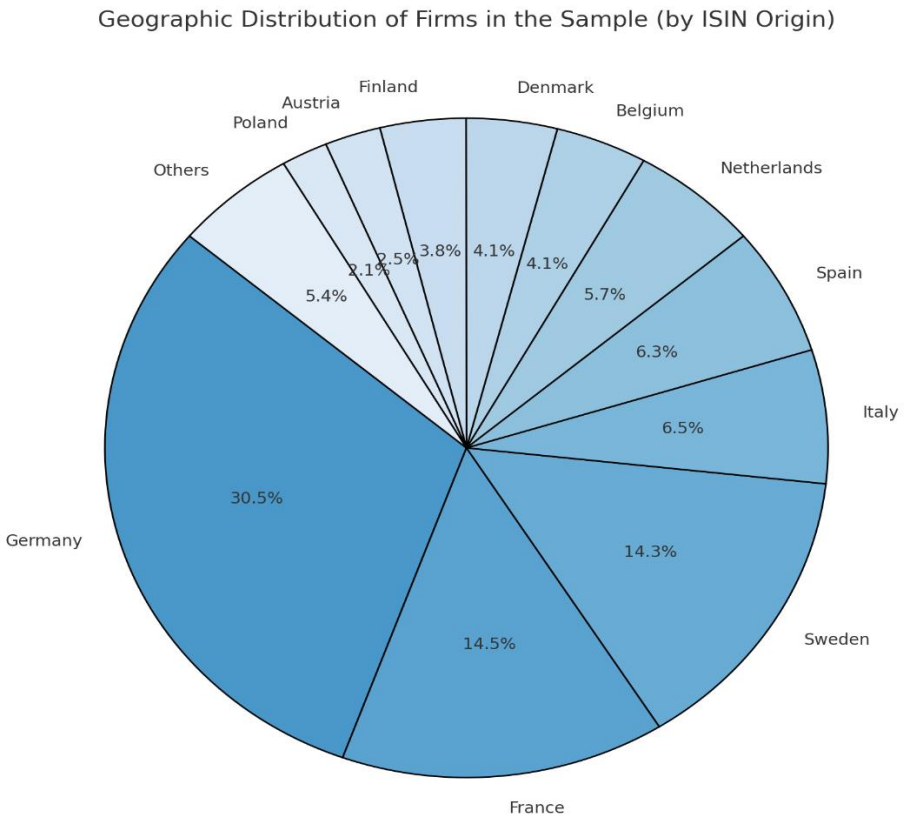
[22] Not only the 'climate factor' which is a component of the 'E' factor but also other relevant concerns that affect all three of the ESG components

offering updated, region-specific evidence that reaffirms that sustainability and profitability are not mutually exclusive in the context of European equity markets.

APPENDIX A

Figure 1A. Geographical distribution of the firms within the dataset

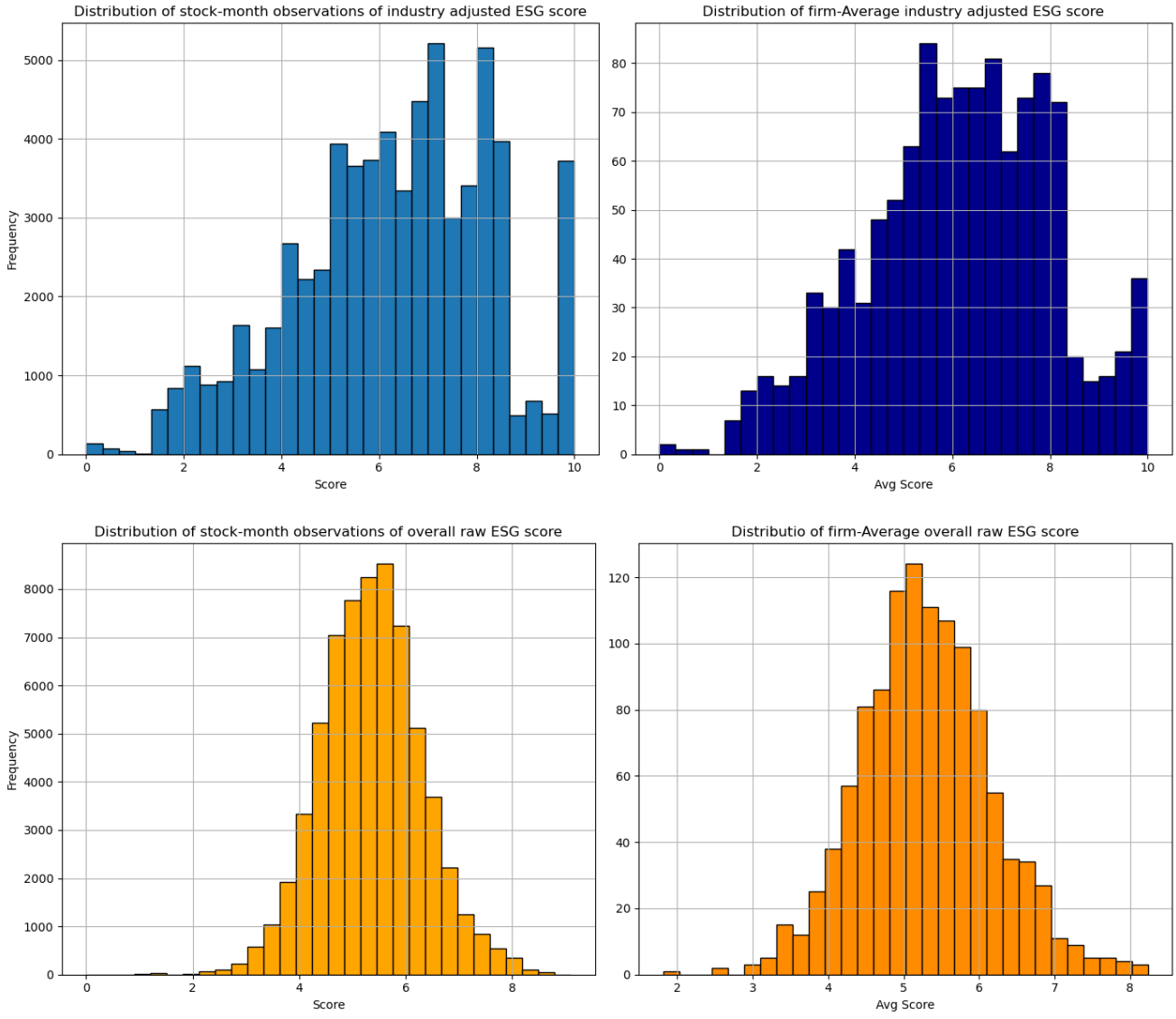
Figure 1A. Pie chart showing the geographical distribution of the firms present in the database used. Countries that have a presence lower than 2% are aggregated in the 'Others' section.



APPENDIX B

FIG 2A: Distribution of industry adjusted and raw overall ESG scores

The figure shows the distribution of the industry adjusted and raw overall scores in the database. The left side represents the distribution of all the stock month observations, the right side, instead, shows the distribution of the average scores per firm. Obtained by averaging all the relative ESG scores for each firm over time. Data is obtained from MSCI, regarding the European equity markets in the period from 2018 to 2024.



APPENDIX C

Table **1A**: Summary Statistics of Regression Variables

The table shows the summary statistics of the database used in the analysis. Data is obtained from Compustat Global, Orbis and MSCI. It covers the European Equity markets over the 2018 to 2024 period. Data is winsorized at the 99% and 1% levels.

Variable	Count	Mean	Min	25%	Median	75%	Max	Std. Dev.
ESG adj. Score	45140	6.3714	0.0000	5.1000	6.5000	7.9000	10.0000	2.0116
Market Cap	45140	7.9971	1.9191	6.8070	7.9180	9.1267	12.9375	1.6343
Book to Market	45140	-0.413	-4.401	-1.186	-0.5243	0.2090	6.6965	1.2415
Investment	45140	0.0070	-0.939	0.0000	0.0000	0.0000	6.2994	0.0809
Profitability (ROA)	45140	0.2977	-1.356	0.1694	0.2547	0.3814	2.1191	0.2132
Leverage	45140	0.2636	0.0000	0.1481	0.2535	0.3606	0.8681	0.1534
Tangibility	45140	0.2408	0.0000	0.0962	0.1941	0.3537	0.9383	0.1830
R&D	45140	0.0276	0.0000	0.0000	0.0035	0.0272	2.2372	0.0768
Returns	45140	0.0064	-0.985	-0.055	0.0038	0.0653	1.8499	0.1129
Volatility	45140	0.1076	0.0230	0.0793	0.0980	0.1245	0.6115	0.0469
BETA	45140	1.0161	-0.986	0.7131	1.0060	1.2680	3.5300	0.4381
Momentum	45140	0.0173	-0.988	-0.132	-0.0003	0.1383	3.8283	0.2604

APPENDIX D

Table 2A: Fama-MacBeth Regression Results on ESG Momentum

Table 2A. Shows the results of the Fama-MacBeth regression using ESG momentum as the ESG variable. The data is retrieved from 'Compustat Global', 'MSCI' and 'Orbis', and regards public companies of the EU's equity markets. The sample period goes from 2018 to 2024. Coefficients marked with '*', '**' and '***' are significant respectively at the 0.10, 0.05 and 0.01 levels of p-values

Variable	Coefficient	NW Std. Error	t-Statistic	p-Value
Constant	-0.0107	0.0086	-1.2415	0.2192
ESG Momentum	0.0008	0.0015	0.5453	0.5875
Volatility	0.0175	0.0417	0.4209	0.6753
Momentum	0.0008	0.0026	0.3109	0.7570
Market Capitalization	0.0023***	0.0008	2.9648	0.0043
Book-to-Market Ratio	-0.0034***	0.0010	-3.3847	0.0013
Investment	0.6913	0.7779	0.8887	0.3777
Profitability (ROA)	0.0003	0.0060	0.0476	0.9622
Leverage	-0.0165***	0.0058	-2.8279	0.0063
Tangibility	-0.0021	0.0076	-0.2811	0.7796
R&D	-0.0450***	0.0251	-1.7947	0.0777
Average R^2	**0.0974**			
Observations	**29,917**			

APPENDIX D CONTINUED

Table 3A: Fama-MacBeth Regression Results Post-2023

Table 3A. Shows the results of the Fama-MacBeth regression using overall industry scores as the ESG variable. Data is retrieved from 'Compustat Global', 'MSCI' and 'Orbis', the sample period goes from 2023 to end of 2024. Coefficients marked with '*', '**' and '***' are significant respectively at the 0.10, 0.05 and 0.01 levels of p-values.

Variable	**Coefficient**	**NW Std. Error**	**t-Statistic**	**p-Value**
Constant	-0.0046	0.0094	-0.4834	0.6363
Overall ESG Score	-0.0034**	0.0016	-2.1947	0.0455
Volatility	-0.0115	0.0672	-0.1715	0.8663
Momentum	0.0039	0.0041	0.9610	0.3529
Market Capitalization	0.0045***	0.0009	4.7184	0.0003
Book-to-Market Ratio	-0.0028***	0.0009	-3.1094	0.0077
Investment	3.0127	2.7277	1.1045	0.2880
Profitability (ROA)	0.0049	0.0051	0.9594	0.3536
Leverage	-0.0079	0.0120	-0.6529	0.5244
Tangibility	-0.0075	0.0144	-0.5205	0.6108
R&D	-0.0343	0.0263	-1.3040	0.2133
Beta	-0.0003	0.0054	-0.0395	0.9686
Average R^2	**0.0633**			
Observations	**11,607**			

APPENDIX D CONTINUED

Table 4A: Fama-MacBeth Regression Results Pre-2023

Table 4A. Shows the results of the Fama-MacBeth regression using Overall Industry scores as the ESG variable. Data is retrieved from 'Compustat Global', 'MSCI' and 'Orbis', the sample period goes from 2018 to end of 2022. Coefficients marked with '*', '**' and '***' are significant respectively at the 0.10, 0.05 and 0.01 levels of p-values.

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Constant	-0.0095	0.0121	-0.7798	0.4388
Industry adj. ESG Score	0.0009	0.0006	1.4674	0.1479
Market Capitalization	0.0015*	0.0009	1.7657	0.0829
Book-to-Market Ratio	-0.0050**	0.0019	-2.5877	0.0123
Investment	0.0337	0.0943	0.3573	0.7222
Profitability (ROA)	-0.0046	0.0054	-0.8435	0.4025
Leverage	-0.0287***	0.0099	-2.9027	0.0053
Tangibility	-0.0034	0.0063	-0.5473	0.5864
R&D	-0.0395	0.0422	-0.9376	0.3525
Momentum	0.0042	0.0082	0.5073	0.6139
Beta	0.0011	0.0052	0.2115	0.8330
Average R^2	**0.0871**			
Observations	**33,533**			

APPENDIX E

TABLE 5A: VARIABLES CONSTRUCTION

Table 5A. Explains how the variables used in this study are constructed, which items were taken from the respective databases and which assumptions were made in the construction.

FINANCIAL DATA VARIABLES

Returns = Returns were computed using data from Compustat Global. The closing monthly price (item *prccm*) was adjusted using two adjustment factors, items *ajexm* and *ajpm* to account for stock splits, dividends and share structure changes. After computing the adjusted monthly prices the returns were computed as follows:

$$returns_t = \frac{price_t - price_{t-1}}{price_{t-1}}$$

Market Capitalization (size) = Market capitalization was obtained directly from the Orbis Bureau Van Dijk databank (item monthly market capitalization).

Book to Market Ratio = Computed using both data from Compustat Global and Orbis. It's the natural logarithm of the ratio between book value of equity to total market capitalization (obtained as explained previously). The book value of equity was computed by the difference between Total Assets (item *AT*) and Total Liabilities (Item *LT*).

Investment = Investment is computed as the percentage change of Total Assets year over year (Compustat item *AT*).

Profitability (ROA) = Computed as revenues (Compustat item REVT) minus cost of goods sold (Compustat item COGS) divided by total assets (Compustat Item AT).

Leverage = Computed as the ratio between total debt (Compustat items DLTT and DCL) and total assets (Compustat item AT).

TABLE 5A CONTINUED

Tangibility = Computed as property plant and equipment (Compustat item PPENT) divided by total assets (Compustat item AT)

Research and Development = Computed as Research and Development spending (Compustat item XRD) divided by total assets (Compustat item AT). When the Research and Development expense is missing it is assumed to be 0.

Momentum = Computed as the cumulative return in month t over the 11 months period between month t-2 and month t-12. We skip the most recent month in order to avoid short-term reversion bias.

Volatility = Computed as the annualized standard deviation of stock returns over the previous 12 months.

Beta = Obtained directly from the Orbis Bureau Van Dijk database (Item beta)

ESG VARIABLES

Overall ESG Score = Obtained directly from MSCI. This value is the overall score for the company after calculating the weighted average score of the three pillar scores (ESG).

Industry Adjusted ESG Score = Obtained directly from MSCI. This value adjusts the overall score based on the relevant industry of a company. From the MSCI 'ESG ratings methodology' (2024):"*This score is calculated by normalizing the Weighted Average Key Issue Score relative to the ESG Rating industry peer group, based on score ranges set by the benchmark values in the peer set."*

ESG Momentum = ESG momentum in month t is calculated as the most recent change in ESG rating that occurred in the previous 12 months. Because of its construction the first 12 months of data for each stock are discarded for this variable.

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