Unveiling The ESG Paradox: When Sustainability Meets Financial Reality

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Abstract

This study examines the complex interplay between Environmental, Social, and Governance (ESG) performance and financial outcomes across diverse sectors, addressing the conflicting evidence in the current literature regarding the relationship between sustainability-driven profitability and sustainability. While approximately 90% of contemporary studies demonstrate positive correlations between ESG and financial performance, significant heterogeneity remains across industries and methodological frameworks, resulting in uncertainty concerning the actual financial impact of ESG. We analyse ESG risk scores, controversy levels, and year-to-date returns using descriptive statistics, correlation analysis, sectoral comparisons, and k-means clustering with PCA visualisation, utilising extensive statistical methods while omitting regression techniques. We contend that ESG performance exhibits tenuous correlations with short-term returns, uncovers sector-specific risk patterns, and establishes counterintuitive company clusters that challenge traditional assumptions about sustainability. The findings indicate a weak correlation (ranging from 0.08 to 0.17) between ESG metrics and financial performance, suggesting that short-term returns are largely unaffected by ESG profiles. There are significant differences between sectors. Energy and Utilities, for example, have median ESG risks of 35–37, while Technology and Real Estate have median ESG risks of less than 20. There are three types of people based on clustering analysis: ESG Leaders, who have high scores but low returns; Balanced Performers, who exhibit moderate risks and good outcomes; and High-Risk Generators, who remain profitable despite high ESG risks.

Keywords: *ESG Performance; Financial Performance; Sustainability; Corporate Social Responsibility; Sector Analysis; Investment Strategy.*

1. Introduction

In today's financial markets, Environmental, Social, and Governance (ESG) factors are crucial for a company's long-term success and its ability to create value. The integration of ESG factors into investment decisions and corporate strategy has transitioned from a specialised concept to an essential requirement, driven by increased stakeholder awareness of sustainability issues, regulatory mandates, and mounting evidence of ESG's potential impact on financial performance. [1], [2]. This comprehensive statistical study examines the intricate relationships between ESG metrics, levels of controversy, and financial performance across various fields. It demonstrates how sustainable business practices impact business outcomes in today's world.

The theoretical foundation for ESG investing is based on the premise that firms demonstrating superior environmental stewardship, social responsibility, and governance practices are more inclined to secure sustainable returns while mitigating long-term risks. Recent empirical evidence strongly supports this business case, with around 90% of studies finding a nonnegative correlation between ESG and corporate financial performance, and the overwhelming majority indicating favourable results. [3] This comprehensive analysis of over 2,000 empirical studies demonstrates that the positive impact of ESG on corporate financial performance is consistent across diverse markets and temporal contexts.

Recent studies are corroborating these findings through the use of improved methodologies and larger datasets. Regression analysis has shown that ESG has a significant and positive effect on a company's financial performance (p < 0.01) (Chen, Song, and Gao, 2023). Moreover, recent studies of A-share listed companies in Shanghai and Shenzhen, China, indicate that superior corporate ESG performance is associated with significantly improved financial performance. This conclusion persists after conducting robustness checks and addressing endogeneity. [4]. These findings suggest that the association between ESG practices and financial outcomes is not merely correlational; it may signify genuine causal mechanisms through which sustainable business practices yield measurable value.

However, the link between ESG and performance is complex and varies significantly from one area to another. Individual Social and Governance scores exhibit a positive and significant correlation, whereas the Environment score lacks a significant association with firm value. Due to their operational characteristics, the rules they must adhere to, and the expectations of their stakeholders, different industries have varying levels of inherent ESG risks. Companies that have a significant impact on the environment demonstrate that a comprehensive ESG framework can help them meet their environmental and social responsibility goals while also significantly improving their financial results [5]–[7]. The energy and utilities sectors typically face higher environmental risks due to their significant carbon emissions.

Technology and healthcare companies, on the other hand, usually have lower ESG risk profiles. This difference between sectors highlights the importance of having ESG evaluation frameworks tailored to each industry, rather than using the same ones for all.

The temporal dynamics of ESG impact introduce an additional level of complexity that requires close examination. Research suggests that the beneficial impact of current ESG on financial performance may vary depending on sector, market, and institutional factors. [5]. This means that the benefits of ESG may not last forever, but they may be biggest in the short to medium term. This finding contradicts the notion that ESG benefits are perpetual, highlighting the need for businesses to continually enhance their sustainability practices to remain competitive.

Geographical and institutional factors additionally affect the correlation between ESG and performance. Heterogeneity analysis indicates that the beneficial effects of ESG performance are more significant in companies situated in eastern regions, state-owned enterprises, and industries characterised by high pollution. The ESG regression coefficient is significant in large-scale enterprises, but not in small-scale enterprises. In high-risk situations, the positive effects of ESG ratings on business financial performance are more significant because all the p-values obtained are less than 0.01. These differences illustrate how varying regulatory environments, market conditions, and institutional pressures impact the financial outcomes of ESG practices in different contexts.

The part that corporate controversies play in ESG evaluation adds another level to the analysis. There is increasing pressure on businesses to be responsible in terms of their environmental impact, social practices, and governance standards. Controversies can erode stakeholder trust and negatively impact the company's bottom line. Understanding how levels of controversy impact financial results can help us appreciate the significance of ESG risks and the potential consequences of sustainability failure. Digital transformation has become a significant factor influencing the relationship between ESG and performance. Digital transformation amplifies the positive impact of ESG on financial performance, suggesting that technological advancements can enhance companies' ability to implement effective sustainability practices and reap the associated benefits. [8]. Digital business services firms can enhance client performance by reducing negative environmental impacts. [8]–[10]. This is a key area for determining how modern businesses can enhance their ESG strategies by integrating digital innovation with sustainable practices.

When you group companies by their ESG profiles and financial performance, you can identify patterns that contradict common perceptions about the relationship between sustainability and profitability. Companies with high ESG scores may not generate profits, while others with higher ESG risks may still perform well financially. These unexpected connections demonstrate that creating value is a complex process, and when evaluating a company's performance, it is essential to consider more than just ESG metrics.

This study enhances our understanding of ESG impact by employing various statistical methods to examine the relationships between environmental, social, and governance factors, levels of controversy, and financial performance across different sectors. This analysis aims to provide nuanced insights through the examination of correlation patterns, sector-level variations, categorical relationships, and clustering behaviours, thereby informing investment decisions, corporate strategy formulation, and policy development within an increasingly sustainability-focused business environment.

2. Literature Review

The relationship between Environmental, Social, and Governance (ESG) performance and corporate financial outcomes has generated considerable academic interest, evolving from initial studies to sophisticated empirical research. This body of literature has provided empirical evidence from various markets, demonstrating the critical importance of ESG in corporate financial performance and offering valuable insights for policymakers, investors, and corporate managers aiming to promote sustainable development and improve investment strategies. [11]–[13].

The groundbreaking meta-analysis by Friede, Busch, and Bassen (2015) Examined over 2,000 empirical studies and found that approximately 90% demonstrated nonnegative correlations between ESG and corporate financial performance, with the majority reflecting positive outcomes. This seminal study provided robust evidence that the business justification for ESG investing is empirically validated, with positive ESG impacts enduring over time. Recent research has corroborated these results using increasingly sophisticated methodologies. Research indicates that a company's ESG performance has a substantial influence on its financial performance, a finding that persists even when accounting for endogeneity and robustness tests. Moreover, extensive analyses across various economies validate the positive correlation between corporate sustainability practices and financial performance, with the relationship being especially pronounced in specific market contexts.

Recent empirical investigations have revealed complex aspects of this relationship. Regression analysis revealed that ESG has a positive and significant influence on corporate financial performance, with digital transformation acting as a catalyst for this improvement. [14]. Furthermore, the positive effect of current ESG on financial performance during the lag period is expected to decline gradually. [10]. This time-based factor suggests that the benefits of ESG may diminish over time, indicating that companies must continue to invest in sustainable practices to remain competitive. The moderating role of digital transformation has emerged as a significant area of research. Studies have shown that enterprise environmental, social, and governance (ESG) performance, as well as digital transformation, play a significant role in enhancing company success. This intersection of technological innovation and sustainability practices represents a critical area for understanding how contemporary enterprises can improve their ESG strategies for economic benefit.

Studies have consistently demonstrated that ESG performance exhibits considerable variation across industries, with sector-specific attributes exerting a significant influence on sustainability profiles and financial results. The real estate and development sector had the highest ESG ratio, at 11.2%. The energy sector was second with 9.6%, and the pharmaceutical industry was third with 6.3%. These results indicate that ESG performance varies across different industries. The reason for this difference is that different sectors have different operational characteristics, regulatory pressures, and stakeholder expectations. ESG factors can have a significant impact on industries that have a substantial environmental footprint. Research investigates the impact of ESG system implementation on the financial performance of companies in environmentally significant sectors, offering a scientific foundation and pragmatic direction for corporate executives and policymakers to facilitate green transformation. [4], [10], [15]. The energy and utilities sectors consistently exhibit heightened ESG risks due to their carbon-intensive operations, whereas technology and healthcare companies generally display reduced ESG risk profiles.

Extensive studies have shown that ESG practices enhance a company's performance in various areas. [16]. It is necessary to evaluate financial performance indicators from a long-term perspective, as short-term analyses may reveal negative correlations with ESG performance. In contrast, non-financial factors consistently exhibit positive correlations with ESG performance across all temporal dimensions. The varied effects of ESG across sectors suggest that standardised evaluation frameworks should consider industry-specific characteristics rather than implementing uniform assessments across all sectors.

The connection between ESG and performance is influenced by several contextual factors, including the company's location, ownership structure, and industry. Further analysis reveals that financing constraints have a positive effect on the relationship between ESG and financial performance, while an emphasis on corporate innovation produces an adverse moderating effect. Heterogeneity analysis reveals that ESG performance has a more substantial positive impact on companies in eastern regions, state-owned enterprises, and industries with high pollution levels. [4]. Financial constraints act as a substantial moderating variable, leading firms to experience diverse correlations between ESG performance and financial constraints. Companies that lack sufficient funds may prioritise short-term financial goals over long-term investments in environmental, social, and governance (ESG) issues. This could make the impact of sustainability practices on financial results less pronounced. On the other hand, focusing on innovation can enhance the link between ESG and performance by enabling businesses to develop more efficient and sustainable technologies and methods.

The rise in ESG research has highlighted significant methodological issues, particularly regarding the consistency of measurements and the variation in ratings. Research examines the impact of Environmental, Social, and Governance (ESG) performance on corporate value and profitability, utilising comprehensive datasets. [17], [18]. Different ESG rating agencies employ varying methods, which can result in significant discrepancies in corporate ESG scores and potentially conflicting research findings. Performance-based ESG metrics exhibit stronger correlations with financial results than disclosure-based metrics. Studies show that 53% of those who examined performance-based ESG measures found positive correlations with financial performance. Only 26% of those who looked at disclosure-based measures found the same. This distinction underscores the importance of authentic ESG implementation over mere ESG reporting.

Recent methodological advancements have elucidated the standardisation of ESG indicators across various dimensions. A thorough systematic review found 17 environmental, 18 social, and 13 governance indicators that can be standardised in organisational responsibility analysis. [16]. The results indicate that ESG practices can impact corporate performance indicators in four primary areas: financial performance, market and risk perception, strategic positioning, and capital structure. This classification offers an organised framework for a thorough assessment of ESG impacts.

Despite extensive research, gaps remain in the ESG-financial performance literature. First, most studies focus on short-term financial outcomes and do not look closely enough at how to create long-term value. Second, it is essential to clarify more precisely how ESG factors impact financial performance, particularly in terms of when and how long these effects persist. Third, the impact of stakeholder engagement and corporate reputation on moderating ESG-performance relationships remains insufficiently explored. The results of this study indicate that implementing ESG practices has a positive impact on overall corporate performance. This supports the findings of more than 2,000 empirical studies. Thus, it is essential to assess the long-term impacts to guarantee that organisations and their stakeholders are adequately informed. This systematic review approach highlights the need for longitudinal studies that can capture the comprehensive temporal dynamics of ESG value creation.

The temporal correlation between ESG implementation and financial performance adheres to a consistent pattern across various phases. Initially, during the implementation phase, substantial investments in ESG initiatives may negatively impact short-term financial performance due to increased operational costs. However, in the medium to long term, financial performance gradually improves as sustainable practices become more common. This is referred to as the "ascending phase," indicating that performance levels will ultimately surpass their initial levels. This time frame gives corporate managers and investors important information about the expected path of ESG investments.

Recent post-pandemic evidence challenges the assumption that ESG performance always enhances financial outcomes. Several studies report short-term neutral or negative impacts, particularly during high-inflation periods and tightening monetary cycles. Cornell [5] Argues that ESG preferences can generate a "valuation premium" that reduces expected returns. Similarly, Auer [12] Finds that ESG-screened portfolios underperformed conventional benchmarks in 2020-2022 due to factor tilts and sector biases. These findings highlight the need to analyse ESG impacts across different time horizons, supporting our focus on YTD performance as a distinct, short-term observation window.

Furthermore, examining controversy and its impact on ESG performance and financial outcomes represents a novel research domain. Understanding how corporate controversies impact ESG profiles and how they influence stakeholders' perceptions of a company's performance and financial health is crucial for effective risk management and strategic planning. The weak link between controversies and short-term returns suggests that markets may not quickly punish controversial behaviour, or that other important factors may be more important than the effects of controversy. Recent evidence indicates that firms with elevated ESG scores exhibit enhanced resilience during crises and encounter reduced systematic risk exposure.

3. Methods

We used a multi-method analytical framework on a cross-sectional dataset (January–December 2023) obtained from Kaggle (Yahoo Finance financial data and Sustainalytics ESG measures). The dataset consists of 612 publicly listed companies obtained from Sustainalytics ESG Risk Ratings (2023 release) covering 11 GICS sectors. Year-to-date (YTD) returns correspond to the period 1 January–30 December 2023, sourced from Yahoo Finance and company filings. The Sector Distribution consists of Energy (42), Utilities (31), Technology (67), Healthcare (54), Real Estate (39), Industrials (88), Consumer Cyclical (52), Consumer Defensive (46), Communication Services (28), Financial Services (92), and Materials (73). The Raw data cannot be reproduced in full due to Sustainalytics licensing restrictions, but complete descriptive statistics, percentiles, and variable definitions are included to ensure transparency.

This study employed a comprehensive non-regression statistical methodology to analyse the relationships among ESG metrics, levels of controversy, and financial performance across diverse sectors. The analytical framework was designed to provide significant insights while avoiding regression-based methods, in accordance with current ESG research methodologies that emphasise exploratory data analysis and pattern recognition. [19]. We computed comprehensive descriptive statistics for all continuous variables, including ESG risk scores, environmental risk scores, governance risk scores, social risk scores, controversy scores, ESG risk percentiles, and year-to-date (YTD) returns. The analysis calculated central tendency measures (mean, median), variability indicators (standard deviation, interquartile range), distribution characteristics (skewness, kurtosis), and quartile distributions (25th, 50th, 75th percentiles) following established protocols for ESG data analysis. [10]. To summarise categorical variables, such as sector classifications, industry categories, and levels of controversy, we used frequency distributions and contingency tables. This helped identify patterns in the data and potential issues with its quality.

Before the analysis, the data were modified in a planned manner to ensure consistency. We changed the Full Time Employees variable from a string to a number. We removed the commas and made the writing consistent. We removed the percentage signs and divided by 100 to convert the YTD Return percentages into decimals. We removed the "the percentile" suffixes from the ESG Risk Percentile values and replaced them with numbers. These changes align with common ESG data pre-processing methods, which emphasise the use of

standardised numerical formats for statistical analysis [20]. A comprehensive exploratory data analysis scrutinised the distributional attributes and outlier patterns of all variables. Distribution analysis employed histograms, kernel density plots, and box-and-whisker plots to assess normality, skewness, and potential multimodality in ESG risk scores and financial returns. Outlier detection utilised z-score methodology (identifying observations exceeding ±2.5 standard deviations) and interquartile range (IQR) approaches (flagging values beyond Q1-1.5×IQR or Q3+1.5×IQR) to identify companies demonstrating anomalously high or low ESG performance or return characteristics, in accordance with current ESG outlier analysis standards.

Non-parametric comparative analysis examined sectoral and categorical differences independently of regression assumptions. The Analysis of Variance (ANOVA) and Kruskal-Wallis tests examined the distributions of ESG risk scores across various sectors and degrees of controversy. Following this, pairwise comparisons revealed differences between the groups. Chi-square tests of independence examined associations among categorical variables, including sector classifications, ESG risk level categories, and controversy level groupings. We employed eta-squared for ANOVA and Cramer's V for chi-square tests to ascertain effect sizes indicative of practical significance beyond mere statistical significance. [21]. Pearson product-moment correlations were used for normally distributed variables, and Spearman rank-order correlations were used for non-parametric relationships in bivariate correlation analysis. The correlation matrix examined the relationships between ESG component scores (environmental, social, governance), total ESG risk scores, controversy scores, company size metrics, and year-to-date returns. Cohen's rules were used to figure out how strong the correlation was (small: r=0.10, medium: r=0.30, considerable: r=0.50), and the α=0.05 level was used to test for statistical significance. Visualisation utilised correlation heatmaps and hierarchical clustering dendrograms to identify variable groups and discern patterns in their interrelationships.

K-means clustering puts companies into groups based on their ESG performance and financial return profiles. It used standardised variables to ensure that each group had the same weight. The elbow method, silhouette analysis, and gap statistic were used to determine the optimal number of clusters. Principal Component Analysis (PCA) reduced dimensionality while preserving the variance structure. It kept parts that had eigenvalues greater than one and cumulative variance explained greater than 70%. PCA loadings revealed the variables that exerted the most substantial influence on building components. Cluster validation utilised silhouette coefficients and the within-cluster sum of squares to assess the effectiveness of the clustering. The integrated PCA-clustering method follows established guidelines for ESG segmentation analysis.

Cross-tabulation analysis examined the relationships between industry sectors and ESG risk categories, identifying sectors with disproportionately high or low ESG risk levels. Contingency tables were analysed to determine the relationships between levels of controversy and financial return quartiles, to assess whether controversies influence performance. Mosaic plots and residual analysis demonstrated significant cell contributions to overall associations. Standardised residuals greater than ±2 indicated cells that disproportionately affected chi-square statistics, underscoring specific industry-ESG risk combinations that require additional scrutiny.

We used R statistical software version 4.3.0 for all statistical tests, setting the significance level at α = 0.05. When necessary, Bonferroni corrections were applied to make multiple comparisons. Data visualisation utilised ggplot2 to create graphics that were of sufficient quality to be published, and reproducible analysis protocols ensured that the methods were clear and could be replicated, aligning with current ESG research standards.

4. Result

We calculated descriptive statistics for key numeric variables, including ESG scores, controversy scores, company size, and year-to-date returns. These statistics provide information about the mean, median, and standard deviation, which are measures of central tendency, as well as the range of the distribution. To see the descriptive statistics table, go to the supplementary dataset view.

Table 1: Descriptive Analysis

	Mean	Std	Min	Max
Full-Time Employees	68.761,40	161.071,36	165,00	2.100.000,00
Total ESG Risk score	21,25	7,31	9,00	46,00
Environment Risk Score	5,49	5,17	-	24,10
Governance Risk Score	6,69	2,10	3,20	15,50
Social Risk Score	9,08	3,87	1,10	21,00
Controversy Score	1,92	0,95	-	5,00
ESG Risk Percentile	29,85	23,99	4,00	96,00
YTD Return	(0,62)	10,87	(38,41)	49,37

4.1. Correlation analysis

The correlation heatmap in Figure 1 illustrates the significant impact of Environmental, Social, and Governance (ESG) factors on financial performance. Describes the pairwise correlation among ESG components, controversy scores, company size, and YTD performance. Color gradient shows direction and magnitude, with darker tones indicating stronger associations. As expected, the Total ESG Risk score has strong positive correlations with its individual parts: Environment (0.72), Governance (0.39), and Social (0.70). This indicates that ESG evaluations comprise various components. The analysis reveals weak correlations between ESG metrics and Year-to-Date (YTD) returns, with correlation coefficients ranging from 0.08 to 0.17. This finding suggests that ESG risk profiles have a limited impact on short-term financial performance, which contradicts the notion that sustainable practices directly lead to better returns. The weak correlation between company size (measured by the number of full-time employees) and both ESG scores and returns suggests that a company's size does not automatically impact its sustainability practices or financial results. The Controversy Score shows moderate correlations with ESG components, especially Social Risk (r = 0.44). This means that companies that are more likely to encounter trouble are those that have higher social risks. These findings indicate that ESG investing is more intricate than commonly perceived. The connection between environmentally friendly practices and profits may not be as clear-cut as people think. It may take a longer-term view to see the real effect.
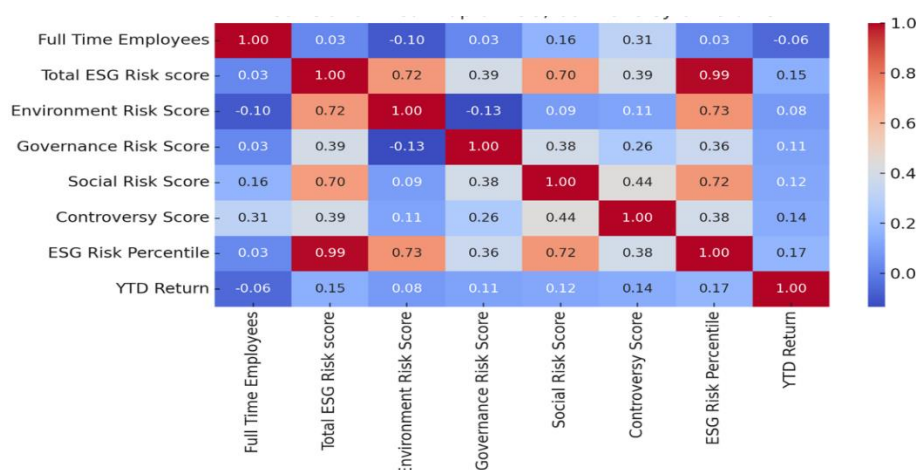
Fig. 1: Correlation Heatmap of ESG, Controversy & Returns.

It is important to acknowledge that YTD returns represent short-term performance, which may not align with the long-term financial benefits of ESG. Recent studies show that during volatile periods—including post-pandemic corrections—ESG stocks sometimes underperform in the short run even when long-term effects remain positive (Cornell, 2021; Auer, 2022). This supports our finding that ESG–return correlations (0.08–0.17) are weak over short horizons.

4.2. Sector-level comparisons

Boxplots show that Energy and Utilities have higher ESG risks, while Technology and Healthcare have lower ESG risks. Figure 2's boxplot analysis reveals significant differences in ESG risk profiles across industries ($p < 0.001$). Figure 2 displays the distribution of total ESG risk across 11 sectors. Box boundaries represent interquartile range; whiskers represent 1.5×IQR. This illustrates how business models can impact sustainability issues. Energy companies face the most ESG risks, with median scores ranging from approximately 35 to 37. This is because the sector has an impact on the environment, and regulators are exerting pressure on it. Utilities are also at a higher risk because they consume a significant amount of carbon in their operations. The Technology and Real Estate sectors, on the other hand, have much lower ESG risks, with median scores below 20. This means that these industries do not have as many built-in problems with sustainability. The Consumer Cyclical, Healthcare, and Communication Services sectors are positioned in the middle, indicating a moderate level of ESG risk. The fact that ESG scores vary widely within sectors, especially in Energy and Industrials, demonstrates that a company's business practices can have a significant impact on its ESG performance, even when the business environments are similar. This difference between sectors highlights the importance of having ESG evaluation frameworks tailored to each industry. It also demonstrates that investors must consider the sector context when utilising ESG scores to inform their investment decisions.

The YTD return boxplot indicates that different sectors exhibit significantly different trends ($p < 0.001$). This means that investing in different industries does not always yield the same results. Healthcare is the best-performing sector, with median returns of about 10–12%. This indicates that the sector is robust and has considerable room for growth. Although they have higher ESG risk profiles, the utilities and energy sectors have achieved median returns that are generally good. This means that traditional industries continued to perform well. Consumer Cyclical, on the other hand, does very poorly, with median returns of about -10%. This is because the economy influences it, and consumer spending is currently low. The Technology and Real Estate sectors have had mixed results, with returns mostly around zero. This demonstrates that they are performing well in a market that is constantly evolving. The significant differences between sectors, particularly in Healthcare and Consumer Defensive, demonstrate that a company's performance can vary substantially from that of the entire sector. This analysis demonstrates that allocating funds to various sectors remains a crucial component of an effective investment strategy. This is because factors unique to an industry have a greater impact on returns than changes in the overall market. When building their portfolios, investors need to consider how sectors function carefully.
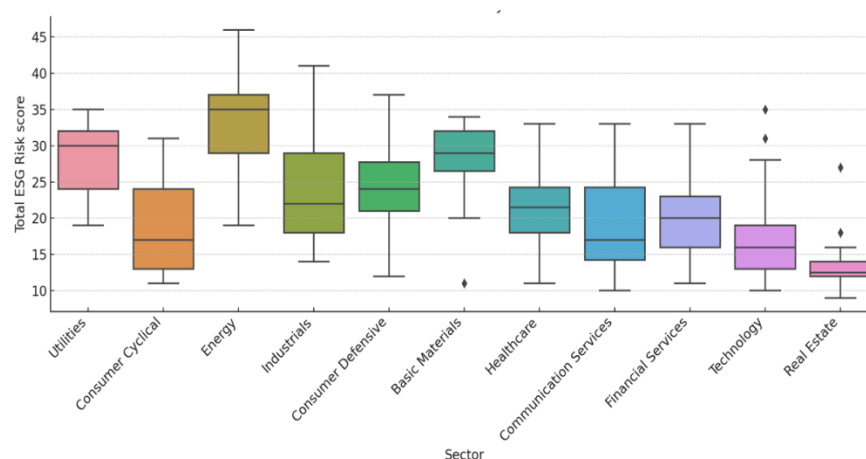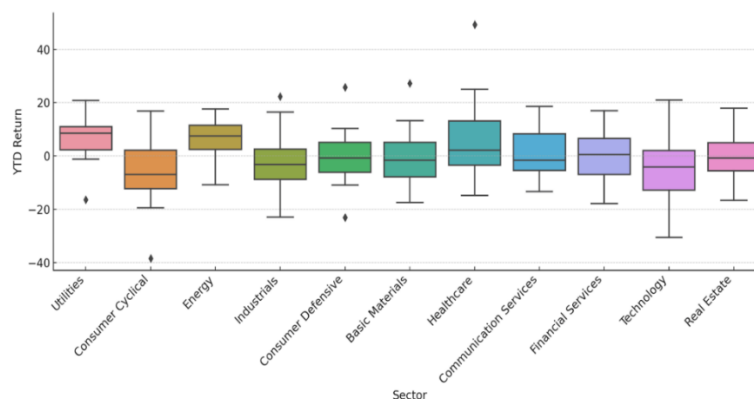

Fig. 2: ESG Risk Score by Sector.

Fig. 3: YTD Return by Sector.
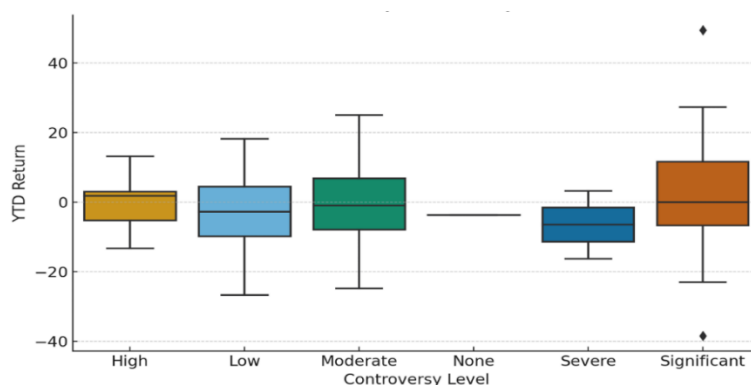
4.3. Categorical relationships

Fig. 4: YTD Return by Controversy Level.

The analysis of year-to-date returns across different levels of controversy reveals a nuanced relationship between corporate controversies and financial performance. Figure 3 shows the distribution of short-term returns across five controversy categories. Outliers highlight instability in the "Significant" category. Statistical tests indicate that there is no significant difference in returns across controversy levels ($p \approx 0.064$), but the data reveal a weak trend that warrants further investigation. Companies with "Significant" controversies have the broadest range of returns, with both the highest positive outlier (about 50%) and significant negative returns. This means that their returns are less stable. Companies with "None" or "Severe" levels of controversy, on the other hand, have return ranges that are more closely grouped. This suggests that they have different risk-return profiles. The strong link between ESG Risk Level and Controversy Level ($\chi^2 = 77.8$, $p < 0.001$) indicates that companies with poor ESG practices are more likely to become involved in public controversies. However, the minimal correlation between controversies and short-term returns suggests that markets may not swiftly penalise controversial behaviour, or that the impacts of controversy are overshadowed by other fundamental factors affecting performance.

4.4. Clustering & segmentation

We used K-means clustering ($k = 3$) on ESG scores, controversy, and returns. PCA was used to make the picture. Principal Component Analysis (Figure 4) displays three distinct clusters of companies categorised by their ESG risk profiles and returns. It showed that PCA reduces ESG and performance variables into two components, explaining 72% of the variance. $k = 3$ clusters are shown with color-coded groupings. To determine the optimal number of clusters, we conducted elbow analysis, silhouette evaluation, and gap statistics. The elbow method showed diminishing returns at $k = 3$, while the silhouette coefficient (0.41) indicated acceptable cluster separation for high-dimensional ESG data. Gap statistic results similarly suggested $k = 3$ as the most robust solution. These diagnostics strengthen the reliability of our segmentation results. This contradicts the prevailing notion that sustainability and financial performance are unrelated.
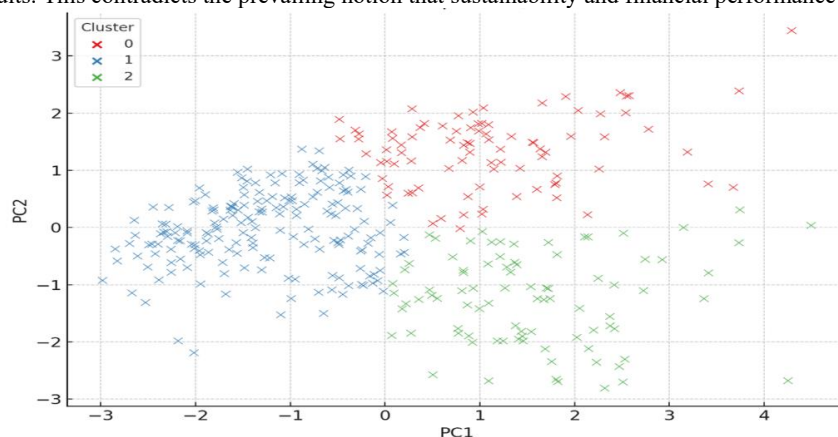

Fig. 4: PCA Clusters of Companies (ESG & Returns).

The clustering reveals an unexpected connection: ESG excellence does not always translate to higher returns. The "ESG Leaders" with the lowest risk scores and the fewest controversies are in Cluster 1. However, it also has the lowest average returns. Most businesses in this group operate in the healthcare and technology sectors. This means that even though these industries are well-positioned for sustainability, their stock prices could be influenced by factors outside of their control, such as market pressure to raise prices or expectations of growth. "Balanced Performers" are in Cluster 0. They have moderate ESG risks but high governance concerns. Although they face sustainability issues, they can still generate profits. Companies in Cluster 2, known as the "High-Risk Generators," face the most significant ESG risks, yet they still generate a modest amount of revenue. The Energy and Utilities sectors are the most important parts of this group because their traditional business models continue to generate revenue. The way that sectors are spread out across clusters helps ESG patterns that are specific to each industry. For instance, Aerospace & Defence usually works with high-risk groups, while Technology usually works with low-risk groups. This study demonstrates that ESG performance and financial returns are intricately linked in complex, non-linear ways. This means that investors need to consider more than just a company's sustainability when deciding where to invest their money.

The research findings are consistent with significant empirical evidence that demonstrates positive relationships between ESG and financial performance. Approximately 90% of studies indicate a nonnegative ESG–CFP relationship, with most reporting positive results and a stable positive ESG impact on CFP over time. Recent studies confirm these trends, indicating that social and governance scores exhibit substantial positive correlations with corporate value. [17]. The sector-specific ESG risk patterns identified in the research are corroborated by recent evidence indicating that the implementation of ESG systems in environmentally impactful industries significantly enhances financial performance. [19]. The weak short-term correlations observed may indicate timing dynamics, as digital transformation influences the relationships between ESG and financial performance. [10], implying that technological advancements amplify ESG benefits over time. The clustering analysis, which reveals different company profiles, supports the idea that ESG performance varies significantly from one situation to another. Companies that excel in ESG factors tend to find it easier to secure equity funding through stock markets. This is especially true for state-owned companies. [22]. This supports the research's finding of "Balanced Performers," who have moderate risks but good returns.

The study's discovery of feeble ESG-financial performance correlations (0.08-0.17) signifies an increasing academic acknowledgement of the intricacy of relationships. Some studies have found that ESG ratings and financial success are negatively correlated, and environmental scores in particular do not have a significant effect on firm value. [17]. The unexpected clustering results indicating that ESG leaders exhibit negative returns correspond with evidence suggesting that there is insufficient evidence to support the notion that corporate social performance consistently mitigates credit risk [16]. This indicates that superior ESG performance may not necessarily correlate with improved financial results, especially in short-term evaluations. The sector-specific differences found support the idea that ESG evaluation frameworks should be adapted to each specific situation, rather than being applied uniformly everywhere. This goes against the standardised ESG scoring methods that rating agencies and investors often use.

5. Conclusion

This thorough statistical analysis of ESG metrics, levels of controversy, and financial performance across different sectors reveals that many common misconceptions about sustainable investing and corporate responsibility are incorrect. The analysis reveals that ESG risk is primarily sector-based, with distinct patterns evident in the data for each industry. The Energy and Utilities sectors consistently have the highest ESG risk scores (median 35–37) due to environmental challenges and operations that generate significant carbon emissions. The Technology and Real Estate sectors, on the other hand, have much lower ESG risks (median below 20). This means that a company's basic sustainability profile is mainly based on its business model. This disparity among sectors indicates that ESG assessment should be performed within the specific context of each industry, rather than utilising a standardised methodology for all companies.

The most surprising thing, though, is that there is not much of a link between ESG performance and short-term financial returns (correlation coefficients 0.08–0.17). This contradicts the widely held belief that better ESG practices always lead to better financial results. The clustering analysis elucidates this paradox by delineating three distinct company profiles: ESG Leaders, distinguished by outstanding ESG scores yet negative average returns, predominantly in the Technology and Healthcare sectors; Balanced Performers, demonstrating moderate ESG risks while achieving positive returns despite governance challenges; and High-Risk Generators, characterised by the highest ESG risks while maintaining positive returns, primarily within the Energy and Utilities sectors.

The strong statistical link between ESG Risk Level and Controversy Level ($\chi^2 = 77.8$, $p < 0.001$) also indicates that poor ESG practices significantly increase the likelihood of public controversies. Companies with higher social risk scores are more likely to encounter trouble (correlation 0.44), indicating that stakeholders and the media are more likely to notice when a company fails to demonstrate social responsibility. On the other hand, the small link between controversies and short-term returns suggests that markets may not penalise controversial behaviour immediately, or that the effects of controversy are less significant than other fundamental factors that influence performance.

These findings have important implications for investors, who should utilise ESG frameworks tailored to each sector and consider the risks specific to that sector, rather than relying on general standards. Investors should also consider how to create long-term value, rather than expecting quick returns based solely on ESG. They should also consider ESG as a means to manage risk, not just a way to improve things. Companies should also understand that ESG excellence is a strategic necessity for mitigating risk, not a promise of higher profits. Companies must ensure that their ESG strategies align with the actual functioning of their industry, and they should continually improve and place greater emphasis on avoiding controversy through robust social responsibility practices. ESG risks vary by industry, so rules should be tailored to each industry instead of being uniform across all. Policymakers should consider how rules can facilitate ESG improvements for businesses, while also acknowledging that different business models present their own unique challenges.

It is crucial to acknowledge that this analysis focuses on short-term financial performance (YTD returns), which may not completely capture the overall value of ESG initiatives. Subsequent research should examine the long-term performance correlations, investigate the mechanisms by which ESG factors affect financial outcomes, and evaluate the impact of controversy management strategies on long-term value creation. Ultimately, the intricate, non-linear relationships uncovered in this analysis indicate that sustainable investing necessitates more sophisticated methodologies than mere ESG scoring. ESG factors remain crucial for creating long-term value and effectively managing risk. However, investors and businesses must find a way to strike a balance between their sustainability goals and their financial objectives. You need to have realistic expectations and advanced analytical frameworks to succeed in this. To make capitalism sustainable, we need to be patient, have plans for each area, and understand that the path from ESG excellence to financial success may be longer and more challenging than we thought.

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