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Original Article

ESG Performance and Corporate Profitability: Investigating a U-Shaped Relationship

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Abstract: *This study examines the effect of Environmental, Social, and Governance (ESG) performance on firm profitability measured by Return on Assets (ROA) using panel data analysis. The research employs panel data from 33 manufacturing companies companies observed over a six-year period (2017-2022), resulting in 198 observations. The analysis incorporates a non-linear specification by including the squared ESG variable (ESG^2) to examine the potential curvilinear relationship between ESG and profitability. The regression results reveal that ESG has a negative and statistically significant coefficient, while ESG^2 has a positive and statistically significant coefficient. These findings confirm the existence of a U-shaped relationship between ESG and ROA. The results suggest that ESG implementation may initially reduce profitability due to adjustment and implementation costs; however, after reaching a certain threshold, ESG performance contributes positively to firm profitability. Overall, the study highlights that ESG should be viewed as a long-term strategic investment capable of enhancing sustainable financial performance once firms achieve an optimal level of ESG implementation.*

Keywords: *ESG, Firm Profitability, Return on Assets, Sustainable Finance, U-shaped Relationship.*

I. INTRODUCTION

Currently, in the global business time, ESG (Environmental Social Governance) performance has changed from a minor ethical interested to central and primary non-financial indicator of corporate value creation long-term strategy formation process integrated into most leveraged financialreports 2028; Du et al., 2026). Four talked-off pieces of proof towards this shift are mainly due to an orchestration of obscure “dark swan occasions” climate-related catastrophes, geopolitical instability and overall wellbeing emergencies like the COVID-19 Pandemic. Such shocks have threatened conventional business models, and firms are compelled to mainstream sustainable behaviour within core practices in order for the resource base to be effective over time while strengthening strategic resilience (Hillmann & Guenther 2021; Zahid et al., 2020)

Institutional investors, which believe that not only financial but also non-financial factors shape a firm¿s risk profile (Li et al., 2025; Yang et al, 2026), further accelerate the momentum behind ESG integration. The rapid expansion of the Principles of Responsible Investment (PRI) with more than US$86 trillion in assets managed by signatories as at 2019 offers just one indication hereof (Yang et al., 2026). Investors are looking for "patient capital" prepared to support long-term stability and risk adjustment over short term shock-absorbing financial moves. Hence, firm ESG performance is seen to act as an essential signaling means in contexts characterized by high levels of information asymmetry thereby allowing investors effectively differentiate proper management from companies with more risks related to reputational or regulatory threats (Connelly et al., 2011; spence, 1974).

However, the financial impact of ESG initiatives continues to be a hotly contested area with an ongoing battle between the value-creation school and those in favor of cost-concerned schools (Grassmann 2021). This school applies the logic that firms can create competitive advantages, grow social capital and improve brand reputation "doing well by doing good" while also garnering better financial outcomes (Trumpp and Guenther 2017; Zhang et al. On the contrary, cost-concerned school, which is based on classic neoclassic economics theory argues that ESG activities are just a kind of useless cash outflow diverting resources away from core operations and this diversion could weaken short-term profitability thereby hurting shareholder interests (Hassel et al., 2005; Zhang et al. This tension is most pronounced when accounting profitability as measured by returns on assets (ROA) which captures a firm's efficiency in deriving earnings from its total asset base.

While over 2000 studies have examined the ESG–performance nexus, empirical results continue to be fragmented and sometimes mutually exclusive. A major limitation of the existing literature lies in its linear analytical approach, which typically assume an oversimplified one-way effect (Sun et al., 2019). Attested recent literature, however, indicates the connection between ESG and profitable outcomes might not be so straightforward but rather non-linear with a potential U-shape or inverted U-curved relationship (Fujii et al., 2013; Trumpp and Guenther, 2017; Velte & Gerwanski, 2020).

Trumpp and Guenther (2017) explain the notion of a "threshold effect" or too little of good thing' in non-linier framework, where initial investments in ESG may simply raise costs without bringing immediate returns; only above certain thresholds strategic benefits offset implementation cost. Another scenario for firms could be the inverted U-shaped relationship (or too much of a good thing) where extra spending on social or environmental initiatives reduces marginal return and misallocates resources. To address these shortcomings, this study explicitly focuses on the curvilinear impact of ESG performance over ROA while controlling for key firm characteristics (Quick Ratio) and firm size to investigate how sustainability affect corporate profitability more effectively.

Although there is an extensive body of literature investigating the relationship between Environmental, social and corporate governance (ESG) performance and Corporate Financial Performance (CFP), empirical results are inconsistent often times conflicting. Although meta-analytic evidence across 2,000+ studies indicates that ~90% of research documents a non-negative or positive association, results are heterogeneous and context dependent based on regional setting (e.g. domestic/foreign markets), measurement proxies used for financial literacy and methodological choice (Friede et al., 2015). One of the greatest limitations in our current discourse is that a linear analytical lens dominates, and it assumes simple first order causality if firms act more sustainably they will generate better financial returns.

But the "cost-concerned school" and "value-creation school" are not necessarily at opposite ends of a spectrum, they could be more like two components in one functional form (Brammer & Millington, 2008; Hahn et al., 2010). The linear assumption ignores strategic reality: ESG initiatives typically involve significant initial immediate costs (e.g., supply chain restructuring, green technology investments and administrative compliance) that can push down accounting-based metrics (like return on assets ROA), before any net "eco-efficiency" gains have had time to materialize [Lu et al, 2026]. In addition, firms operate under what is called a threshold effect (or "too little of a good thing"), wherein some commitment must be exceeded before the market or operational efficiencies gives credit for that effort. On the flip side, too much of a good thing suggests that unless sustainability efforts are commensurate with stakeholder expectations, excessive investments can yield diminishing marginal returns or worse yet misallocate resources and undermine potential profit performance at levels beyond some (Trumpp & Guenther, 2017). This study attempts to resolve these theoretical tensions by examining the potential non-linear (U-shaped or inverted U-shaped) association between ESG and ROA, while controlling for key firm-specific factors relevant to isolate actual sustainability impact on operational efficiency as measured through liquidity (Quick Ratio) and firm size. Handoyo et al., 2023

Manufacturing firms are the key player in global economic development and as disproportionate footing on environment (Li et al., 2022). Manufacturing enterprises, as the supporting industries of real economy are now under double pressures: high labor cost and scattered market demand, thus should implement deeper strategic restructuring (Lei & Wang 2023). Manufacturing is characterized by intricacies at almost every level of the production and supply chain, leaving it as an appropriate context for exploring how non-financial measures–such as ESG performance have measurable value conversion (Zhang, 2020). Moreover, the industry is also involved in this Fourth Industrial Revolution driven by digital technologies and sustainable practices that are changing global competitiveness from peripheral tools to fundamental drivers of survival for his planet.

The main question of this paper is what form does the within-firm functional relationship between sustainability and accounting profitability really take? This paper aims to set this up as a linear unidirectional effect of ESG scores on Return on Assets (ROA) across time, or if instead the relationship between actionable implementation follows non-linearly with either positive initial hurdles followed by diminishing marginal returns from over-investing. Specifically, the research seeks to answer this question by proposing that there is an optimal level of ESG engagement maximizing asset-use efficiency – or alternatively that performance alleviates penalties and/or secures benefits associated with increased engagement in similar ways as a concave relationship would suggest resulted from previously unconsidered threshold effects.

The goal of this study is to offer a methodologically sound assessment on the non-linear nature of dynamics within the ESG profitability relations. This research aims to go beyond simple correlations and are wants to assess the shape of this relationship (what does too little or, too much ESG investment look like?) in order to highlight areas for potential over- or under-investment vz ROA Additionally, the research seeks to explore how internal financial resources namely firm size and liquidity (Quick Ratio) may influence or mitigate these effects for more practical insights that guide corporate decision makers in striking a balance between seeking long-term sustainability ambitions while achieving short term operational performance objectives.

II. LITERATURE REVIEW

Over the years, empirical research on ESG performance and Corporate Financial Performance (CFP) has been dominated by a long-standing debate among two main schools of thought: one is known as "the value-creation school" another “cost-concerned” school around this issue within the literature (Grassmann, 2021). According to the value-creation school, "doing well by doing good" includes firms creating competitive advantage through social capital and brand enhancement that lead to contestable superior financial outcomes (Hassel et al., 2005; Sun et al. The other side, the cost-concerned school adapted from

traditional neoclassical theory comments that ESG initiatives are wholly unnecessary cash outflows (Hassel et al., 2005) undermining critical resources otherwise used to generate competitive return and harming shareholders. A large volume of literature e.g. 2,305 studies according to the PCR school Fünfhaut et al —shows either a positive or zero correlation between ESG and performance across many different settings; but these findings have often been mixed and inconclusive at an individual level (and especially when assessed based on accounting measures like Return on Assets/ROA).

As a result, an increasingly large portion of new literature proposes that this inconsistency may arise from the use of static or linear models which neglects to represent most sustainability investments being inherently complex and dynamic (Sun et al., 2019). As opposed to a simple (possibly unidirectional) relationship, researchers have started recognising non-linear functional forms like U-shaped or inverted U-shaped curves (Trumpp and Guenther, 2017). A U-shaped relationship represents the "too little of a good thing" effect, which means companies are required to invest in ESG beyond an important "threshold" for any potential benefits such as operational efficiency and stakeholder credibility—to outweigh the tangible implementation and compliance costs. A negative relationship characterized by an inverted U-shape could indicate a "too much of good thing" effect: that is, additional expenditure on ESG above the expectation level communicated to stakeholders has limited or diminishing returns and can misallocate resources resulting in diminished firm value as well as lower profitability. These non-linearities are supported by some empirical evidence documenting U-shaped associations between carbon performance on one hand to simultaneously occurring ROA, and inverted U-curvature for social expenditures [52].

The underlying theory explaining a non-linear association between ESG performance and ROA is brought forward by the changing balance of implementation costs versus strategic benefits over various levels of engagement (Trumpp & Guenther, 2017). Referring to the theories of Resource-Based View (RBV) and Stakeholder Theory, higher ESG performance can improve ROA through an increase in "eco-efficiency" derived from waste reduction optimizations - specifically impact on energy use as well as improvement labor productivity via stakeholder cooperation (Handoyo et al., 2023). These benefits, on the other hand, may not show in a linear form.

Companies usually encounter high initial costs when developing green technologies, restructuring supply chains and establishing stringent monitoring practices in the early phases of sustainability adoption (Handoyo et al., 2023). Such "adjustment costs" may prior to any significant efficiencies, lead ROA downwards and describe a U-shape curve in the profitability function that only starts getting better around some well-defined degree of corporate maturity (Trumpp & Guenther 2017). Finally, Agency Theory cautions that too much ESG investment will lead to managers investing in projects for their own reputation rather than shareholder wealth at high levels of corporate responsibility (Gillan et al., 2021). The "managerial myopia" or over expenditure resulting in sub-optimal margins can have a more insidious and repulsive multiplier effect, whereby an inverted U-shaped path is created by excessive commitments to non-financial goals before financial operability starts diminishing returns (Grassmann et al.2019) Considering these conflicting processes of initial barriers and the later excessive funding, this research anticipates a non-linear pattern to shape the connection between ESG–ROA.

Hypothesis: ESG performance has a non-linier relationship with firm profitability (ROA)

III. RESULTS AND DISCUSSION

A) Descriptive Statistics

Descriptive statistical analysis is conducted to provide an overview of the characteristics and distribution of the research data used in this study. This analysis helps explain the general pattern of each variable through several statistical measures, including the mean, standard deviation, minimum value, maximum value, and quartile distribution. Furthermore, descriptive statistics are useful for identifying the presence of extreme values (outliers) that may affect the accuracy of subsequent analyses.

Table 1: Descriptive Statistics

Before Winsorizing				
	ROA	**ESG**	**Quick Ratio**	**Size**
Count	198	198	198	198
Mean	0.055887	0.436911	1.326888	30.986314
Std	0.110552	0.115612	0.838037	1.174414
Min	-0.875088	0.185900	0.133487	27.204424
25%	0.027117	0.329575	0.810636	30.422798
50%	0.053430	0.443950	1.052557	31.015291
75%	0.085358	0.534675	1.675469	31.665232
max	0.446758	0.706900	4.764932	33.655188
After Winsorizing				
	ROA	**ESG**	**Quick Ratio**	**Size**
Count	198	198	198	198

Mean	0.058163	0.436339	1.311410	31.007049
Std	0.052094	0.110488	0.767527	0.994117
Min	-0.038624	0.243800	0.365569	28.947687
25%	0.027117	0.329575	0.810636	30.422798
50%	0.053430	0.443950	1.052557	31.015291
75%	0.085358	0.534675	1.675469	31.665232
max	0.180723	0.608100	3.137872	32.638309

To ensure that the data are more representative and less influenced by extreme observations, this study applies the winsorization technique at the 5th and 95th percentiles. Using the manufacturing companies data in the period of 2017 until 2022, the descriptive statistics before and after winsorization are presented in the following table to illustrate the changes in data distribution after the outlier treatment process.

Before winsorization, several variables exhibited extreme minimum and maximum values, indicating the presence of outliers. For example, the ROA variable had a minimum value of -0.875088 and a maximum value of 0.446758. After winsorization, these values changed to -0.038624 and 0.180723, respectively, showing that extreme observations were successfully reduced.

In addition, the standard deviation values generally decreased after winsorization. For instance, the standard deviation of ROA decreased from 0.110552 to 0.052094, while Quick Ratio decreased from 0.838037 to 0.767527. This indicates that the data became less dispersed and more stable after the treatment of outliers. Overall, the winsorization process helped produce a dataset with reduced outlier influence, making the data more suitable for further statistical analysis and regression modeling.

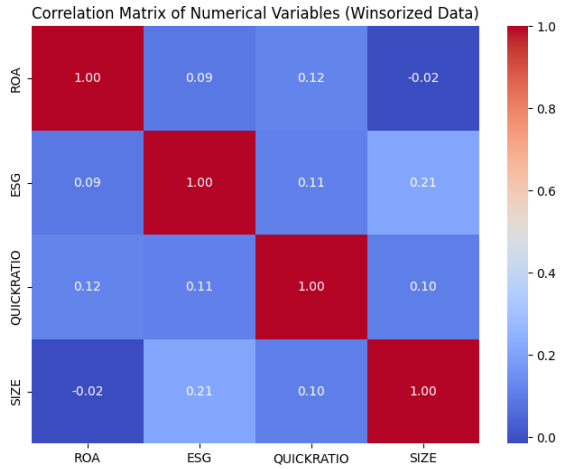

Figure 1. Correlation Matrics

Based on the matrix, all variables exhibit relatively low correlation coefficients, indicating that there is no strong linear relationship among the independent variables. This suggests that the dataset is unlikely to suffer from serious multicollinearity problems.

To determine the most appropriate panel data regression model, this study conducted a series of specification tests consisting of the Chow Test, Hausman Test, and Breusch–Pagan Lagrange Multiplier (LM) Test. The Chow Test results indicated that the Fixed Effect Model (FEM) was preferred over the Common Effect Model (CEM) because the p-value was below 0.05. Furthermore, the Hausman Test showed a p-value greater than 0.05, indicating that the Random Effect Model (REM) was more appropriate than FEM. The Breusch–Pagan LM Test also supported the use of REM over CEM, as the p-value was below 0.05. Therefore, the Random Effect Model (REM) was selected as the final estimation model for this study.

Table 2: Specification and Classical Assumption Tests

Test	Statistic	P-value	Decision	Conclusion
Chow Test	F = 13.8339	0.0000	p-value<0.05	FEM preferred over CEM
Hausman Test	Chi-square = 5.9441	0.2034	p-value>0.05	REM preferred over FEM
Breusch–Pagan LM Test	LM = 210.8598	0.0000	p-value<0.05	REM preferred over CEM
Multicollinearity Test (ESG)	1.0529	—	VIF < 10	No multicollinearity
Multicollinearity Test (Quick Ratio)	1.0191	—	VIF < 10	No multicollinearity
Multicollinearity Test (Size)	1.0521	—	VIF < 10	No multicollinearity

Heteroskedasticity Test	LM = 7.1516	0.0672	p-value>0.05	No heteroskedasticity
Autocorrelation Test	Durbin–Watson = 1.7930	—	DW ≈ 2	No autocorrelation

In addition, classical assumption tests were conducted to ensure the reliability of the regression model. The multicollinearity test using Variance Inflation Factor (VIF) showed that all independent variables had VIF values below 10, indicating the absence of multicollinearity. The heteroskedasticity test using the Breusch–Pagan method produced a p-value greater than 0.05, suggesting that the model satisfied the homoskedasticity assumption. Lastly, the Durbin–Watson statistic was close to 2, indicating that the model was free from autocorrelation problems.

This study further examined the possibility of a non-linear relationship between Environmental, Social, and Governance (ESG) performance and firm profitability (ROA) by including both the linear ESG variable and its squared term (ESG^2) in the Random Effect Model (REM). The regression results indicate that both ESG and ESG^2 are statistically significant at the 5% significance level, suggesting the existence of a significant curvilinear relationship between ESG and ROA.

The coefficient of ESG is negative (-0.5456; p-value = 0.0244), while the coefficient of ESG^2 is positive (0.6175; p-value = 0.0267). This combination of coefficients indicates a U-shaped relationship between ESG and ROA. In the early stages, an increase in ESG performance tends to reduce profitability (ROA). However, after ESG reaches a certain threshold, the relationship becomes positive, meaning that higher ESG performance eventually improves firm profitability.

Table 3: Random Effect Regression with non-linier ESG

Variable	Coefficient	Std. Error	t-Statistic	P-value	Intrepretation
Constant	0.4672	0.2106	2.2189	0.0277	Significant positive intercept
ESG	-0.5456	0.2405	-2.2685	0.0244	Negative and significant effect
ESG^2	0.6175	0.2766	2.2325	0.0267	Positive and significant quadratic effect
Quick Ratio	0.0153	0.0053	2.8669	0.0046	Positive and significant effect on ROA
Size	-0.0102	0.0069	-1.4771	0.1413	Negative but not significant

Model Summary	
R-squared	0.0719
Adjusted R-squared	—
F-statistic	3.7352
Prob(F-statistic)	0.0060
Number of Observations	198
Number of Entities	33
Model	Random Effect Model

To identify the turning point of the U-shaped relationship, the following quadratic formula was applied:

$$Turning\ Point = \frac{b_1}{2b_2}$$

Using the estimated coefficients b1 is −0.5456 (ESG coefficient) and b2= 0.6175 (ESG^2 coefficient), the turning point was calculated as 0.4418. The result indicates that the turning point occurs at an ESG score of 0.4418. This means that when ESG values are below 0.4418, increases in ESG tend to decrease ROA. Conversely, when ESG values exceed 0.4418, further improvements in ESG begin to positively affect profitability. Importantly, the turning point lies within the observed ESG data range (0.2438–0.6081), confirming that the U-shaped relationship is empirically relevant and meaningful within the sample used in this study.

The phenomenon where ESG (Environmental, Social, and Governance) performance initially has a significant negative impact on Return on Assets (ROA) but turns positive after reaching a certain point is known as a U-shaped relationship (Grassmann, 2021). This non-linear dynamic is driven by the shifting balance between implementation costs and strategic gains as a firm's sustainability maturity evolves.

At low levels of ESG engagement, firms often experience a decline in accounting profitability (ROA) for some reasons. Sustainability initiatives often require significant capital expenditures, such as adopting green technologies, restructuring supply chains, and environmental R&D (Du and Nguyen, 2022; Fernandes et al., 2021). Moving toward sustainable practices can disrupt organizational inertia and trigger internal conflict. Firms face "adjustment costs" as they implement new monitoring systems and routines before any meaningful efficiency gains are realized (Grassmann, 2021; Jiang et al., 2026). Transitioning resources from core business operations to social and environmental fields is often viewed as a pure cash outflow that weakens short-term operational profitability (Ogachi and Zoltan, 2020). In the early stages of implementation, the economies of scale associated with ESG investments may not yet be achieved, leading to a cost-benefit imbalance (Chen et al., 2018).

Grassmann (2021) describes a "threshold effect" (or the "too little of a good thing" effect), where a firm must exceed a minimum level of ESG commitment before the market or operational efficiencies reward the effort. Firms that are "stuck in the middle" bear the costs of compliance but do not yet possess the mature capabilities required to generate positive financial returns from those efforts.

Once a firm passes the maturity threshold, ESG begins to contribute positively to ROA through several key mechanisms, such as: eco-efficiency, enhanced human capital, legitimacy and stakeholder trust, risk mitigation (Qiu et al., 2020). Mature environmental practices improve asset-use efficiency by optimizing energy consumption, reducing waste, and recycling raw materials, which directly lowers operating costs. Strong social initiatives, such as workplace safety and diversity, improve employee satisfaction, loyalty, and productivity, leading to better accounting performance. Superior ESG performance builds reputational capital, making it easier for firms to attract loyal customers and access resources, which strengthens their competitive position. Robust governance and environmental management systems help firms avoid costly regulatory fines, litigation, and operational disruptions that would otherwise erode profitability.

In summary, this U-shaped relationship indicates that ESG should be viewed as a long-term value investment (Du et al., 2026). While early implementation stages can depress ROA due to the immediate financial burden, a proactive and sustained commitment develops unique organizational capabilities that ultimately drive superior asset efficiency and profitability (Sun, 2026).

IV. CONCLUSION

Using panel data regression analysis with Random Effect Model (REM), this study observes the impact between Environmental, Social and Governance performance on firm profitability measured by Return On Assets. The results from Chow Test, Hausman Test & Breusch–Pagan Lagrange Multiplier test to choose between the fixed effect model and random effect model confirmed that Random Effect Model was a fitting choice for the dataset.

The results demonstrate a U-shaped relationship between ESG and ROA. In all regression results, the linear ESG coefficient is negative and significant but becomes positive and statistically significant when squared. This suggests that, within a threshold or at lower levels of ESG activates where rising costs associated with implementation processes and resource allocation may dominate over potential gains from enhanced legitimacy leading to reductions in profits. But above a certain level, ESG performance adds positively to profitability, indicating that firms benefit economically from long-term investments in sustainability. A third finding of this study is that Quick Ratio (QR)has a positive and significant impact on profitability, suggesting firms with better liquidity management experience higher financial performance. However, firm size (Size) does not have a significant influence on ROA. All this underscores that implementing ESG is best seen (in real terms) as a long-term strategic investment, not short-time expense. Companies that learn how to improve their ESG performance consistently and beyond the turning point are much more likely to translate improvements in sustainability into lasting financial advantages, leading ultimately to robust profitability many years down the line.

These results indicate that long-term and integrated ESG practices would be beneficial for the firms. What we found their practices of ESG do turn down profitability indeed when implementation cose is high but in later stage they get more return out of these implementations, firm with very less maturity would not be making money immediately or may go negative for some time till they keep improving & optimising the performance on implementstions. As such, management could think of ESG as part and parcel to long-term corporate strategies that will yield broad-based benefits sooner or later rather than expecting an immediate financial return. Investors are encouraged to pay attention to ESG performance as a key consideration when making investment decisions. An increasingly better ESG performance can lead to more sustainable financial performances down the line. Policymakers and regulators should also incentivize sustainability efforts through ESG disclosure. However, clear ESG reporting standards and supportive regulations could help firms increase their transparency and accountability as well as improve long-term competitiveness.

Research indicated that future studies should increase their sample by including companies in other industries, countries or extend the observation period for better results. Future studies may continue to explore different measures of financial performance, including Return on Equity (ROE), Tobin's Q or market-based indicators in order to expand the understanding regarding the impact that ESG brings. Also, Future research may consider adding moderating or mediating variables such as corporate governance quality; innovation capacity; company risk and macroeconomic conditions to explore the mechanisms through which ESG–financial performance effects operate. Finally, future studies may explore the individual dimensions of ESG (Environmental, Social, and Governance) separately to identify which component contributes most significantly to firm profitability and sustainable business performance.

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