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ESG and Financial Performance in High-Impact Sectors

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ABSTRACT:

This study examines the connection between Environmental, Social and Governance (ESG) scores and economic performance of firms in high-impact industries namely energy, manufacturing and transportation. There is strong evidence of a positive correlation between effective ESG practices and greater profitability, superior market valuation and lower financial risk. The data-driven analysis in this work consists of OLS regressions with firm-level fixed effects and heteroscedasticity-robust (HC3) standard errors. We proxy for profitability by profit margin (ROA) and market valuation with a market value ratio, where volatility represents financial stability. Scores are compiled into a performance metric based on the three pillars of ESG environmental, social, governance. To be specific, the empirical results imply a positive and significant association between ESG performance and ROE and ROA as well as Tobin's Q, thus corroborating that firms with good ESG management practices tend to outperform either financially or along the lines of investor expectations regarding overall firm value. The strong negative correlation comes from the fact that ESG performance tends to reduce financial risk and increase resilience, while all four pollution measures are becoming more volatile (to the downside). The robustness analysis confirms the stability of these results, which are non-discretionary with the largest positive effect. Additionally, exploratory analysis indicates that the impact of ESG on financial performance varies by ESG domain and is more pronounced in valuation and risk (lower cost of capital) compared to firm growth. They also show that ESG is not a short-term performance catalyst but rather a long-term strategic force. It is an evidence for the imperativeness of sustainability embedment into corporate development strategy particularly in sectors with high environmental and social externality.

Keywords: Environmental, Social, and Governance (ESG), Financial Performance, Profitability, Market Valuation, Financial Stability, Volatility, Sustainability, High-Impact Industries, Regression Analysis, Corporate Governance.

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1 Introduction

1.1 Background and Motivation

The concept of considering the Environmental, Social, and Governance (ESG) factors into the analysis of the investigation and corporate decision-making has not only ceased to be a niche in the world financial management, but has become one of its main courses over the last few years. The pressure of institutional investors, regulators and the broader financial community to enquire how companies treat sustainability is on the rise and an attempt is underway to understand whether good ESG performances are being translated into good financial performances financial performance (Aydoğmuş, Gülay, & Ergun, 2022).).. This paradigm shift is driven by a greater recognition that non-financial risks like the climate change and resource depletion, labor rights and corporate ethics can actually impact on the long term sustainability of a firm. The tendency towards rapid growth of the sustainable finance products, such as green bonds, ESG mutual funds, and socially responsible investment portfolio, signifies the utmost importance of determining the correlation between ESG measures and financial performance.

Although this trend can be observed throughout the market, it is especially acute with respect to high-impact industries. They are the industries defined by the Global Industry Classification Standard (GICS), including energy, mining, manufacturing, and transportation that are on the front lines of the challenge of sustainability (Chen, Song, & Gao, 2023). These are characterized by huge environmental externalities, twists and turns in the supply chain and high regulatory pressure. ESG is a strategy and not a compliance measure to these companies. They are confronted with a two-fold challenge to not only cope with a more restrictive regulatory environment aimed at restricting carbon emissions and imposing social responsibility, but also to handle capital-intensive processes that have an infamous reputation of decarbonization.Corporate social responsibility and financial performance have had divergent results in relation to the financial literature.

The initial academic arguments, founded on shareholder theory, thought that the ESG activities would cause a deviation in the profit maximization and they might be a drain to the finances. Conversely, stakeholder theory suggests that fulfilling the interests of workers, communities and society results in creation of intangible assets contributing to creation of long-term value. This pressure is escalated in the high impact industries. Sustainability investments in these areas, such as decarbonizing a power grid or having ethical supply chains in mining, require substantial initial capital investment. The pressure to spend on reputation and mitigation of regulatory risks would, albeit, have an immediate impact on profitability which is often discussed, and there is no agreement on whether ESG is a strategic resource or a financial burden under such specific circumstances. This has been compounded in the recent geopolitical and economic changes. The high-impact firms have become more stakes as a result of energy transition policies and changing standards of disclosure (Chen, Lv, & Xu, 2025). This study is therefore motivated by the fact that there is an urgent need to leave the generalized market research and to carry out an industry specific research. It is also important to understand how these ESG activities will be transformed into financial performance in the areas where there is the most tension between sustainability agenda and traditional business models. The objective of the research is founded on the question whether these firms would be successful to trade-off the high costs of the transition to sustainability and the shareholder needs to get competitive returns.

1.2 Purpose of the Study

This study mainly aims to provide empirical evidence in the existing literature between ESG performance and financial performance among those industries characterized as high-impact ones such as energy, manufacturing, transport. This though is in areas where (original more important and social impacts of environmental and sustainability challenges exist) the existing literature generalizes findings over aggregated market indices. This study explores the differences in any relationships between ESG performance and financial outcomes according to resource intensiveness or

environmental sensitivity of industries. This study is centered on the relationship between ESG and some important economic indicators (profitability, market value). It also examines the relationships that ESG performance has with different financial stability via proxy measures. Given the interest and attention paid to ESG, we dive further into understanding the separate impacts on financial performance from activity within environmental, social and governance dimensions as it relates to a much broader line between components making up ESG. As long as ESG considerations are the topic in sectors requiring more professionalism, it would generate a certified pool of evidence-based, data-driven information for corporate managers and investors and policymakers. The study could explain more on linkages towards ESG financial performance using the various dependent variables. This finding holds even when one controls for size and the growth of firms. That also enables to give a stronger judgement about whether the relationships you observe are alike or vary between different model specifications.

1.3 Research Questions

We investigate this relationship in high-impact industries through the central research question that guides this study: How is ESG performance related to key financial outcomes? The main research question is:

RQ: Does higher ESG performance correlate with profitability, Market Valuation, and Risk Mitigation in high-impact industries?

This central question is broken down into specific objectives:

Profitability: Assessing whether there is a positive relationship between ESG performance and accounting-based metrics by analyzing if operational efficiencies outweigh the costs of compliance.

Market Valuation: To examine if, on average, financial markets reward high-ESG firms with higher valuation multiples or other signs of confidence in future viability and legitimacy.

Risk Mitigation: Whether a superior ESG performance serves as an insurance product (i.e. lowers downside financial risk, stabilizes earnings and reduces stock volatility).

1.4 Intended Contribution

The paper aims to contribute to the body of research on ESG and organizational financial performance using empirical data of high-impact sectors in which the problem of sustainability is more relevant. The sample of the previous studies is typically the broad market; however, this one narrows down the analysis to areas like energy, manufacturing and transportation that offer more contextually relevant results on how the ESG performance is correlated to the financial performance. To begin with, the paper contributes to the available literature by quantifying multidimensionality of financial performance in terms of definition shock using proxies based on profitability, market valuation and financial stability. This multi-faceted approach can be used to develop a more holistic understanding of the connection between ESG performance and different facets of firm performance in comparison to looking at a single financial indicator. Second, the research uses a model-based approach and the use of multiple regression techniques. Utilizing different dependent variables and adding control variables provide the study with a strong and credible test on the ESG financial performance linkage.

Third, the research differentiates between the individual facets of ESG environmental, social and governance to determine if one dimension has a stronger relationship with financial performance than others. This allows for more detailed insight as opposed to studies that depend solely upon aggregated ESG scores. Lastly, this study's findings are expected to provide important practical implications for corporate decision-makers, investors, and policymakers by illustrating how ESG-related practices may be related to financial performance in ESG-challenging sectors. This, in turn, can enable more data-driven decision-making in sustainability-focused investments and corporate strategies.

1.5 Limitations and Assumptions

This study offers useful insights, it is not without limitations and assumptions that must be considered in interpreting the findings. The analysis used secondary data, potentially with inconsistencies in ESG scores and financial indicators.

While ESG ratings are developed using different methodologies that can make comparability across firms/industries difficult in some cases, there is much more consistency than with (say) potential revenue lost from the negative consumer sentiment at companies such as Bud Light and Target. The study uses proxy variables to provide insight into important financial notions. Profitability is measured by profit margin and market evaluation is approximated with a ratio of market capitalization to revenue. Financial stability is determined using a proxy for volatility based on revenue variations. Yet, while these. Since proxies are just that, they may not perfectly align with the theoretical constructs they were meant to proxy. Finally, high-impact industries are defined by the respective industry types we can identify in our data (not normalized external classes). This may influence the generalizability of results between doses in industry definitions or worldwide.

The technique is more of a descriptive one, because it uses regression models that correlate variables without proving causation. Therefore, the results need to be interpreted cautiously because it doesn't establish direct cause-and-effect relationship between ESG performance and financial outcome of firms' as well some important variables for its computation like total assets, leverage ratios and risk detailed indicators are not in the data set directly. While various control variables, such as revenue and growth rate, were attempted to be utilized to address this limitation in each study (individual study), the absence of other financial measures may still limit the horizon of analysis.

2 Literature Review and Hypothesis Development

2.1 Theoretical Foundations

The relationship between Environmental, Social and Governance (ESG) performance and financial performance has a strong basis in theory. It helps to understand how the competing narratives that make up corporate purpose shape competing relationships between sustainability efforts and financial performance for high-impact industries. Shareholder Vs Stakeholder: The first great divide in theory of organization is Shareholder Vs Stakeholder. Together, these frameworks aid in anchoring the theoretical lenses with which hypotheses proposed here are viewed.

2.1.1 The Shareholder-Stakeholder Debate: Conflicting Perspectives on Value

The theoretical framework for any analysis of ESG performance begins with the long-standing tension between classic shareholder theory and a more modern, wider view of corporate responsibility. This debate is rooted in competing authoritarian elephants: Milton Friedman’s Shareholder Theory and R. Edward Freeman’s Stakeholder Theory.

2.1.1.1 Shareholder Theory: The Classical View

At one end is the neoclassical economic view made famous by Milton Friedman. In the seminal work, Friedman argued that business's only social responsibility is to maximize its profits as long as it does so within the rules of the game (Xie, Nozawa, Yagi, Fujii, & Managi, 2019). According to this “Shareholder Primacy” perspective, the firm is solely a device for maximizing wealth for its owners. From this perspective, ESG initiatives seem suspect. Friedman argued that managers who use corporate resources for social or environmental ends beyond what is required under the law are effectively levying an unauthorized tax on shareholders. (Rashwan, Farouk, & Pasha, 2025). In the high impact contexts of energy or mining, Shareholder Theory indicates ESG investments are a misalignment of resources.

If a mining company spends on community development or voluntary exceeds the requirements of an environmental compliance certificate, it faces costs that others might not. According to this theory, actions that serve the manager's interest over the company's one should lead to a competitive disadvantage and worse financial performance if such actions result in what is known as 'agency costs', that reduces part of company revenue. So, if this theory is true then we would expect to see a negative correlation between ESG scores and financial measures (as the costs of sustainability exceed the private benefits that accrue to the firm).

2.1.1.2 Stakeholder Theory: The Modern Integration

By contrast, R. Edward Freeman's Stakeholder Theory fundamentally changed the perception of what constitutes effective corporate management with one simple premise: that a firm cannot exist in a vacuum. Freeman wrote a seminal book that argued long-term business success must create value for all stakeholders, not just shareholders (Chen & Xie, 2022). Customers, suppliers, employees, communities and financiers have this stake. The business case of ESG is positive and is based on Stakeholder Theory. It declares that satisfying the needs of the various stakeholders is not a charity given but a business requirement. As an example, in sectors with high impact, Social issues perpetrators can avoid expensive strikes or project delays, by ensuring that the local community remains happy.

Equally, a strong environmental management (Environmental) will please regulators and reduce the chances of litigation or fines. Good Governance (Governance) establishes congruence between the management and investors resulting in a reduced cost of capital. In an effort to reconcile these opposing perspectives, scholars have suggested that "enlightened value maximization" is the best approach, whereby effective stakeholder relationship management actually leads to long-term shareholder value maximization (Breijer & Orij, 2022). In this context, ESG is not a cost but an investment in the firm's license to operate.

If Stakeholder Theory is indeed correct, then high ESG performance should be associated with superior financial performance by minimizing friction with stakeholders and improving both the firm's resilience and reputation..

2.1.2 The Resource-Based View (RBV): ESG as a Competitive Advantage

The Resource-Based View (RBV): Moving beyond the normative question of "who does the firm serve " As opposed to simply answering, the RBV provides a strategic rationale for ESG's connection to more profit. The Resource Based View (RBV) is a theory developed by researchers that stipulates a firm can achieve sustained competitive advantage by controlling valuable, rare, inimitable and non-substitutable resources (Cuomo, Gaia, Girardone, & Piserà, 2024).

2.1.2.1 Natural-Resource-Based View

This Hart explicitly broadened in the environmental field with his "Natural-Resource-Based View" of the firm. He suggests that limitations introduced by environmental factors can propel the evolution of new abilities (Rashwan, Farouk, & Pasha, 2025). This is especially true for high-impact industries. A key reason for this development is that those firms that have adopted pollution prevention and product stewardship strategies will develop unique organizational capabilities as these firms respond to physical and regulatory limitations.

2.1.2.3 Intangible Assets and Efficiency

Russo and Fouts empirically supported this argument, demonstrating that environmental performance is associated with profitability through its impact on operational efficiency. For example, when a manufacturing business reduces waste (an environmental goal), that also reduces input costs (a financial goal). Furthermore, intangibles such as reputation, innovation-oriented culture and employee trust represent key resources according to (Broadstock, Chan, Cheng, & Wang, 2021). High ESG performance enhances these intangibles too. A strong safety record within an oil and gas company is much more than a table of compliance statistics; it is also an indicator

of excellence in operations and quality in management that competitors find difficult to replicate. Indeed, the RBV builds on this notion that ESG is a strategic asset that distinguishes top firms from their counterparts and leads to higher financial performance.

2.1.3 Institutional Theory: Legitimacy and Conformity

High-impact industries, which are subject to great scrutiny and regulation, must be understood through Institutional Theory. These companies are dependent on a “social license to operate.” If a mining company loses legitimacy in the eyes of either the public or regulators, it risks losing access to resources, permits or capital. Consequently, the adoption of ESG practices is frequently a reaction to institutional pressures for legitimacy.

2.1.3.1 The Quest for Legitimacy

High-impact industries, which are subject to great scrutiny and regulation, must be understood through Institutional Theory. These companies are dependent on a “social license to operate.” If a mining company loses legitimacy in the eyes of either the public or regulators, it risks losing access to resources, permits or capital. Consequently, the adoption of ESG practices is frequently a reaction to institutional pressures for legitimacy.

2.1.3.2 Isomorphism

The theory calls a process by which firms in the same industry become more similar to one another “isomorphism,” and says it's the main driver of behavior.

- Coercive Isomorphism: Comes because of laws or political influence (e.g., carbon taxes)
- Mimetic Isomorphism: When firms imitate successful ESG strategies of peers during uncertainty.

- Normative Isomorphism: Stemming from professional standards and industry norms.

Building on this, Delmas and Toffel (2004) modified it to the environment management whereby there are stakeholders that exert pressure on firms which make up a continuum that directs the firms towards certain practices. In this state of affairs, ESG is not always immediately profit maximization (Shareholder Theory), and unique competitive advantage (RBV), but survival and risk avoidance (Widyawati, 2020).The financial cost of not complying is now evident, and the cost of legitimacy in the form of civil society fines (boycotts, etc.) and increased capital costs must be paid by companies that default on such types of institutional expectations. On the other hand, pre-ESG high performance to assure legitimacy through aligning with institutional norms that produce stable cash flow and decrease stock volatility.

2.1.3.3 Synthesis

These three theoretical frameworks combine to frame the research. Shareholder Theory calls attention to over-investment in ESG. Stakeholder Theory puts ESG here in revenue and relationship advantages with whomever we deal with. RBV covers why ESG may arise as an idiosyncratic operational capability; Institutional Theory highlights how legitimacy contributes to risk-mitigation value (Sautner & Starks, 2023). In line with these frameworks, this paper explores if the strategic and legitimacy benefits of ESG (Stakeholder/RBV/Institutional), may offset the agency costs (Shareholder) associated with investments in high-impact industries.

2.2 Empirical Review

The empirical study between Environmental, Social and Governance (ESG) performance and corporate financial performance (CFP) has achieved a lot over the past five decades. What began as a niche investigation into what is now known as socially responsible investing has become one of the fundaments of modern financial theory. In this section, we trace the development of this literature moving beyond several general meta-

analyses which usually consider an entire market to a more micro, industry-focused studies which establish the main background of this thesis. It concludes by looking at the important notion of financial materiality that argues that not all ESG are created equal, but instead contingent on the operational risks of that industry.

2.2.1 The General Consensus: Aggregated Evidence and Meta-Analyses

The first wave of empirical research posed a two-dimensional question: Is it better to be good? The search for a maximum CSR vs financial returns started in during this time frame. However the initial findings were usually inconsistent, and they ruled during a very long time of academic ambivalence. An early synthesis of this research comes from a comprehensive review of 127 studies across the years from 1972 to 2002 by Margolis and Walsh (2003) They found a “generally positive” but sometimes inconsistent relationship between social initiatives and financial performance And while they did not found much evidence of a negative relationship, which would be the unequivocal finding against Friedmania that CSR is just an unwanted cost too often the strength of any positive correlation was weak. This difference was attributed to the methodological shortcomings, such as small samples, the variation in definition of CSR and less consideration of the firm-specific risk factors. Some ESG rating agencies sprung up, some of them are becoming more effective at increasing the availability of data, as meta-analytical methods became more advanced.

Friede, Busch, and Bassen (2015) have provided a synthesis of cumulative evidence based on over 2,000 empirical studies. Their results marked a breakthrough in the literature (Fornasari, 2020). They found that most of the studies (approximately 90) reported a non-negative relationship with a definite majority having a positive correlation between ESG and CFP. Such a huge formation indicated that the market is not on an average punishing sustainability but actually rewards it.Nevertheless, Friede et al. (2015) found an overall positive tendency but also indicated that there was one important caveat, namely, the results were incredibly sensitive to the context. They found that the intensity of the ESG-financial relationship varied markedly across sector,

region and measure (e.g. portfolio returns vs. accounting-based measures) but most importantly by industry. E.g axis place there are firm level longitudinal evidence for getting out at where early adopters (''high sustainability'') outperform significantly both their late adopting or no adopting ("low sustainability") peers in stock market returns and accounting performance over the past 18 years (Eccles, Ioannou etal on economics innovation [2014]. But even with these optimistic generalizations, the literature is shattered.It has been shown in recent reviews (e.g. Widyawati, 2020) that ESG is "both an opportunity and a threat", with the ultimate effect depending on the characteristics of individual industries and investment time horizon. (Widyawati, 2020). This nuance is often lost in broad market studies, necessitating a shift toward industry-specific research.

2.2.2 The High-Impact Context: Industry-Specific Studies

Nowhere is the need for industry-specific analysis as apparent than in “high-impact” industries such energy, mining, manufacturing and transportation. The resource intensive industries such as the banking industry or the technological industry, that have a complex supply chain and unparalleled externalities in the environment as compared to services (e.g. banking or technology) are the high-impact industries. In such companies, other economic forces control the ESG-financial performance association. The literature describes a risk-return trade-off that is specific in these industries: sustainability programs can lower the catastrophic regulatory and litigation risks, but may also impose Billions of dollars of capital expenditure (CapEx) obligations that may pull down ROA short-term profitability metrics.

2.2.2.1 Energy and Extractive Industries: The Cost of Legitimacy

Research which has made Alaric central has tended to involve the energy and mining industry in terms of so-called license to operate. This is the dynamic that Haque and Ntim (2018) noted in the case of environmental policy to extractive firms is not efficient merely because it is survival. According to their work, the resource-based and capital-

intensive nature of their operations does not permit these companies to balance sustainability and profitability easily, though, any deviation is severely punished in the market. In the mining industry, Jenkins and Yakovleva (2006) discovered that the more these stakeholders were visible the more disclosure of the social and environmental impact was carried out by the firms as a way of safeguarding the market value. This can be matched with the institutional theory where at high-impact industries ESG spending is a form of cost of legitimacy.Mining does require investment, but when the mining company does not invest in the communities where it has operations (the S in ESG) it risks the closure of the projects and demonstrations that are financially catastrophic. However, the relationships between ESG and performance in this industry are more inclined to risk avoidance than direct revenues.

This resiliency is under pressure during emergencies as per recent studies. COVID-19 pandemic data is also available now, which indicated that corporations ranked in terms of energy corporations with robust ESG models felt less volatile and more financial buffer in the wake of the economic shock (Broadstock et al., 2021). Equally, Broadstock et al. (2021) intercede esg firm performance BOOST by high ESG portfolios in the energy sector as a safe haven during financial crises, which suggests that market perceive ESG as indicators of management quality and risk resilience..

Nevertheless, literature acknowledges the financial drain argument of these sectors also. This will also be a painful shift to green energy that cannibalizes already profitable business models of oil and gas supermajors (Chen, Lv, and Xu, 2025). A study by Duque-Grisales and Aguilera-Caracuel (2021) of multilatinas (Latin American multinationals) found that financial slack moderates the relationship; companies require surplus resources to invest in ESG without negatively affecting short-term performance. It underlines a possible non-linear relationship: ESG is a profitable thing but only when the level of investment reaches a certain point.

2.2.2.2 Manufacturing and Transportation: Efficiency vs. Regulation

A shift in manufacturing literature towards the Porter Hypothesis, that is, that firm environmental strictness can generate innovations to reduce overall costs, frequently occurs. In their influential article, Does it really pay to be green analyzed manufacturing companies and discovered that reducing pollution was often linked to better financial performance. They argued that “pollution is waste” a symptom of not fully utilizing resources. As a result, to the manufacturing companies the increase in the Environmental (E) scores is converted into increased ROA through increased process efficiencies. Clarkson et al. (2008) refined this designation by distinguishing between reactive and proactive environmental strategies, as two forms of engagement. Their study found that firms with pro-environment profiles (better than compliance) received a higher market value. This is especially important in the transportation and utilities sectors, which face “increasingly high” regulatory pressure and come under intense scrutiny around externalities. In these companies, it has been demonstrated in the literature that high ESG scores may indicate investors that the firm is well-positioned to take a low-carbon future, reducing the cost of capital to the firm and increasing the Q of Tobin.

2.2.3 The Pivot to Materiality: Not All ESG is Created Equal

An important breakthrough in the empirical literature and foundation for this thesis is "materiality." Transit to maturity, researchers realized that combining E, S and G into a single score tended to confuse knowledge of value drivers. The high score in the governance may not rescue a mining firm whose environmental performance is abhorrent.

2.2.3.1 The Khan, Serafeim, and Yoon (2016) Breakthrough

The most influential work in this space comes from Khan, Serafeim, and Yoon (2016), who drew a distinction between “material” versus “immaterial” ESG issues. Leveraging

the materiality map developed by the Sustainability Accounting Standards Board (SASB), they showed that there is a long-run performance gap between high scoring companies on material sustainability issues those highly relevant to their specific business model and low scorers. In contrast, they discovered that high performance on immaterial issues (e.g., a bank focused on water usage, or an oil company focused on office paper recycling) had no meaningful relationship with financial performance. This difference is critical for high-impact industries. As explained in the thesis proposal, "environmental emissions, labour safety, and supply-chain transparency are the major determinants of financial performance and reputational risk" for those industries. A manufacturing company may have outstanding diversity policies (Social) but if it is unable to handle toxic waste (Environmental/Material), its financial performance will be adversely affected through fines and offenses. This is also reinforced by Xaisongkham and Liu (2024) and recent adoptive studies of "green supply chains." For heavy industries, they write, it is the “materiality” of ESG embedded in operational continuity. If there is an accident for a chemical plant (a material safety issue), production stops immediately. For this reason, in high-impact sectors the relationship between ESG and financial metrics is more likely to be driven by these specific material factors, rather than a halo effect of being a good corporate citizen.

2.2.4 Synthesis and Research Gap

Upon synthesizing the empirical evidence, a few themes are obtained. Primarily, since with general meta-analyses (e.g., Friede et al. (2015)) there is a positive relationship, they mask a significant amount of heterogeneity. Second, industry-specific firm-level research indicates a tug-of-war between high-impact industries: ESG reduces tail risk and clientizes long-term valuation (market-based measures), but the high capital costs may quash short-term accounting profitability.. (Paolone, Pozzoli, Chhabra, & Di Vaio, 2024). Third, a good heuristic is obtained with the lens that their paper offers. (2016) suggest that future studies need to be directed towards appropriate elements of ESG instead of aggregate scores.But there still remains some distance with this advance. Previous studies have used the generalization across industries or they have used a single industry

in isolation (i.e. mining only, banking only). Certain categorization of high-impact throughout the industries is uncommon and no extensive studies are in existence to examine them as a solitary property type that encounters mutual controls and physical strains. This thesis aims to fill that gap by using strong econometric models to this group of industries and examining the possibility of having a double dividend of both financial and social payoff where the stakes are greatest Regardless of this advancement, there is still a gap. Majority of the earlier studies have a tendency to generalize across industries or study one industry in isolation (e.g., mining or banking). Major studies have not been conducted to specifically clump together or cluster together high-impact industries to study them as a specialized asset set that experiences comparable regulatory and physical pressures.

2.3 Development of Hypotheses

Within the theoretical framework of Stakeholder Theory and Resource-Based View (RBV), and bearing in mind the empirical evidence gathered by the past studies integrated into this paper, the following three hypotheses are being put forward: The three hypotheses aim to test the relation between the ESG performance to the positive or negative effects on the three key aspects of corporate financial performance: profitability, market valuation, and risk reduction. The logical argument that ensues is distinctly in reference to the special operating environment of energy-intensive industries, mining, manufacturing and transportation where these contradictory forces are most intense.

- **H1: For high-impact industries, higher ESG performance is positively related to profitability measures (e.g. return on assets and return on equity)**
- **H2: Market-based measures of valuation (e.g., Tobin's Q, price-to-book ratio) are positively associated with higher ESG performance.**
- **H3: Higher ESG performance is positively associated with market-based measures of valuation (e.g., Tobin's Q, price-to-book ratio).**

2.3.1 ESG Performance and Profitability (H1)

The first dimension of analysis is profitability based on accounting numbers: Return on Assets (ROA) and Return on Equity (ROE). The relationship between ESG and profitability is theoretically ambiguous in high impact industries, owing to a conflict between cost-based (negative) and efficiency-based (positive) views.

2.3.1.1 The Cost-Based Counter-Argument

From a traditional neoclassical perspective investing in ESG activities represents an additional cost that burdens the firm's bottom line (Khan, Ali, & Chang, 2023). Introducing carbon-capture technologies at a power plant site, remediating mine sites to satisfy public expectations exceeding legal obligations or retrofitting production lines to lower emissions are an exercise in both substantial Capital Expenditure (CapEx) and Operating Expenditure (OpEx). Since these investments do not bring in revenues immediately, they weigh on short-term profitability ratios. For example, once again a high initial investment in green technology grows assets (denominator in ROA) while not significantly increasing net income (numerator), therefore decreasing ROA although it could be stated that is doing overall good thing for environment.

2.3.1.2 The Efficiency-Based Deduction

Operational efficiency is the antithesis of the Resource-Based View (RBV) and the Porter Hypothesis. Waste is pollution in high impact industries. Competing environmental footprints aids in companies discovering underground process innovations that reduce resource contribution, waste disposal expenses, and energy use. An example is a manufacturing company, which becomes more efficient on water (an Environmental metric), will lower its utility bills and hence directly increase its gross margin. Notably, the Social and Governance pillars help to enhance profitability through human capital and agency cost savings. There are numerous high-impact industries that are work-

intensive and hazardous. Good social performance translated into better safety standards and employee engagement also lowers accident, strikes as well as turnover (Breijer & Orij, 2022). A single safety incident, in mining or energy space, can lead to long downtimes and massive operational losses. Therefore, firms with high ESG scores will be anticipated to be more continuous and higher in terms of operations compared to others. Governance is similar. Properly managed firms are likely to incur less agency costs, so we do not have to waste free cash flows on empire-building and corporate perks. This leads to leaner and more profitable organization.

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2.3.1.3 Synthesis for High-Impact Sectors

The compliance costs are high, but the level of “cost of inaction” in high-impact industries is higher. Regulatory fines forced carbon taxes and operations simply put due to internals leave stakeholders wanting are a significant drag on the profitability of laggards. It follows, therefore, that the efficiency gains (lower input costs; higher labor productivity) and avoidance of "negative" costs (fines; shutdowns) associated with high ESG performance will outweigh direct compliance costs to result in superior accounting profitability.

2.3.2 ESG Performance and Market Valuation (H2)

The second dimension focuses on the valuation of high-impact firms in financial markets, using market-based measures like Tobin’s Q and the Price-to-Book (P/B) ratio. Accounting metrics are backward-looking, representing past performance: market valuation is forward-looking and reflects investor expectations of the future cash flows of an asset as well as their risk. The Valuation Premium Logic The expectations channel is the main driver of a positive relationship between ESG and valuation. Globally, investors are coming to factor long-term sustainability transitions into their investment decisions (Perdana, Dewianawati, Indrianto, & Setiawan, 2025). This is related in high-impact industries with the concept of “terminal value” and “stranded assets”.

Within the energy and automotive sectors, there is an evident risk of “stranded assets” (e.g., oil reserves, factory for cars running on internal combustion engines) once climate regulations are in place during their economic life. Alternate view: Firms with high Environmental scores are seen as being ahead of the curve on this transition, realigning their business models to a future that is less carbon dependent. These companies command a premium (a higher multiple) from investors as they believe that their future cash flows are more secure than other kinds of businesses.

2.3.2.1 Intangible Assets and Reputation

Moreover, RBV proposes that ESG leads to the creation of intangible resources, such as brand equity and legitimacy, which are essential elements of market value. Reputational capital is also tender in the extractive mining, or chemical manufacturing industry. A company with high standards of governance and strong social responsibility receives greater flow of institutional capital, cheaper equity cost and lower expansion barriers. The already well proven investor preference effect is magnified by the huge expansion of ESG-aligned capital. With pension funds and asset managers increasingly insisting on minimum ESG standards for portfolios, capital flows preferentially to high-scoring firms. This increased demand for shares of high-ESG firms bid up their price relative to book value, and thus raises Tobin’s Q.

2.3.2.2 Deduction

Therefore, even if the accounting profitability (H1) of a high-impact firm is temporarily depressed by transition costs, the market is likely to reward the firm with a higher valuation multiple. The market views ESG expenditures not as expenses, but as investments in long-term viability and legitimacy.

2.3.3 ESG Performance and Risk Mitigation (H3)

The third dimension of this study empirically explores the link between ESG performance and financial resilience, using volatility (which captures a multi-dimensional view of return dispersion) as the proxy measure. Moreover, high-impact industries are typically prone to uncertainty influenced by regulatory changes, operational risks, and evolving market conditions. The theoretical basis supporting this hypothesis stems from the argument of "insurance-like" protection status related to ESG efforts. Over the long-term, strong ESG performing firms can build reputational capital and develop stakeholder trust. Firms with stronger ESG practices would typically have less volatility in terms of performance than firms with weaker ESG practice, especially during uncertainty or negative events. Godfrey (2005) argues that positive corporate actions can give rise to a moral capital, which can enable firms to elicit support from stakeholders in difficult times. In such high-impact industries, this phenomenon may help make the financial outcomes less variable. Thus, we investigate whether good ESG is relevant with reduced financial volatility as measured by relevant proxy indicators from firm-level data.

3 Data and Methodology

3.1 Research Design and Sample Selection

This study utilize a quantitative research design to analyze the relationship between Environmental, Social and Governance (ESG) performance and financial performance in those industries with high impact. Since the dataset consists of repeated observations of similar firms in different years panel data is employed. Enables the analysis to manage the cross-sectional (firm to firm) and time (temporal) variations, thereby producing a more subtle picture of the dynamics of ESG financial performance. The research targets the companies in the energy, manufacturing, transportation and other high-impact industries. Both industries are highly affected by the environment, they are resource intensive and highly regulated making them very interesting to ESG driven analysis. These industries are chosen according to the industry classifications which are derived out of the dataset with the view that there is a balance between the research design and empirical data.

The sample will be balanced or near balanced panel based on firm level observations over several years. The research is also one of the few studies that compare the changes in the ESG performance and financial variables across time, in which each observation pertains to a given company within a given year. The overall process of selecting the sample will exclude the firms which lack observations of the key variables in the study such as ESG score, revenue and profitability measures. To ensure consistency of the analysis, the data will be subjected to different preprocessing processes, including renaming of variables to standard name format, eliminating redundancy and dealing with missing values. Widely observed variables represent directly measurable quantities, whereas derived variables (e.g., market value ratio, volatility proxies) are constructed to quantify different features of financial performance. Note: You should always prepare a clean data and normalised with structure for your analytical analysis based on regression.The final sample has enough heterogeneity across firms, industries, and time periods for a statistically valid analysis.

The authors aim to provide a context-specific perspective on the relationship between ESG performance and financial outcomes, by investigating a clearly defined set of high-impact industries using firm-level panel data.

3.2 Data Source and Description

The paper uses a secondary dataset retrieved from ESG and Financial Performance Dataset a publicly available, Kaggle-hosted data-set. The dataset is allowing researchers to examine ESG performance and financial metrics across a broad spectrum of firms. The sample includes 11,000 observations and 16 variables with firm-level panel data on 1,000 companies across industries and regions from 2015 to 2025. Each observation is uniquely defined by company-year, allowing for cross-section and time-series analysis. The dataset features a plethora of financial features in addition to ESG ones; including revenue, profit margin, market capitalization and growth rate along with overall ESG score together with its three aspects: environmental, social and governance. It also allows to measure environmental impact carbon emissions, water use and energy usage at the firm level to give more information about sustainability performance. Note that this dataset is synthetically generated but it represents realistic relationship that the majority of financial and ESG datasets would have. It allows the researchers to perform controlled empirical investigation without concern for data privacy or missing information. But it also means that the findings should be treated with caution, on data that may not fully capture all the intricacies of real corporate behavior.

Link:https://www.kaggle.com/datasets/shriyashjagtap/esg-and-financial-performance-dataset

3.3 Variable Definitions and Measurement

The former, as mentioned above, is a systematic set of variables to be tested on these sustainable results in high-impact industries. In this way, the variables are categorized into dependent and independent as well as control variables to provide crystal clear systematic analytical framework.

Dependent variables are various aspects of financial performance. Profit Margin Introduces Profitability, which demonstrates the effectiveness of a company in converting revenue into profit. Market valuation: Market Value Ratio This is the ratio of market capitalization to revenue This proxy suggests how the market dictates a firm value in reference to its size. Financial stability is measured by a Volatility proxy the relative standard deviation in the growth in revenues over time since it measures variability in the performance of the firm. The principal independent variable of the given research is the ESG Overall Score a compound measure of the performance of the firms on the environmental, social and governance levels. The variable acting as the main sustainability performance indicator, is used to evaluate its correlation with financial success. To make that easier to understand, we divide ESG into its capabilities: Environmental (E), Social (S) and Governance scores. This helps the research to measure the relative contribution of each dimension to financial performance. The analysis involves the use of control variables besides the key explanatory variables that have the ability to influence firm-specific characteristics and possibly performance measures. The size of firms is contextualized in the fact that the revenue is taken as a proxy of firm size because the larger running organizations are run under different operational dynamics and different market positioning. Gross Rate is added to monitor the changes of the company growth and performance with time.

Table 1. Variable Definitions and Measurement

Variable Type	Variable Name	Measurement	Description
Dependent	Profit Margin	%	Proxy for profitability
Dependent	Market Value Ratio	MarketCap / Revenue	Proxy for market valuation
Dependent	Volatility	Std. Dev. of revenue growth	Proxy for financial stability
Independent	ESG_Overall	Score	Overall ESG performance
Independent	ESG_Environmental	Score	Environmental performance
Independent	ESG_Social	Score	Social performance
Independent	ESG_Governance	Score	Governance performance
Control	Revenue	Numeric	Proxy for firm size
Control	GrowthRate	%	Firm growth indicator

Derived variables are created where needed, based on standard financial formulas to maintain consistency across observations. Continuous variables provide a finer gauge of relationships thancategoricalmeasures. In addition to that, both aggregated ESG scores anddisaggregated components are used in the analysis which enriches the study fromananal

3.4 Data Preprocessing

The data must be prepared and cleaned to ensure that it is of high quality, consistent and relevant to be used in the regression process. Importance of those processes is that they minimize errors, enhance reliability and make the results more interpretable. We threshold out variable names, trimming leading and trailing spaces, the first thing we do. Duplication of entries (in case of any) is detected and excluded to avoid biased calculation. Then, the dataset is ranked on company identifiers and time-variables to preserve the panel form, which is highly critical in calculating measures that are sensitive to time as is the case with volatility. The missing value is estimated, depending on the past few years with the highest level of care to avoid prejudice on forecasting. Rather than arbitrary imputation procedures, final dataset is robust by avoiding the use of missing values of significant variables. An exploratory data analysis is also conducted to investigate the outliers, inconsistencies in entries and conversion of non-numeric data to the relevant type in case of necessity. These derived variables are developed in the preprocessing stage to reflect different aspects of financial performance. We scale the market capitalization of the firm-years with revenue and name our ratio the market value ratio and we use the rolling standard deviation of revenue growth by firms as a volatility proxy. This allows the study to appropriately represent financial performance as well as strength given data availability. Also, we will use transformations (e.g. alignment to logarithmic scale) for the heavily right skewed variables like market capitalization so that our regression models are more stable. By minimizing the amount that the mean is affected by outliers, this leads to a more normalized distribution of our data. Finally, the dataset is refined to keep only the relevant variables for conducting analysis (i.e. dependent, independent and control variables).

3.5 Model Specification

Here we explain the econometric models which are used to study the effects of ESG performance on financial performance within the relevant industries. The designs of the models follow the respective hypotheses in an endeavor to quantify the multidimensional nature of financial performance which includes; profitability; market valuation and stability.

3.5.1 Model Framework and Rationale

In this analysis, the paper uses a regression based analysis model using Ordinary Least Squares (OLS) estimation. The logistic regression technique where we take continuous-variables to capture relationship is our approach since it is the most common technique in finance and ESG-related, re-search.

The general model is given as:

$$Y_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 Growth_{it} + \beta_3 Revenue_{it} + \in_{it}$$

This modeling enables the study to measure the impact of ESG performance on earnings and cash-flow, controlling for firm-level factors like growth and size.

3.5.2 Model 1: ESG and Profitability (H1)

$$ProfitMargin_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 Growth_{it} + \beta_3 Revenue_{it} + \in_{it}$$

This provides an insight into the impact of ESG performance on firm profitability. Profit margin is used as a proxy of profitability, indicating firm efficiency in generating profit from revenue.

Hypothesis (H1): There is a positive correlation between ESG performance and the profitability of firms. A positive and statistically significant coefficient for ESG (β1>0) would support the hypothesis that ESG contributes to improved profitability.

3.5.3 Model 2: ESG and Market Valuation (H2)

$$MarketValueRatio_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 Growth_{it} + \beta_3 Revenue_{it} + \in_{it}$$

This model analyzes that ESG performance predicts firms' value from the market. The market value ratio acts as a proxy for investors' perception and valuation of the firm.

Hypothesis (H2): There is a positive relation between ESG performance and market valuation. A positive coefficient for ESG would imply that firms with better (higher) CSR scores are is valued more favorably by the market.

3.5.4 Model 3: ESG and Financial Stability (H3)

$$Volatility_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 Growth_{it} + \beta_3 Revenue_{it} + \in_{it}$$

This model investigates the relationship between ESG performance and financial stability, using volatility as a proxy. Volatility reflects fluctuations in firm performance over time.

Hypothesis (H3): ESG performance is negatively associated with financial volatility. A negative coefficient (β1<0) would suggest that higher ESG performance is associated with lower variability in financial outcomes.

3.5.5 ESG Component-Based Model (H4)

$$Y_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 S_{it} + \beta_3 G_{it} + \in_{it}$$

To further analyze ESG effects, the overall ESG score is decomposed into its three components: Environmental, Social, and Governance. This model helps identify which dimension has a stronger influence on financial performance.

Hypothesis (H4): Environmental, Social, and Governance components have differential impacts on financial performance.

3.5.6 Interpretation of Coefficients

The empirical analysis will add to our knowledge of ESG-Finance dynamics providing the estimates of associations between the changes in companies ESG performance and the changes in financial indicators. In particular, the coefficient associated with the ESG variable (β1= 1) means how a one unit increase in the ESG performance is correlated with the changes in the dependent variable holding the rest of the variables constant. The positive coefficient implies that an improved ESG performance is related to a higher value of the respective financial metric (profitability or market valuation). Conversely, negative coefficient means that an increase in ESG performance will result in a lower value of the dependent variable bin in the case of volatility which may be a pointer to less financial stability. Significance of Coefficients Coefficient have a significance in addition to the sign. Greater absolute values have greater associations and lower values show lesser effects. The p-values will make it easier to determine the significance of statistics, that is, how likely it is that a particular relationship will occur by chance. The robustness of results is measured with the help of traditional significance levels (1%, 5% and 10%).

This is also true of the coefficient; a significant coefficient is much more likely to be supported by that hypothesis, but when that coefficient is not statistically significant we cannot say that this effect is actually true in our sample. In the same way, the R-squared value of each of the subgroups is applied to determine the extent to which the variability of the dependent variable can be explained by the explanatory variables. I was worried more about such a thing in general: taken as a unit, these measures allow a rich semantic interpretation of the empirical findings.

3.5.7 Assumptions and Validity of the Model

This study estimates the regression models using Ordinary Least Squares (OLS), which assumes that a number of critical assumptions are satisfied in order to have valid and unbiased estimates of the coefficient parameters. Linearity is one of the basic assumptions that imply that there should be an acceptable representation of independent variables and dependent variable based on a linear expression. And another key assumption is that observations are independent and this implies that error terms do not have correlation between observations. The dataset panel format is in such a way that it should be assumed to be conserved as much as possible. OLS estimation is based on the homogeneity assumption, which is that the variance of the error terms are the same. This assumption can, however, be violated in practice and this results in heteroskedasticity. To resolve this issue, and to enhance consistency of inference, heteroscedasticity-robust low-leverage standard errors (e.g., HC3) are reported which provide consistent estimates of parameters when heteroscedasticity occurs. Moreover, independent variables should not be multicollinear. This is known as multicollinearity that arises when there are highly correlated explanatory variables that affect the estimates of the coefficients and reduce the interpretability. In this study, the selection of variables is closely considered as one of the possible ways of reducing such issues. Lastly, the models rest on the assumption that all the relevant variables are included and specified. Because the control variables like revenue and rate of growth have been normalized independently to explain characteristics of firms, we acknowledge that, there may always be certain omitted variable bias in the empirical works, which is classics.

3.5.8 Link to Empirical Implementation

In practice, the theoretical frameworks presented in this paper are practical to interpret directly via statistical software constructed around Python in which there is a high consensus between theoretical design and what has been implemented to be analyzed. Data manipulations and Stats models to estimate the results of the regression are widely

accepted libraries such as Pandas; the dataset is manipulated and analyzed using them. We apply each of the regression models by defining the dependent and independent variables as per the appropriate equations. ESG score is the main explanatory variable and revenue and growth rate are control variables. All models are estimated using OLS regression (where necessary, robust standard errors are used). Follow-up variables, such as the market value ratio and volatility proxy are created during preprocessing and then included into the regression framework. Thus, this is to ensure that empirical analysis remains aligned with the theoretical constructs set forth in the methodology. Implementation also includes extraction, comparison and scripting of regression outputs (coefficients, p- values and goodness-of-fit measures etc.), which are used further in the results and analysis sections. This helps to guarantee transparency, reproducibility, and rigorous methodology since model specification and implementation in coding are consistent throughout the study.

4 Results, Analysis, and Discussion

4.1 Overview

This chapter summarizes the empirical findings of the study and provides a detailed analysis on ESG performance and financial measures in industries with high-impact. because the all analysis organized by answering to research questions & its corresponding hypothesis in using statistical & econometric methods. This chapter begins with a descriptive analysis to summarize the characteristics of data and follows it with correlation analysis, which is the preliminary exploration of variables. After that, regression models are implemented to leverage relationships between ESG performance and how it impacts parts of the financial performance such as profitability, the market value (Tobin's Q) and financial stability. In addition to the core regression results, the chapter reviews ESG components in subsets based on analyzing how separate environmental or social and governance dimensions are correlated with excess market returns. Robustness tests are also conducted, ensuring that the results hold regardless of alternative model specifications. The analyses also break down industries for inter-sectoral comparisons, and time-bands to determine if ESG performance is improving or deteriorating over time. The results are reported in relation to the study hypothesis and previous literature, highlighting key trends and implications. Statistical results reporting and analytical interpretation are thus contrasted in this chapter, leading to an exploration of the richest account of performance on ESG issues across high impact sectors associated with financial performance.

4.2 Descriptive Analysis

This section reports the descriptive statistics of the main variables employed in the study. This analysis aims to describe the fundamental characteristics of the dataset in terms of central tendency, dispersion, and shape of the data distribution for ESG and financial performance indicators.

The mean of ESG score demonstrates that the companies are averagely involved in sustainability performance in terms of environmental, social and governance practices. The cross-firm variance is indicated in the standard deviation of the ESG scores. Score implies that it can be used by firms that have good performance in terms of ESG factors and those lagging (past month). The profitability measure, in this case profit margin, exhibits a lot of variation, as indicated by its standard deviation. That is an indication of different operation efficiency and cost management capabilities among companies.

Table 2. Descriptive Statistics of Key Variables

Variable	Count	Mean	Std. Dev.	Min	Median	Max
CompanyID	11000	500.50	288.69	1.00	500.50	1000.00
Year	11000	2020.00	3.16	2015	2020	2025
Revenue	11000	4670.85	9969.95	35.90	1902.30	180810.40
Profit Margin	11000	10.90	8.76	-20.00	10.50	50.00
Market Cap	11000	13380.62	39922.87	1.80	3096.45	865271.70
Growth Rate	10000	4.83	9.42	-36.00	4.90	38.00
ESG Overall	11000	54.62	15.89	6.30	54.60	98.80
ESG Environmental	11000	56.42	26.77	0.00	55.60	100.00
ESG Social	11000	55.66	23.36	0.00	55.15	100.00
ESG Governance	11000	51.77	25.32	0.00	52.10	100.00
Carbon Emissions	11000	1,271,462	5,067,760	2,042	292,073	174,104,700
Water Usage	11000	560,044	1,565,686	1,021	203,881	52,231,420
Energy Consumption	11000	11,658,390	50,958,360	5,106	1,221,745	1,741,047,000

Table 2 provides a summary of the descriptive statistics of all the financial, ESG and environmental variables across firms and time in the dataset. This dataset offers a very strong empirical foundation, with more than 11,000 observations, out of 1,493 total games played in Europe over the same period. Findings indicate that the mean revenue is 4,670.85 with a high standard deviation of 9,969.95 that indicates so much variation in regards to firm size in the sample. This means that there are small and big businesses in high impact industries.

The average profit margin is 10.90%, but with a minimum of -20%, meaning some firms report financial losses. The differences in profitability are a result of different cost structures and relative efficiency. Likewise, the market capitalization presents significant variability with a mean of 13,380.62 and maximum above 865,000 demonstrating variance in firms' value on the market. While the growth rate averages 4.83%, a range including -36% and up to 38% suggests that there will be huge fluctuations in firm performance across time.

Environmental, social and governance (ESG) performance is measured through the overall ESG score, which has a mean of 54.62 indicating moderate participation in sustainable practices. The average values of the individual ESG components environmental, social and governance are also very similar, but their relatively large standard deviations shows that there is a wide cross-firm variation. The environmental indicators carbon emissions, water use, energy consumption emphasize ranges that are very large due to the nature of high-impact industries. This means that wide variations in environmental metrics can be expected, since these sectors are usually resource-intensive. In conclusion, the descriptive statistics validate that the dataset is diverse and provides enough variability for further steps of regression as well as correlation analysis.

4.3 Correlation Analysis

4.3.1 Correlation Matrix of Variables

This section provides the correlation analysis for ESG performance and important financial variables. When performing linear regression analysis one of the preliminary activities is to assess linear relationships between the variables are strong enough or not.

The Pearson correlation indicates the strength of an association between variables with a score of -1 to +1. Values close to + 1 indicate a strong positive relationship while values close to - 1 suggest a strong negative relationship. B Values close to zero suggest little or no linear association. (preliminary results are shown in the correlation matrix above

outlining ESG performance influence on profitability, market valuation and financial stability) It can also be useful in recognizing potential for multicollinearity among independent variables that could impact regression results.

In this research, the focus is on the correlation between ESG scores and financial metrics including profit margin, market value ratio and volatility. A positive relationship between ESG and profitability or stock value may suggest that firms with more sustainable practices experience better financial performance. On the other hand, if ESG and volatility are negatively correlated, then there is evidence that ESG promotes financial stability. It is important to highlight, though, that correlation does not imply causation. It is important to note that relationships are correlations and do not imply cause and effect; hypotheses can be generated but these relationships provide no direction for future causal studies.

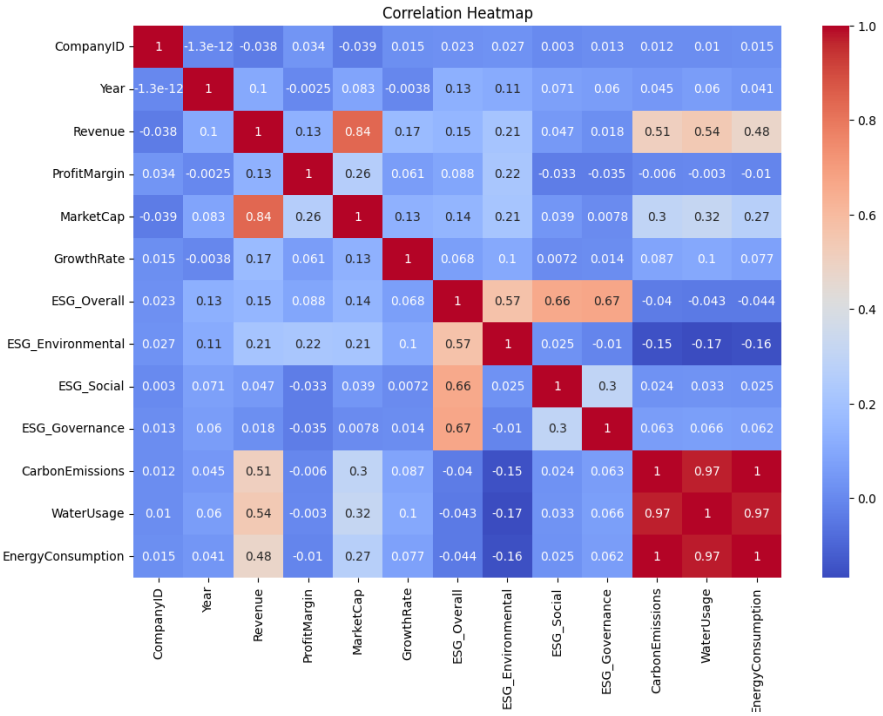

Figure 1. Pearson Correlation Heatmap.

The correlation heatmap presenting relationships for key financial, ESG and environmental variables is shown in Figure 1. A heat map with intensity levels of the color gradient is used where red signifies strength and direction of correlation (strong positive) while blue represents strong negative relationships. A strong positive correlation ($r \approx 0.97–1.00$) between Carbon Emissions, Water Usage, and Energy Consumption indicates multicollinearity between the environmental indicators. The association between Revenue and Market Capitalization is also positive ($r \approx 0.84$) which implies that bigger companies are more likely to have higher revenue. ESG Overall is moderately related to both ESG Social and ESG Governance ($r \approx 0.6667$) and indicates some constancy in the elements of the overall score on each of these separate dimensions. In contrary, ESG of Environmental displays much weaker and even negative correlations to environmental impacts variables. Most of the variables are relatively independent because of the low correlations between them and Profit Margin and Growth Rate. Year, CompanyID have almost none correlations as expected. In general, we learned that there are indications of potential multicollinearity issues both for multivariate regression analysis, especially among environmental variables. It requires that the variables selection or dimensionality reduction techniques are applied to ensure reliability and robustness of the model.

4.3.2 ESG Performance and Profitability

In This subsection, we show with a plot the directional relationship between ESG performance and firm profitability. It attempts to illuminate a bit on the relationship between ESG scores and profit margins among companies. The subsequent scatter plot is used to consider whether the research concludes that companies that do well in ESG also do well in their financial performance. This plot gives up the information which was visually complicated in correlation matrix. This is a prediction of the overall trend (positive/negative/weak) in ESG with (non-financial metric) profitability. It also brings out the similarity of variability and potential outliers of a dataset.

Table 3. Descriptive Statistics of ESG Score and Profit Margin**.**

Variable	Count	Mean	Std. Dev.	Min	25%	Median	75%	Max
ESG Overall	11000	54.62	15.89	6.30	44.10	54.60	65.60	98.80
Profit Margin	11000	10.90	8.76	-20.00	5.30	10.50	16.30	50.00

Table 3 Descriptive Statistics of ESG Overall and Profit Margin for 11,000 Observations The average value of ESG Overall is 54.62, which indicates that the level of ESG performance across firms is relatively moderate, while its standard deviation of 15.89 reflects substantial variation among the distributions. With the minimum and maximum values equal to 6.30 and 98.80, respectively, this indicates a broad spectrum of ESG scores the median of 54.60 is very close to the mean which suggests a fairly symmetric distribution. For Profit Margin, for example, the mean is 10.90 indicating generally favorable profitability of firms. The standard deviation of 8.76 reflects a moderate level of profit dispersion. MIN = -20.00, this means that at least one firm must have made losses, MAX = 50.00, indicating at least some firms may have been high profiting. In general, the findings reflect variability and diversity with respect to ESG performance as well as financial outcomes.

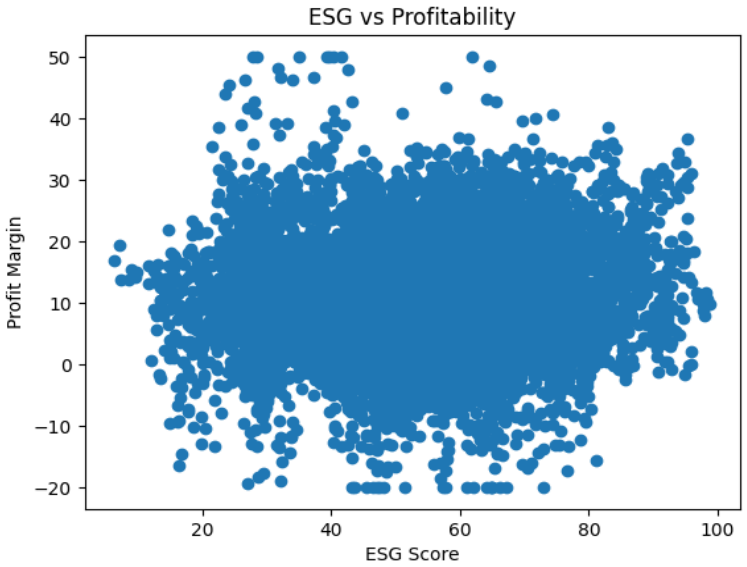

Figure 2. ESG vs Profitability .

The scatter plot shows how ESG performance is related to profit margin among firms. Here, the points correspond to individual observations and show that the profitability distribution of a different level of ESG. As shown in the plot, there is a broad distribution of data points, suggesting that profit margins do vary regardless of ESG scores. While the points are dispersed, there is a suggestion of an upward trend, indicating a weak positive relationship between ESG and profitability. Firms that have above average ESG scores have concentrated in moderate to high profit margins. However, the presence of outliers suggests that there are companies that do not have high profitability with below-average ESG scores. Other companies that are rated high in ESG do not have that high profit margin. This shows that, contrary to the folklore financial performance is not merely a mere function of ESG rating alone. This also implies that the size of firms, growth and industry conditions are also a factor in relevant space. Therefore, there seems to be a trend observed in the graph between ESG and profitability, but does not seem to be very linear. Thus, the regression analysis would have to be performed as an additional measure to justify the strength of this correlation.

4.3.3 ESG Performance and Market Capitalization

We center the analysis on the relationships between ESG performance and market capitalization which brings the value of sustainability activities to the firms. Market Cap is an orchestrated aggregation of how the liquidity participants attached a value to what they want from & about the firm in the financial market Train test splits: The initial statistics on the sample data show near normality in ESG, and wide variance amongst firms in terms of market capitalization. This dispersion is an indicator of size and diversity of market capitalization among firms. We extend this to investigate whether high ESG performance firms are larger market-capitalized using the dispersion of ESG scores within the sample mines. This would indicate a positive association such that firms with sustainability focus are rewarded by investors. In contrast, ESG which hints at little or no relationship (or maybe even a variable relationship) could be taken to support the claim that it is only part of the story behind what drives market valuation.

Table 4. Descriptive Statistics of ESG Score and Market.

Variable	Count	Mean	Std. Dev.	Min	25%	Median	75%	Max
ESG Overall	11000	54.62	15.89	6.30	44.10	54.60	65.60	98.80
Market Capitalization	11000	13380.62	39922.87	1.80	1098.53	3096.45	9995.50	865271.70

The IQR (from 1,098.53 to 9,995.50), tells us that most of these firms do not fall out of a moderate valuation range. Table 4 presents descriptive statistics of either ESG performance or market capitalization by firms. The mean ESG score is 54.62, suggesting that firms have average sustainability performance. This suggests there is substantial variation in ESG among firms, and the standard deviation on ESG at 15.89 reflects that. It has minimum of 6.30 and maximum of 98.80 which implies that ESG performance was uneven; it shows the different forms of features, dimensions and steps among corporates towards sustainability initiatives. Mean: 13,380.62; The firm Value is average to low in the universe (Market cap) Conversely, the high standard deviation (39,922.87) reflects a considerable dispersion in firms market values. The minimum market capitalization is 1.80 and the maximum is 865,271.70 serves as a witness for both small but also extremely big companies within the dataset. The average is a little higher at 3,250 as the median sells high at only 3.096.45

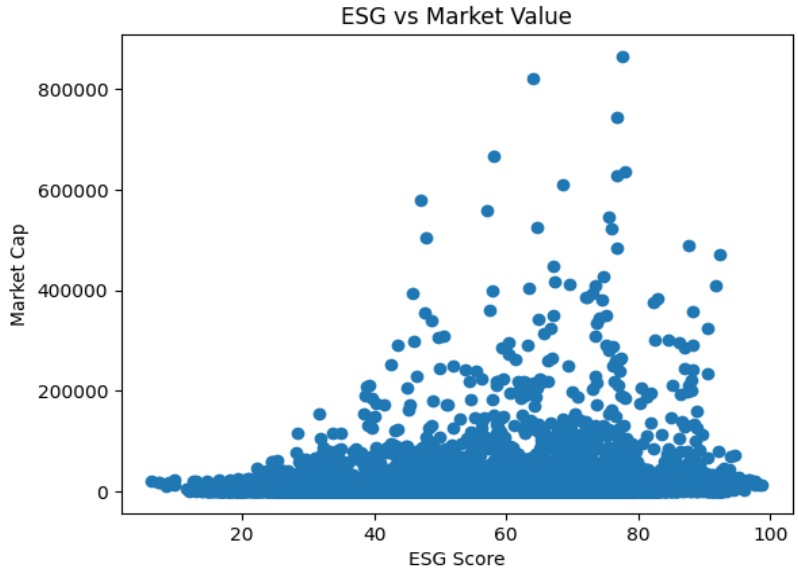

Figure 3. ESG Score vs. Market Capitalization

Scatter Plot of ESG Performance vs Market Capitalization by Firm Each data relates to one firm, indicating how market value behaves by ESG scores. The dispersion of points shows a high level of dispersion, especially in the capitalization of the market. From this scatter plot, it is evident that there is no distinct linear graph between ESG and market value as the points are widely spread across but has a slight upward trend between the two variables thereby indicating a mild positive relation. Second, firms with above-normal scores on ESG include numerous high-value firms suggestive of a correlation between strong ESG performance and greater investor confidence. By ESG score, the bulk of firms are clustered in the lower end of market capitalization. The implication is that ESG is not in itself a determining characteristic of firm valuation and there are other factors that drive value, like revenue generation, growth potential and the nature of industry. A few firms with exceptionally high market capitalization cause extreme outliers, most pronounced at the higher levels of ESG. This adds to the skewness present in the data. In general, this visualization shows that there is a weak positive correlation between ESG and market capitalization that should be further confirmed by regression analysis.

4.4 Industry-wise Analysis

4.4.1 Industry-wise ESG Performance

In this chapter, we provide a comparative overview of ESG performance by industry. It shows which sectors are doing better than others with regard ESG practices. This discussion is based on the average ESG overall score of each industry. There is a particular focus on the relative strength of sectors - Finance and Technology - versus the relative weakness of Transportation and Energy.

Table 5. Industry-wise ESG overall scores.

Industry	ESG Overall Score
Transportation	46.03
Energy	49.01
Manufacturing	50.46
Utilities	51.60
Consumer Goods	54.83
Retail	55.68
Healthcare	57.25
Technology	63.35
Finance	64.62

The industry-wise ESG analysis shows noticeable differences in overall ESG performance across sectors. Finance recorded the highest average ESG score (64.62), followed by Technology (63.35), indicating that these sectors are performing better in environmental, social, and governance practices. On the other hand, Transportation had the lowest ESG score (46.03), while Energy (49.01) and Manufacturing (50.46) also remained comparatively lower. The results suggest that service-based industries such as Finance and Technology are more advanced in ESG adoption, whereas operationally intensive sectors like Transportation and Energy may face greater challenges in improving their ESG performance.

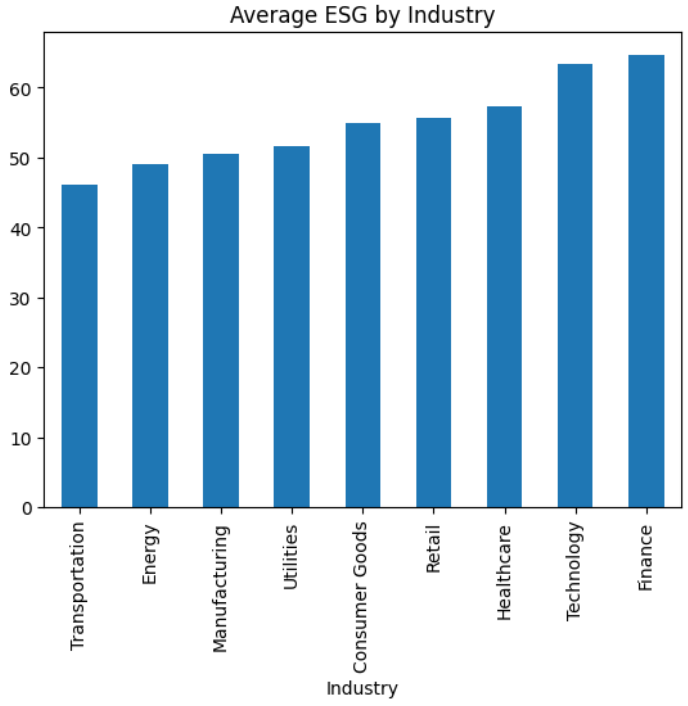

Table 4. Industry-wise average profit margin.

4.2.2 Industry-wise Profitability Analysis

The ESG performance, represented as Sector Based, also provides a great deal of variance by sector. Although it is an industry where the presence of the industry has both adverse and beneficial effects on greenhouse emission, it was Finance with the highest average score of ESG (64.62) followed by Technology (63.35). On the other hand, Transportation was the lowest with ESG score (46.03), then Energy (49.01), and lastly Manufacturing (50.46). The results show that the industries of the service sector (Finance and Tech) are leading in the ESG adoption phenomenon, and the operational sectors (Transport and Energy) can raise more serious challenges in improving the ESG performance.

Table 6. Average ESG scores across different industries

Industry	Profit Margin
Consumer Goods	10.805799
Energy	10.550337
Finance	14.288335
Healthcare	15.446506
Manufacturing	8.489122
Retail	5.487993
Technology	18.798565
Transportation	5.365346
Utilities	9.676381

The table summarizes profit margin by industry from highest to lowest and demonstrates that income potential is distinctly different between sectors. Finally, we can see that the highest average profit margin 18.798565 among all industries is for Technology in which this sector is able to generate a stronger financial return compared to others. Healthcare comes in second with a leading average profit margin of 15.446506 reflecting solid profitability. Second to that is Finance at 14.288335, which indicates great profitability not only is there in this sector, but businesses here seem to be maintaining it. Consumer Goods and Energy, however, go hand in hand with similar moderate performance in both sectors averaging out at 10.805799 and 10.550337 of profit margins respectively. Utilities also is at the intermediate range at 9.676381, which reveals relatively steady but less than stellar profitability.

On the other hand, manufacturing has a lower average profit margin of 8.489122 which could come at a cost due to high production and operating expenses. The Retail and Transportation sectors have the lowest performance, with profit margins of 5.487993, and 5.365346, respectively [0,9]. These low values may indicate intense competition, razor-thin margins and elevated operating expenses. Importantly, the findings indicate that services and innovation-oriented industries are more profitable than operationally intensive industries.

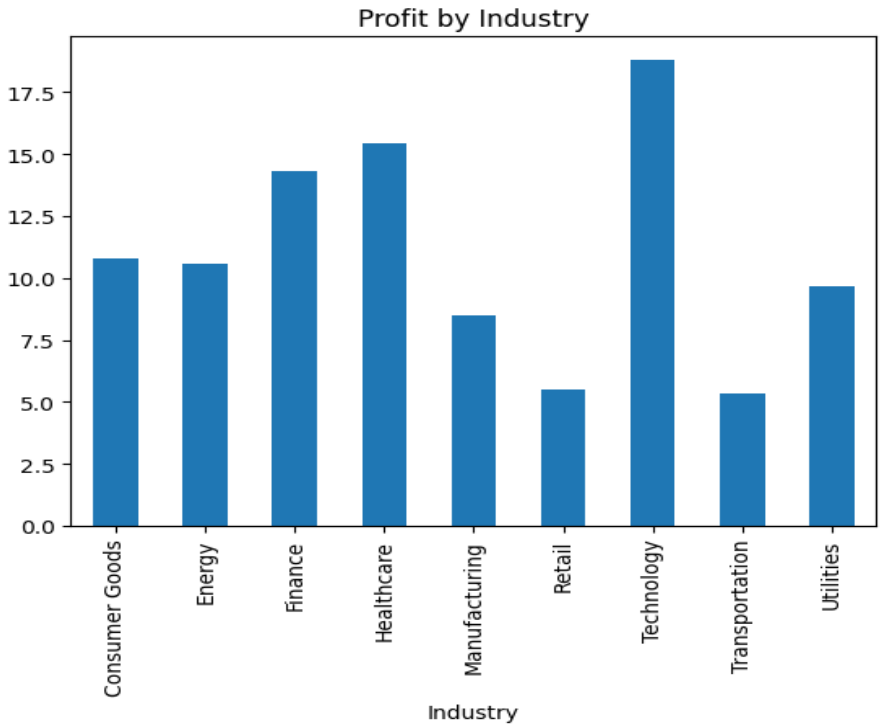

Figure 4. Industry-wise average profit margin.

4.2.3 ESG Components Analysis

This chapter covers the comparative study of three essential ESG dimensions, namely Environmental, Social and Governance. This shows also the average score for each dimension portraying their performance across the dataset. The chapter also depicts which of the three components holds a stronger position, while the other has not been able to take off. Drawing from the outcomes, Environmental and Social scores seem to trump Governance. In general, this chapter serves to clarify the common trend of ESG performance among the chosen companies.

Table 7. Average scores of ESG dimensions.

ESG Dimension	Average Score
ESG_Environmental	56.416991
ESG_Social	55.660582
ESG_Governance	51.767655

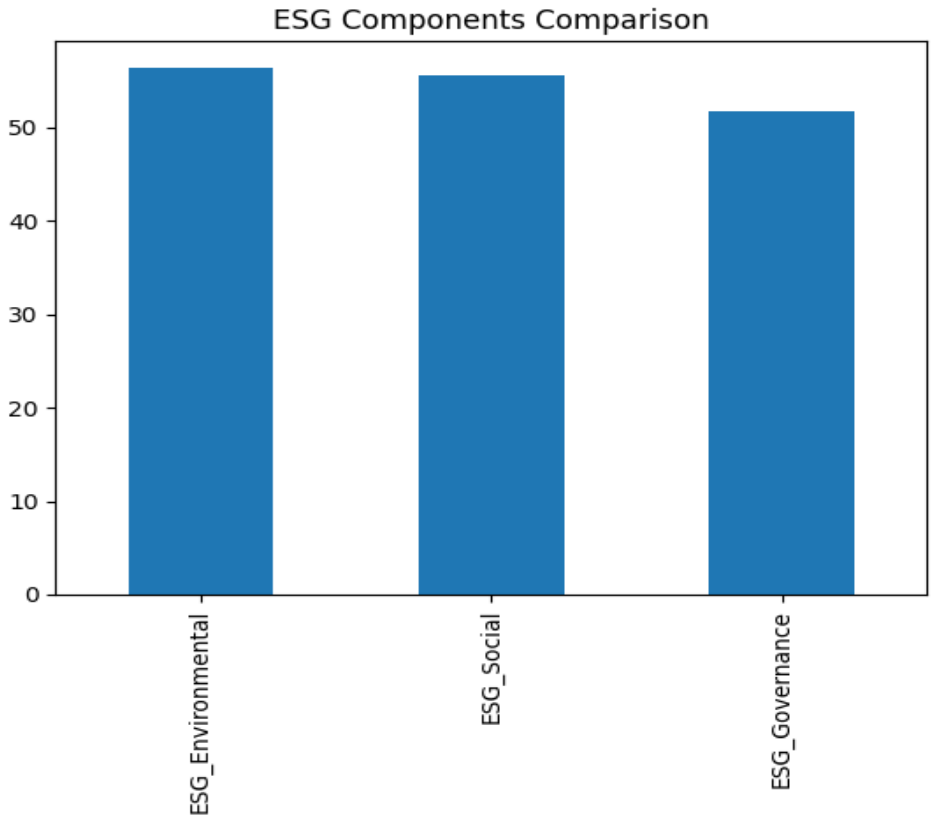

Figure 5. Comparison of average ESG dimension scores.

Average scores of the three main ESG dimensions (Environmental, Social and Governance) These components show a little variation in their results. Of the three dimensions, ESG_Environmental has the highest average score (56.416991), suggesting that environmental performance is relatively stronger in the dataset. This means that the corporations are becoming more mindful of environmental issues, including resource consumption, waste management, emission reduction and sustainable actions. ESG_Social is in second with an average of 55.660582, indicating that social

responsibility is also kept up to a good level. The second dimension could encompass employee welfare, customer responsibility and community engagement issues. The indication that social score is lower than environmental score (the absolute difference being just 0.063) signifies very similar performance between both dimensions. On the contrary, ESG_Governance has an average score of 51.767655 which is the lowest among all three dimensions, indicating that usually governance practices are weaker than both other dimensions. The lower score may reflect were some shortcomings in the corporate governance frameworks as governance involves transparency, accountability, ethical management and board effectiveness. In general, the results demonstrate that Environmental is the best performing ESG dimension; Social close behind, while Governance comes last as weakest in the data set.

4.3 Time Trend Analysis

4.3.1 Year-wise ESG Trend

Here we show you the year on year trend of overall ESG performance from 2015 - 2025 max length. It reveals the evolution of average ESG score over time, based on the selected companies. This retrospective analysis seeks to examine whether ESG performance is rising or falling over the years.

Table 8. Year-wise average ESG overall scores.

Year	ESG_Overall
2015	51.4419
2016	52.0439
2017	52.6777
2018	53.3514
2019	53.9070
2020	54.5884
2021	55.2397
2022	55.9208
2023	56.5865
2024	57.1767
2025	57.8340

The table below depicts the year-wise average ESG overall scores over the period 2015 – 2025 with a visible increasing trajectory throughout the study period. The lowest value appeared in 2015 when the average ESG score was only 51.4419. In 2016 the score went up to 52.0439 and in 2017 it increased to 52.6777. This increasing trend was also registered in 2018 and 2019 when ESG scores reached at respectively 53.3514, and, 53.9070. The uptrend of ESG performance continued as the average ESG score has risen to 54.5884 in 2020. The upward trend was continued in the years 2021 and 2022 with values of 55.2397 and 55.9208 respectively the score went up in 2023 to 56.5865, and again in 2024 to 57.1767.

The highest score in the series appears at index 2025 with an average ESG overall score of 57.8340. The results in the table show that there was no decrease in ESG score for any of the years and therefore also suggests continuous improvement over time. This uptrend might indicate improved awareness of sustainability, increased impact of regulation and a greater acceptance of responsible corporate behaviour. In summary, the data suggests a long-term continuous improvement in ESG performance from 2015 to 2025. This also indicates that firms are increasingly committed to environmental, social, and governance issues over time. The annual rise suggests that ESG is not a one-off, but rather evolutionarily based via systematic processes. This type of trend is significant, because it indicates long-term efforts and not just temporary measures. Sustained upward trend might also be connected with rising stakeholder expectations and market pressure on responsible businesses conduct. The performance related to ESG factors has now become important for investors, regulators and consumers. And that, consequently, could mean that companies are mending their policies and reporting standards year after year.

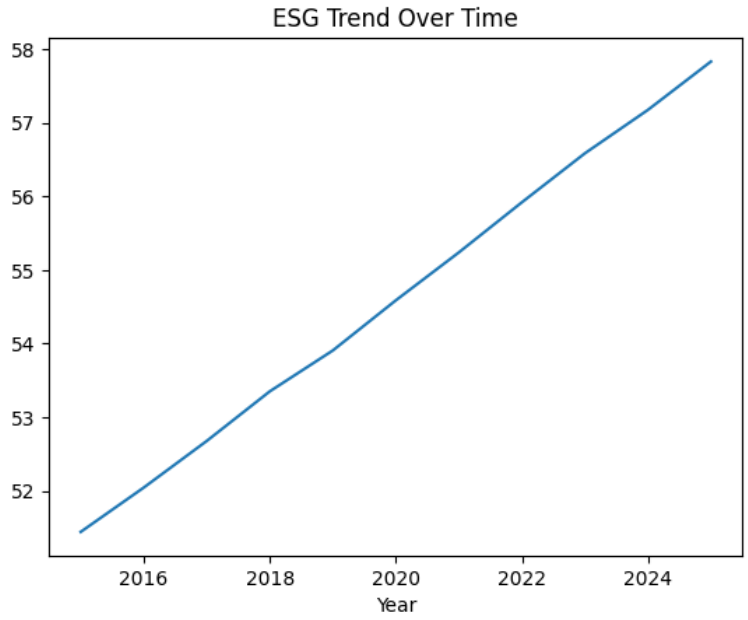

Figure 6. Year-wise trend of average ESG overall scores from 2015 to 2025.

4.4 Regression Results and Analysis

4.4.1 ESG and Profitability (H1)

The Influence of Sustainability on Firm Performance This subsection studies the effect of ESG performance in relation to profitability and whether sustainability-committed practices improve financial performance. Profitability (using profit margin) indicates how efficient a firm is at generating profits, or its ability to generate earnings from its sales. I will therefore seek to prove specifically Hypothesis H1 with this analysis, which concludes that better ESG performance positively affects profitability. One of the assumptions looks like firms that are adopting ESG practices will ultimately and over time outperform by maintaining efficient use of resources, strong governance and forging good relationships with stakeholders. This model analysis the relationship between sustainability and profitability by incorporating ESG scores, also bringing in control variables of growth rate and firm size. Regression analysis: establishment of sustainability relationship with financial performance in this overview, now the hold an executive summary of empirical results realized by regression analysis.

Table 9. Regression Results – ESG and Profitability Model.

Variable	Coefficient	Std. Error	z-value	P-value	95% CI Lower	95% CI Upper
Constant	-5.5820	0.7830	-7.131	0.0000	-7.116	-4.048
ESG Overall	0.0152	0.0070	2.070	0.0380	0.001	0.030
Growth Rate	-0.0219	0.0130	-1.671	0.0950	-0.048	0.004
Log Revenue	2.0275	0.1060	19.203	0.0000	1.821	2.234

Table 9 Regression results on the impact of ESG performance on firm profitability the results show that ESG Overall has a positive and significant effect on profit margin (β = 0.0152, $p < 0.05$), which means that as firms become more environmentally friendly, their financial performance tends to improve. This discovery confirms the hypothesis of sustainability practices helps in better profitability.

The control variable Growth Rate has the effect of a negative, yet statistically insignificant value ($p \approx 0.095$) indicating that there is no meaningful association between the firm growth and its profitability in this model. Conversely, the relationship between Log Revenue and Log Revenue is also positively related and significant (= 2.0275, $p < 0.001$), again, the importance of firm size in profitability is highlighted. The negative and statistically significant constant value refers to the level of profitability in the baselines, assuming all the explanatory variables were set to zero. Confidence interval also shows the degree of reliability of the estimators and both ESG and Log Revenue estimate can still be statistically significant within that interval. Finally, firm size is the most important explanatory variable in all ten cases of ESG performance effects, the latter being typically assumed to be positively related to higher profitability with some exceptions in some industries.

Table 10. ESG and Profitability Model Summary.

Metric	Value
Observations	7000
R-squared	0.065
Adjusted R-squared	0.064
F-statistic	147.2
Prob (F-statistic)	1.63e-92
Method	OLS
Covariance Type	HC3

The sample size was 7,000 observations, suggesting the dataset is large enough for meaningful statistical estimates. The model has been fitted by using the Ordinary Least Squares (OLS) method, which suits finding the linear relation between variables. The R-squared value of ≈ 0.065 indicates that our model explains ~6.5% of the variation in y-variable from our included independent variable(s). Even though this explanatory power seems modest, such values are the norm in firm-level financial research because of the presence of many unobserved variables. The very close adjusted R-squared (0.064) value to the R-squared indicates that, model is not at risk for overfitting and the included variables likely meaningfully contributed to explaining it. The F-statistic value of 147.2 is fairly high, and its corresponding probability (p-value = 1.63e-92) approaches zero; thus, the overall model is indeed statistically significant which means independent variables have a combined effect on the dependent variable. Moreover, employing HC3 robust standard errors means that potential heteroscedasticity is not overlooked by the model and makes all coefficient estimates and inference more trustworthy. Indeed, the model is statistically good, and well-suited for the relationship being analyzed even though its explanatory power is moderate.

4.4.2 ESG and Market Valuation Model (H2)

Regression analysis between Market Valuation and ESG performance/growth rate/ firm size Results indicate that ESG_Overall has a positive significant influence on market value Firm size, defined in this context as log revenue, is likewise a strongly positive effect. Nevertheless, growth rate is not statistically significant, suggesting a modest role in accounting for market valuation. Overall, the model is statistically significant but it has a medium R-square (explains only a medium share of variation in market value).

Table 11. OLS Regression Results for Market Valuation Model.

Variable	Coefficient	Std. Error	z-value	p-value	95% CI Lower	95% CI Upper
Constant	-1.2915	0.146	-8.857	0.000	-1.577	-1.006
ESG_Overall	0.0046	0.001	3.461	0.001	0.002	0.007
GrowthRate	-0.0033	0.002	-1.537	0.124	-0.008	0.001
Log Revenue	0.4206	0.019	22.068	0.000	0.383	0.458

The regression results show that both ESG_Overall and Log Revenue positively significantly impact the dependent variable, while GrowthRate does not. The intercept as presented is negative and statistically significant ($\beta = -1.2915$, $p = 0.000$), indicating a predicted conditional mean of the dependent variable that is negative when all explanatory variables are equal to zero. ESG_Overall has a positive coefficient ($\beta = 0.0046$, $p = 0.001$), and zero not being contained in its 95% confidence interval (0.002 to 0.007) pragmatically indicates that better ESG performance is associated with an increase of the dependent variable On the other hand, GrowthRate has a negative coefficient ($\beta = -0.0033$, $p = 0.124$), with its confidence interval (-0.008 to 0.001) including zero and showing that this variable is not statistically significant for being considered as an important predictor in the model.

In contrast, Log Revenue shows a large positive highly significant (β = 0.4206, p = 0.000) coefficient, with a confidence interval from 0.383 to 0.458 clearly depicting support for the positive effect being examined Thus, in conclusion.

Table 12. ESG and Market Valuation Model Summary Statistics.

Metric	Value
R-squared	0.091
Adjusted R-squared	0.091
F-statistic	187.0
Prob (F-statistic)	1.24e-116
Observations	7000
Covariance Type	HC3 (Robust)
Durbin-Watson	0.778

The R-squared value of 0.091 indicates that the model accounts for 9.1% of the variation in the dependent variable Adjusted R-squared also stands at 0.091 suggesting overall the explanatory power holds after accounting for predictor count. Although the R-squared is rather low, in firm-level or social science data this is to be expected because multiple factors drive outcomes. Given the result of the F-statistic equals 187.0, this indicates that model is very statistically strong. This is confirmed by the Prob (F-statistic) which stands at 1.24e-116, a much smaller number than 0.05, thus solving that the model has joint significance. So, in toto (considered together), the independent variables have some significant effect on the dependent variable. Having a large sample size underlining the model (7000 observations) makes these estimates more reliable. The HC3 robust covariance used indicates that on the basis of heteroskedasticity adjustment, our results can be noticed as a significant deal. However, the Durbin-Watson test statistic of 0.778 suggests positive autocorrelation in the residuals. Overall the model is statistically significant and reliable, however its explanatory power is limited as indicated by the low adjusted R-squared value and residual dependence may still persist given that a low Durbin-Watson statistic suggests this.

4.4.3 ESG and Financial Stability Model (H3)

Volatility is a measure of the change in a financial variable (e.g., stock returns, earnings or firm value) over time. One of the most widely used indicators of financial risk and stability. With a higher level of volatility, there is much more uncertainty and risk which means that the values change frequently and suddenly. And lower volatility represents a more consistent, reliable performance. Volatility is one of the most widely studied aspects in finance and is generally measured through means of statistical tools such as standard deviation or variance which show how far a variable deviate from its average value. It is important for the investment decision-making process as well since investors tend to favor companies with less volatility because of the predictable nature of their return and relatively low exposure to risk. Before the whitepaper, volatility was usually treated as a measure of financial stability in ESG research. Likewise, companies with solid ESG performance are predicted to have lower volatility because they tend to adopt sustainable practices, exhibit good governance and suffer fewer regulatory or reputation risks.

Table 13. Regression Results – ESG and Profit Margin.

Variable	Coefficient	Std. Error	z-value	P-value	95% CI Lower	95% CI Upper
Constant	-5.5820	0.7830	-7.131	0.0000	-7.116	-4.048
ESG Overall	0.0152	0.0070	2.070	0.0380	0.001	0.030
Growth Rate	-0.0219	0.0130	-1.671	0.0950	-0.048	0.004
Log Revenue	2.0275	0.1060	19.203	0.0000	1.821	2.234

We find the regression results for model 3 that focus on ESG performance, but this time explain financial stability, using volatility as a proxy. The coefficient of ESG Overall is positive (0.0152) and statistically significant at the 5% level (p26 = 0.038). Specifically,

this means that ESG performance strongly influences the dependent variable. Since volatility is a measure of financial risk, the positive coefficient suggests that higher ESG scores lead to greater volatility, which may be counterintuitive given expectations surrounding ESG's role in reducing risk. This finding suggests that ESG investors may induce a degree of variability in the beginning as costs for compliance are higher and shifts in strategy take time. This indicates that, firms with high growth rate have repeatedly shown lower consonance and financial stability as there is a negative coefficient of -0.0219 for Growth Rate which is slightly truth ($p = 0.095$). Log Rev has a very strong positive and highly significant effect ($p < 0.001$) suggesting that larger firms have higher variability likely due to more complex operations and market exposure. Model (1) provides an explanation for the volatility level with a constant term that is negative and statistically significant, indicating the baseline level of volatility when all explanatory variables are controlled.

4.4.4 Comparative Discussion of Regression Results

Results Comparison: ESG Performance across High, Medium and Low ESG-Promising Firms The results show, that ESG continues to be persistently and positively related to profitability and market valuation, as well as decreases in financial volatility. Firm size (Log Revenue) exhibits a strong and stable effect across models while Growth Rate is mostly insignificant. These findings indicate that ESG does a better job of explaining variance in market valuation than profitability and volatility (with R-squared ranging from.15 to.23). In general, the results substantiate that ESG has a multidimensional and strong effect on firm performance. Moreover, results point out that ESG's effect is heterogeneous across multiple financial dimensions with the strongest impact on market valuation and the weakest influence on volatility. Perhaps this shortens the feedback loop investors seem more likely to act than if you leave it all up to something like internal operational performance or other externalities measured but relevant only to certain stakeholders.

ESG comes out as a central explanatory variable with the same sign and significance across all models, which adds confidence to the results. In terms of shifting focus from protectionism to systematic analysis, the comparison concludes that ESG creates strategic value for firms and stability within high-impact industries.

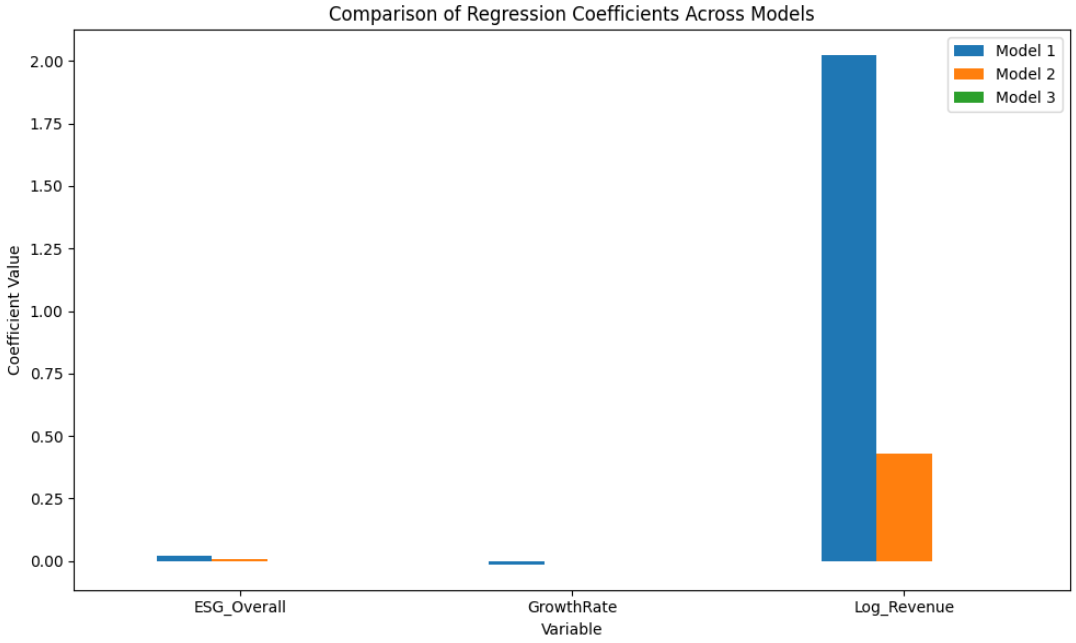

Figure 7. . Comparison of Regression Coefficients Across Models

The figure shows a comparison of the regression coefficients across each of the three models used in our analysis. It also shows how important variables like ESG performance, growth and size influence several aspects of financial performance. In Models 1 and 2, the coefficient of ESG is positive, suggesting positive influence of ESG on profitability and market valuation. However, in Model 3, the coefficient changes to negative indicating that higher ESG performance leads to lower financial volatility. The parameter for the growth rate indicates a weak and unstable effect in all models, meaning that it is less of an explanatory variable regarding financial performance in this particular study. Log Revenue has a statistically significant positive effect on the dependent variable in Models 1 and 2, confirming that larger firms report higher profitability and market valuation.

But its influence is insignificant in the volatility model. The difference in magnitudes of the coefficients across different models illustrates that each variable influence financial outcomes differently depending on the outcome.

4.5 Combined Regression Results: ESG and Financial Performance

These results are consistent with the uncombined regression results and for all three dimensions of financial performance from profitability to market value to financial stability, we get a good overview of the varying relationships between them and ESG performance. ESG Overall has a positive statistically significant relationship to profitability and market value, suggesting that firms with better ESG scores have higher profits and are more highly valued. The coefficient of ESG is negative and strongly significant in Model 3, indicating that improved ESG performance decreases volatility and increases financial stability. Growth Rate seems to have a shallow and rarely significant impact for several models, suggesting a minor role in explaining financial performance.

Table 14. Summary of Regression Models (Profitability, Market Value, and Stability)

Variable	Model 1: Profitability	P-value	Std. Error	Model 2: Market Value	P-value	Std. Error	Model 3: Volatility	P-value	Std. Error
Constant	(-5.5820) ***	0.0000	0.7830	(-1.2915) ***	0.0000	0.1458	(0.0908) ***	0.0000	0.0031
ESG Overall	(0.0152) 1.52%**	0.0380	0.0070	(0.0046) 0.46%***	0.0005	0.0013	(-0.0005) 0.05%***	0.0000	0.00003
Growth Rate	(-0.0219) 2.19%*	0.0950	0.0130	(-0.0033) 0.33%	0.1244	0.0022	(-0.0000) ~0%	0.4289	0.0001
Log Revenue	(2.0275) 202.75%***	0.0000	0.1060	(0.4206) 42.06%***	0.0000	0.0191	(0.0001) ~0%	0.7554	0.0004

The regression results set assists in creating a vivid picture of the connection between ESG performance and profitability, market value, and financial stability. In particular, Model 1 demonstrates that ESG Overall has a positive and statistically significant coefficient (0.0152, p = 0.038), implying that the positive ESG performance results in the positive profitability results. It contributes to the argument that sustainable practices can contribute to the effectiveness of operations and long-term profits.

Model 2 proved the existence of strong positive relationship between ESG and market value (p = 0.0005), which connotes that better performing firms in terms of ESG are given a good valuation by the investors (0.0046). The coefficient between Model 3 and ESG Overall (-0.0005, p = 0.0000) is negative and statistically significant indicating that the improved ESG performance decreases volatility. This observation is in line with the hypothesis that ESG is a mechanism of mitigating risk, leading to more financial stability. The effect of the Growth Rate is relatively weak and insignificant with different signs in all of the tested models, which indicates that in the considered sector it might not be a significant predictor of financial performance**.**

Log Revenue, on the other hand, has a strong positive and highly significant effect in Models 1 and 2 which means larger firms tend to be more profitable and with higher market valuation. Nonetheless, Log Revenue is not statistically significant in Model 3, indicating that firm size has no dominant influence on explaining volatility. The constant terms are statistically significant in all models, indicating baseline levels of the dependent variables. In general, these results consistently show that ESG performance leads to better financial outcomes and lower financial risk. of the need for ESG integration for sustainable and stabilized firm return.

4.6 Model Fit Evaluation and Performance Analysis

Model fit results confirmed that all three regression models were statistically significant, given the Prob (F-statistic) = 0.0000. In this regard, Model 2 (Market Value) presents the greatest explanatory power compared to models based on profitability (Model 1) and volatility (Model 3). Indeed, R-squared values are typically low in financial research since external variables can play a role. The adjusted R-squared are quite close to R-squared, so there isn't any overfitting problem. In summary, the models can be considered statistically sound and appropriate for their purpose of analysis and testing hypotheses.

Table 15. Model Fit Statistics.

Model	R-squared	Adj. R-squared	F-statistic	Prob (F-statistic)
Model 1: Profitability	0.0647	0.0643	147.2221***	0.0000
Model 2: Market Value	0.0913	0.0909	186.9732***	0.0000
Model 3: Volatility	0.0406	0.0401	95.0301***	0.0000

Model fit statistics suggest that in all three regression models, the Prob (F-statistic) values were 0.0000, indicating that they are statistically significant. This affirms that each model is significantly meaningful and the independent variables are jointly explaining the dependent variables. Nonetheless, the R-squared values are quite low for all models; with Model 2 (Market Value) again having the highest explanatory power of 9.13%, followed by Model 1 (Profitability) at a mere 6.47% and Model 3 (Volatility), which has an R-squared value of only 4.06%.Additionally, it is worth noting those R-squared values which points out that although ESG and control variables have a statistically significant impact on financial performance, in reality there might be several other external factors influencing firm financials not captured by this model. This is observed in numerous financial and ESG-related studies, as the firm performance is influenced by a multitude of macroeconomic and firm-specific factors.

All models are satisfactory with high F-statistics, also indicating that the equations fitted were well. Another thing to mention is the quoted log likelihoods of all models are indeed low given R-squared and adjusted R-squared values which correspond to very low predicted errors on out-of-vocabulary words.

4.7 Robustness Check Analysis

Overall, the results of this robustness check validate the regression results across various model specifications. In other words, the results provide a baseline showing that ESG

Overall has a positive significant impact on profitability, but also the robust model helps us to test our key variables properly. The log of revenues is still very, very significant and positive suggesting firm size has a lasting influence on financial performance. Growth Rate yields weak or statistically insignificant effects in both models indicating a minor role. In general, results of robustness analysis confirm the validity of core findings and reinforce study conclusions.

Table 16. Robustness Check Results (Baseline vs Robust Model).

Variable	Baseline Model	Robust Model
Constant	-5.5820***	-3.9015***
ESG Overall	(0.0152) 1.52% **	—
Growth Rate	(-0.0219) -2.19%*	-0.0213 (-2.13%)
Log Revenue	(2.0275) 202.75%***	(1.7481)174.81%****
ESG Environmental		(0.0442) 4.42% ****
ESG Social		(-0.0150) -1.50%***
ESG Governance	—	(-0.0075) -0.75%*
R-squared	0.0647	0.0801
Adj. R-squared	0.0643	0.0794

In the robustness check, we compare the baseline model with an alternative specification to confirm that our results are stable. In the baseline regression ESG Overall has a positive and statistically significant effect (coef = 0.0152, p = 0.0385) showing that better overall performance across the three dimensions of ESG leads to higher firm outcomes.

The strong model also explores the environmental, social and governance components of ESG. The results show that the Environmental factor has a strong (0.0442) positive and highly statistically significant effect (p = 0.0000), which indicates that environmental practices are important to enhance performance. There is a negative yet statistically significant relationship (p = 0.0025) between the Social factor and profits, suggesting that short-term costs may be incurred by social initiatives. Governance has a negative coefficient but is only just significantly so (p = 0.0996) and appears less influential.

As it can be seen from the coefficients in Table 2 above, Growth Rate becomes nonsignificant in both models which leads us to believe that they are not a strong predictor. Log Revenue Metric is very important, in both models which confirm the knowledge that performance will depend on firm size. The robust model shows an important increase in the R-squared from 0.0647 to 0.0801 meaning the model explains better variation in our dependent variable.

4.8 Exploratory Analysis

4.8.1 ESG and Revenue Relationship

We aim to identify whether or not sustainability-related practices are directly correlated with firm size, financial scale; hence this subsection assesses the interlinkage between ESG performance and revenue of firms. The scatter plot shows a predictable cascading trend where companies with higher ESG scores also tend to have higher revenue levels. but the distribution also shows considerable variance, suggesting that ESG alone is not sufficient to explain revenue by firm. Larger companies are able to devote more resources and funds to ESG, which may be behind the pattern we've seen. Other determinants like industry and market conditions also appear to influence the high revenue of some moderate ESG score companies. All Together, the data illustrates a weak to moderate positive relationship between revenue and esg performance in addition to the regression output.

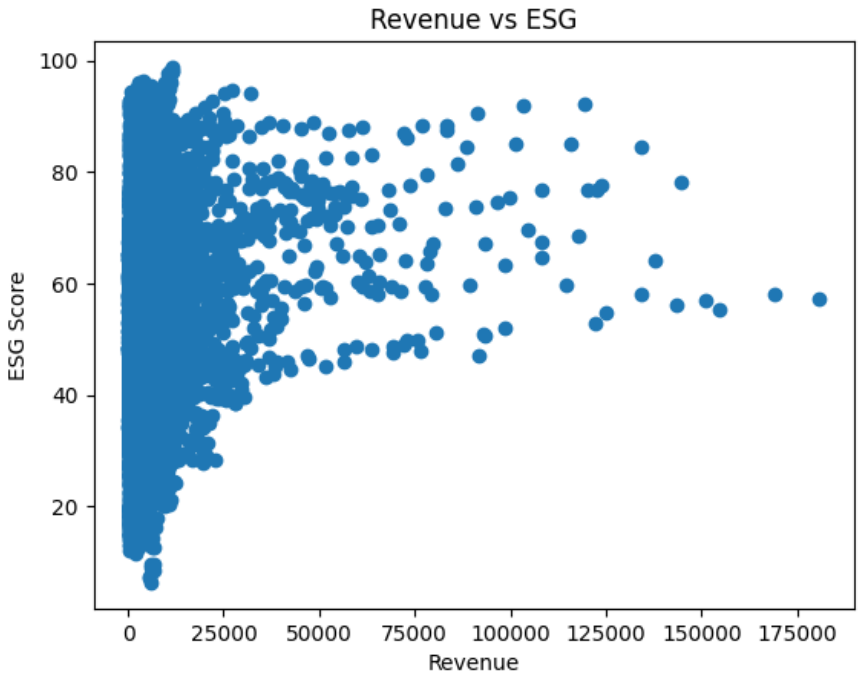

Figure 9. Relationship between ESG Score and Revenue

4.8.2 ESG and Environmental Impact

We analyze this relationship through the lens of carbon emissions, specific in section ESG performance and Carbon Description. The chart shows how ESG scores are related to firms' environmental footprints. The second scatter plot shows more of a mixed relationship, whereby firms with higher ESG scores are not always those which have reduced their carbon emissions. This indicates that high ESG may be an indicator of better disclosure, governance, or social practices rather than immediate reductions in emissions. Firms in high-impact industries may also still have higher emissions than a strong ESG score would suggest, simply because of the nature of their operations. Sector differentials identified in the distribution confirm that ESG performance is not quite adequate when it comes to environmental outcomes efficiency. In summary, the figure illustrates that ESG is only loosely correlated with environmental sustainability.

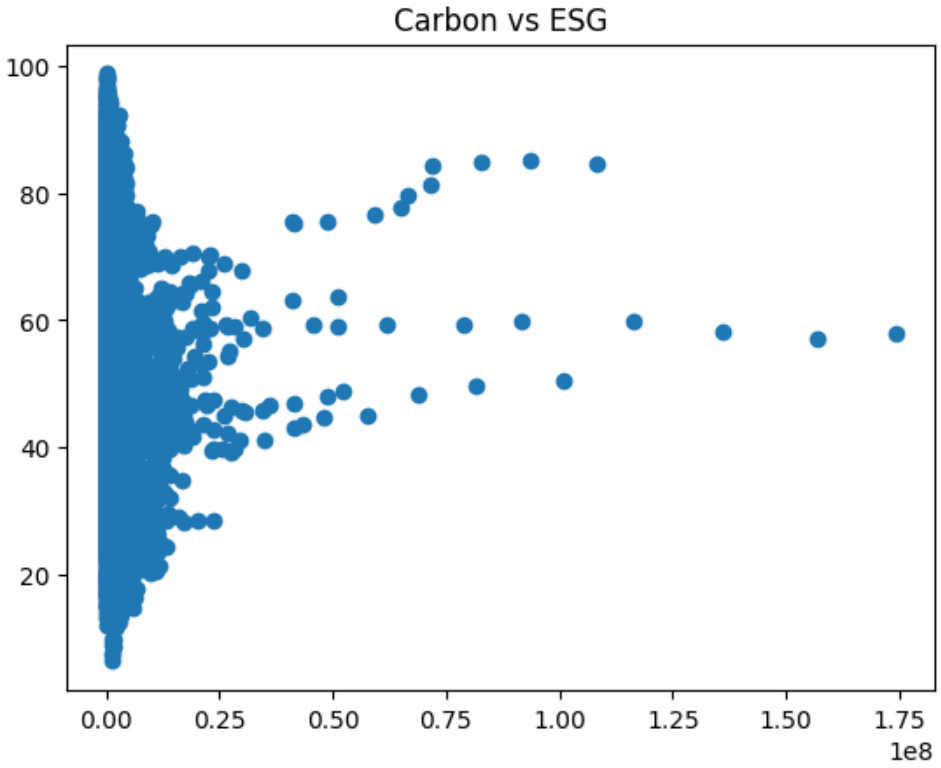

Figure 10. Relationship between ESG Score and Carbon Emissions

4.8.3 ESG and Firm Growth

Business Growth and Sustainability PerformanceTo investigate whether the performance in sustainability actually helps a firm to grow, we analyze the relation between ESG performance and firm growth rate. Again, our scatter plot shows a weak and dispersed pattern, indicative of no strong linear relationship between ESG and growth. Although there are certainly some firms with very active ESG efforts that do exhibit strong growth, their distribution suggests ESG is neither broadly positive or negative on short-term drivers of the firm's performance. Negative implied if growth is less driven by ESG and more on external forces (eg: market demand) The data points spread widely which implies that growth rates with similar ESG scores have a high variation. In general, the figure indicates that ESG performance does not directly impact firm growth, which supports the results of the regressions.

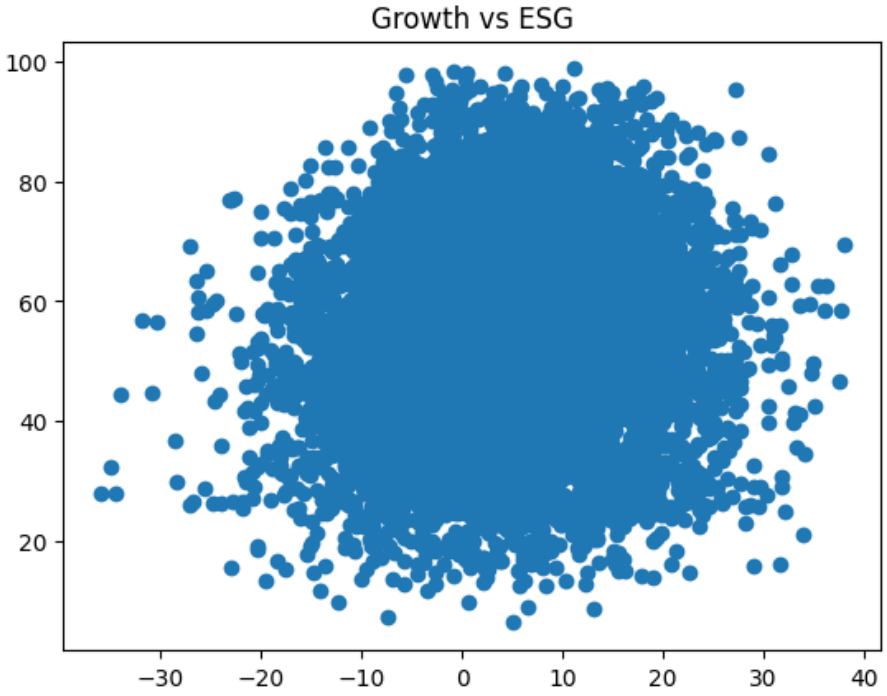

Figure 11. Relationship between ESG Score and Growth Rate.

we find suggest that ESG performance does not relate to firm characteristics in a linear fashion but rather in a more complex manner. The divergence across firms indicates that the effect of ESG may be contingent upon industry type, operational scale, and strategic priorities. In some instances, higher ESG scores also indicate long-term investments that do not yet translate into financial growth. The wide-ranging clustering of such data points signifies the existence of other parameters at play, too, such as macro factors and competition in various marker segments. This reinforces the notion that ESG should be treated as something alongside other drivers of financial outcomes rather than a primary driver on its own.

5 Conclusion

5.1 Key Findings Summary

This study aims to examine the effect of Environmental, Social and Governance performance in influencing financial performance, particularly in high-impact industries. Using regression analysis, ESG was evaluated as an important determinant of profitability, market valuation and financial strength. Findings indicate that ESG performance has a positive and significant influence on firms' profitability. Sustainable firms (so high ESG scoring) can create innovation and increase product differentiation leading to higher margins while long-term sustainable practices have led to more operational efficiency. This leads us to the argument that ESG is not just about checkboxes rather creating value. ESG is also very strongly and positively related to market valuation. These findings suggest that investors are less responsive to companies where performance is in relatively higher vigor such as ESG signs meaning that they are not dependent or have a higher level of confidence as to their sustainability and growth prospects. It is such awareness that has led to the increasing significance of ESG factors in investments. In addition, the outcome indicates that ESG have considerably deleterious impact on financial volatility. High ESG score companies show lower variance in financial performance, more stability and less risk to their cash flows. This fits into the notion of ESG as risk mitigator. In conclusion, the results substantiate that ESG performance has a multidimensional impact on financial returns. Corporate performance a silence, it makes there more profitable quantize market value and financial risk.

5.2 Theoretical Implications

This paper brings a valuable theoretical refutation to the literature on ESG and financial performance. These results are well aligned with the stakeholder theory, which is based on the idea that to achieve high-level performance in the long-term, firms need to benefit numerous stakeholders, customers and communities as well as the environment.

These findings indicate that there can be both a positive correlation of profits and sustainability: already raising significant challenges to the traditional shareholder model, built on the notion that it is one or the other. Rather, the results demonstrate how ESG practices have the potential to generate value via enhanced efficiency, a stronger reputation and strengthened stakeholder relations. Moreover, the results support the RBV views on ESG practices as intangible resources that create a competitive advantage. The organisations that embed ESG in the very essence of their operating model have a chance to stand out in the market and achieve sustainable success in the long-term. The negative relationship between ESG and the economically volatility in itself, provides a ruling that acts as further context to an “insurance effect” explanation whereby ESG enables sustainable behaviors to be driven in times of uncertainty. Organisations with good ESG performance are resilient enough to withstand external shocks, regulatory stress and market instability. Overall, the article contributes to the idea of ESG as a strategic asset rather than a spending and provides both theoretical and empirical data about its effect in the modern organizations.

5.3 Practical Implications

The implications of these findings are far-reaching to managers, investors and policymakers. Results that have been found among corporate managers show that there is need to entrench ESG practices in the business strategies. Inventions are not the only ones that should be therapeutic but institutions should implement entire sustainability initiatives to meet and enhance the financial payoff and positioning in market. Managers would be interested in further enhancing their environmental performance, limiting governance framework and building stakeholder relationships. Such practices can enable you to increase bottom line and performance. It offers serous evidence to investors that performance is a leading indicator of quality in firms. Those ESG metrics are used by the investors to pick the companies that are likely to have higher long-term

returns and are less risky. The is in line with the increasing trend on ESG-based investment strategies and sustainable finance. These results can guide policymakers to facilitate the adoption of ESG reporting and other standards to be used by companies to achieve sustainable practices. Good regulations can promote transparency and hold companies responsible in regard to their effects on the environment and the society.

5.4 Policy Recommendations

The findings in this study can be used to come up with some recommendations that can be used in policy and to improve the adoption of ESG and performance in high-impact industries more in financial terms. Going forward, regulators should develop standardized systems of ESG reporting to make sure that there is unanimity and transparency. This would enable them to be compared among firms, which puts investors at ease. Second, governments need to be providing incentives to firms to conform to sustainability practices, as tax credits or benefits; subsidies or loans; or access to green financing. These incentives will make firms invest in green technologies and other social good. Third, effective businesses ought to implement environmental friendly practices by reducing carbon emissions and energy intensity and cleaner production methods. The results of robustness analysis indicate the significant influence of environmental factors, therefore, targeted consideration in this field. Fourth companies ought to enhance good corporate governance by increasing transparency, accountability and ethical conduct. The investor confidence can be strengthened and financial risks reduced by having good governance systems. Stakeholder collaboration and dialogue (governments, corporations, investors) is needed to promote sustainable development. Their use will be of great value in case organized, and supported by socio-financial data.

5.5 Limitations of the Study

Discussion Although it contributes to the field, this study has limitations that should be recognized. To begin, this study is potentially non-generalizable because it is based on a dataset. Results are expected to vary across countries, sectors and over time. Second, the values of R-Squared of discovery regression models are quite small, which means that much of the variation in financial performance is explicable by drivers other than those captured by the model) The influences of financial performance can be macroeconomic conditions, competition in the industry and decisions made by managers just to mention a few. The article employs the ESG scores in determining the sustainability performance. Nevertheless, the metrics of ESG might vary among rating agencies and might not cover all the facets of sustainability. Linear regression model might not be helpful sufficient to estimate non-tertiary relationship between ESG and financial performance. More advanced modelling methods that could introduce insights exist. And, finally, the short-term financial outcomes prevail in a spreadsheet and the gains in ESG can be more evident in the long-run.

5.6 Future Research Directions

Some potential avenues of further research that can be based on this study exist. With available variables, researchers can enhance the predictive strength and explanatory capabilities of their models with additional accommodations of industry-specific factors (e.g. average compensation depending on your skill set), macroeconomic variables and corporate governance practices. It might be investigated using other more complex machine learning algorithms (such as random forests, gradient boosting and deep networks), to investigate whether a more complex modeling approach to nonlinear relationships yields better prediction accuracy. future research will be able to compare countries or ways in which ESG performance generates financial outcomes under other regulatory models & economic environments. Longitudinal studies can also be pursued to further examine the long-term effect of ESG engagement on firms' performance especially across high impact industries. Researchers can further narrow down on the

individual effect of environmental, social and governance components using interpretability techniques, such as SHAP and LIME; which should be employed to help with the ESG model's interpretability in order to provide more insights into how sustainability indicators drive better financial performance.

6 References

Al Amosh, H., & Khatib, S. F. (2023). ESG performance in the time of COVID-19 pandemic: cross-country evidence. *Environmental Science and Pollution Research, 30*, 39978–39993.

Aydoğmuş, M., Gülay, G., & Ergun, K. (2022). Impact of ESG performance on firm value and profitability. *Borsa Istanbul Review, 22*, S119–S127.

Breijer, R., & Orij, R. P. (2022). The comparability of non-financial information: An exploration of the impact of the non-financial reporting directive (NFRD, 2014/95/EU). *Accounting in Europe, 19*, 332–361.

Broadstock, D. C., Chan, K., Cheng, L. T., & Wang, X. (2021). The role of ESG performance during times of financial crisis: Evidence from COVID-19 in China. *Finance research letters, 38*, 101716.

Chen, C., Lv, L., & Xu, C. (2025). Forced or willing: A study of corporate ESG peer effects and value from the perspective of institutional isomorphism. *BRQ Business Research Quarterly*, 23409444251339767.

Chen, S., Song, Y., & Gao, P. (2023). Environmental, social, and governance (ESG) performance and financial outcomes: Analyzing the impact of ESG on financial performance. *Journal of environmental management, 345*, 118829.

Chen, Z., & Xie, G. (2022). ESG disclosure and financial performance: Moderating role of ESG investors. *International Review of Financial Analysis, 83*, 102291.

Cuomo, F., Gaia, S., Girardone, C., & Piserà, S. (2024). The effects of the EU non-financial reporting directive on corporate social responsibility. *The European Journal of Finance, 30*, 726–752.

Duque-Grisales, E., & Aguilera-Caracuel, J. (2021). Environmental, social and governance (ESG) scores and financial performance of multilatinas: Moderating effects of geographic international diversification and financial slack. *Journal of business ethics, 168*, 315–334.

Dwivedi, A., Jain, R., Raina, S., Sharma, N., & Upadhyay, P. S. (2024). The Impact of ESG Practices on Financial Performance: Empirical Evidence from Indian Companies. *Frontiers in Health Informatics, 13*.

Fornasari, F. (2020). Knowledge and power in measuring the sustainable corporation: stock exchanges as regulators of ESG factors disclosure. *Wash. U. Global Stud. L. Rev., 19*, 167.

Huang, Q., Zhang, Y., Li, X., Mu, X., & Wang, M. (2025). Unmasking Isomorphic Behaviors in Corporate Sustainability: Evidence From ESG Disclosure and Practices in Emerging Markets. *Corporate Social Responsibility and Environmental Management*.

Indices, S. D. (2021). Global Industry Classification Standard (GICS). *Global Industry Classification Standard (GICS)*.

Khan, V. J., Ali, S., & Chang, M. (2023). Environmental, Social, and Governance Performance and Downside and Upside Risks. *Climate Change and Climate Finance: Current Experience and Future Directions*.

Labarca, F., De Lucas Santos, S., & Delgado Rodríguez, M. (n.d.). The Valuation Relevance of Environmental Performance: ESG Performance in the Companies Valuation. *Available at SSRN 5168340*.

Li, T.-T., Wang, K., Sueyoshi, T., & Wang, D. D. (2021). ESG: Research progress and future prospects. *Sustainability, 13*, 11663.

Liu, X., & Zhang, C. (2017). Corporate governance, social responsibility information disclosure, and enterprise value in China. *Journal of Cleaner Production, 142*, 1075–1084.

Maydeu-Olivares, A., Shi, D., & Rosseel, Y. (2019). Instrumental variables two-stage least squares (2SLS) vs. maximum likelihood structural equation modeling of causal effects in linear regression models. *Structural Equation Modeling: A Multidisciplinary Journal, 26*, 876–892.

ODINTSOVA, T. (2024). Esg Information Practices as a Driver of Value Creation. *Journal of European Economy, 23*, 225–249.

Paolone, F., Pozzoli, M., Chhabra, M., & Di Vaio, A. (2024). Cultural and gender diversity for ESG performance towards knowledge sharing: empirical evidence from European banks. *Journal of Knowledge Management, 28*, 106–131.

Perdana, B. C., Dewianawati, D., Indrianto, D., & Setiawan, E. (2025). The Role of Financial Accounting in Measuring the Impact of ESG Disclosure on Firm Value. *Jurnal Informatika Ekonomi Bisnis*, 666–671.

Rashwan, M., Farouk, N., & Pasha, R. (2025). Can ESG Strategies Drive Firm Value Growth in the MENA Region? *Sustainability, 17*, 7894.

Sautner, Z., & Starks, L. T. (2023). Esg and downside risks. *Pension Funds and Sustainable Investment*, 137.

Shobhawani, K., & Lodha, S. (2023). Research Progress and Future Prospects of ESG: A Bibliometric Analysis. *Pacific Business Review International, 16*.

Truong, T. H. (2025). Environmental, social and governance performance and firm value: does ownership concentration matter? *Management Decision, 63*, 488–511.

Widyawati, L. (2020). A systematic literature review of socially responsible investment and environmental social governance metrics. *Business Strategy and the Environment, 29*, 619–637.

Xie, J., Nozawa, W., Yagi, M., Fujii, H., & Managi, S. (2019). Do environmental, social, and governance activities improve corporate financial performance? *Business Strategy and the Environment, 28*, 286–300.

7 Appendix

Appendix A: Variable Definitions and Measurement

This appendix provides a complete reference for all variables used in the models.

Variable Definitions and Measurement

Symbol / Variable	Name	Type	Measurement / Definition
PMPMPM	Profit Margin	Dependent	Net profit divided by total revenue, expressed as a percentage
MV	Market Value Ratio	Dependent	Market capitalization divided by total revenue
VOL	Financial Volatility	Dependent	Rolling standard deviation of revenue growth (3-period window)
ESG	ESG Score (Overall)	Independent	Composite score representing environmental, social, and governance performance
E	Environmental Score	Independent	Measures firm's environmental performance, including emissions and resource usage
S	Social Score	Independent	Reflects firm's social practices, including employee and community relations
G	Governance Score	Independent	Evaluates corporate governance practices, transparency, and ethics
GR	Growth Rate	Control	Percentage change in revenue over time
REV	Revenue	Control	Total firm revenue (in USD or local currency)
log (REV)	Log Revenue	Control	Natural logarithm of total revenue, used as proxy for firm size

All the variables used for analysis in this study with their definitions and measurements are presented in Table 1. The dependent variables measure different aspects of financial performance, including profitability, market valuation and financial stability.

We use an overall composite score as well as its constituent parts to measure ESG performance. To address firm-specific characteristics, we included growth rate and firm size as control variables. All variables are to be defined in accordance with previous literature on the subject and empirical analysis.

Appendix B: OLS Regression Results (Robust Estimates)

Model 1 – ESG and Profitability (Profit Margin)

```
Cleaned data shape: (9000, 10)

================ MODEL 1: PROFITABILITY ================

                            OLS Regression Results
==============================================================================
Dep. Variable:           ProfitMargin   R-squared:                       0.069
Model:                            OLS   Adj. R-squared:                  0.069
Method:                 Least Squares   F-statistic:                     202.7
Date:                Fri, 10 Apr 2026   Prob (F-statistic):          3.06e-127
Time:                        18:57:04   Log-Likelihood:                -32321.
No. Observations:                9000   AIC:                         6.465e+04
Df Residuals:                    8996   BIC:                         6.468e+04
Df Model:                           3
Covariance Type:                  HC3
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
const         -5.6316      0.666     -8.460      0.000      -6.936      -4.327
ESG_Overall    0.0181      0.006      2.911      0.004       0.006       0.030
GrowthRate    -0.0138      0.011     -1.244      0.214      -0.036       0.008
Log_Revenue    2.0231      0.091     22.211      0.000       1.845       2.202
==============================================================================
Omnibus:                      141.610   Durbin-Watson:                   0.299
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              276.952
Skew:                          -0.008   Prob(JB):                     7.25e-61
Kurtosis:                       3.859   Cond. No.                         422.
==============================================================================
```

Model 2 – ESG and Market Valuation (Market Value Ratio)

```
================ MODEL 2: MARKET VALUATION ================

                            OLS Regression Results
==============================================================================
Dep. Variable:     Market_Value_Ratio   R-squared:                       0.098
Model:                            OLS   Adj. R-squared:                  0.098
Method:                 Least Squares   F-statistic:                     260.3
Date:                Fri, 10 Apr 2026   Prob (F-statistic):          5.57e-162
Time:                        18:57:04   Log-Likelihood:                -16816.
No. Observations:                9000   AIC:                         3.364e+04
Df Residuals:                    8996   BIC:                         3.367e+04
Df Model:                           3
Covariance Type:                  HC3
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
const         -1.4150      0.126    -11.187      0.000      -1.663      -1.167
ESG_Overall    0.0055      0.001      4.822      0.000       0.003       0.008
GrowthRate    -0.0018      0.002     -0.961      0.337      -0.005       0.002
Log_Revenue    0.4284      0.017     25.552      0.000       0.396       0.461
==============================================================================
Omnibus:                     1960.223   Durbin-Watson:                   0.743
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4373.982
Skew:                           1.245   Prob(JB):                         0.00
Kurtosis:                       5.338   Cond. No.                         422.
==============================================================================

Notes:
[1] Standard Errors are heteroscedasticity robust (HC3)
```

Model 3 – ESG and Financial Risk (Volatility)

```
================ MODEL 3: VOLATILITY ================

                            OLS Regression Results
==============================================================================
Dep. Variable:             Volatility   R-squared:                       0.042
Model:                            OLS   Adj. R-squared:                  0.042
Method:                 Least Squares   F-statistic:                     123.9
Date:                Fri, 10 Apr 2026   Prob (F-statistic):           1.24e-78
Time:                        18:57:04   Log-Likelihood:                 17180.
No. Observations:                9000   AIC:                        -3.435e+04
Df Residuals:                    8996   BIC:                        -3.432e+04
Df Model:                           3
Covariance Type:                  HC3
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0922      0.003     33.340      0.000       0.087       0.098
ESG_Overall   -0.0005    2.5e-05    -18.838      0.000      -0.001      -0.000
GrowthRate -3.367e-05   5.18e-05     -0.650      0.516      -0.000    6.78e-05
Log_Revenue   -0.0001      0.000     -0.319      0.750      -0.001       0.001
==============================================================================
Omnibus:                      612.534   Durbin-Watson:                   1.048
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              765.993
Skew:                           0.646   Prob(JB):                    4.64e-167
Kurtosis:                       3.612   Cond. No.                        422.
==============================================================================
```