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The Impact of Enterprise Digital Transformation on ESG Performance: A Perspective on Enterprise Overseas Expansion

Tianqin Zhang

School of Economics, Fudan University, Shanghai, China
24300680279@m.fudan.edu.cn

Abstract. In the context of enterprises expanding overseas, digital transformation offers a strategic pathway for improving quality, reducing costs, and enhancing operational efficiency, thereby supporting long-term sustainable development. Drawing on panel data from A-share listed companies between 2014 and 2023, this study employs both baseline regression model and mediating effect model to examine the interplay among corporate digital transformation, ESG performance, and international expansion. The findings reveal that corporate digital transformation can significantly boost ESG performance; overseas expansion plays a crucial mediating role between digital transformation and ESG performance; and the impact of corporate digital transformation on ESG performance varies by region, industry, ownership type, and performance dimension. Manufacturing firms, non-eastern regions, and state-owned enterprises benefit more significantly, and among ESG dimensions, the effect on environmental indicators is particularly notable. Consequently, to elevate corporate ESG performance, it is necessary to strengthen the development of mechanisms for corporate digital transformation and overseas expansion, as well as enhance cooperation between regions and industries.

Keywords: Digital Transformation, ESG Performance, Enterprise Overseas Expansion, Mediation Effect Model

1. Introduction

In recent years, rapid advances in technologies such as big data, artificial intelligence, and blockchain have accelerated the integration of digital transformation with the real economy, becoming a key pathway for improving quality, reducing costs, enhancing efficiency, and reshaping value creation. At the national level, this agenda has been elevated to a strategic priority. The Third Plenary Session of the 20th CPC Central Committee called for "supporting enterprises in upgrading traditional industries with digital-intelligent and green technologies" [1], followed by a series of intensive policy initiatives to guide corporate digital transformation, facilitate industrial upgrading, and promote high-quality economic growth.

At the same time, ESG performance has emerged as a core measure of corporate environmental responsibility, social contribution, and governance standards. China is drawing on international

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benchmarks to accelerate its regulatory framework, advancing green transition and sustainable development. Policy trends indicate strong alignment between digital transformation and ESG goals in areas such as data-driven decision-making, environmental sustainability, and information transparency.

2. Literature review

2.1. Research on corporate digital transformation and ESG performance

Corporate ESG practices inherently generate externalities, and digital transformation can convert these into internal drivers of corporate behavior. Leveraging technologies such as cloud computing, artificial intelligence, big data, and blockchain, digital transformation takes diverse forms and pathways, influencing ESG performance across multiple dimensions [2]. Most existing studies examine this relationship at the micro level and generally conclude a positive correlation. Research based on data from Chinese A-share listed firms shows that digital transformation significantly enhances ESG performance and delivers economic benefits by increasing firm value, easing financing constraints, improving the accuracy and timeliness of information disclosure, and fostering green innovation [3]. Further analysis across ESG's three pillars finds the strongest improvement in corporate governance, followed by social responsibility, while gains in environmental responsibility are comparatively weaker [4]. Some scholars, however, contend that digital transformation may hinder ESG performance and bring potential social risks [5]. Other studies reveal an inverted U-shaped relationship—moderate digital transformation supports ESG performance, but excessive levels may have a suppressive effect.

The literature also explores mechanisms linking digital transformation to ESG performance. At the macro level, national policies are viewed as important in shaping this impact. At the micro level, most research suggests that improvements in green innovation capacity and in the quality of internal and external information disclosure are primary drivers. Financial performance, decision-making efficiency, and operational management are also identified as key mediators, with the mediating effect of disclosure quality found to be particularly significant compared with green innovation and financial performance [6].

2.2. Research on corporate digital transformation and overseas expansion

Overall, digital transformation has been shown to significantly enhance firms' internationalization performance. Xu et al. [7] report that its positive effect is particularly pronounced in non-state-owned enterprises, technology- and capital-intensive sectors, and in developed countries or regions. Wang et al. [8] further find that digital transformation positively influences outward foreign direct investment, with stronger effects in state-controlled firms, non-IT service industries, and companies based in central, western, and inland regions. Yi et al. [9] argue that digital transformation improves overseas investment efficiency by curbing short-term managerial behavior, strengthening risk tolerance, and reducing agency costs.

The literature also addresses the breadth, depth, pace, and resilience of firms' global expansion. Regarding breadth, Wang et al. [10] find that digital transformation significantly improves the ability to enter multiple national markets, with the impact shaped by host-country institutional environments and ownership structures. Mechanistically, this stems from enhanced capacity to perceive and respond to complex international environments and to acquire and reconfigure resources, thereby expanding global market layouts. In terms of depth, higher levels of digitalization

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increase the likelihood of establishing deep operations in target markets, mitigating the adverse effects of institutional and geographic distances between home and host countries [11]. Concerning pace, Lin [12] notes that digital transformation helps firms establish and maintain a consistent internationalization rhythm, with strategic flexibility and financial development providing internal and external reinforcement. It can both accelerate and regulate the speed of international expansion [13] and significantly strengthen resilience, though in the short term its benefits may be obscured by multiple concurrent shocks, warranting evaluation from a long-term perspective [14].

In summary, while prior studies have explored the impacts of digital transformation on both internationalization and ESG performance from various angles, systematic analysis of the intrinsic linkages between the two remains limited. Building on existing research, this paper adopts an internationalization perspective—specifically, firms' going global strategies—to investigate the complex relationship between digital transformation and ESG performance.

3. Theoretical model and research hypotheses

Drawing on dynamic capability theory and stakeholder theory, firms with strong environmental sensing and opportunity-capturing abilities are better positioned to gain competitive advantages in evolving environments and to meet stakeholder demands more precisely. Accordingly, digital transformation is expected to have a positive effect on ESG performance. From an external perspective, transaction cost theory and information asymmetry theory suggest that digital platforms enhance transaction efficiency, reduce information gaps between investors, regulators, and firms, and improve the credibility of ESG ratings. Based on this reasoning, the first hypothesis is proposed:

H1: Digital transformation positively promotes ESG performance.

As globalization accelerates, "going global" has become an important pathway for Chinese firms to achieve transformation, upgrading, and sustainable development. According to comparative advantage theory and social network theory, digital transformation improves operational efficiency and management transparency, providing technical support for overseas expansion and facilitating the development of global networks and non-price competitiveness. Firms operating internationally are more likely to adopt ESG standards, gain access to international partnerships and high-end clients, and acquire spillover benefits in green management and governance frameworks through cross-border learning. Driven by global competition and supply chain compliance requirements, firms are compelled to place greater emphasis on environmental protection, employee welfare, and social value creation. Thus, overseas expansion constitutes a key channel through which digital transformation enhances ESG performance, leading to the second hypothesis:

H2: Digital transformation improves ESG performance through overseas expansion.

Grounded in resource-based theory, firms differ significantly in resources, operational models, and governance structures depending on their region, industry, and ownership type, which may influence the impact of digital transformation on ESG performance. Ownership structure also shapes strategic choices and risk preferences: state-owned enterprises tend to assume greater social responsibilities, whereas private firms may excel in market responsiveness and innovation mechanisms, potentially leading to distinct ESG pathways. Moreover, since ESG is evaluated across environmental, social, and governance dimensions, the effects of digital transformation may vary across these dimensions. This yields the third hypothesis:

H3: The impact of digital transformation on ESG performance is heterogeneous.

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4. Model setting and description of variables

4.1. Research design

To examine the relationship between the corporate digital transformation and ESG performance, this study establishes a regression model as shown in Equation (1). In this model, DT_{it} represents the degree of digital transformation in a corporate, ESG_{it} denotes ESG performance, and $Controls$ signifies a set of control variables. Here, i refers to corporates, t indicates the year, β represents the coefficients to be estimated, $Time_i$ and $Industry_i$ account for time and industry fixed effects separately, and σ_{it} stands for the random error term.

$$ESG_{it} = \beta_1 + \beta_2 DT_{it} + \beta' Controls + Time_i + Industry_i + \sigma_{it} \quad (1)$$

To investigate the mechanism through which digital transformation enhances ESG performance, this study constructs the following Equation (2) and (3). Here, $Open_{it}$ represents mediating variable overseas expansion, while the remaining variables have the same meanings as in Equation (1).

$$Open_{it} = \beta_1 + \beta_2 DT_{it} + \beta' Controls + Time_i + Industry_i + \sigma_{it} \quad (2)$$

$$ESG_{it} = \beta_1 + \beta_2 Open_{it} + \beta' Controls + Time_i + Industry_i + \sigma_{it} \quad (3)$$

4.2. Variable selection

The explanatory variable is digital transformation (DT). Following Wu et al. [15], this is measured using the frequency of 76 keywords related to corporate digitalization across five dimensions, producing an overall score. A higher score indicates a deeper level of digital transformation. The dependent variable is ESG performance (ESG), measured using the annual average ESG ratings from the China Securities Index. These ratings are generated through AI and NLP-based assessments of firms' ESG practices, with higher scores reflecting better ESG performance. The mechanism variable is overseas expansion (Open), defined as a firm's overseas operating revenue. For consistency, this study measures it as total overseas revenue in 100 billion yuan.

Control variables (Controls), drawn from prior research, are included in the regression model. At the firm level, the following are controlled for: (1) Leverage – the ratio of total liabilities to total assets. (2) Price-to-earnings ratio (PE) – the natural logarithm of the ratio of market price per common share to earnings per share. Given the influence of the top management team on overseas expansion decisions, two additional variables are controlled for: (3) TMT size (TMTSize) – the natural logarithm of the total number of incumbent executives. (4) Independent directors (Independent) – the number of serving independent directors. Finally, industry fixed effects (Industry) and time fixed effects (Time) are included based on the firm's industry classification and the statistical year.

4.3. Data source and descriptive statistics

This study uses data from A-share listed companies in China from 2014 to 2023, excluding firms in the financial and banking sectors as defined by the Shenwan industry classification. Data on digital transformation are compiled from corporate annual reports, while ESG performance data are sourced from the CSI ESG ratings. Information on overseas expansion and control variables is

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obtained from the CSMAR database. After merging datasets, the following screening criteria are applied: (1) exclude firms designated as ST; (2) remove observations with missing data; (3) exclude samples with a leverage ratio above 1. The final dataset comprises 3,139 observations from 575 firms.

Table 1. Descriptive statistics of variables (N=3139)

Variable	Mean	Std Dev	Min	Max
ESG	4.081	1.020	1.000	7.000
DT	1.625	1.420	0.000	6.148
Open	0.028	0.098	0.000	1.934
Leverage	0.439	0.182	0.009	0.972
PE	8.297	1.109	5.012	13.693
TMTSize	1.967	0.329	0.000	3.091
Independent	3.167	0.547	1.000	8.000

5. Analysis of empirical results

5.1. Benchmark regression

Table 2 presents the baseline regression results on the impact of digital transformation on corporate ESG performance. Across columns (1) to (5), the regression coefficients for digital transformation remain significantly positive, regardless of whether control variables are included, and all pass the 1% significance level. This confirms Hypothesis 1, indicating that digital transformation has a significant positive effect on ESG performance. A possible explanation is that, in advancing digital transformation, firms often adopt more sophisticated information systems and management tools, which improve the efficiency and transparency of environmental monitoring, compliance management, and social responsibility fulfillment, while also enhancing the standardization of corporate governance structures—factors that collectively boost ESG performance.

Regarding the control variables, the regression coefficients for leverage and price-to-earnings ratio are significantly negative, indicating adverse effects on ESG performance. This may be because high leverage constrains a firm's capacity to invest in environmental and social responsibility initiatives, while firms with high P/E ratios are often in rapid expansion stages, facing intense market scrutiny and growth expectations, leading resources to be concentrated on core business expansion at the expense of ESG investments. In contrast, management-related control variables show significant positive effects, suggesting that larger top management teams and boards with more independent directors enhance strategic execution and internal governance efficiency, thereby supporting improvements in ESG performance.

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Table 2. Regression results (N=3139)

Variable	ESG				
	(1)	(2)	(3)	(4)	(5)
DT	0.059***	0.064***	0.063***	0.059***	0.058***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Leverage		-0.560***	-0.547***	-0.585***	-0.592***
		(0.149)	(0.149)	(0.148)	(0.149)
PE			-0.086***	-0.086***	-0.084***
			(0.020)	(0.020)	(0.020)
TMTSize				0.253***	0.238***
				(0.084)	(0.083)
Independent					0.082*
					(0.044)
Industry, Time Fixed			Yes		
Constant	3.366***	3.620***	4.380***	3.882***	3.630***
	(0.363)	(0.344)	(0.393)	(0.441)	(0.461)
R^2	0.015	0.019	0.019	0.017	0.017

Note: Robust standard errors are in parentheses; ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively, as in the table below.

5.2. Robustness and endogeneity test analysis

Table 3 reports the results of robustness and endogeneity tests for the baseline regression. To assess robustness, three approaches were applied. In column (1), 2020 samples were excluded due to the significant impact of the COVID-19 pandemic, which restricted production and labor mobility and could potentially bias the results. Column (2) implements winsorization at the 1st and 99th percentiles for all relevant variables to reduce the influence of extreme values. Column (3) adds firm age as a control, considering its potential effect on internal governance and social-environmental outcomes. Results across all three approaches remain significantly positive at the 1% level, demonstrating strong robustness.

To address potential endogeneity between digital transformation and ESG performance, this study follows Fan et al. [16] by using the first lag of digital transformation as an instrumental variable and applying two-stage least squares regression. Column (4) shows that in the first stage, the instrument's coefficient is significantly positive at the 1% level, and the Kleibergen-Paap rk Wald F-statistic is 123.183, indicating no weak instrument problem. Column (5) reports the second-stage regression, where the coefficient of the core explanatory variable (DT) remains significantly positive, confirming that the baseline results are robust even after addressing endogeneity.

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Table 3. Robustness and endogeneity test results

Variable	(1)	(2)	(3)	(4)	(5)
	Excluding year2020 samples	Winsorizing	Adding control variable	Instrumental variable method	
DT	0.059***	0.057***	0.056***		0.076***
	(0.020)	(0.019)	(0.020)		(0.018)
L.DT				0.874***	
				(0.010)	
Controls					
Industry, Time Fixed			Yes		
Constant	3.726***	3.667***	3.806***	-0.026	3.362***
	(0.450)	(0.461)	(0.475)	(0.233)	(0.359)
R^2	0.016	0.017	0.017	0.792	0.139
N	2768	3139	3139	2350	2350

5.3. Mechanism analysis

Table 4 presents the results of testing overseas expansion as a mediating variable. In column (1), when digital transformation is the explanatory variable, the coefficient for overseas expansion is 0.006 and significant at the 10% level, indicating that digital transformation positively drives firms' overseas performance. Column (2) shows that overseas expansion has a coefficient of 0.888 on ESG performance, significant at the 1% level, suggesting that international operations enhance ESG outcomes. Overall, these results indicate that digital transformation facilitates overseas expansion, which in turn improves ESG performance.

Table 4. Mechanism test results (N=3139)

Variable	(1)	(2)
	Open	ESG
DT	0.006*(0.003)	
Open		0.888***(0.267)
Controls		
Industry, Time fixed	Yes	
Constant	-0.020 (0.023)	3.631***(0.460)
R^2	0.078	0.017

5.4. Heterogeneity analysis

To examine whether the impact of digital transformation on ESG performance varies across manufacturing versus non-manufacturing firms, different regions, and ownership types, the sample was divided into six groups for separate testing. The results, shown in Table 5, indicate that in columns (1) and (2), digital transformation significantly affects ESG performance in manufacturing firms but not in non-manufacturing firms. Columns (3) and (4) show a stronger effect for firms in

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non-eastern regions. Columns (5) and (6) reveal that the impact is more pronounced in state-owned enterprises. These findings support Hypothesis 3.

Table 5. Heterogeneity analysis

Variable	ESG					
	Manufacturing	Non-manufacturing	Eastern	Other	State-owned	Non-state-owned
DT	0.057***	0.017	0.043*	0.100***	0.086**	0.047**
	(0.021)	(0.049)	(0.023)	(0.038)	(0.035)	(0.024)
Constant	3.938***	5.009***	4.470***	2.504***	3.466***	3.605***
	(0.304)	(0.722)	(0.724)	(0.669)	(0.639)	(0.638)
Controls	Yes					
Time Fixed	Yes					
Industry Fixed	No				Yes	
N	2538	601	2299	840	1062	2077
R^2	0.017	0.010	0.017	0.042	0.024	0.025

To examine whether the impact of digital transformation on different ESG dimensions is heterogeneous, this study tests each of the three ESG dimension scores using the CNRDS database. The regression results in Table 6 show significant differences across the dimensions, indicating that the effects are not uniformly positive, supporting Hypothesis 3. The coefficient for the environmental (E) dimension is negative and significant at the 1% level, suggesting that firms may prioritize technology and efficiency improvements over environmental sustainability during digital transformation. The coefficient for the social (S) dimension is also negative but not significant, indicating that the effect on social responsibility is unclear and may vary widely across firms. For the governance (G) dimension, the coefficient is positive, implying that digital transformation may enhance corporate governance structures, such as improving internal controls and information transparency, though this effect has not reached statistical significance.

Table 6. Heterogeneity test results across ESG performance dimensions (N=3139)

	(1)	(2)	(3)
	E_score	S_score	G_score
DT	-0.847***(0.312)	-0.093(0.219)	0.014(0.167)
Controls	Yes		
Industry, Time fixed	Yes		
Constant	0.713(4.968)	24.300***(6.057)	27.960***(3.685)
R^2	0.319	0.028	0.194

6. Conclusion and recommendation

6.1. Conclusion

Based on panel data from 575 A-share listed companies in China between 2014 and 2023, this study examines the interplay between corporate digital transformation, overseas expansion, and ESG performance through both theoretical and empirical analyses. The findings are as follows: (1) Digital

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transformation significantly enhances ESG performance. (2) Overseas expansion serves as a critical intermediary in this relationship, with digital transformation indirectly improving ESG performance by promoting internationalization. (3) The effects vary across regions, industries, ownership types, and performance dimensions: the benefits are more pronounced for manufacturing firms, non-eastern regions, and state-owned enterprises; by dimension, digital transformation has a marked impact on environmental indicators and exerts divergent effects on the environmental and social dimensions—suppressing the former while boosting the latter.

6.2. Recommendation

Drawing on the research findings, this paper offers three recommendations. First, strengthen corporate digital transformation by leveraging technologies such as cloud computing, big data, and artificial intelligence to optimize R&D, production, supply chains, marketing, and management, while enhancing internal collaboration and innovation mechanisms. At the societal level, use industrial internet platforms and regional digital service systems to foster industry–university–research cooperation, enabling technology sharing and unified standards. Second, improve the overseas expansion framework by establishing global market intelligence systems and cross-border e-commerce networks in the external environment, formulating precise internationalization strategies; internally, strengthen capabilities in international operations, financial management, logistics, and compliance, while enhancing localization and global competitiveness. Finally, promote resource and experience sharing across industries, regions, and ownership types by developing industry collaboration platforms, regional alliances, and demonstration zones to advance technology diffusion, talent mobility, and joint innovation, thereby creating a collaborative digital ecosystem.

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