When E Rises, Does S Fall? ESG Trade-Offs and Resource Allocation After the Paris Agreement

Evidence from European Public Firms Under Climate Regulation

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Abstract: The ratification of the Paris Agreement in 2015 introduced significant regulatory pressure for most companies, but more importantly, on carbon-intensive industries. This thesis draws on Resource Dependence Theory to investigate whether this external shock forced high-emitting European firms to prioritize Environmental (E) performance at the expense of Social (S) dimension, which would indicate a possible substitution effect.

Using a Difference-in-Differences (DiD) design on a dataset of European public firms from 2014 to 2020, we analyze the impact that the Paris Agreement has had on high-emitters relative to low-emitting firms. Our empirical results reject the trade-off hypothesis. In fact, we find evidence of a comprehensive sustainability upgrade, simultaneously improving the E, S, and G dimension scores.

A more detailed analysis of cost structures reveals that, while maintaining high ESG performance is associated with increased administrative (SG&A) expenses, firms that actively accelerate their environmental improvements reallocate resources from administration to Research and Development. Additionally, financial slack was found to be insignificant, meaning that increases in ESG pillar scores are not directly affected by the presence of unused financial potential. Our findings suggest that the Paris Agreement effectively promoted increases across all three ESG pillars, preventing companies from selecting only the Environmental pillar.

Key words: ESG Trade-offs, The Paris Agreement, Financial Slack
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1 Introduction

The Paris Agreement, adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC), marked a turning point in global climate governance. It brought together 195 Parties to commit to collective climate action and created the first universal framework to address climate change. Its main goal is to keep the rise in global average temperature well below 2°C above pre-industrial levels, aiming for 1.5°C. The Agreement takes a bottom-up approach, requiring each country to set its own emission-reduction pathway through Nationally Determined Contributions (NDCs), which are updated every five years under a transparent review framework (UNFCCC, n.d.; Raiser et al., 2020).

Nations set climate commitments, but the private sector implements them. Governments use policy tools such as carbon pricing, emissions trading systems, and mandatory climate-related disclosures to meet their targets (Narassimhan et al., 2018). These measures create both incentives and requirements for firms to adjust operations. For example, the European Union Emissions Trading System (EU ETS) covers power generation and heavy industry, forcing companies to absorb carbon costs (European Commission, n.d.). Sweden's strong carbon tax proves that national pricing can cut manufacturing emissions (Andersson, 2019). As a result, firms face strong pressure to decarbonize and increase their Environmental (E) scores to attract investors and reduce risk (Tao et al., 2024; Ott & Schiemann, 2022).

Firms have limited financial and organizational resources. Resource Dependence Theory states that external pressures force organizations to shift their focus and resources, thereby changing internal priorities (Pfeffer & Salancik, 1978). After the Paris Agreement, climate regulation became a major external pressure. The theory predicts that companies will shift limited capital to meet environmental regulations, sometimes at the expense of other goals. This conflict creates tension in the Environmental, Social, and Governance (ESG) framework. The triple bottom line calls for balancing environmental, social, and economic outcomes (Elkington, 2004). Still, research shows it is rare for firms to optimize all three areas at once. Hahn et al. (2010) argue that firms typically face trade-offs across ESG dimensions due to resource constraints.

Recent scholarship underscores this conflict. Farzamfar et al. (2022) demonstrate that firms prioritizing environmental compliance are more likely to incur social responsibility fines. This finding implies that environmental risk mitigation may inadvertently elevate social risks. Some researchers argue that financial slack, defined as surplus resources, enables firms to pursue

ESG objectives without necessitating trade-offs (Duque-Grisales & Aguilera-Caracuel, 2019). However, this perspective is contested, as other studies argue that excess slack does not inherently lead to value creation (Singh et al., 2023). Despite ongoing debate, limited research investigates how the Paris Agreement's regulatory shock influences the balance among the Environmental, Social, and Governance pillars in European public firms.

This thesis seeks to address this gap by explicitly asking: Has the intensified pursuit of environmental performance since the Paris Agreement led to a substitution effect, resulting in stagnation or decline in Social (S) and Governance (G) performance among high-emitting European firms? The analysis centers on firms in manufacturing, heavy industry, and utilities, which encounter the most significant regulatory and transition risks (Gross, 2021). To isolate the impact of the Agreement, we use a Difference-in-Differences (DiD) research design, consistent with Zhang (2025), and treat the ratification of the Paris Agreement (effective 2016) as an exogenous policy shock. Additionally, we incorporate a triple-interaction analysis to assess how financial slack and cost structures moderate these effects.

Our findings challenge the conventional perspective on ESG trade-offs. While the initial hypothesis posited that prioritizing environmental performance would diminish outcomes in other ESG domains (H1), the analysis reveals that high-emitting firms experienced a comprehensive sustainability upgrade following the Paris Agreement. These firms improved their Environmental, Social, and Governance scores relative to low emitters. This outcome suggests that stringent regulation compels companies to pursue holistic compliance, thereby achieving full institutional legitimacy rather than engaging in greenwashing or selective adherence. Nevertheless, financial constraints persist. Enhancing environmental scores is associated with higher Selling, General, and Administrative (SG&A) expenses among firms with high ESG performance. Firms that rapidly improve Environmental scores tend to reallocate resources toward research and development. Additionally, a divergence between Return on Assets (ROA) and Return on Equity (ROE) is observed, as the asset base expands to support green investments while debt may be utilized to sustain shareholder returns. Section 2 reviews the literature; Section 3 describes our data and methods; Sections 4 and 5 present statistics and results; Section 6 discusses theoretical and practical implications.

2 Literature Review

2.1 Origins and Global Significance of the Paris Agreement

The Paris Agreement, adopted in 2015 under the United Nations Framework Convention on Climate Change, marks a significant moment in global climate governance. It united 195 Parties, making it the first time all nations pledged to work together on climate action. The main aim of the Agreement is to keep the rise in global average temperature "well below" 2°C above pre-industrial levels, while striving to limit warming to 1.5°C. To achieve this, each country sets its own emission reduction plan through Nationally Determined Contributions, which are updated every five years within a transparent review system (UNFCCC, n.d.). Unlike the Kyoto Protocol, which set specific obligations for individual countries, the Paris Agreement offers a platform for all Parties to communicate, collaborate, and gradually improve their commitments within a transparent framework (Raiser et al., 2020).

The Agreement relies on peer pressure and transparency, not sanctions, to encourage compliance. In practice, this method has led to mixed results across different regions and economies. Commitment levels vary widely. The European Union and countries like Sweden have adopted strong domestic climate policies, such as Sweden's carbon tax, which has significantly cut CO_2 emissions. However, others have fallen behind (Andersson, 2019). A significant political setback happened when the United States withdrew from the Paris Agreement during the Trump Administration, raising concerns about fairness, costs, and sovereignty. The U.S. formally exited in 2020 but rejoined under President Biden in early 2021, reaffirming its support for the framework (Leggett, 2021).

Despite its limitations, the Paris Agreement serves as the foundation of international climate policy. Even if all current NDCs were fully implemented, they would only decrease global emissions by 4-10% by 2030 compared to 2019 levels, which falls far short of the reductions needed to meet the Agreement's temperature goals (UNEP, 2024). As a result, these efforts are still inadequate to reach the 1.5°C target, highlighting the need for stronger commitments and consistent enforcement among countries.

2.2 Implementation and Enforcement Mechanisms

To meet their climate goals under the Paris Agreement, governments use several policy tools that directly influence how companies operate. Among these, three key mechanisms stand out:

carbon pricing, emissions trading systems, and mandatory climate-related disclosure (Narassimhan et al., 2018). Together, these mechanisms create financial, regulatory, and transparency-based incentives that drive firms to reduce emissions and shift to a low-carbon economy. Carbon pricing has become one of the most direct and widely used tools. A carbon tax assigns a cost per ton of carbon dioxide emitted, encouraging firms to cut emissions. It provides cost certainty since companies know the tax rate in advance and can plan their strategies accordingly (Baranzini et al., 2017).

In contrast, an emissions trading system, or cap-and-trade scheme, sets a limit on total allowable emissions and distributes or sells permits to emitters. Companies that emit less than their allowance can sell extra permits, while those that exceed their limits must buy additional permits (Bayer & Aklin, 2020). This market approach offers flexibility and ensures that total emissions stay within the cap; however, it can cause price fluctuations.

In practice, many countries use a mix of these strategies. The European Union Emissions Trading System, established in 2005, is one of the largest cap-and-trade programs globally, covering power generation and heavy industry (European Commission, n.d.). Sweden introduced a carbon tax in 1991, which is now among the highest in the world and has led to significant emissions reductions in manufacturing without hindering economic growth (Andersson, 2019). Both systems show that effective carbon pricing can promote emission reductions and innovation. The success of these policies depends on factors such as the carbon price level, coverage, and enforcement strength (Revelle, 2009).

Another important mechanism is climate-related information disclosure. Recent research indicates that clear disclosure of climate risks and strategies can build credibility with investors and enhance firms' ability for green innovation by improving access to financial support and increasing stakeholder confidence (Tao et al., 2024). When firms disclose their carbon footprints and climate risks, investors can better evaluate risks and allocate capital accordingly. High-quality disclosure shows preparedness and accountability, whereas poor or missing disclosure can lead to investor doubt and higher financing costs. The focus on transparency in the Paris Agreement has raised expectations for reporting and accountability in global climate governance (Raiser et al., 2020).

2.3 Implications for companies

These policy developments have concrete consequences for companies' financial performance and valuation. Academic research consistently finds that carbon-intensive firms experience adverse financial effects from the introduction of carbon pricing or strict emission regulations (Ott & Schiemann, 2022). Higher carbon costs reduce profit margins, limit investment capacity, and depress market value (Park et al., 2024). Studies of European carbon markets have shown that investors tend to apply valuation discounts to firms with large emission footprints, reflecting expected future compliance costs (Perdichizzi et al. 2023). Conversely, firms that adopt credible sustainability strategies or invest in cleaner technologies often achieve higher valuation multiples and improved access to capital. Evidence from several countries indicates that investors reward companies that voluntarily disclose carbon data or establish explicit emissions reduction targets (Khandelwal et al., 2022). Transparent reporting appears to enhance investor confidence by reducing information asymmetry and signaling effective risk management (Ott & Schiemann, 2022).

Financial markets also react quickly to major climate policy announcements. When governments introduce carbon taxes or strengthen emission trading systems, the stock prices of affected industries frequently decline as investors anticipate higher future costs (Bai & Yang, 2025). For example, carbon-intensive sectors such as energy and mining typically experience negative abnormal returns around policy events, while firms in renewable energy or green technology often gain (Broadstock et al., 2024). These reactions suggest that markets internalize carbon risk by re-pricing firms according to their expected exposure to regulatory change.

The effects of carbon regulation are not uniform across industries. Heavy industries, including oil and gas, mining, metals, cement, and chemicals, face the most significant challenges because their production processes are energy-intensive and technologically difficult to decarbonize. Many of these operations depend on fossil fuels for high-temperature heat or chemical feedstocks that currently lack cost-effective low-carbon substitutes. As a result, carbon pricing imposes larger relative costs on these firms (Gross, 2021). Heavy industry remains at the center of the climate transition debate, as it accounts for roughly one-fifth of global emissions and will determine the success or failure of long-term decarbonization efforts.

2.4 Most affected industries by the Paris Agreement

The Paris Agreement imposes uneven burdens across sectors, with the most severe effects concentrated in energy-intensive industries such as manufacturing, heavy industry, and utilities. These sectors are structurally reliant on fossil fuels and emit disproportionately high levels of greenhouse gases, making them primary targets for national decarbonization policies (Gross, 2021). Under the EU Emissions Trading System (EU ETS), for instance, companies in sectors like cement, steel, and chemicals are subject to strict carbon caps and must either invest in cleaner technologies or purchase increasingly costly emissions allowances (Bayer & Aklin, 2020). Similarly, Sweden's longstanding carbon tax regime illustrates how national carbon pricing frameworks translate global climate goals into financial constraints for industrial emitters (Andersson, 2019).

Manufacturing firms face high adjustment costs due to the technological complexity of decarbonizing processes that rely on thermal combustion, process emissions, or specific feedstocks. In many cases, viable low-carbon alternatives either do not exist or remain prohibitively expensive (Gross, 2021; Park et al., 2024). As a result, firms must undertake costly R&D, retrofit existing infrastructure, or bear high abatement costs, all of which can reduce profitability or delay investment (Ott & Schiemann, 2022). These pressures have triggered growing interest in carbon capture, hydrogen, and electrification technologies, although deployment remains limited in scope and scale.

Utilities are also undergoing structural transformation. Firms reliant on coal or gas have experienced a shift in capital allocation as policy incentives and investor preferences favor renewable energy sources (Perdichizzi et al., 2023; Broadstock et al., 2024). This has accelerated asset retirement, increased stranded asset risk, and pushed many utilities toward cleaner portfolios. In parallel, mandatory emissions disclosures and ESG expectations have added compliance burdens and affected firms' financing costs (Khandelwal et al., 2022).

Overall, the Paris Agreement functions as a structural catalyst, reshaping cost structures, capital flows, and strategic priorities in high-emissions sectors. While not all firms are equally exposed, those in carbon-intensive industries face a convergence of regulatory, technological, and financial pressures that make their transition pathways especially complex and costly (Broadstock et al., 2024).

2.5 Trade-offs between ESG pillars

Trade-off tensions in sustainability are well recognized. When the triple bottom line was introduced, it encouraged companies to look at environmental and social impacts alongside economic performance, changing the way business success was viewed (Elkington, 2004). However, later studies show that this kind of alignment is uncommon. Hahn et al. (2010) argue that trade-offs are more common than not, since companies often do not have the resources to address all ESG dimensions equally. When one area gets more focus, others may be overlooked. This is especially true during times of economic or policy pressure, where restricted funds or management capacity force strategic decisions (Margolis & Walsh, 2003).

The idea of limited economic resources helps explain this. Firms operate with limited financial and organizational capacity. Resource dependence theory states that when organizations face outside pressures, they shift their focus and resources to manage those dependencies, which can change their internal priorities (Pfeffer & Salancik, 1978). Yu & Luu (2021) show that more environmental disclosure relates to a lower cost of equity, indicating that markets see transparency about environmental risks as a sign of reduced firm risk. Rodriguez et al. (2021) report similar findings in crisis situations. These studies support the notion that resource trade-offs shape ESG performance, often hidden in overall ESG scores.

The enforcement tools related to the Paris Agreement, such as carbon taxes, emissions trading, and climate disclosure, have made achieving environmental outcomes more pressing. Consequently, many companies, especially in high-emission industries, have redirected capital toward compliance and decarbonization (Narassimhan et al., 2018; Bayer & Aklin, 2020). While these changes often result in better environmental scores, they may also come at the expense of other goals. Farzamfar et al. (2022) find that companies improving their environmental compliance often face more social-responsibility fines. They conclude that "going green" may lower environmental risk but increase social risk.

This tension reflects broader strategic behavior when facing constraints. If external demands push for better environmental performance, firms with limited resources might neglect softer or less regulated areas. In terms of resource dependence, more powerful stakeholders, like regulators or investors focused on climate issues, influence internal resource allocation, often hurting other areas (Pfeffer & Salancik, 1978). When companies lack internal capacity, scaling investments in ESG across all dimensions becomes challenging.

Investor reactions to these trade-offs vary. Some studies suggest that markets do not significantly penalize imbalances between ESG areas (Yusifzada et al., 2025), while others indicate that weak performance in social or governance aspects results in long-term risk exposure (Khan et al., 2016; Clarkson et al., 2014). At the company level, ESG outcomes seem interconnected. Uyar et al. (2022) find that inconsistent prioritization across environmental, social, and governance dimensions limits reputational benefits, showing that ESG pillars cannot be pursued separately.

In general, ESG improvements rarely come without costs. Conceptual work warns against one-dimensional approaches, where focusing too much on one pillar leads to underperformance in others (Hahn et al., 2015). In the context of climate policy, especially under Paris-aligned regulation, this risk is more pronounced. For firms with ample financial resources, the trade-off may be small, but when resources are tight, environmental compliance may negatively impact social and governance priorities.

2.6 The Role of Financial Slack

The literature offers contrasting views on how financial slack influences sustainability performance. On one hand, Duque-Grisales and Aguilera-Caracuel (2019) argue that financial slack acts as a crucial facilitator for ESG implementation. In their study, which was formed mostly of Latin American companies, they found that while ESG investments generally had a negative impact on financial performance due to high implementation costs, the presence of financial slack reversed this relationship. They view financial slack as a moderator between ESG investments and corporate financial performance. On the other hand, there is also an opposing perspective in the academic literature, suggesting that financial slack does not automatically translate into improved sustainability outcomes. For instance, Singh et al. (2023) challenge reports of positive effects of financial slack, arguing that unabsorbed slack can tempt managers to use excess cash for personal utility or greenwashing rather than for actual value creation.

What we see from the previous literature is that there are two opposing views; it is not entirely clear if financial slack has a positive or negative effect on a firm when sustainability and ESG topics are involved. Additionally, previous research does not explicitly look at the trade-off between financial slack and the environmental pillar score. This, together with the varying conclusions from previous research, leads us to test whether there is evidence of a substitution effect between slack and E-score after the Paris Agreement.

2.7 Hypothesis development

The Paris Agreement has increased regulatory pressure on firms to improve environmental performance through mechanisms such as carbon pricing and mandatory disclosure (Narassimhan et al., 2018; Ott & Schiemann, 2022). As a result of the resource scarcity theory, prioritizing environmental goals may reduce resources available for social or governance initiatives for firms.

Recent studies highlight this trade-off. Farzamfar et al. (2022) find that environmental improvements can coincide with declines in social outcomes. Hahn et al. (2010) argue such tensions are typical in sustainability efforts, especially under tight constraints. Uyar et al. (2022) further show that unbalanced or inconsistent ESG efforts weaken social reputation, indicating that such trade-offs are not costless.

Hypothesis H1: In the post-Paris period, increases in environmental scores are associated with stagnation or declines in social score.

3 Methodology

This section explains how the research has been designed, data collection, and the models used to study how the Paris Agreement affected changes in the Environmental Pillar score for high-emitting companies and related financial trade-offs. The analysis uses a Difference-in-Differences (DiD) approach, viewing the Paris Agreement's ratification as a major change in global climate policy.

3.1 Research Design

A Difference-in-Differences (DiD) design, as described by Zhang (2025), is used to estimate the causal effect of the Paris Agreement on firms' behaviour. The main idea is that the Paris Agreement created a major shift in climate risk, especially for firms with high carbon emissions compared to those with lower emissions.

The year 2016 is used as the cut-off, marking when the Paris Agreement was ratified and took effect. Following Zhang (2025), the study assumes that high-emitting firms faced more regulatory pressure after 2016, leading them to change their ESG strategies more than the control group.

3.2 Data and Sample Selection

3.2.1 Data Sources

The main dataset includes firm-level financial and ESG data from the LSEG workspace. The sample covers firms listed on European stock exchanges, as these companies are expected to be most affected by the requirements imposed by the Paris Agreement. The data includes financial variables such as sales growth, ROA, ROE, Leverage, and R&D intensity, as well as ESG metrics such as E-Score, S-Score, G-Score, and total CO2 emissions.

3.2.2 Sample Construction and Cleaning

The sample period is from 2014 to 2020. The years 2016 and 2017 are excluded from the regression analysis, which helps separate the immediate implementation phase and clearly distinguishes the pre-treatment period (2014–2015) from the post-treatment period (2018–2020). Rows with incomplete or missing data have been removed to form the final dataset. To reduce the risk of outliers affecting the results, winsorization was applied to all variables at the 1st and 99th percentiles.

3.3 Variable Definitions

3.3.1 Dataset Variables

All of the data in our dataset has been obtained from the LSEG workspace database and includes both ESG-related metrics and firm-level financial data. Specifications of the variables and how they have been employed in our study are outlined in Appendix A.

3.3.2 Created Variables

To capture the effect of the Paris Agreement on the ESG pillars, we introduce two additional variables. First, there is a binary variable (After) that is set to 1 if the observation is after 2016, the policy year, and zero otherwise. The second variable is also a binary variable (High Emission), assigning a value of 1 to the 25% highest-emitting companies based on Carbon intensity, which was calculated as $\frac{Total\ emissions_{i,t}}{Sales_{i,t}}$, drawing the methodology from Chapple et al. (2013). We obtained the sales and emission data from the LSEG workspace. This differs from the approach of Zhang (2025), who identifies high emitters using industry classification.

Nevertheless, the goal remains the same – to differentiate between high- and medium/low-emitting companies.

3.3.3 Financial Slack

Following Duque-Grisales and Aguilera-Caracuel (2019), we also use Financial Slack in our regressions. It is measured as the ratio of $\frac{Current\ Assets_{i,t}}{Current\ Liabilities_{i,t}}$. This shows how much liquid resources managers could potentially spend on ESG initiatives without risking the firm's short-term financial health. This variable is included in the triple interaction in our regression analysis to examine whether higher levels of financial slack affect changes in Environmental and Social pillar scores.

3.4 Empirical Strategy

3.4.1 Baseline Model: The Impact of the Paris Agreement

To see if high-emitting firms improved their ESG scores more than low-emitting firms after the Paris Agreement, similar to how it was done by Zhang (2025), the following Two-Way Fixed Effects (TWFE) model is used:

$$Y_{i,t} = \alpha + \beta_1(After_t * HighEmitting_i) + \gamma X_{i,t} + \mu_i + \delta_t + \epsilon_{i,t} \quad (1)$$

where $Y_{i,t}$ is the E-Score (or S/G Score) for firm i in year t; β_1 is the main coefficient of interest (the DiD estimator), which measures how much ESG performance changed for heavy emitters after the Paris Agreement; $X_{i,t}$ are the control variables; μ_i and δ_t are the firm and year fixed effects.

3.4.2 Economic Consequences and Trade-offs

To study the financial effects and identify potential trade-offs associated with changes in the Environmental pillar score, the analysis examines whether higher scores are linked to improvements in financial performance. It uses a triple interaction, with the E-score to see the effects of increasing the Environmental pillar score on various other company financials after the Paris Agreement:

$$Y_{i,t} = \alpha + \beta_1(After_t * HighEmitting_i * E_score_{i,t}) + \beta_2(After_t * HighEmitting_i) + \beta_3(After_t * E_score_{i,t}) + \beta_4(HighEmitting_i * E_score_{i,t}) + \beta_5 After_t + \beta_6 HighEmitting_i + \beta_7 E_score_{i,t} + \gamma X_{i,t} + \mu_i + \delta_t + \epsilon_{i,t} \quad (2)$$

Then, to understand if the effect is more pronounced for firms with bigger changes, the E-score level variable is exchanged for percentage change in E-score in the triple interaction:

$$Y_{i,t} = \alpha + \beta_1(After_t * HighEmitting_i * \Delta E_score_{i,t}) + \beta_2(After_t * HighEmitting_i) + \beta_3(After_t * \Delta E_score_{i,t}) + \beta_4(HighEmitting_i * \Delta E_score_{i,t}) + \beta_5 After_t + \beta_6 HighEmitting_i + \beta_7 \Delta E_score_{i,t} + \gamma X_{i,t} + \mu_i + \delta_t + \epsilon_{i,t} \quad (3)$$

At first, variables such as Sales growth, ROA, ROE, R&D intensity, Dividends, Cash ratio, Sustainability Compensation Incentives, Sustainability Committee, and Leverage were used as dependent variables, which could entail potential trade-offs in firm fundamentals. After that, to dig deeper into possible substitution effects, we use various cost groups as dependent variables in our triple interaction regression analysis. This approach tests whether the financial performance of high emitters after the Paris Agreement depends on their environmental performance.

3.4.3 Heterogeneity Analysis: The Role of Financial Slack

To test if having more resources changes how firms respond to regulatory pressure (Duque-Grisales & Aguilera-Caracuel, 2019), the baseline model adds a triple interaction term:

$$Y_{i,t} = \alpha + \beta_1(After_t * HighEmitting_i * Fin_slack_{i,t}) + \beta_2(After_t * HighEmitting_i) + \beta_3(After_t * Fin_slack_{i,t}) + \beta_4(HighEmitting_i * Fin_slack_{i,t}) + \beta_5 After_t + \beta_6 HighEmitting_i + \beta_7 Fin_slack_{i,t} + \gamma X_{i,t} + \mu_i + \delta_t + \epsilon_{i,t} \quad (4)$$

This helps us understand whether a firm with more readily available funds would engage in ESG pillar score-improving activities. This could possibly explain why no significant substitution effects are found with company fundamentals or costs.

3.4.4 Robustness and Estimation

All models are run using the plm package in R. To deal with possible serial correlation and heteroskedasticity in panel data, standard errors are clustered at the firm level using a heteroskedasticity-consistent covariance matrix (HC1). Including both firm and year fixed

effects helps control for firm traits that do not change over time, like corporate culture, and for global trends that do change, such as inflation or economic cycles.

4 Data and Descriptive Statistics

4.1 Data

The empirical sample is constructed from firm-year observations of European public companies, integrating standard financial ratios (ROA, Leverage, etc.) with environmental, social, and governance (ESG) metrics, specifically the E-score, using data from LSEG workspace. The following data manipulations were performed to come to the final sample of companies:

Sample Selection: The analysis began by removing missing observations from the E-score, S-score, G-score, and Total emissions columns, ensuring only complete cases were retained. Since the Carbon Intensity variable includes sales figures in the denominator, there is a possibility that a company in a given year has 0 or very low sales figures, which could lead to CI variable becoming infinite. For the regression analysis, these values are removed. Lastly, only relevant policy years are filtered out. Sample construction is displayed in Table 1.

Treatment Variable Construction: The core Difference-in-Differences (DiD) variable, Treat Post, was constructed by interacting the Paris Agreement inception dummy (for years 2016 and onwards) with the High Emitting companies dummy.

Outlier Mitigation (winsorizing): Given the inherent volatility of financial and environmental variables, continuous regression variables were symmetrically winsorised at the 1% and 99% levels. This necessary procedure identifies values above and below our set thresholds and sets these values to 99th and 1st perecentaile, respectfully. This secures us a robust final sample size of 2 734 firm-year observations for the regression analysis (Table 1).

Table 1: Sample Construction

Action	Observations removed	Observations remaining
Initial dataset with all European companies 2014-2024		**72 668**
Removing observations with missing ESG pillar scores	-63 148	9 520
Removing observations with missing Total emissions	-752	8 768
Removing observations with infinite Carbon Intensity values	-50	8 718
Filtering for policy years (2014, 2015, 2018, 2019, 2020)	-5 984	2 734

Final analysis dataset	**2 734**

4.2 Descriptive Statistics

Table 2 shows the descriptive statistics for European publicly listed firms used in the analysis. The table provides an overview of the financial and ESG performance of the winsorized sample that was created from a full sample to avoid outliers and data skewness. Variables with less than 2 734 observations are due to missing values (NA) that occur when the numerator and the denominator are zero. For example, in calculating Carbon Intensity (Total Emissions / Sales), observations where a firm reported zero sales and zero emissions in a given year yield NA values in R. Our models automatically omit observations with missing values.

Table 2: Summary Statistics

Variable	N	Mean	St. Dev.	Min	Max
Environmental Score	2 734	55.18	25.56	2.77	96.58
Social Score	2 734	62.96	21.37	9.10	96.27
Governance Score	2 734	52.19	22.25	7.26	93.53
Total emissions*	2 734	15.73	42.51	0.00	290.70
S2 emissions*	2 734	0.29	0.95	0.26	15.10
S1 emissions*	2 734	1.83	10.14	0.14	179.70
R&D expense**	2 734	108.26	469.73	0.00	3 679.98
R&D intensity	2 728	0.01	0.03	0.00	0.14
Dividends**	2 734	253.18	609.19	0.00	6 766.97
Dividends dummy	2 734	0.76	0.43	0.00	1
Cash**	2 734	2 844.21	13 927.60	-0.23	308 703.00
Cash ratio	2 728	0.10	0.09	0.00	0.49
Sales**	2 734	10.52	21.83	0.21	357.23
Sales growth	2 710	0.58	2.31	-0.89	16.27
Sust. Comp. Incentives	2 734	0.27	0.45	0.00	1
Sust. Committee	2 734	0.66	0.47	0.00	1
Assets**	2 734	40 749.34	165 838.61	0.00	2 488 491.00
Equity**	2 734	5 438.67	12 056.96	-5 351.00	112 799.00
Net income**	2 734	436.64	1 339.15	-10 495.00	13 886.00
ROA	2 734	0.04	0.07	-0.22	0.30
ROE	2 734	0.10	0.19	-0.67	0.82
Debt**	2 734	6 864.04	20 828.49	0.00	150 069.70
Leverage	2 728	0.26	0.16	0.00	0.71

Financial Slack	2 412	1.98	11.30	0.00	536.74
Carbon Intensity	2 734	11.58	66.92	0.00	617.16

* Figures shown in billions of tons of greenhouse gas emissions
** Figures shown in million EUR

It can be seen from the table that on average, Social score is higher for companies in the selected sample, since the mean is the highest among all 3 ESG dimensions, with social pillar having a mean of 62.96, environmental of 55.18 and governmental - 52.19. Across the sample, the highest and lowest recorded pillar scores occur in different firms and years, reflecting variation in sustainability performance across dimensions.

When looking at accounting and financial metrics, it becomes clear that the sample is diverse in a sense of the size of the companies used in the analysis, their profitability and capital structures. We believe that total assets and sales are representative proxies for the size of a particular firm, meaning that we have included both small companies with total assets and sales value less than 1 million EUR, as well as big enterprises with the biggest company having the turnover of 357.23 million EUR.

The sample also differs with regards to management decisions. 76% of the firms are considered to be dividends paying. Also, while 66% of the companies have sustainability committee, only 27% have financial incentives for employees tied to the ESG performance.

Regarding the newly created variables that will later be used in the regressions, financial slack and carbon intensity, there is a high dispersion among the companies. While the mean value for financial slack is 1.98, the maximum is 536.74. Similarly, the average carbon intensity for the sample is 11.58, but the highest value is 617.16.

These differences in ESG scores and financial metrics for European companies indicate the importance of the correct design for the empirical analysis. Although we have decided to base our regressions of the carbon intensity variable that is a firm-level measure in contrast to Zhang (2025) that focuses on industries, we still believe that it is valuable to look at the variance among sectors. Table 2 shows how the average ESG performance, carbon emissions, financial scale, and capital structure vary across industries in the sample.

4.3 Industry-Level Variation

Table 3: Industry-Level Summary Statistics

Industry	n	E Score	S Score	G Score	CI Mean	CI Median	Assets (bn EUR)	Sales (m EUR)	R&D Intensity	Leverage
Accommodation and Food Services	22	76.5	80.0	53.4	1.01	0.70	7.88	5.16	0.00%	0.428
Administrative and Support and Waste Management and Remediation Services	64	41.9	58.6	46.5	3.20	0.42	4.57	5.02	0.18%	0.344
Agriculture, Forestry, Fishing and Hunting	8	34.7	34.1	65.2	6.07	2.53	1.24	0.36	2.65%	0.270
Arts, Entertainment, and Recreation	28	36.5	47.3	35.7	0.29	0.07	1.29	1.76	0.00%	0.333
Construction	131	60.3	62.7	47.3	7.13	0.77	10.46	4.16	0.09%	0.255
Educational Services	2	26.7	55.8	34.7	0.28	0.28	1.65	1.69	0.00%	0.564
Finance and Insurance	372	59.8	61.4	57.6	10.32	1.26	215.08	15.10	0.01%	0.123
Health Care and Social Assistance	26	49.2	62.7	57.9	0.50	0.09	16.88	11.44	0.24%	0.417
Information	210	45.7	61.0	53.3	21.06	0.11	14.36	13.36	0.78%	0.313
Manufacturing	1 095	55.4	64.2	51.4	9.86	0.88	14.90	11.74	2.15%	0.232
Mining, Quarrying, and Oil and Gas Extraction	42	58.1	66.4	51.0	20.43	7.41	4.78	2.90	0.36%	0.283
Other Services (except Public Administration)	9	52.4	65.6	56.9	7.46	7.57	4.30	1.27	0.00%	0.260
Professional, Scientific, and Technical Services	157	48.3	64.9	50.3	3.49	0.15	5.57	5.07	1.59%	0.259
Real Estate and Rental and Leasing	157	54.8	57.5	49.0	7.80	0.05	10.04	4.33	0.00%	0.453
Retail Trade	107	61.1	66.1	50.8	24.86	0.55	8.87	8.43	0.00%	0.288
Transportation and Warehousing	104	61.8	70.0	54.5	3.36	1.41	11.39	9.55	0.02%	0.372
Utilities	132	65.4	65.3	57.2	34.66	2.76	33.86	18.21	0.00%	0.324
Wholesale Trade	68	41.2	51.4	50.4	15.93	1.85	6.68	3.58	0.12%	0.259

The dataset is not evenly distributed across industries, since Manufacturing accounts for the largest number of firm-year observations with 1 095, followed by Finance and Insurance with 372, and the Information sector with 210 observations. In contrast, only 2 observations come from Educational Services and 8 from Agriculture, Forestry, Fishing and Hunting, which reflects the limited presence of listed companies in those categories in Europe.

In terms of ESG scores, the Accommodation and Food Services industry shows the highest average environmental and social performance (E-score 76.5, S-score 80.0), whereas the Educational Services sector displays the lowest Environmental pillar score (26.7) and the Agriculture, Forestry, Fishing and Hunting sector shows the lowest Social pillar score (34.1). Governance scores are more balanced across industries, however, Agriculture, Forestry, Fishing and Hunting tend to score relatively high (65.2), while the Arts, Entertainment and Education sector performs worse with a G-score of around 34-36.

Carbon intensity exhibits a greater variation than ESG scores. For example, the Utilities sector shows a high mean carbon intensity (34.66), whereas Retail Trade, Mining and Information also stand out with high emissions. Because the mean is skewed by large emitters, the median offers a more representative picture. Based on the median, sectors such as Arts, Entertainment (0.07) and Real Estate (0.05) are considerably less carbon-intensive, reflecting differences in production processes and the degree of material and energy use required.

As noted previously, total assets and sales serve as a proxy for firm size. Finance and Insurance represents the largest firms in the sample with average assets of 215.08 billion EUR, while Utilities also exhibit substantial size (33.86 billion EUR). Conversely, the Agricultural sector shows notably smaller firms with average assets of only 1.24 billion EUR. Research and development activity is concentrated mainly in Manufacturing (2.15% R&D intensity) and Agricultural sector (2.65%), while many service-based industries invest comparatively little in this area. Leverage also varies across sectors, with Educational Services firms operating with higher leverage (0.564) and Finance and Insurance firms showing lower leverage (0.123), which is likely linked to regulatory capital requirements or differenced in the balance sheet structure compared to other industries.

Overall, the table highlights structural differences between industries in terms of emissions exposure, sustainability performance, firm size and financial characteristics. After looking at

the absolute differences across the industries and the whole sample, we decide to research the correlations between different measures.

4.4 Correlation Analysis (ESG, Emissions, Financial Performance)

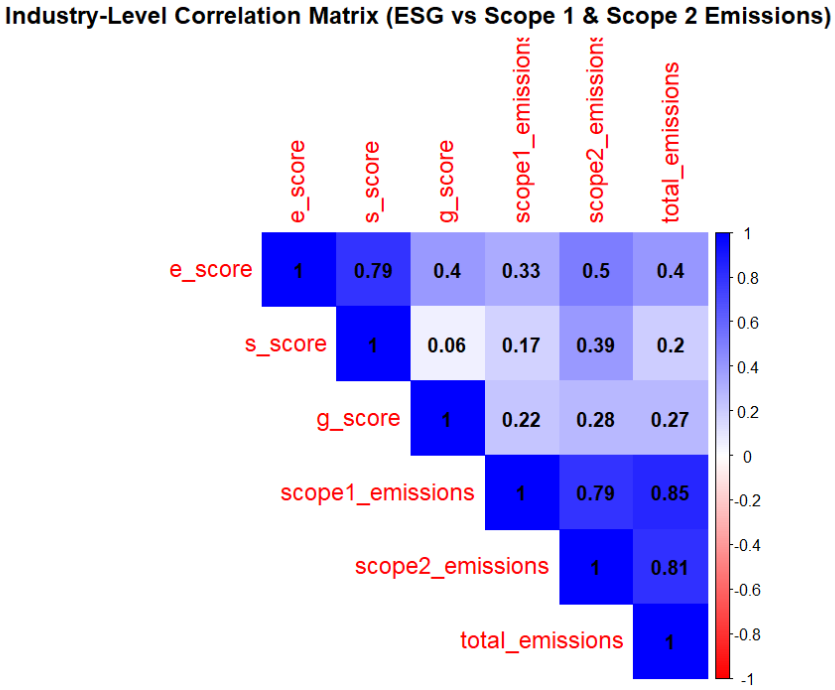

Figure 1. *Industry-Level Correlation Matrix between ESG Scores and Scope 1 & Scope 2 Emissions.*

Figure 1 shows the industry-level correlations between the ESG parameters.

The environmental score shows a moderate positive correlation with Scope 2 emissions (0.50) and a weaker correlation with Scope 1 emissions (0.33). This suggests that industries with higher reported environmental scores are not necessarily those with lower direct emissions, which may reflect differences in reporting practices, the timing of sustainability initiatives, or the fact that some industries with heavy indirect energy use invest more in environmental disclosure and efficiency programmes.

Social and governance scores display much weaker associations with emissions. The correlations between the social score and Scope 1 (0.17) or Scope 2 (0.39) emissions remain low, while governance correlations are very small (0.22 and 0.28), indicating that governance quality is only slightly related to the carbon emissions of an industry. This implies that improvements in corporate governance or socially oriented policies do not automatically translate into reductions in emissions at the industry level.

As expected, Scope 1 and Scope 2 emissions are strongly correlated with one another (0.79) and with total emissions (0.85 and 0.81, respectively), confirming that sectors with high direct emissions tend to exhibit high indirect emissions as well, reflecting the overall emissions-intensive nature of their production processes.

The most important finding from this correlation matrix is the correlation between the ESG pillars with one another. There is a highly positive correlation between the E-score and S-score of 0.79. On the other hand, similarly to the emissions correlation findings, the G-score has a lower correlation with E-score (0.40) and S-score (0.06).

After finding a high correlation between the environmental and social dimensions on the industry lever, the firm level analysis was conducted.

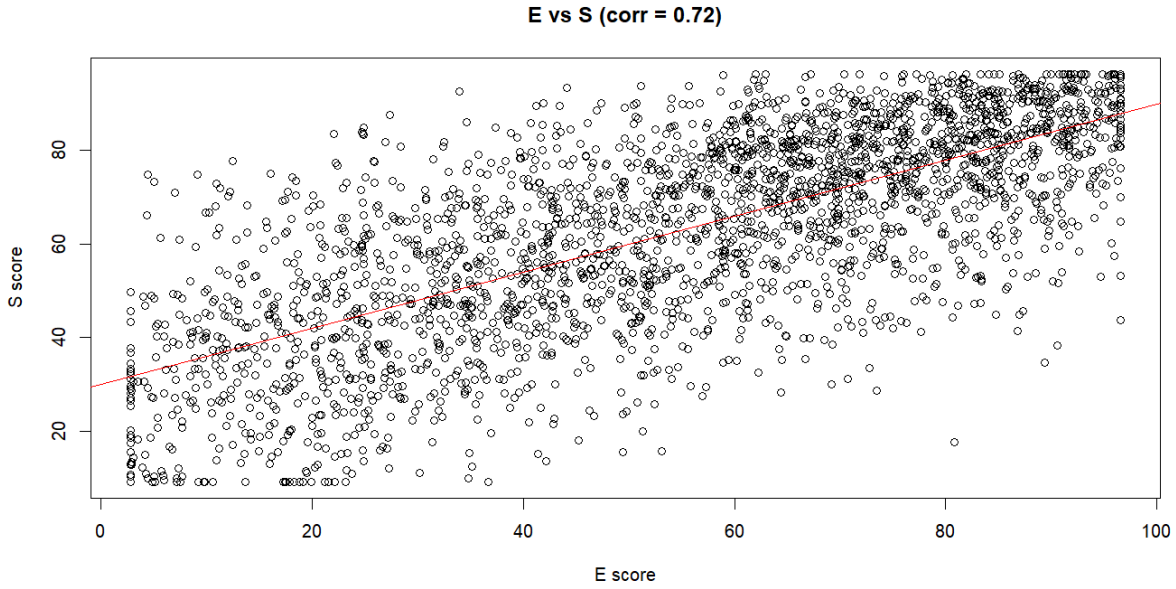

***Figure 2**. Relationship Between Environmental and Social Scores on a Firm-Level.*

Following the same pattern as Figure 1, the scatterplot illustrates a strong positive association between environmental and social scores, reflected in a correlation of 0.72. This indicates that firms with higher environmental ratings tend to also receive higher social ratings. The upward trend line suggests that improvements or strong performance in one dimension are often associated with similar outcomes in the other. This alignment may reflect shared underlying drivers such as stakeholder expectations, regulatory compliance, or resource allocation to sustainability as a whole.

4.5 Environmental and Financial performance

Figure 3 presents the firm-level correlations between total CO_2 emissions and key financial indicators, illustrating how emissions relate to profitability, leverage, and debt across companies.

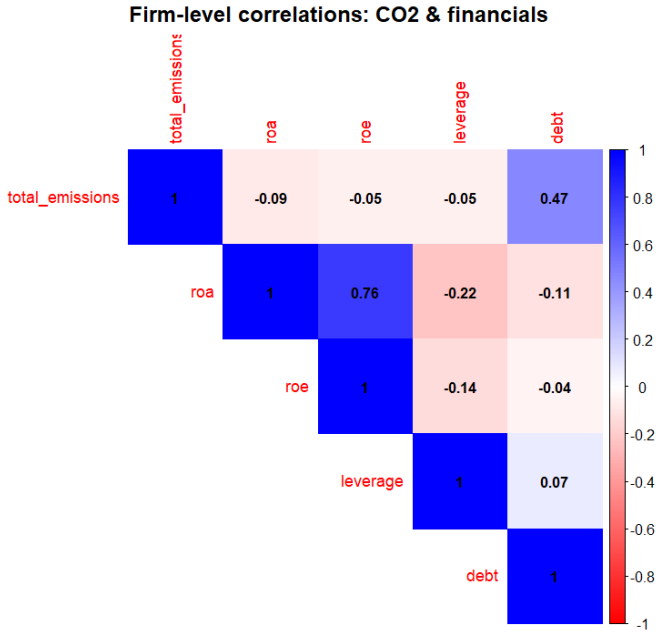

Figure 3. *Correlation Matrix of CO_2 Emissions and Financial Indicators.*

The correlation matrix shows that total emissions exhibit very weak relationships with profitability measures in general, as indicated by near-zero correlations with ROA (-0.09) and ROE (-0.05). This suggests that higher or lower emissions do not translate directly into differences in accounting-based profitability at the firm level. A similarly small negative correlation is observed between emissions and leverage (-0.05), showing that more highly leveraged firms are not necessarily more emissions-intensive. In contrast, the correlation between total emissions and debt of 0.47 is noticeably stronger, implying that firms with higher levels of absolute debt tend to be larger emitters. This likely reflects scale rather than financial strategy, as bigger firms typically carry more debt and produce more emissions. As expected, ROA and ROE display a strong positive correlation (0.76), confirming the internal consistency of profitability metrics. Overall, the figure indicates that emissions is only weakly related to profitability and leverage, but positively associated with debt, possibly due to underlying differences in firm size.

4.6 Carbon Intensity

Following the creation of the carbon intensity variable, it was essential to check the interaction between the newly created measure and the variables of interest. Figure 4 illustrates the relationship between carbon intensity and both environmental and social scores at the firm level.

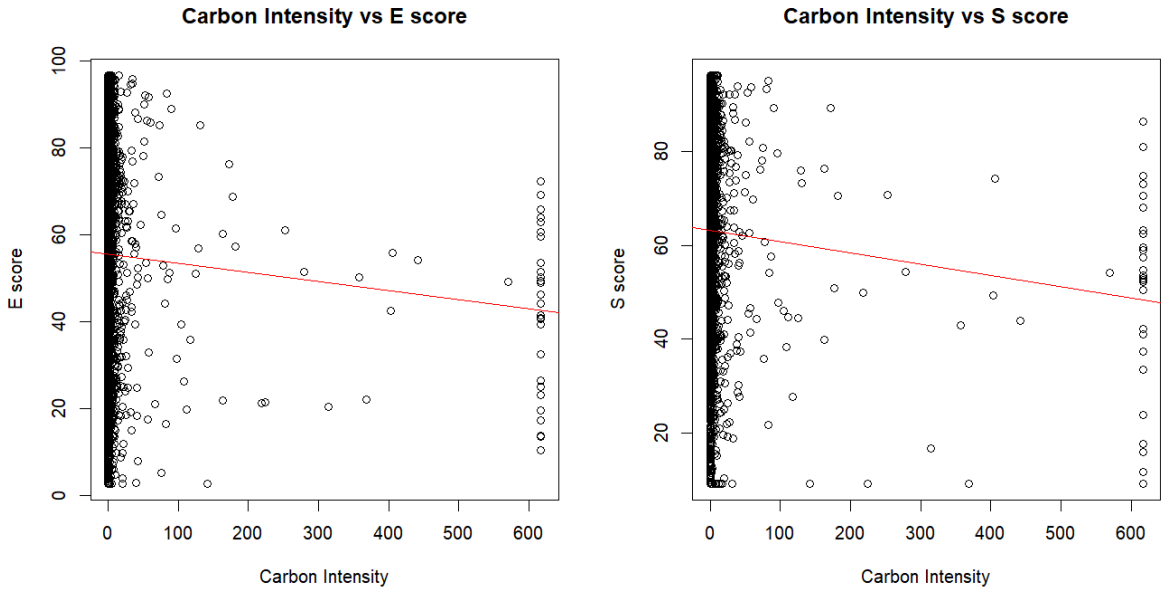

Figure 4. *Firm-Level Relationship Between Carbon Intensity and ESG Scores.*

In both panels, the downward-sloping trend lines point to a weak negative relationship, suggesting that firms with higher carbon intensity tend to receive slightly lower environmental and social scores. Nonetheless, the wide dispersion of observations shows that many high-emitting firms still report comparatively strong ESG performance. This may reflect differences in disclosure practices, varying transition strategies, or the time lag between actual emission reductions and updates in ESG ratings.

Figure 5 provides a firm-level visualisation of how carbon intensity relates to key financial indicators. Similarly to the previous findings, across the plots, the associations appear weak and in most cases statistically small, indicating that emissions intensity is not strongly tied to short-term financial performance or capital structure for the firms in the sample. The negative correlations with ROA (–0.077) and ROE (–0.058) suggest that more carbon-intensive firms slightly underperform in accounting profitability, although the effect is marginal and likely influenced by industry characteristics. A weak and insignificant association with leverage (-0.002) indicates that high-emitting firms are not significantly more leveraged, contradicting the expectation that carbon risk may constrain access to debt financing.

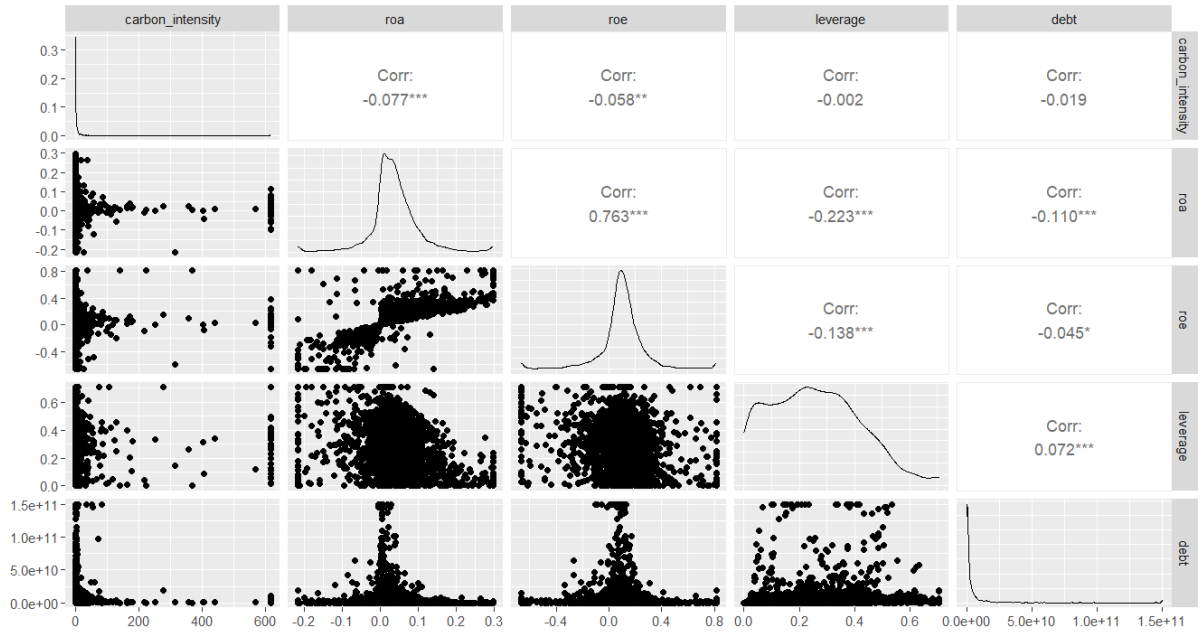

Figure 5. *Firm-Level Associations Between Carbon Intensity and Financial Indicators.*

4.7 High Emitters vs Low/Medium Emitters

Table 4 summarises the average financial and organisational characteristics of high emitters compared with low and medium emitters.

Table 4: Mean Differences Between High and Low/Medium Carbon Emitters

Variable	High Emitters	Low/Medium Emitters
Carbon Intensity	44.45	0.61
Total Emissions	41 066 952	7 275 053
Scope 1 Emissions	5 549 272	583 678
Scope 2 Emissions	550 815	204 589
Sales	5 918 064	12 054 062
R&D Intensity	0.00575	0.01200
Financial Slack	1.47	2.14
ROA	0.0158	0.0446
ROE	0.0535	0.1145
% Sustainability Committee	69.2%	65.0%

All values reported represent mean (average) values for firms within each group

Unsurprisingly, high emitters report dramatically higher carbon intensity and total emissions. On average, high-emitting firms release approximately 41.1 billion units of GHG emissions compared to 7.3 billion for low/medium emitters, with substantially higher Scope 1 and Scope 2 emissions, confirming the classification effectively distinguishes between the two groups.

In terms of firm size, low/medium emitters generate considerably higher average sales (12.1 million EUR) than high emitters (5.9 million EUR), indicating that heavy carbon emitters in the sample are not necessarily the largest firms by revenue. High emitters also appear to invest less in innovation, as their R&D intensity is roughly half that of low/medium emitters, which may suggest a slower transition pace or lower capacity to support decarbonisation-related development.

Financial performance differs significantly between the two groups. High emitters show notably lower profitability, with ROA (1.58%) and ROE (5.35%) well below the corresponding averages for low/medium emitters (4.46% and 11.45%).

Governance indicators show less divergence. The presence of a sustainability committee is only slightly more common among high emitters (69.2%) than low/medium emitters (65.0%), suggesting that formal governance structures alone do not differentiate the emissions profile of firms.

5 Results

5.1 Baseline Regression Analysis

We begin our analysis with a baseline regression to assess whether ratification of the Paris Agreement led to a substitution effect across Environmental (E) and Social (S) pillars. Governance (G) was added to the baseline regression to assess whether the results are consistent across all ESG pillars. Our primary goal is to address Hypothesis 1: improvements in the Environmental pillar may come at the expense of the Social pillar due to resource constraints.

Table 5 presents the results of this regression. The coefficient we focus on is Post * High Emitting, which isolates the effect on high-polluting firms after 2016.

Table 5: Baseline Environmental Pillar score regression

	Dependent variable:		
	E-Score	S-Score	G-Score
	(1)	(2)	(3)
Post * High Emitting	9.850***	9.080***	6.500***
	(2.203)	(1.884)	(1.878)
ROA	-19.147	-4.477	-6.886
	(12.346)	(11.275)	(11.498)

ROE	2.788	1.906	3.009
	(4.113)	(3.361)	(3.264)
R&D intensity	-8.507	60.863***	48.821*
	(24.511)	(22.566)	(27.103)
Dividends	8.224***	5.609***	-0.237
	(1.376)	(1.147)	(1.339)
Cash Ratio	-5.157	-0.420	-12.985*
	(6.941)	(6.117)	(6.701)
Sales Growth	-0.610***	-0.603***	-0.111
	(0.175)	(0.145)	(0.172)
Sustainability Compensation Incentives	6.135***	6.749***	13.696***
	(1.148)	(0.983)	(1.142)
Sustainability Committee	24.184***	21.572***	13.321***
	(1.391)	(1.153)	(1.251)
Leverage	-2.640	2.165	-1.920
	(4.655)	(3.804)	(4.315)
Observations	2,704	2,704	2,704
R^2	0.324	0.351	0.208
Adjusted R^2	0.194	0.226	0.056
Note:			**p<0.1; **p<0.05; ***p<0.01*

From the results, we observe statistically significant, positive coefficients across all three pillars, which contradicts our expectation of the substitution effect. High-emitting firms increased their Environmental score by 9.850 points, their Social score by 9.080 points, and their Governance score by 6.500 points relative to the Low-emitting firms.

These findings lead us to reject H1. Rather than trading off one pillar for another, high-emitting firms appear to be engaging in a "comprehensive sustainability upgrade." This leads us to believe that firms under high regulatory scrutiny, such as heavy emitters after the Paris Agreement, cannot afford to greenwash by only improving environmental metrics. Neglecting social welfare or governance is not an option. To not lose the trust of the market and investors, they have to monitor all non-financial aspects of the company; they cannot single out any one of them.

5.2 Impact on Firm Fundamentals

After confirming that ESG scores rose overall, we next analyse company fundamentals to see the financial effects of maintaining high Environmental scores. Here, we introduce our triple

interaction model (Post * High Emitting * E-Score) to assess whether greater environmental performance affects profitability, liquidity, or solvency.

Table 6: Triple interaction regression with financial data

	Dependent variable:		
	R&D Intensity	ROA	ROE
	(1)	(2)	(3)
Post * High Emitting * E-Score	-0.0001	-0.0005*	0.002*
	(0.0001)	(0.0003)	(0.001)
Post * High Emitting	0.007	0.031	-0.096
	(0.006)	(0.020)	(0.067)
Post * E-Score	-0.00003	0.00003	-0.0001
	(0.00002)	(0.0001)	(0.0002)
High Emitting * E-Score	-0.0001	-0.0001	-0.0003
	(0.0001)	(0.0001)	(0.0003)
E-Score	0.00003	-0.0001	0.0002
	(0.00004)	(0.0001)	(0.0002)
Sales Growth	-0.0005**	0.001	-0.001
	(0.0002)	(0.001)	(0.002)
ROA	0.016		2.222***
	(0.019)		(0.081)
ROE	-0.004	0.253***	
	(0.004)	(0.017)	
R&D Intensity		0.050	-0.109
		(0.061)	(0.116)
Dividends	-0.002	0.023***	-0.003
	(0.002)	(0.004)	(0.009)
Cash Ratio	0.061***	0.032*	-0.032
	(0.012)	(0.017)	(0.041)
Sustainability Compensation Incentives	0.0002	-0.003	0.005
	(0.001)	(0.002)	(0.008)
Sustainability Committee	0.003	0.0001	-0.002
	(0.002)	(0.003)	(0.007)
Leverage	-0.028***	-0.067***	0.079***
	(0.006)	(0.011)	(0.029)
Observations	2,704	2,704	2,704
R^2	0.104	0.633	0.594

Adjusted R^2	-0.069	0.562	0.515
Note:			**p<0.1; **p<0.05; ***p<0.01*

Table 6 reveals a notable divergence between profitability metrics. We observe a negative coefficient for ROA (-0.0005) but a positive coefficient for ROE (0.002). Both of them are statistically significant.

When it comes to ROA, the negative impact on this variable suggests an "asset heaviness" effect: firms are investing in green assets to improve their Environmental score. This increases the total assets denominator. However, these investments take time to generate the desired returns. The positive ROE suggests that these investments may be debt-financed. Alternatively, firms may be managing their equity base to maintain shareholder returns despite operational cost pressures.

R&D Intensity in this model is statistically insignificant, which is an interesting finding. This implies that simply maintaining a high Environmental score does not necessarily require consistently high R&D spending. Later sections will show that R&D intensity is more sensitive to the rate of change (innovation) than the level (maintenance). What this implies is that, to an extent, the Environmental pillar score can be improved through policy implementation and/or improved disclosure.

5.3 Cost Structure Analysis

Since the trade-offs in fundamentals were mixed, we turned to the firm's cost structure to identify where resources are being consumed. We hypothesised that higher sustainability scores would be associated with higher operating costs.

Table 7: Triple interaction regression with cost data

	Dependent variable:	
	SG&A Expense	Interest Expense
	(1)	(2)
Post * High Emitting * E-Score	59 675 862**	3 393 522*
	(27 188 379)	(1 997 428)
Post * High Emitting	-3 900 815 072**	-290 324 423**
	(1 864 565 132)	(143 783 455)
Post * E-Score	-20 015 325***	138 289.400
	(4 314 788)	(224 723)

High Emitting * E-Score	22 480 312*	1 821 679**
	(12 604 097)	(857 271.200)
E-Score	50 246 982***	629 777.400**
	(6 497 798)	(259 429)
Sales Growth	-46 238 977***	-383 546.400
	(17 643 148)	(897 218.100)
ROA	-1 464 729 490	-92 134 186
	(1 525 627 631)	(83 351 472)
ROE	292 132 998	28 383 617
	(463 894 069)	(22 380 263)
R&D Intensity	445 812 989	-588 096 239***
	(3 842 666 102)	(222 869 363)
Dividends	194 859 909	-19 390 023*
	(151 687 734)	(10 313 128)
Cash Ratio	259 032 174	-31 982 055
	(705 865 083)	(40 197 146)
Sustainability Compensation Incentives	900 657 796***	3 371 427
	(190 969 181)	(11 710 089)
Sustainability Committee	365 451 147***	3 844 214
	(131 097 024)	(6 903 232)
Leverage	-708 732 466	-80 124 760**
	(533 521 257)	(33 469 129)
Observations	2 704	2 704
R^2	0.213	0.090
Adjusted R^2	0.061	-0.086
Note:		**p<0.1; **p<0.05; ***p<0.01*

Table 7 highlights these costs. The triple interaction for SG&A Expense (Selling, General, and Administrative Expense) is positive and significant. For a high-emitting firm, a 1-unit increase in E-score post-2016 is associated with about €59.6 million in higher SG&A expenses. This shows that sustainability is administratively intensive and requires substantial spending on environmental monitoring; additionally, these are one of the costs where management has considerable flexibility.

We also observe a positive and significant coefficient for Interest Expense. This leads us to believe that lenders seem to view high-emitting firms as inherently riskier due to transition risks, like potential carbon taxes or stranded assets, which in the end could even worsen the

situation for the company. Even as these firms improve their E-scores, the banking sector prices in the risk of their legacy business models. This leads to higher interest burdens than those of low-emitting peers.

5.4 Dynamic Analysis: Percentage Change in E-Score

To gain deeper insight into firms' strategic behaviour, we replaced the E-score with the Percentage Change in E-score. This approach lets us observe firms that are actively and rapidly decarbonising, not just those maintaining a high score.

Table 8: Triple interaction regression (% change in E-score) with financial data

	Dependent variable:		
	ROE	R&D Intensity	Sust. Comp. Incentives
	(1)	(2)	(3)
Post * High Emitting * E-score % Change	-0.134**	0.014*	-0.665**
	(0.066)	(0.009)	(0.286)
Post * High Emitting	0.019	-0.005	0.251***
	(0.018)	(0.003)	(0.060)
Post * E-score % Change	-0.056	-0.006	0.232***
	(0.046)	(0.005)	(0.068)
High Emitting * E-score % Change	0.084	-0.011	0.755***
	(0.059)	(0.008)	(0.292)
E-score % Change	0.059	0.007	-0.286***
	(0.047)	(0.005)	(0.066)
Sales Growth	-0.002	-0.0002	0.001
	(0.003)	(0.0003)	(0.005)
ROA	2.183***	0.027	-0.310
	(0.108)	(0.023)	(0.300)
ROE	-0.114		-0.004
	(0.151)		(0.591)
R&D Intensity		-0.003	0.060
		(0.004)	(0.099)
Dividends	-0.006	-0.001	-0.031
	(0.011)	(0.002)	(0.029)
Cash Ratio	-0.049	0.068***	0.389**
	(0.050)	(0.014)	(0.177)

Sustainability Compensation Incentives	0.005	-0.00001	
	(0.008)	(0.001)	
Sustainability Committee	0.002	0.004**	0.092***
	(0.008)	(0.002)	(0.031)
Leverage	0.078**	-0.030***	0.378***
	(0.035)	(0.007)	(0.103)
Observations	2,221	2,221	2,221
R^2	0.534	0.122	0.061
Adjusted R^2	0.422	-0.091	-0.166

Note: *p<0.1; **p<0.05; ***p<0.01

Table 9: Triple interaction regression (% change in e-score) with cost data

	Dependent variable:	
	SG&A Expense	Interest Expense
	(1)	(2)
Post * High Emitting * E-score % Change	-1 790 232 005*	-105 941 900*
	(923 448 962)	(59 711 850)
Post * High Emitting	1 797 703 608***	82 300 348*
	(676 968 158)	(42 620 896)
Post * E-score % Change	-1 279 311 030**	-13 400 448
	(505 119 068)	(15 280 293)
High Emitting * E-score % Change	858 478 208	29 337 609
	(710 589 013)	(27 201 847)
E-score % Change	663 106 214	2 823 953
	(498 997 712)	(13 593 378)
Sales Growth	-80 634 441***	47 220.790
	(25 115 462)	(870 857.800)
ROA	-2 680 446 348	-134 035 154
	(1 963 037 433)	(117 730 181)
ROE	297 227 328	34 923 010
	(594 590 660)	(28 014 963)
R&D Intensity	-76 925 860	-919 608 207**
	(6 065 739 760)	(377 693 767)
Dividends	505 977 714***	-16 180 827
	(194 289 658)	(13 160 762)
Cash Ratio	-303 716 856	-47 991 159
	(996 216 595)	(65 980 103)
Sustainability Compensation Incentives	1 118 002 398***	14 089 732
	(224 339 103)	(14 359 672)

Sustainability Committee	1 176 508 747***	32 570 377**
	(174 350 275)	(12 700 382)
Leverage	-957 847 507	-113 464 031**
	(753 850 533)	(47 195 430)
Observations	2 221	2 221
R^2	0.108	0.048
Adjusted R^2	-0.109	-0.184
Note:		**p<0.1; **p<0.05; ***p<0.01*

Table 9 complements this dynamic view by analysing the cost implications of these rapid improvements. In stark contrast to the static model (Table 7), where higher E-scores were associated with higher SG&A costs, Table 9 reveals a negative and statistically significant coefficient for SG&A Expense (-1.79 EUR billion in the triple interaction term).

This finding contradicts previous results, making it interesting but at the same time also challenging to analyse. As mentioned before, we believe that maintaining a high sustainability rating involves significant administrative investment in people and monitoring. On the other hand, quickly improving that rating could lead to the need for considerable resource reallocation. High-emitting firms that are aggressively decarbonising are likely to cut general administrative bloat (SG&A) to free liquidity for the increased R&D investment observed in Table 8. This finding suggests that firms that are planning to quickly boost their E-score are shifting resources from monitoring and oversight to more innovative activities to meet Paris Agreement targets.

Finally, we observe a negative coefficient for Sustainability Compensation Incentives, which is a dummy variable and shows if a company has implemented rewards linked to meeting environmental, social, and governance (ESG) targets. This likely reflects the governance maturity of these transitioning firms. Companies striving to improve (high percentage change) may not yet have formalised ESG compensation structures like those of mature green firms, or they may be suspending variable compensation (bonuses or performance-based pay) to preserve cash for urgent research and development (R&D) investments required by the transition.

5.5 Heterogeneity Analysis: The Role of Financial Slack

Lastly, we examine whether these sustainability improvements depend on the availability of excess cash in the form of Financial Slack. For this regression analysis, we exclude the Finance

and Insurance sector due to the specific Balance Sheets of firms in this sector, which caused limitations in calculating their Financial Slack variable.

Table 10: Triple interaction regression with financial slack

	Dependent variable:
	E-Score
Post * High Emitting * Financial Slack	1.555
	(4.587)
Post * High Emitting	3.959
	(5.010)
Post * Financial Slack	-1.044
	(0.935)
High Emitting * Financial Slack	1.945
	(3.179)
Financial Slack	0.945
	(0.937)
ROA	-25.276**
	(12.764)
ROE	6.569
	(4.133)
R&D Intensity	7.522
	(26.288)
Dividends	8.355***
	(1.474)
Cash Ratio	-10.071
	(6.836)
Sustainability Compensation Incentives	6.111***
	(1.213)
Sustainability Committee	22.820***
	(1.531)
Leverage	2.682
	(4.759)
Observations	2,351
R^2	0.313
Adjusted R^2	0.180
Note:	**p<0.1; **p<0.05; ***p<0.01*

As shown in Table 10, the triple interaction coefficient for Financial Slack is statistically insignificant. We believe that the Paris Agreement made firms include sustainable activities and future projects as a part of their strategic goals, which is why we obtained this result. High-emitting firms are allocating resources to improve their E-scores regardless of their excess liquidity possibilities. They are driven by the regulatory requirements and market pressure of the Paris Agreement rather than internal financial abundance, which is especially true for the companies operating in Europe.

6 Discussion

The findings of this thesis challenge the conventional view that gains in one area of corporate responsibility must entail losses in others after the Paris Agreement. This is shown by comparing past beliefs to the new results. The main theory (H1) was that companies that emit a lot but have limited resources would have to cut back on Social efforts to meet their Environmental targets.

However, the data tells a different story. High-emitting companies did not make this trade-off. These results show that, under the new rules following the Paris Agreement, simply picking and choosing what to do is not enough for high-emission companies. The ESG topic has become increasingly more important and popular in recent years, which could explain why we do not see a trade-off between the three pillars. The market, investors, and consumers expect companies to operate more sustainably, and whilst the Paris Agreement mostly focused on environmental aspects, due to the demanding and well-informed stakeholders, firms cannot afford to neglect the other two pillars. To add to this argument from the baseline regression analysis in Table 5, we see that the presence of a sustainability committee and/or sustainability compensation incentives has a positive and significant impact on all three ESG pillar scores. This means that for high-emitting firms, there are not only external factors that pressure management to implement improvements across the board, but also an internal team that drives sustainable practices, helping companies improve all pillars simultaneously. Earlier research by Hahn et al. (2010) and Farzamfar et al. (2022) found that companies with limited resources often have to choose among different types of non-financial goals. The current data shows that firms now feel pressure to do well in all areas, not just one, so they do not look like they are pretending to be green. Unlike past findings, this research suggests that strict environmental rules push firms to improve in all areas. Meeting environmental standards also raises their performance in social and governance areas.

The difference between keeping a high environmental score and improving it also shows how companies use their resources. Keeping a high score increases the cost of tasks like office work and compliance, since they must do more checking and reporting. By contrast, companies that quickly improve their scores shift their spending. They spend less on office work and more on research and development. So, these firms shift resources from paperwork to creating new things, reallocating administrative costs to innovation investments. This shows there are two ways companies cut emissions: one way focuses on following the rules, and the other on new ideas. And whilst these findings suggest some sort of substitution effects, putting them into perspective shows that they are not as strong as we had expected. For example, the results in Table 7 show that, for high-emitters after 2016, a 1-unit increase in E-score would increase SG&A costs by about 60 million EUR. Whilst this seems a lot, given that the average yearly SG&A expense for a company in our dataset is about 1.79 billion EUR, the increase no longer seems material (only about 3%). When it comes to the triple interaction coefficients for R&D intensity in Table 8 (0.014) and SG&A expense in Table 9 (-1.79 billion EUR), both of these results are the same as the average of these 2 variables in our dataset, which means that the effects are material for a specific part of the companies in our sample.

Whilst it is an insightful finding that trade-offs are present, mostly in the cost component, when increasing the Environmental pillar score, the magnitude of our results suggests this does not fully explain the improvement. When breaking down the criteria that make up the E-score, we notice that there are points that are more policy-oriented, and the other part is money/number-oriented. This leads us to believe that the part of the Environmental pillar score increase that we cannot explain most likely comes from the policy-oriented criteria. This includes things like more transparent disclosure or setting sustainability targets; doing this is not as expensive as, for example, researching a new formula for producing sustainable concrete. In our view, policy-oriented criteria do not affect company fundamentals or impose costs large enough to affect the variables in our research.

Lastly, another difference to consider is the extra money companies might have. Unlike the earlier belief that only cash-rich companies can focus on sustainability, our analysis shows no such effect. High-pollution companies improved their environmental performance regardless of whether they had spare funds. This shift is important. Before, having extra cash allowed for more attention to the environment. Now, all companies have to act. The Paris Agreement has changed, reducing emissions from a choice to something companies must do. In Europe, rules

and market expectations are now strong enough to push resources towards environmental goals, regardless of companies' financial positions. Today's environment is not about making trade-offs between Social, Environmental, and Governance areas, but about choosing between doing things the old way and trying something new and transformational.

7 Conclusion

This thesis examined whether companies experience a trade-off between ESG pillars after the Paris Agreement. It focused on whether better environmental performance impacts social or governance outcomes. The findings did not support the idea of a trade-off. Instead, high-emitting European companies raised their Environmental, Social, and Governance scores simultaneously after the Agreement. This shows that firms facing regulatory and stakeholder pressure are taking a broader approach to sustainability, rather than just focusing on environmental disclosure.

The financial results were more mixed. Better environmental performance linked to higher operating and financing costs when looking at ESG levels. However, companies that quickly improved their E score seemed to reallocate resources internally. The different trends for ROA and ROE suggest that firms might be absorbing the initial costs of environmental improvements through their assets while still providing returns for equity holders, possibly through debt financing or changes in their capital structure.

7.1 Limitations

This study has several limitations. First, the dataset was not perfectly balanced between the pre- and post-Paris Agreement periods. Some firms left the sample while new firms joined, and we could not determine if these changes were related to the Paris Agreement or to other business developments. Using only firms that were present in both periods would have made the sample too small, so we used the full dataset. This choice affects comparability across periods.

Second, while the data was generally reliable, some financial variables still have accuracy issues. During dataset construction, we found inconsistencies and measurement problems, especially with variables used for cost and performance analysis. These discrepancies likely come from differences in reporting standards or restatements across firms and years. As a

result, some relationships in the regression output may reflect reporting practices rather than actual economic effects.

Finally, the study focuses on publicly listed European firms, which operate in an environment with strong regulatory and investor pressure. The results may not apply fully to other regions, private companies, or markets with weaker sustainability requirements.

7.2 Further Research

Since this study did not find clear evidence of ESG trade-offs, future research should look beyond numerical scores and focus more on decision-making by managers. The positive and significant results for factors related to management structures, such as sustainability committees and ESG-linked pay, suggest that internal governance may play an important role in how sustainability is implemented.

Further research could also examine how ESG scores change over time. For instance, it could investigate whether environmental gains come more from disclosure or from costly operational changes, and if this varies by industry or by companies with different levels of emissions. Finally, a longer time frame may be needed to determine if trade-offs appear later, after the initial regulatory adjustment period has ended.

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9 Appendices

Appendix A: Variables

Variable	Description	Source
S-score	Social Pillar Score (0-100), measuring social performance	LSEG workspace
G-score	Governance Pillar Score (0-100), measuring governance performance	LSEG workspace
E-score	Environmental Pillar Score (0-100), measuring environmental performance	LSEG workspace
Total Emissions	Total greenhouse gas emissions, measured in metric tons of CO_2 equivalent, representing the sum of Scope 1, Scope 2 and Scope 3 emissions	LSEG workspace
Scope 1 Emissions	Direct greenhouse gas emissions, measured in metric tons of CO_2 equivalent	LSEG workspace
Scope 2 Emissions	Indirect greenhouse gas emissions, measured in metric tons of CO_2 equivalent	LSEG workspace
R&D intensity*	R&D intensity (R&D expenses / Sales)	Calculated variable
Dividends*	Binary variable indicating if dividends were paid (1) or not (0)	LSEG workspace
Cash ratio	Cash ratio (Cash & equivalents / Current Liabilities)	Calculated variable
Sales growth	Year-over-year growth in sales	LSEG workspace
Sustainability Compensation Incentives	Indicates if executive compensation is linked to sustainability targets (binary variable)	LSEG workspace
Sustainability Committee	Indicates existence of a board-level sustainability committee (binary variable)	LSEG workspace
ROA*	Return on Assets (Net income / Total assets)	Calculated variable
ROE*	Return on Equity (Net income / Shareholder's equity)	Calculated variable
Leverage*	Financial leverage (Total debt / Total equity)	Calculated variable
SG&A expense	Total Selling, General, and Administrative (SG&A) expenses	LSEG workspace
Interest expense	Interest expenses	LSEG workspace
E-score % change*	Percentage change in Environmental Score from previous year	Calculated variable
Financial slack*	Financial slack (Current assets / Current liabilities)	Calculated variable

**Variables are calculated by the authors using data obtained from LSEG workspace*

Appendix B: Usage of AI Tools in Thesis Writing

We used AI tools during the development of this thesis for support with coding, language improvement, and research. The tools used were ChatGPT by OpenAI, Gemini, and Perplexity, mainly to help with writing R code, solving coding errors, and improving the clarity and phrasing of our text. ResearchRabbit was used only at the early stage of the research to help us find relevant academic papers for the literature review.

When working in R Studio, these tools helped us understand error messages, suggested code options, and offered explanations when we were unsure which functions to use. While this saved time and made the process easier, we were careful with every suggestion. AI-generated code is not always correct, so we checked all recommendations using official documentation and manual validation of the results. For example, when merging datasets, we reviewed sample entries across years to ensure the data aligned properly.

For writing and editing, AI tools helped improve grammar, clarity, and sentence structure. We always reviewed the suggestions to make sure the meaning remained correct and important details were not lost. Some tables were also formatted with the help of AI, based on screenshots from R Studio, and we checked every table against the original output to avoid errors.

ResearchRabbit was used only to locate suitable literature and explore connections between relevant research topics. All reading decisions, summaries, and conclusions were carried out independently by us.