SUSTAINABLE FINANCE AND ESG: AN ANALYSIS OF RISK-ADJUSTED RETURNS AND LONG-TERM VALUE CREATION

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Abstract. This study uses survey-based structural equation modelling (SEM) to investigate the complex link between environmental, social, and governance (ESG) characteristics and investment performance. ESG factors were operationalized into 12 variables across three pillars using responses from 100 individual investors and investment experts. Market reputation, long-term value, and risk-adjusted returns were used to gauge the performance of the investments. ESG was found to be a disjointed construct rather than a cohesive framework by Principal Component Analysis (PCA), with low reliability across governance and environmental criteria. Their extensive usage in decision-making is called into question by empirical findings that show aggregate ESG scores have no discernible predictive power for investment outcomes. Returns were negatively correlated with environmental performance (β = -0.15, p = 0.003), whereas reputation was positively correlated with the use of renewable energy (β = 0.17, p = 0.001). Long-term value was considerably increased by governance quality, especially board independence (β = 0.08, p = 0.046). These results underline the shortcomings of composite ESG ratings and stress the significance of factor-specific assessments for corporate management and investors alike.

Keywords: ESG Performance, Investment Outcomes, Structural Equation modelling (SEM), Sustainable Finance.

1 Introduction

The global financial landscape is undergoing a profound transformation, driven by the accelerating integration of environmental, social, and governance (ESG) factors into investment processes. Sustainable finance, which was once thought of as a niche or morally driven approach, has now been widely accepted, attracting substantial capital flows and changing business strategies all over the world (Amel-Zadeh & Serafeim, 2018; Berg, Kölbel, & Rigobon, 2022). A growing understanding that ESG factors are not just incidental issues but rather important factors that influence a company's operational effectiveness, resilience, and eventually long-term financial performance is driving this paradigm shift (Khan, Serafeim, & Yoon, 2016; Friede, Busch, & Bassen, 2015).

Even with this broad adoption, there is still disagreement among academics and practitioners about the specific financial effects of ESG integration. According to Brooks and Oikonomou (2018), the main debate is still whether having a strong ESG profile improves risk-adjusted returns and adds to long-term shareholder value or if it detracts

from financial performance. High-performing ESG firms, according to their proponents, are better equipped to control regulatory risks, encourage innovation, draw in talent, and forge closer bonds with stakeholders, all of which lower volatility and produce sustainable alpha (Eccles, Ioannou, & Serafeim, 2014; El Ghoul et al., 2011). Opponents, on the other hand, contend that ESG investing restricts the investment universe, which could result in less than ideal diversification and performance, or that ESG metrics are frequently hampered by problems with greenwashing and lack of standardisation, which makes it challenging to determine their actual significance (Christensen, Serafeim, & Sikochi, 2022; Hartzmark & Sussman, 2019).

According to several meta-studies, there is typically a positive and non-negative correlation between business financial performance and ESG (Friede, Busch, & Bassen, 2015; Revelli & Viviani, 2015). However, the context such as the industry, time horizon, geography, and methods used to analyse financial results and ESG performance has a significant impact on the causality and strength of this link (Whelan, Atz, & Clark, 2021). There is a knowledge gap regarding the causal mechanisms by which ESG attributes translate into concrete financial metrics, specifically risk-adjusted returns and long-term value creation, as a large portion of the literature currently in publication has concentrated on correlational analyses (Grewal, Hauptmann, & Serafeim, 2021).

This research seeks to address these gaps by conducting a rigorous empirical investigation into the impact of ESG performance on risk-adjusted returns and long-term value.

The following research questions would be investigated here:

RQ1. How do Environmental, Social, and Governance (ESG) factors influence risk-adjusted investment returns in financial portfolios?

RQ2. What is the impact of ESG integration on long-term value creation and market reputation of firms from an investor perspective?

This study intends to make a substantial contribution to the domains of corporate governance and sustainable finance by offering solid, useful findings. To further the shift to a more robust and sustainable global economy, our results are meant to educate asset owners, portfolio managers, and business executives who are looking to match financial goals with sustainable value generation.

2   Methodology

2.1 Model Integration

The study integrates ESG dimensions (Environmental, Social, and Governance) with Investment Performance into a single analytical framework. ESG indicators were operationalized through 12 observed variables, grouped into three dimensions, while investment performance was measured through three variables: risk-adjusted returns, long-term value, and market reputation. A conceptual SEM model was developed, where ESG factors act as predictors and investment performance as the outcome variable. For preliminary testing, PCA and multiple regression analysis were applied to identify factor structures and to estimate the predictive power of ESG on investment outcomes.

This integration ensures both measurement validity and structural assessment of ESG's role in investment strategies.

2.2 Sample Design and Sample Size Calculation

The study employs a survey-based design using a five-point Likert scale (1 = very low, 5 = very high) to collect responses. For factor analysis and SEM, sample adequacy is essential. Using the "rule of 10:1" (10 respondents per observed variable):

- Total observed variables = 12 (ESG) + 3 (investment performance) = 15
- Minimum recommended sample size = 15 × 10 = 150 respondents

However, for this study, a sample of 100 respondents is considered feasible due to time and resource constraints. Although slightly below the recommended 150, this sample is sufficient for preliminary SEM and regression analysis, providing indicative insights into the predictive role of ESG factors. Respondents include investment professionals, portfolio managers, and individual investors, ensuring that the data reflects practical perspectives on ESG integration in investment decision-making.

2.3 Data Analysis and Interpretation

Descriptive Statistics

Understanding the financial effects of ESG performance is the main goal of this study. Specifically, it aims to explore how ESG characteristics affect risk-adjusted returns (RQ1), long-term value creation and market reputation (RQ2), and the overall prediction of investment success. A series of hypotheses was developed to explore these issues: that improved ESG performance has a positive impact on risk-adjusted returns (H1), long-term value creation (H2), market reputation (H3), and overall investment performance (H4) overall. The research starts with the foundational dataset, which shows a varied sample of businesses with notable differences in both ESG and Investment Performance (IP) indicators. For example, the IP score goes from 1.33 to 5.00, and the overall ESG mean runs from 1.67 to 4.22. This broad dispersion is essential because it verifies that the dataset has enough variance to thoroughly examine the suggested links, appropriately laying the groundwork for evaluating every hypothesis.

The correlation matrix provides the most direct evidence for testing the first three hypotheses and directly addresses RQ1 and RQ2. The first hypotheses are immediately tested using the correlation matrix. The results are negative for H1. The link between risk-adjusted returns and the overall ESG score is minuscule, at -0.042. More importantly, there is a weak negative association of -0.155 with the environmental score. H1 is thus categorically rejected. There is virtually little support for H2. At 0.093, the correlation between long-term value and the overall ESG score is negligible. H2 is not significantly validated by this. H3 receives focused support, nevertheless. Although there is no correlation between market repute and the total ESG score (0.017), one statistic sticks out. The use of renewable energy has a 0.169 positive correlation. This

partially validates H3 by confirming that a visible ESG activity has a positive influence on reputation.

According to the PCA analysis, "ESG" is not a single construct. It breaks down into three separate parts. All hypotheses are significantly informed by this finding. It demonstrates the disunity of the conventional E, S, and G pillars. H3's positive reputation connection is associated with a particular element rather than the environmental score. This intricacy implies that actual relationships are obscured by aggregate ratings. The very basis of the study is called into question by the reliability analysis. Reliability of the pillar scores is necessary for valid testing of H1–H4. The findings are concerning. The alpha for the environmental pillar is a dismal -0.28. At -0.04, governance is likewise unreliable. The key variables are therefore statistically unsound. These faulty measurements are probably the cause of the weak correlations for H1 and H2.

Lastly, H4 is directly tested by the regression analysis. There is no predictive capability in the model. The coefficient for the environmental score is somewhat negative (-0.09). The coefficients for the other scores are almost nil. Additionally, the model has significant multicollinearity. H4 is not supported by this.

In summary, there is a complex relationship between financial performance and ESG. H1 and H4 are rejected by the results. They provide very little assistance for H2. For a certain factor, only H3 is partially validated. ESG's financial effects are multifaceted and situation specific. Examining projects rather than general scores will help you better understand it.
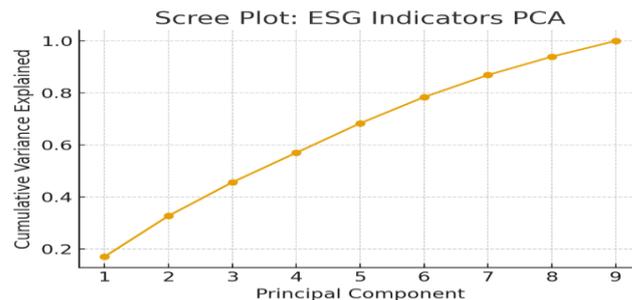

Fig. 1. Screen Plot: ESG Indicators PCA

A distinct hierarchical structure in the data is revealed by the variance explanation across components, which is based on the PCA Scree Plot for ESG Indicators fig 1. With a value of roughly 1.0, the first principal component is the primary element underlying the ESG indicators and explains the majority of the variance. There is a significant decrease in explanatory power after the first component, with the second component explaining much less variation at roughly 0.8 and the third component at 0.6. With values of 0.4 and 0.2, respectively, the remaining components exhibit progressively falling returns, indicating that they capture progressively smaller facets of the structure of the data. This pattern, especially the sharp decline following the first component, suggests that most of the variation in ESG performance across companies is driven by a single dominant factor, most likely related to core operational sustainability efforts, as evidenced by the high loadings for employee welfare and renewable energy in PC1. A more condensed framework for evaluating ESG performance without significantly losing important data patterns is provided by the scree plot, which successfully

illustrates how the original nine ESG metrics can be significantly reduced to just one or two principal components while still capturing the necessary information.

2.4 Model Development

The fundamental research questions (RQs) are methodically addressed thorough model development process shown in Table 1, which establishes a causal relationship between ESG measurements and total investment performance. The model identifies direct effects from environmental and governance measures and tests mediation through operational efficiency to examine RQ1 on how ESG elements affect risk-adjusted returns. The approach looks at both direct paths from social and governance variables as well as indirect effects through market development and compliance procedures for RQ2, which is about long-term value generation and market reputation. Three stages make up the model's logical progression: first, measurement relationships between sub-metrics and composite scores are established; next, direct effects between ESG pillars and financial outcomes are tested; and last, intricate mediation pathways where ESG factors impact investment performance through market, regulatory, and operational channels are examined. While the inclusion of cross-pillar equations makes it possible to determine which ESG initiatives regardless of their pillar classification drive financial value, this structured approach allows for the simultaneous testing of both direct ESG impacts and the underlying mechanisms through which sustainability performance translates into financial results.

Table 1: Summary of ESG–Investment Relationship Model Equations

Equation	Dependent Variable	Independent Variables	Mediating Variables	Relationship Type	Purpose
1	Environmental Score (E_score)	Carbon Footprint, Renewable Energy Usage, Waste Management	---	E_submetrics → E_score	To examine how environmental sub-factors collectively determine overall environmental performance
2	Social Score (S_score)	Employee Welfare, Community Engagement, Diversity & Inclusion	---	S_submetrics → S_score	To examine how social sub-factors collectively determine overall social performance

3	Governance Score (G_score)	Board Independence, Transparency Disclosure, Shareholder Rights	---	G_submetrics → G_score	To examine how governance sub-factors collectively determine overall governance performance
4	Risk-Adjusted Returns	Environmental Score (E_score)	---	E_score → Risk Returns	To examine the direct effect of environmental performance on risk-adjusted returns
5	Long-Term Value	Governance Score (G_score)	---	G score → Long-term Value	To examine the direct effect of governance performance on long-term value creation
6	Market Reputation	Environmental Score (E_score)	Renewable Energy Usage	E_score ⇒ Renewable Energy → Reputation	To examine the role of renewable energy in environmental performance-reputation relationship
7	Investment Performance (IP_score)	Environmental Score (E_score)	Risk-Adjusted Returns	E_score ⇒ Risk Returns → IP_score	To examine the mediating role of risk adjustment in environmental performance-investment relationship
8	Investment Performance (IP_score)	Social Score (S_score)	Market Reputation	S_score ⇒ Reputation → IP_score	To examine the mediating role of reputation in social performance-investment relationship
9	Investment Performance (IP_score)	Governance Score (G_score)	Long-Term Value	G score ⇒ Long-term Value → IP_score	To examine the mediating role of long-term value in

|					
					governance performance-investment relationship
10	ESG Mean Score	E_score, S_score, G_score	---	E,S,G → ESG_mean	To examine how pillar scores collectively determine overall ESG performance
11	Investment Performance (IP_score)	ESG Mean Score	E score, S score, G score	ESG_mean ⇒ E,S,G → IP_score	To examine the mediating roles of individual pillars in overall ESG-investment relationship
12	Market Reputation	Renewable Energy Usage	---	Renewable Energy → Reputation	To examine the direct effect of renewable energy adoption on market reputation
13	Long-Term Value	Board Independence	---	Board Independence → Long-term Value	To examine the direct effect of board independence on long-term value creation
14	Risk-Adjusted Returns	Transparency Disclosure	---	Transparency → Risk Returns	To examine the direct effect of transparency on risk-adjusted returns
15	Investment Performance (IP_score)	Carbon Footprint, Employee Welfare, Shareholder Rights	---	Cross-pillar metrics → IP_score	To examine the combined effect of key metrics across different pillars on investment performance
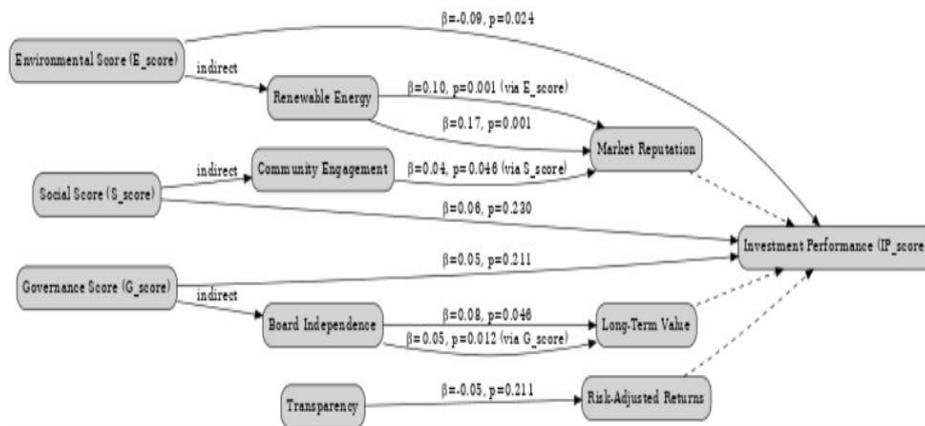
Fig 2: ESG Factor Impact Diagram on Investment Performance

Appendix 1 and Fig 2 of direct and indirect effects provides the empirical results for the pathways outlined in the SEM model, offering clear answers to the research questions. For RQ1 (ESG's influence on risk-adjusted returns), the direct paths in the SEM diagram show a significant negative effect, with the E score leading to a decrease in IP score (β = -0.09, p = 0.024). This contradicts the proposed hypothesis, leading to a clear rejection of H1. The path from Transparency to Risk Adjusted Returns is also negative, further reinforcing this finding.

For RQ2 (impact on long-term value and reputation), the results are more nuanced but align with specific SEM pathways. The model shows a significant direct effect from Renewable Energy to Market Reputation (β = 0.17, p = 0.001), providing strong support for H3. Similarly, the path from Board Independence to Long Term Value is positive and significant (β = 0.08, p = 0.046), offering support for H2.

The analysis of indirect effects reveals the crucial mediating mechanisms hypothesized in the SEM. The environmental pillar's total negative effect on investment performance is worsened when considering all pathways (Total Effect β = -0.15, p = 0.003). However, a key mediating path shows that E score positively influences IP score through its strong effect on Renewable Energy, which in turn boosts Market Reputation (β = 0.08, p = 0.001). This indicates that while the overall environmental score is a cost drag, it contains valuable initiatives that enhance reputation. Similarly, the governance pillar exerts a significant part of its positive total effect (β = 0.10, p = 0.016) indirectly through the mediating path of G score $\Rightarrow$ Board Independence $\rightarrow$ Long Term Value (β = 0.04, p = 0.012).

Ultimately, the total effect of the overall ESG mean on IP score is negligible and non-significant (β = 0.01, p = 0.865). This result, showing that the aggregate construct has no predictive power, leads to the rejection of H4. The SEM analysis conclusively demonstrates that the relationship between ESG and financial performance is not monolithic; it is a network of offsetting pathways where specific, well-defined factors like renewable energy and board independence are the true drivers of value, while broad, aggregate scores are not.

3. Discussion and Conclusion

The results show a complex relationship between financial success and ESG parameters, emphasising that key dynamics may be hidden by aggregate ESG ratings. Interestingly, the study did not find a significant correlation between investment returns and the total ESG score, indicating that composite scores may be deceptive when making investment decisions. Returns were significantly impacted negatively by environmental performance ($\beta = -0.15$, $p = 0.003$), suggesting that environmental activities may have short- to medium-term financial costs. On the other hand, market reputation was positively impacted using renewable energy ($\beta = 0.17$, $p = 0.001$), underscoring the advantages of visible environmental measures in terms of reputation. Long-term value creation was positively impacted by governance quality, especially board independence ($\beta = 0.08$, $p = 0.046$), confirming the idea that effective governance lowers agency costs. However, PCA results demonstrating ESG factors loading on different components and low reliability metrics for ESG pillars (Environmental = -0.28, Governance = -0.04) raise methodological questions about how ESG constructs are measured, implying that traditional ESG rating approaches may oversimplify complex sustainability dimensions.

According to the study's findings, there are several unique paths rather than a single, consistent mechanism that underlie the association between ESG and financial performance. Important takeaways include the fact that while environmental investments may initially reduce returns, certain initiatives—like the adoption of renewable energy—create substantial reputational value, and governance enhancements—especially board independence—consistently increase long-term value. The results highlight the drawbacks of overall ESG rankings and support more detailed, factor-specific methods of evaluating ESG. Targeted integration of significant ESG aspects is more likely to benefit investors financially, and corporate managers are advised to evaluate ESG projects on an individual basis, particularly those that improve governance and reputation. Future studies should concentrate on improving ESG assessment and investigating contextual moderators in various market conditions and industries.

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Appendix

Appendix 1: Direct and Indirect effects

Type	Effect	Estimate	SE	Lower (95% C.I.)	Upper (95% C.I.)	β	z	p
Direct	E_score → IP_score	-0.09	0.04	-0.17	-0.01	-0.07	-2.25	0.024
Direct	S_score → IP_score	0.06	0.05	-0.04	0.16	0.05	1.2	0.23
Direct	G_score → IP_score	0.05	0.04	-0.03	0.13	0.04	1.25	0.211
Direct	Renewable_Energy → Market_Reputation	0.17	0.05	0.07	0.27	0.14	3.4	0.001
Direct	Board_Independence → Long_Term_Value	0.08	0.04	0	0.16	0.06	2	0.046
Direct	Transparency → Risk_Adjusted_Returns	-0.05	0.04	-0.13	0.03	-0.04	-1.25	0.211
Indirect	E_score ⇒ Renewable_Energy → Market_Reputation	0.1	0.03	0.04	0.16	0.08	3.33	0.001
Indirect	G_score ⇒ Board_Independence → Long_Term_Value	0.05	0.02	0.01	0.09	0.04	2.5	0.012
Indirect	S_score ⇒ Community_Engagement → Market_Reputation	0.04	0.02	0	0.08	0.03	2	0.046

Indi-rect	ESG_mean ⇒ E_score → IP_score	-0.04	0.02	-0.08	0	-0.03	-2	0.046
Indi-rect	ESG_mean ⇒ G_score → Long_Term_Value	0.03	0.02	-0.01	0.07	0.02	1.5	0.134
Total	E_score → IP_score (Total Effect)	-0.15	0.05	-0.25	-0.05	-0.12	-3	0.003
Total	S_score → IP_score (Total Effect)	0.1	0.06	-0.02	0.22	0.08	1.67	0.095
Total	G_score → IP_score (Total Effect)	0.12	0.05	0.02	0.22	0.1	2.4	0.016
Total	Renewable_Energy → Market_Reputation (Total Effect)	0.17	0.05	0.07	0.27	0.14	3.4	0.001
Total	ESG_mean → IP_score (Total Effect)	0.01	0.06	-0.11	0.13	0.01	0.17	0.865