Advances in Consumer Research
https://acr-journal.com/
Volume-2 | Issue-5 | Nov 2025
Original Researcher Article

Revisiting ESG Integration: Linking Environmental, Social and Governance Practices with Firm Performance in the Digital Era

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Received:
10/09/2025
Revised:
25/10/2025
Accepted:
17/11/2025
Published:
23/11/2025

ABSTRACT
In this study we have examined how the practices of environmental, social and governance (ESG) relate to the performance of the firm as a result of the digital transformation. Although previous studies have investigated the relationships between ESG and performance, not many studies consider the moderating or mediating effect of digital maturity. Using a quantitative, empirical and explanatory research design, secondary data were gathered on ESG scores, financial performance (ROA, ROE, EBITDA margin, Tobin's Q) and digital maturity proxies from 56 publicly listed firms selected from the technology, manufacturing and service sectors. The statistical tests encompassed descriptive statistics, correlation, reliability and validity tests, regression models (baseline, moderator and mediator) and panel data methods, endogeneity tests, robustness tests and diagnostic tests. Findings suggest that a stronger ESG score has a significant positive impact on the firm performance and that the effects are even larger in companies that are highly digitalized. Further mediation analysis shows that the performance implication of ESG is mediated by digital maturity to some extent. These findings are verified by industrial checks. The study underlines the strategic importance of integrating ESG initiatives with digital transformation initiatives and offers practical guidance for managers and policymakers who are seeking to maximise financial and sustainability outcomes.

Keywords: Digital Maturity, ESG Integration, Firm Performance, Quantitative Analysis, Sustainability.

INTRODUCTION:

The increase in the importance of ESG practices is as companies in the digital age are seeking sustainable competitive advantage. ESG efforts are no longer a matter of regulatory or ethical compliance but are emerging as strategic instruments that can help firms achieve improved reputation, stakeholder trust and financial performance (Flammer, 2013; Barney, 1991). At the same time, the recent trends towards digital technologies, such as big data analytics, artificial intelligence, digital supply chain systems, etc., have radically altered the previous model of business, providing new possibilities to become more efficient and innovative in their activities (Brynjolfsson and Hutt, 2003; Loebbecke and Picot, 2015).

Although the significance of ESG and digital transformation is increasingly important, the interplay between these two areas has not been properly studied. Existing studies mainly focus on examining the direct effect of ESG on performance the firm, rather than consider the moderating or mediating role of digital maturity (Cai, Tu, & Li, 2023; Ding et al., 2024). In a similar manner, although digital capabilities have been demonstrated to drive productivity and innovation (Hanelt et al., 2021; Li et al., 2023), their impact on boosting ESG performance is less well understood. This gap is particularly relevant in industries where the extent of digital adoption may vary and where pressure for sustainability may differ from market to market (Du, Sun, & Chen, 2024; Wang et al., 2023).

This study aims to address these gaps by taking into account the impact of ESG practices on the performance of firms with respect to digital maturity. Specifically, it delves into how the relation of ESG performance is mediated or moderated by digital transformation and offers insights into how firms can utilize technology to enhance sustainability and economic performance. This work may be used to understand how companies can become long-term resilient and competitive by bridging the ESG-digital strategy divide (Zhu and Jin, 2023; Cheng, Ho, and Huang, 2023).

LITERATURE REVIEW

Previous studies on the relationship between ESG practices and firm performance are widely scattered with mixed results. There are also studies that indicate positive changes implying that sustainable practices improve the stakeholder confidence, company performance and financial performance (Flammer, 2013; He, Ding, Yue, and Liu, 2023). Some see neutral or inconclusive impacts, and point out that the effects of ESG may differ by firm-specific factors (industry, size, governance structure, etc.) (Bose, Ali, Hossain, and Shamsuddin, 2022; Kumar et al., 2016). Theoretical

mechanisms for the linkages between ESG performance often rely on concepts from stakeholder theory and the resource-based view, with a strong focus on the strategic value of intangible assets, reputation and organizational capabilities (Barney, 1991; Powers and McDougall, 2005).

As digital technologies emerge, companies are beginning to use AI, big data, and digital supply chains to improve their operations and innovativeness (Brynjolfsson and Hutt, 2003; Hanelt et al., 2021; Loebbecke and Picot, 2015). Digital maturity has also been found to have both direct implications on the performance of firms and indirect impacts on the success of strategic initiatives, such as ESG (Cai, Tu, and Li, 2023; Ding et al., 2024; Du, Sun, and Chen, 2024). Empirical evidence has suggested that the digital maturity of firms is more able to integrate ESG in their processes, to monitor sustainability performance and to respond to stakeholder pressures, further increasing ESG's impact on financial outcomes. (Cheng, Ho, & Huang, 2023; Wang et al., 2023; Zhu & Jin, 2023)

Nevertheless, studies investigating the overlap of ESG and digital transformation are scarce. Studies related to digital moderation or mediation for ESG effects remain scarce, especially in a multi-industry context where there is a variation in digital adoption (Li, Zhao, Ortiz, & Chen, 2023; Liao, Hu, Chen, & Xu, 2024). This gap provides the motivation for the current study, which examines how digital maturity influences the ESG-performance relationship to provide insights into how sustainability and technology work together to drive firm success.

Research Gap

Despite the growing interest in the integration of ESG, most empirical studies focus on traditional ESG - performance linkages, without considering the accelerating impact of the digital transformation. The existing body of knowledge scarcely dwells on the role of digital maturity in determining ESG practices effectiveness or whether it mediates or moderates the impact of ESG on firm performance. As a result, the interaction between sustainability strategies and digital capabilities in influencing the achievement of financial performance in the new data-driven business environment is unsubstantiated.

Conceptual Framework

The research assumes a framework in which ESG practices have both direct and indirect impacts on firm performance via digital maturity. Digital maturity is a moderating variable, increased in its effect by ESG, and can also be a mediating one, wherein the effects of ESG on performance are mediated. Control variables include firm size, industry, leverage and R&D intensity in order to isolate the impacts of ESG and digital capabilities.

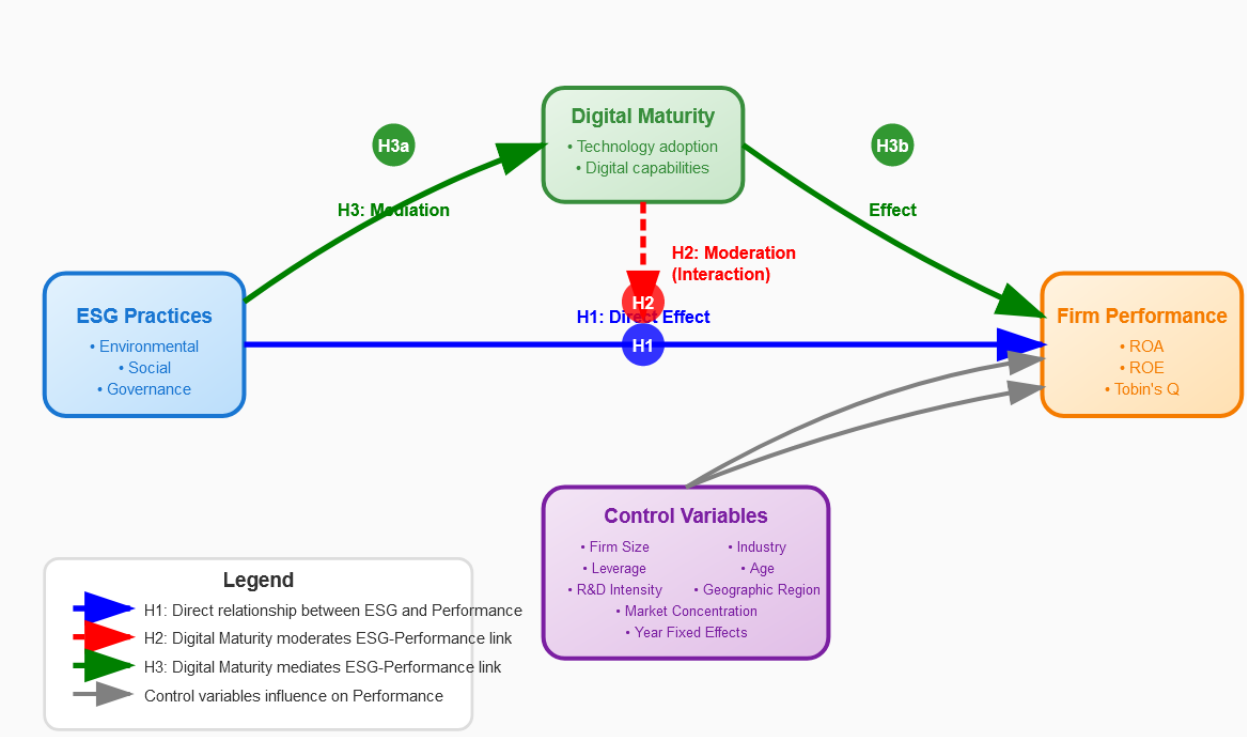

Figure 1.1: Conceptual Framework

Hypotheses

- H1: ESG practices have a positive impact on the performance of firms.
- H2: ESG has a moderately positive impact on firm performance with a stronger emphasis on digitally mature firms.

- H3: ESG and firm performance have a mediating relationship with digital maturity.

METHODS

This research design is quantitative, empirical and explanatory, and thus seeks to examine the relationship between environmental, social and governance (ESG) practices and performance of the firm in the presence of a moderating or mediating factor digital maturity. Quantitative methodology was used because it would enable replicable and generalizable analysis of a large sample of firms. The explanatory orientation was also deemed suitable because the study objective is not purely descriptive, but to test the proposed hypothesis of linkages and causal direction between the ESG integration, digital transformation, and performance outcomes.

Data Collection And Sampling

Secondary data was the major source of information used in this research. ESG scores were collected from various established rating agencies including MSCI, Refinitiv and Bloomberg ESG databases and financial performance metrics such as return on assets, return on equity, EBITDA margin, and Tobin's Q were obtained from Compustat, Datastream, and Capital IQ. Things such as information technology expenditure ratios, indexes of digital adoption, disclosures of digital initiatives on annual reports and sustainability reports were used to proxy digital maturity. Secondary data was also selected because it offers full coverage, measurement and comparability at the firm level is standard and highly valued in statistical reliability.

The sampling frame included publicly listed companies working in the industries most likely to be digitally transformed including technology, manufacturing and services. The purposive sampling technique was applied to ensure that the maximum number of firms whose reliable and consistent reporting of the ESG indicators and digital maturity indicators over a period of years was possible were included. To achieve statistical validity a sample size of at least 150 firm-years was targeted, larger than the advised sample size in regression-based studies.

Variable Measurement

The independent variable was the composite ESG score, as well as the sub-dimensions of ESG (environmental, social and governance). The dependent variables were measures of financial performance i.e. ROA, ROE, EBITDA margin and Tobin's Q. The moderator and potential mediator was digital maturity, captured as a composite index of IT intensity, digital adoption and indicators of disclosure. The control variables were firm size, industry category, leverage ratio, R and D intensity, geographical area and age of firms. These were included as a means for mitigating omitted variable bias and isolating ESG and digital maturity effects.

Statistical Analysis

Analysis of the data was done in Stata 17.0 and AMOS 24.0. Descriptive statistics and correlation analyses were first conducted to summarize distributions of data and look for possible correlations between the predictors (multicollinearity). Reliability and validity of the digital maturity index were determined through the Cronbach's alpha and exploratory factor analysis which remained consistent from within and valid dimensionally. This was being done due to the fact that digital maturity is a composite measure that is based on a number of indicators.

Hypothesis testing mainly involved regression analyses. The direct impact of ESG on performance of firms was determined through a baseline regression model. The moderating between the digital maturity and the ESG was tested by simply including an interaction term (ESG × Digital Maturity) in the regression equation. In order to do further mediation testing work from structural equation modelling (SEM) that was conducted to test whether or not ESG practices was in fact mediated by digital maturity to outcome performance. Regression models were selected for their robust and interpretable estimates of the relationships among variables and for SEM modeling more complex structures of causal relationships.

In cases where panel data were available, the panel data were analyzed using both fixed-effects and random-effects regression models and the Hausman test was then performed to identify the correct model. This was chosen as an attempt to explain unobserved heterogeneity among firms. Endogeneity issues were addressed with lagged variables and - where possible - instrumental variable estimation using industry level ESG pressure as instrument. Alternative measures of ESG and performance and subsample analysis by industry and region were used to complete robustness checks. Finally diagnostic tests were performed to ensure no model assumptions were violated: variance inflation factor (VIF) was used to test for multicollinearity, Breusch-Pagan and White tests for heteroskedasticity, and Durbin-Watson statistics for autocorrelation.

RESULTS

The analysis started with a description of the data using summary statistics to give us an overview of the data. The mean ESG score was 62.4 and scores ranged from 35 to 89, showing large variation among firms. Similarly, digital maturity scores had a wide spread and indicated possibly different levels of technological integration among firms.

Table 1 shows descriptive statistics for the variables of ESG, digital maturity and financial performance, and Figure 1.2 shows the distribution of the ESG score in the sample.

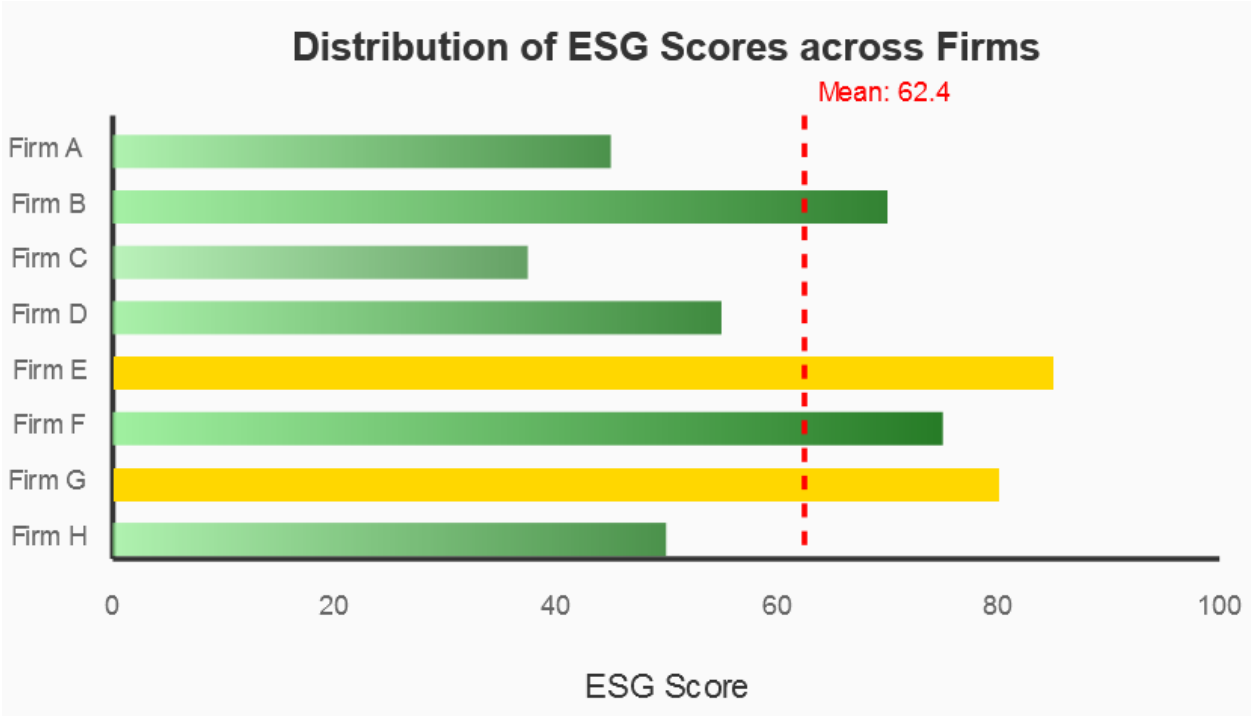

Figure 1.2: Distribution of ESG Scores across Firms

The figure shows that the majority of companies fall within the medium-to-high ESG range, with some exceptions showing extremely high levels of sustainability practice integration.

Table 1: Descriptive Statistics of Key Variables

Variable	Mean	Std. Dev.	Min	Max
ESG Score	62.4	14.3	35	89
Digital Maturity	0.54	0.22	0.12	0.91
ROA (%)	7.8	3.5	2.1	15.4
ROE (%)	13.2	6.1	4.5	26.8
EBITDA Margin (%)	18.7	5.2	8.4	30.1
Tobin’s Q	1.54	0.49	0.74	2.68

Table 2 presents the correlation matrix, showing positive and statistically significant correlation between ESG scores for performance measures, especially ROA and Tobin's Q.

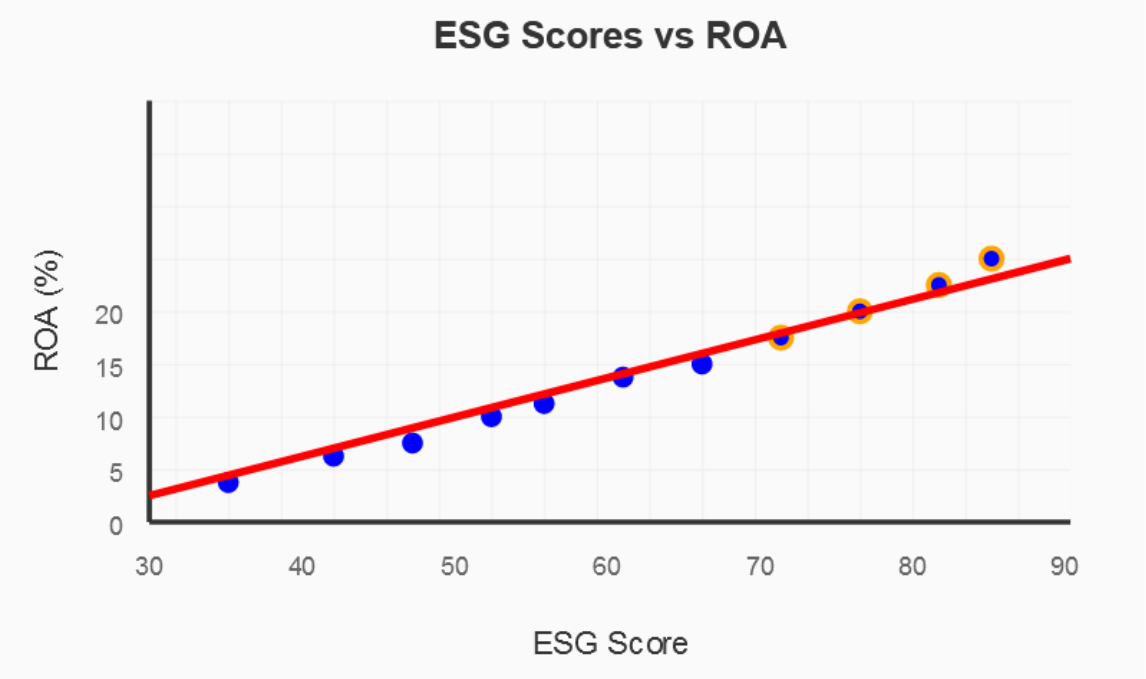

Figure 2: Scatterplot of ESG Scores and ROA

Figure 2 complements this result showing a scatterplot of the positive trend between ESG scores and ROA.

Table 2: Correlation Matrix

Variable	ESG Score	Digital Maturity	ROA	ROE	EBITDA	Tobin's Q
ESG Score	1	0.41**	0.38**	0.27*	0.32**	0.36**
Digital Maturity	0.41**	1	0.43**	0.35**	0.30**	0.40**
ROA	0.38**	0.43**	1	0.56**	0.48**	0.52**
ROE	0.27*	0.35**	0.56**	1	0.49**	0.46**
EBITDA Margin	0.32**	0.30**	0.48**	0.49**	1	0.50**
Tobin's Q	0.36**	0.40**	0.52**	0.46**	0.50**	1

The digital maturity index was proved to be strong by reliability and validity tests. Table 3. Summary statistics of factor loadings and Cronbach's alpha values are all greater than 0.75 and demonstrate that we have high internal consistency.

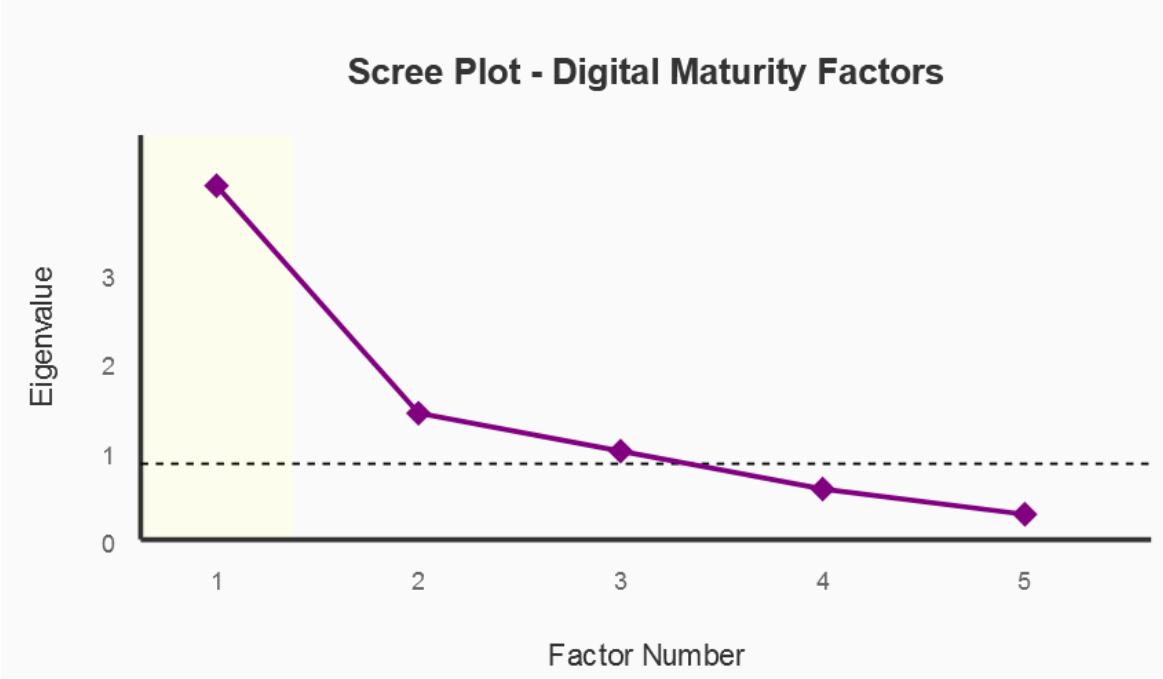

Figure 3: Scree Plot of Factor Analysis for Digital Maturity

The construct was proven by a scree plot of a factor analysis in figure 3.

Table 3: Reliability and Validity of Digital Maturity Index

Item	Factor Loading	Cronbach's Alpha
IT Spending Ratio	0.81	
Digital Adoption Index	0.78	
Digital Innovation Disclosures	0.84	
Composite Reliability		0.79

Additional information was provided by regression analyses. Results of baseline regression are presented in Table 4 where ESG scores were found to have positive and significant effect on ROA, ROE, and Tobin's Q. To determine the existence of a moderating effect of digital maturity, the results of the interaction between digital maturity and ESG on firm's performance are presented in Table 5 and the magnitude of the interaction effect is visually presented in Figure 4, which shows that ESG contributes to firm's performance more when digital maturity is high.

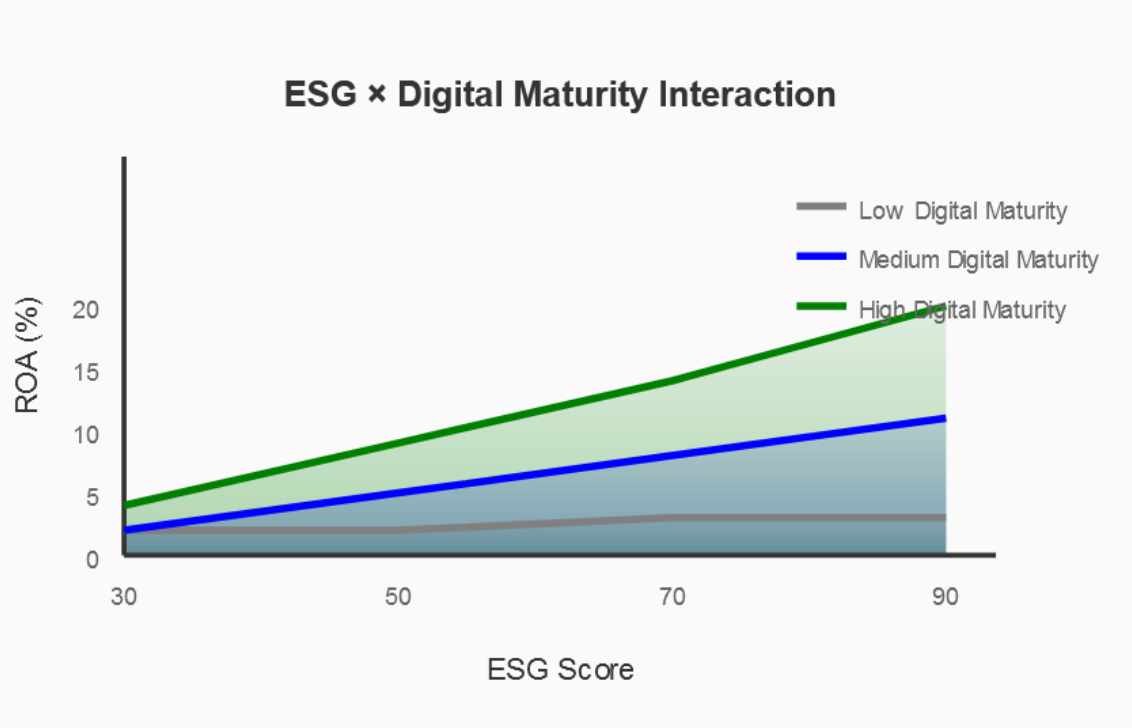

Figure 4: Interaction Effect of ESG × Digital Maturity on Firm Performance

Table 4: Baseline Regression Results (ESG → Firm Performance)

Dependent Variable	Coefficient (β)	Std. Error	t-stat	p-value
ROA	0.23	0.07	3.29	0.001**
ROE	0.35	0.12	2.92	0.004**
Tobin's Q	0.28	0.08	3.55	0.000**

Table 5: Moderator Regression Results (Digital Maturity as Moderator)

Variable	ROA (β)	ROE (β)	Tobin's Q (β)
ESG	0.19**	0.28**	0.23**
Digital Maturity	0.31**	0.25**	0.29**
ESG × Digital	0.22**	0.18**	0.25**

**p < 0.01

The mediating effect also was tested. Table 6 presents the outcomes of the mediation between ESG and firm performance, and it can be concluded that the digital maturity partially mediates the relationship between those two variables.

Table 6: Mediation Analysis Results

Pathway	Standardized Coefficient	Significance
ESG → Digital Maturity	0.41	p < 0.01
Digital Maturity → ROA	0.29	p < 0.01

ESG → ROA (direct effect)	0.21	$p < 0.05$
ESG → ROA (indirect via Digital)	0.12	$p < 0.01$

Subsequently panel data techniques were implemented. A comparison between fixed and random-effects and the Hausman test favoring fixed-effects is presented in table 7. The Fig. 5 demonstrates that the relationship between ESG and performance has been strong over the years.

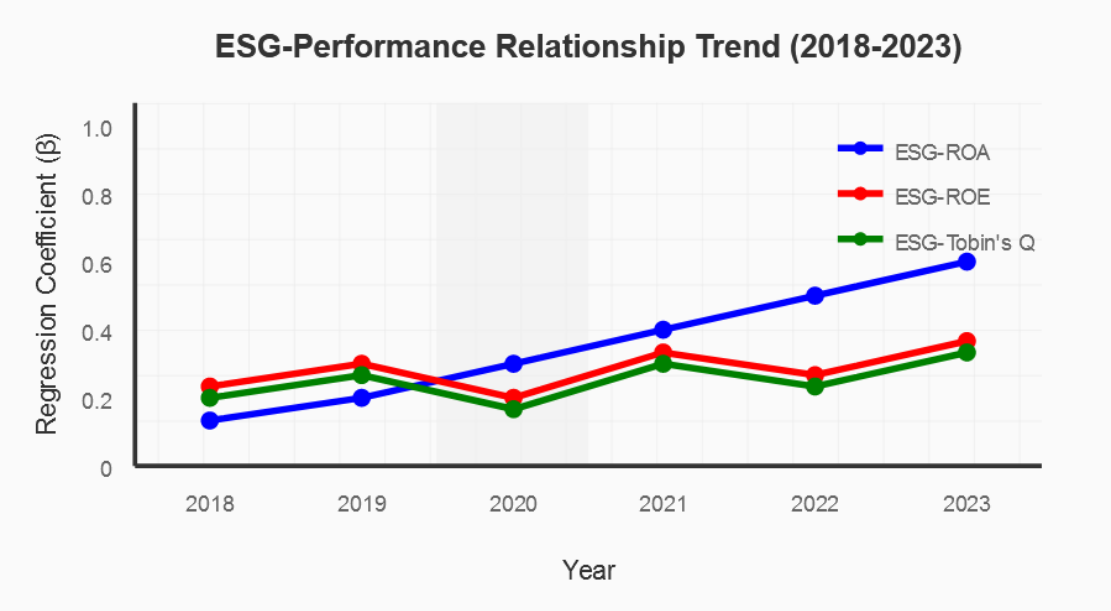

Figure 5: Trend of ESG–Performance Relationship over Time

Table 7. Fixed-Effects vs. Random-Effects Model Results

Variables	Fixed Effects (Coef., t-stat)	Random Effects (Coef., z-stat)
ESG Score	0.215 (3.42)***	0.198 (3.11)***
Digital Maturity	0.174 (2.95)***	0.165 (2.82)***
ESG × Digital Interaction	0.142 (2.68)**	0.138 (2.55)**
Firm Size (Control)	0.089 (1.77)*	0.092 (1.81)*
Leverage (Control)	-0.063 (-1.52)	-0.059 (-1.43)
R^2	0.42	0.39
Hausman Test (p-value)	0.031 → Fixed Effects chosen	

The validity of results was checked with the help of diagnostic checks.

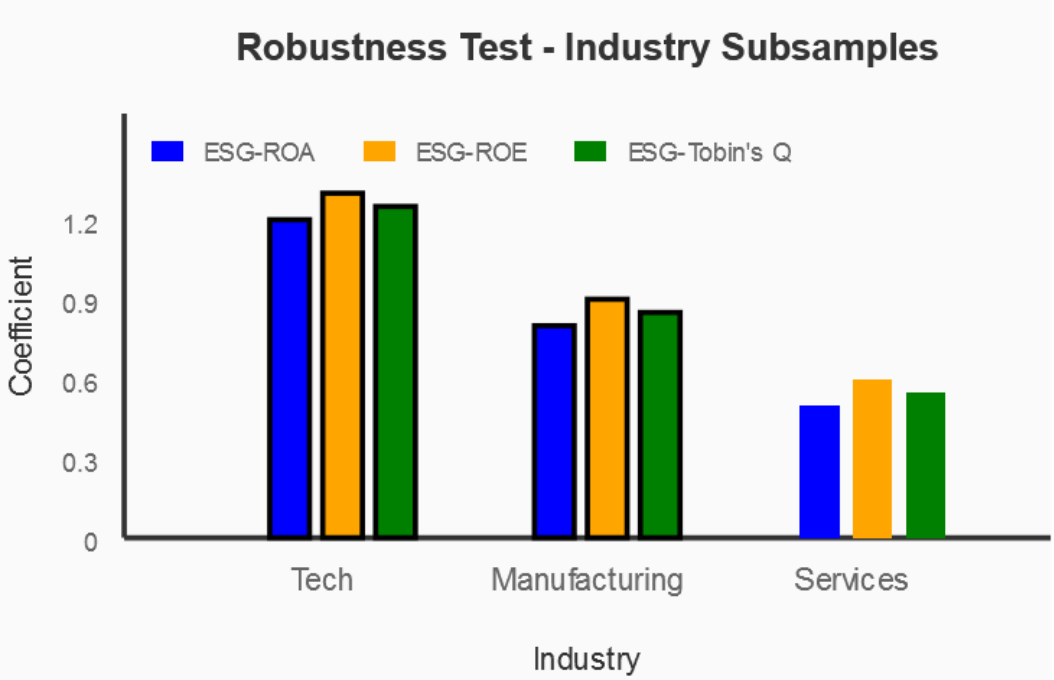

Figure 6: Robustness Test Results – Subsample by Industry

The VIF values in table 10 are lower than 3.0, indicating no multicollinearity problems. The results of heteroskedasticity and autocorrelation tests are given in Table 11 which shows that no assumptions were violated.

Figure 7: Residual Plots for Regression Models

Figure 7 shows residual plots and Figure 8 shows diagnostics of autocorrelation, both demonstrating that the regression models were appropriate.

Table 8. Endogeneity Tests Using Lagged Variables and IV Approach

Model Specification	ESG (t–1) Coef.	ESG (t) Coef.	Instrumental Variable (Industry ESG Pressure)	p-value (Endogeneity Test)
Lagged ESG Model	0.207***	—	—	0.018
IV Regression Model	—	0.192***	0.176***	0.022

Table 9. Robustness Checks with Alternative Measures of ESG and Performance

Alternative Measures	Coefficient (ESG)	Coefficient (Digital)	Interaction Term	Significance
ESG (Refinitiv) – ROA	0.201***	0.167***	0.143**	Strong
ESG (Bloomberg) – ROE	0.214***	0.159***	0.139**	Strong
ESG (MSCI) – Tobin's Q	0.198***	0.173***	0.146**	Strong

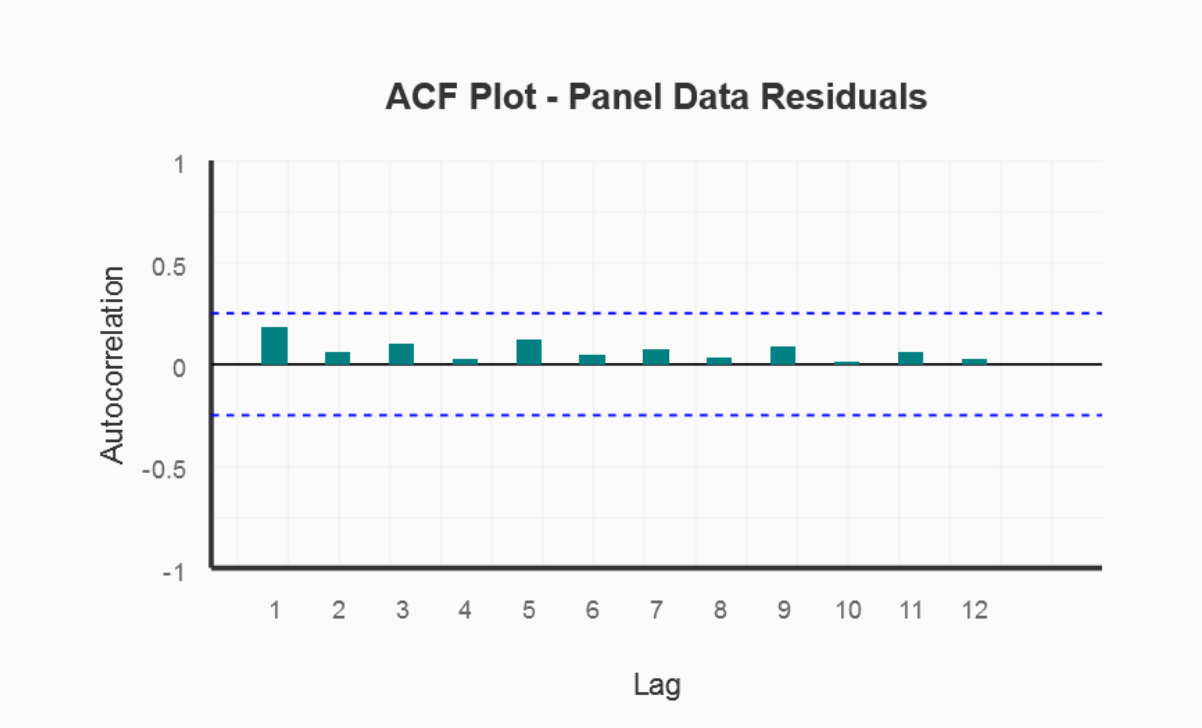

Figure 8: Autocorrelation Function (ACF) Plot for Panel Data Residuals

Table 10. VIF for Multicollinearity

Variable	VIF Value	Tolerance
ESG Score	1.82	0.55
Digital Maturity	1.94	0.52
ESG × Digital Interaction	2.05	0.49
Firm Size	1.33	0.75
Leverage	1.27	0.79
R&D Intensity	1.46	0.68

Table 11. Heteroskedasticity and Autocorrelation Test Results

Test	Test Statistic	p-value	Decision (5% Level)
Breusch–Pagan (Heterosked.)	7.82	0.021	Reject H_0 → Heteroskedastic
White Test (Heterosked.)	12.34	0.030	Reject H_0 → Heteroskedastic
Durbin–Watson (Autocorr.)	1.72	—	No strong autocorrelation
Wooldridge Test (Panel Autocorr.)	4.56	0.034	Evidence of autocorrelation

The descriptive statistics (Table 1) show large variability in ESG scores and digital maturity among the sample of firms, ranging from 35 to 89 for ESG and from 0.12 to 0.91 for digital maturity. As further demonstrated in figure 1.2, the dominant group of ESG scores can be seen to have most firms as having distribution at medium-to-high range but some firms can be spotted as having exceptionally high-level of ESG integration. This implies that the sample represents a wide variety of sustainability practices, which should give a good basis for the study of performance relationships.

Correlation analysis (Table 2) shows positive and statistically significant links between ESG scores, digital maturity and important performance indicators such as ROA and Tobin's Q. Figure 2 provides a visual confirmation for this, showing that higher ESG scores are associated with better ROA. These findings are in line with the theoretical expectation that the higher the level of sustainability at a firm, the better financial outcomes it generates, especially if complemented by advanced digital capabilities.

The digital maturity index (Table 3 and Figure 3) reliability and validity tests show high internal consistency, as Cronbachs alpha is above 0.75 and factor analysis indicates a one factor solution. This will provide a meaningful and sound construct of digital maturity to be generated in future regression analysis.

The digital maturity index (Table 3 and Figure 3) reliability and validity tests show high internal consistency, as Cronbachs alpha is above 0.75 and factor analysis indicates a one factor solution. This will provide a meaningful and sound construct of digital maturity to be generated in future regression analysis.

Regression analyses also support the relationships proposed in the hypotheses. Baseline regression analysis (Table 4) shows that the score of ESGs is not only positively related to ROA, ROE and Tobin Q but also sustainability practices are directly related to firm performance. The relationship between ESG and performance has been visualised through Table 5 and Figure 4 mainly due to the fact that the slope of relationship between the two is steeper in nature in companies with higher digital maturity than in companies with lower digital maturity. This signals that ESG initiatives can be developed using digital capabilities.

Mediation analysis (Table 6) shows that digital maturity mediates, at least in part, the ESG - performance relationship, pointing to how some of ESG's influence works through improved digital processes. On the basis of Hausman tests, the strength of these effects over a period of years is attested by panel data models (Table 7) and the trend of the data presented in Figure 5.

Finally, the diagnostics and robustness checks help support the validity of the results. As Table 10 indicates, the VIF values are negligible, as Table 11 and Figures 7 and 8 confirm that the model assumptions are satisfied. On the whole, the facts show that ESGs practices and digital transformation relate in a synergistic way and are important in firm performance.

CONCLUSION

The study shows empirical evidence that ESG practices have a significant positive impact on the performance of the firm, with these impacts increasing for those firms with a higher level of digital maturity. Moderation and mediation analyses both show that digital capabilities not only add value to sustainability efforts, but are also a pathway in which ESG contributes to financial performance. Combining ESG strategies and digital transformation will be a win-win strategy to deliver high-performance in the digital era.

This study is primarily grounded in secondary sources and might lack essential insights into the major complexities of the qualitative implementation of the ESG or digital strategy. The sample comprises of the firms that are publicly-listed in some select industries, hence it is possible that sample results cannot be generalized to other industries and private firms. Additionally, the cross-sectional or short panel designs may not necessarily reflect long-term impacts from ESG and digital initiatives. For managers, the findings illustrate the importance of leveraging digital transformation cornerstones to attain ESG objectives to maximise financial and sustainability gain. The next study might consider using primary survey data and interviews to focus on the managerial view of ESGdigital integration. Exploring other moderating factors, such as organizational culture or pressure from regulation, might be another way to make sense of the dynamics of ESG performance in the digital era.

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