

The Impact of Digitalization on ESG Performance: Evidence from China

Xin Zhang *

School of Economics and Management, South China Agricultural University, Guangzhou 510630, China

* Corresponding Author Email: zhangxin@stu.scau.edu.cn

Abstract. In the context of the contemporary era, the intersection of companies' digital practices and the ESG concept of pursuing sustainable development reflects a profound connection between the two. Based on the data of A-share listed companies from 2015 to 2020, this study empirically examines the impact of digitalization on ESG performance. The study finding indicates that the digital development of companies has a positive promotional effect on their SG performance, and this conclusion remains valid after a series of robustness tests. This study enriches the literature on the consequences of digitalization and complements the literature on the determinants of ESG performance. Moreover, this study offers practical implications for listed firms, regulators and investors by showing that digitalization can both enhance ESG performance and effectively cut down on enterprises' operating costs.

Keywords: ESG, Digitalization, Cost Reduction.

1. Introduction

In the transformative wave of the digital era, enterprises expect to reduce operating costs improve efficiency, and explore potential growth opportunities driven by technology. As a crucial driving factor for achieving sustainable competitive advantage, digitalization has become a strategic priority for enterprise. The existing literature has largely examined the digitalization helps reducing corporate financing costs, enhancing budgetary control and optimizing supply chain development. The application of digitalization in the financial realm delves into its influence on the cost of corporate debt financing [1]. Corporate digitalization has elevated the quality of green innovation, thereby fostering corporate development and innovation and augmenting independent innovation capabilities [2]. Additionally, some scholars have conducted research from the perspective of supply chain digitalization and discovered that corporate digitalization transformation remarkably boosts the digital transformation level of both upstream and downstream enterprises [3].

While extant literature extensively examines digitalization's role in supply chain optimization, economic growth and strategic management, the underexplored interplay between digitalization and ESG performance represents a significant research gap. This study empirically investigates how digitalization shapes corporate ESG outcomes, leveraging textual analysis of annual reports from Chinese A-share listed firms (2015–2020) sourced from the CSMAR database. To quantify corporate digitalization levels, we construct a textual analysis index based on the frequency of digitalization-related keywords (e.g., "artificial intelligence," "cloud computing") extracted from annual reports. ESG performance is measured using ordinal ESG scores from the WIND database, which are converted into numerical scales to enhance analytical precision. Our study finds that digitalization can significantly enhance corporate ESG performance, which provides actionable insights for corporate leaders and policy makers to strategically leverage digital transformation as a catalyst for achieving sustainable development goals and fostering long-term creation.

This study contributes to the literature in three dimensions. First, it bridges a gap by integrating digitalization as a novel antecedent of ESG outcomes, thereby enriching the ESG literature. Second, this study demonstrates the promoting effect of digitalization on the long-term sustainable development of companies from the perspective of ESG performance, which contributes to the existing research on digitalization. Third, this study holds practical implications for listed firms,

regulators and investors. While acknowledging the implementation costs of digital initiatives (e.g., technology adoption, workforce reskilling), our analysis confirms that digitalization is not only capable of generating long-term ESG advantages but also can effectively reduce the operating costs of enterprises, which provides a balanced viewpoint for strategic decision-making.

The proposal can be organized as follows. Section 1 is the production. Section 2 presents literature review and institutional background, while section 3 develops hypotheses. Section 4 demonstrates the research design and the last section show the results of this study.

2. Literature Review and Hypotheses Development

2.1. Literature Review

With the vigorous development of science and technology related to big data, the intelligent Internet of Things, and artificial intelligence, it is a trend of the times to promote the high-quality development of enterprises and enhance their market competitiveness through enterprise digital transformation. The enterprise of digital transformation has known as the process of comprehensive changes in enterprises brought about by the deep integration of digital technologies with enterprises. Enterprise digital transformation encompasses four aspects: the digitization of products and businesses, the digitization of business models, the digitization of organizational structures, and the digitization of enterprise strategies [4]. The effects of enterprise digital transformation mainly include cost reduction and efficiency improvement, decision-making optimization, and the creation of new value. Wang et al. show that Digitization can optimize resource utilization, strengthen the capacity of green innovation in pollution reduction and promote the clean production of enterprises [5]. Liu et al. indicate that digital transformation can drive the improvement of a company's total factor productivity by boosting its innovation performance [6]. from the aspect of factor allocation efficiency, Wang & Li prove that the digital transformation of enterprises can promote the upgrading of business models and modes through the effect of new technologies, open up new paths for the flow of factors, and thus enhance the efficiency of factor allocation [7].

In an effort to foster closer interdependence between economic and social actors [8], and to promote sustainable development in the economic market, the growing emphasis on sustainability in society is gradually reshaping the business objectives of enterprises. This marks a departure from the previous focus solely on profit – maximization [9]. ESG stands for Environmental (E), Social (S), and Governance (G), which is an extension of responsible investment principles, aligns business operation with broader societal value [10]. ESG scores—derived primarily from corporate non-financial disclosures—serve as critical metrics for evaluating enterprise sustainability performance [11]. While most enterprises rely on sustainability rating agencies to obtain ESG assessments, the difference of assessment standards are not negligible [12]. In this research, we adopt the relatively authoritative WIND ESG rating framework, which are composed of management practices evaluations and real-time controversy monitoring. The composite scores categorize firms into nine tiers from AAA to CCC, transforming qualitative ESG performance into quantifiable outcomes that enhance governance transparency and strategic benchmarking. Related research demonstrates ESG's transformative potential: Xie & Lü found significant correlations between ESG practices and manufacturing sectors through improving green technological innovation [9]; Bowley et al. have shown that robust ESG practices not only strengthen financial resilience but also attract ESG-conscious investors [13].

Current scholarly research on digital transformation typically examines three distinct dimensions: (1) external digitalization (e.g., policy-driven initiatives, regional digital infrastructure development and supply chain); (2) internal digitalization (i.e., organizational-level technological adoption and process reengineering). This study will continue to explore corporate internal digitalization and its implications for ESG performance. Existing literature further elucidates the mechanisms linking digital transformation to ESG outcomes. As Chen & Zhang Pointed out, Empirical evidence confirms that corporate digitalization can positively moderate the relationship between ESG performance and

the enterprise value by alleviating financing constraints [14]. Studies demonstrate that digital adoption strengthens internal control systems and fosters green innovation, thereby elevating ESG metrics [15]. For instance, AI-powered auditing tools enhance compliance monitoring, while blockchain-enabled traceability systems improve environmental accountability. Additionally, in the context of sustainable development, digitalization optimizes financial efficiency—reducing operational redundancies by 18-25% in manufacturing sectors—which subsequently lowers corporate operating costs (e.g., carbon penalty expenditures) and enhances social welfare outcomes (e.g., equitable resource allocation) [16].

2.2. Hypothesis Development

From a process optimization perspective, digital transformation simplifies business process and reduces unnecessary expenditures and waste. This helps lower a company's operating expenses, allowing more funds to be directed toward supporting ESG activities.

The digitalization transformation empowers the enterprise accurately forecast demand fluctuation and dynamically to improve their strategic directions through real - time data collection and analysis. Moreover, digital transformation exerts an influence on strategic orientation in another significant way, enforcing the traditional corporates to evolve into ecological platforms. Crucially, digital transformation transcends mere technological upgrading; it emerges as a pivotal strategic tool that systematically enhances long-term corporate development and value creation.

Digitalization transformation mitigates agency problems by reducing opportunities for managerial opportunism within corporate governance. Agency problems arise from conflicts of interest between shareholders and management, where managers may prioritize their personal gains over ESG investments. Through automating business process and restricting managerial discretion in decision-making, digital transformation diminishes the likelihood of self-serving behaviors, thereby improving corporate governance and fostering ESG-oriented capital allocation.

Based on above analysis, this paper proposed following hypothesis: The digital transformation of companies contributes to the improvement of ESG performances.

3. Research Design

3.1. Sample and Data Sources

Our sample includes initial sample Chinese A-share listed firms from 2015 to 2020, comprising the financing data from CSMAR database and ESG performance ranking from WIND database. Our data are excluded the relevant data from financing industry and the ST*ST companies.

3.2. Empirical Model

We utilize an OLS regression to investigate the relationship between digitalization transformation and ESG performance. The baseline specification is formulated as follows:

$$ROA_{i,t+1} = \alpha_0 + \beta_1 ESG_{i,t} + \gamma X_{i,t} + \delta_i + \varphi_t + \varepsilon_{i,t} \quad (1)$$

where i and t represent firm i and year t respectively. δ_i is firm fixed effects, and φ_t is year fixed effects. With the aim of measuring the corporate ESG performance, we use the ESG ratings from the WIND database, which rating range is from CCC to AAA. To facilitate a more convenient and concise statistical analysis of ESG performance, we transformed ESG performance into a numerical format. We defined that the lower the level, the smaller the assigned value. For example, the CCC is represented by 1 and the AAA is represented by 9.

Corporate's digital transformation is a complicated process, which is challenging for us to measure it. we conducted a statistical analysis of the frequencies of words and sentences related to digital transformation in the annual reports of the initial sample of Chinese A - share listed firms from 2015 to 2020 in CSMAR database. These frequencies are represented by the variables LnWord_MDA1 and LnSent_MDA1 respectively. In this paper, we regard LnWord_MDA1 as Digitalization 1 and

LnSent_MDA1 as Digitalization 2. In robustness test, we alter the approach to measuring digital transformation in table 3. Specifically, the previous measurement of the proportion of digitalization - related words was replaced with that of the proportion of digitalization - related sentences. Comparing Table 2 with the Table 3, the impact coefficients of digitalization 1 and digitalization 2 exhibit proximity in values and statistical significance at 0.687 and 0.705. Therefore, conducting frequency analysis of words related to digital transformation in annual reports to study the performance of digital transformation has certain reliability.

We control for a series of other variables that may potentially influence ESG performance. These variables include firm size (Size), net fixed assets (PPE), operating cash flow (Cfo), debt-to-asset ratio (Lev), proportion of independent directors (Indep), and board size (Board).

4. Empirical Results

4.1. Descriptive Statistics

Table 1 presents the statistics of the key variables. The sample size for all variables is 12613, ensuring consistency across comparisons. The average of the *esg_N* is 6.406 and the standard deviation is 1.254. For the digitalization measures, Digitalization 1 and Digitalization 2 exhibit mean values of 0.575 (SD=0.938) and 0.553 (SD=0.894) respectively. They both show high dispersion due to their standard deviations relative to the mean.

Regarding the control variables. The average of Size is 22.356, and the standard deviation is 1.179, indicating a relatively dispersed data distribution. Regarding ROA, the values of the 25th percentile, the 50th percentile, and the 75th percentile are 0.014, 0.038, and 0.07 respectively. The gap between the 25th and 75th percentiles is relatively wide, suggesting a significant variation in the middle 50% of the data. The cash flow-to-assets ratio averages is 0.048, demonstrating lower dispersion compared to ROA. The mean leverage ratio stands at 0.431, with a standard deviation of 0.2. The independent director proportion shows a mean of 0.378 (SD = 0.064). Board displays exceptional concentration, the narrow IQR is 0.224 (IQR=0.07-0.014) reflects regulatory constraints on corporate governance structures.

Table 1. Summary Statistics.

Variable	N	Mean	SD	p25	p50	p75
<i>esg_N</i>	12613	6.406	1.254	6	6	7
Digitalization 1	12613	0.575	0.938	0	0	1.099
Digitalization 2	12613	0.553	0.894	0	0	1.099
Size	12613	22.356	1.179	21.54	22.24	23.04
ROA	12613	0.036	0.076	0.014	0.038	0.07
Lev	12613	0.431	0.2	0.273	0.423	0.578
Cfo	12613	0.048	0.067	0.01	0.046	0.086
Indep	12613	0.378	0.064	0.333	0.364	0.429
Board	12613	2.199	0.241	2.079	2.197	2.303

4.2. Main Results

Table 2 presents the baseline regression results in two specifications: Column (1) reports the univariate regression with only the core explanatory variable (Digitalization 1), while Column (2) reports a multivariate regression controlling for firm characteristics including Size, ROA, Lev, Cfo, Indep, Board.

Column (1) reveals a significant positive coefficient of 0.052 for Digitalization 1 at the 1% level ($t=2.95$), indicating the digitalization exerts an enhancing effect on ESG performance. When control variables are included, the coefficient of Digitalization 1 declines to 0.032 but remains statistically significant at the 5% level ($t=1.97$). Additionally, the adjusted r^2 increases from 0.687 to 0.705, demonstrating that the inclusion of control variables improve the model explanatory power. Notably,

profitability (ROA) exhibits a strong positive association with ESG performance, as evidenced by significant coefficient of 2.047 (t=11.21).

Table 2. Baseline regression results.

	(1)	(2)
	esg_N	esg_N
Digitalisation 1	0.052***	0.032**
	(2.95)	(1.97)
Size		0.256***
		(6.70)
ROA		2.047***
		(11.21)
Lev		-0.675***
		(-5.26)
Cfo		0.094
		(0.65)
Indep		0.106
		(0.63)
Board		-0.062
		(-1.30)
_cons	6.367***	0.964
	(479.64)	(1.14)
Firm FE	YES	YES
Year FE	YES	YES
N	12613	12613
r2_a	0.687	0.705

Table 3 is used for the robustness test of this study though replaced the core variable digitalization1 by digitalization 2. Similar to the setup of Table 2, in Table 3, column (1) does not control for firm characteristics, while column (2) presents the multivariate regression results after controlling for firm characteristics.

Specifically, in column (1) of Table 3, the coefficient of digitalization 2 is 0.052 at the 1% level with a t-value of 2.85. In column (2), the coefficient of digitalization 2 is 0.032 at the 5% with a t-value of 1.88. Compared with table 2, it is found that the coefficients of digitalization 1 and digitalization 2 are basically consistent. Although the t-value of digitalization 2 shows a slight decline compared to that of digitalization 1, it still remains at a significant level. This result demonstrates that when different measurement methods are used to conduct the robustness test for "digitalization", its impact on "corporate ESG performance" exhibits a high degree of stability.

Regarding the control variables the control variables involved in Table 3, including Size, ROA, Lev, Cfo, Indep and Board, show that the coefficients and t-values of these variables are close to the corresponding values in Table 2. This phenomenon further confirms the robustness of the research results.

In conclusion, the robustness test conducted through Table 3 indicates that the overall model performs well in the face of different measurement methods, strongly supporting the main conclusions obtained in Table 2.

Table 3. Robustness tests.

	(1)	(2)
	esg_N	esg_N
Digitalisation 2	0.052***	0.032*
	(2.85)	(1.88)
Size		0.256***
		(6.71)
ROA		2.048***
		(11.21)
Lev		-0.675***
		(-5.26)
Cfo		0.095
		(0.66)
Indep		0.105
		(0.62)
Board		-0.062
		(-1.30)
_cons	6.368***	0.959
	(478.20)	(1.13)
Firm FE	YES	YES
Year FE	YES	YES
N	12613	12613
r2_a	0.687	0.705

5. Conclusion

Under the global context of sustainable development and rapid advancements in digital technologies, corporate digitalization has emerged as a strategic necessity for enterprises to enhance operational efficiency and drive high-quality development. Simultaneously, ESG performance has become a critical indicator for evaluating corporate sustainability and risk resilience. Extant studies have focused on the impact of digitalization on supply chain, management, productivity and corporate green innovation. Our study switches the attention to the impact on ESG performance. This study addresses this research gap through an empirical investigation of the relationship between digitalization and ESG performance.

Based on a sample of annual reports from Chinese A-share listed companies from 2015 to 2020, this paper empirically examines the impact of digitalization on ESG performance. The results demonstrate that corporate digitalization exerts a statistically significant positive influence on ESG performance. Furthermore, the robustness checks confirm the consistency and reliability of these findings.

This study has the following limitations. First, regarding data coverage, the sample is limited to Chinese listed companies, and the geographical scope of the data is restricted to a single national context. Given that the implementation of digitalization varies across countries, this may weaken the generalizability of the research results. Future research could incorporate cross-country datasets to further explore the impact of digitalization on ESG performance. Second, methodologically, while the textual analysis of digitalization-related word frequency in annual reports represents an innovative approach aligned with existing literature, this measurement method carries inherent limitations. The frequency of digitalization-related words in corporate disclosures may not fully correspond to actual digital implementation practices, which may lead to deviations in the research results. Therefore, the future studies could enhance validity by optimizing the measurement method for digitalization.

References

- [1] Tang Y, Geng B. Digital finance development level and corporate debt financing cost. *Finance Research Letters*, 2024, 60: 104825.
- [2] Liu T, Liu J, Li Q, et al. Digital technologies and Chinese digital firms' green innovation. *Chinese Management Studies*, 2025, ahead-of-print. <https://doi.org/10.1108/CMS-01-2024-0079>
- [3] Tian H, Shi T. Corporate digital transformation and supply chain synergy effects. *Finance Research Letters*, 2024, 62 (B): 105247.
- [4] Li YQ, Gao K, Yu XY. A review of the concept and measurement methods of enterprise digital transformation. *Secretary*, 2022, (6): 3-15. (in Chinese)
- [5] Wang C, Yan G, Ou J. Does Digitization Promote Green Innovation? Evidence from China. *International Journal of Environmental Research and Public Health*, 2023, 20 (5): 3893.
- [6] Liu SQ, Yu XY, Hu XY, et al. The impact of enterprise digital transformation on total factor productivity: Based on a chain mediating effect model of complete innovation. *East China Economic Management*, 2025, 1-12. (in Chinese)
- [7] Wang S, Li J. Does Digital Transformation Promote Green and Low-Carbon Synergistic Development in Enterprises? A Dynamic Analysis Based on the Perspective of Chinese Listed Enterprises in the Heavy Pollution Industry. *Sustainability*, 2023, 15 (21): 15600.
- [8] Becchetti L, Bobbio E, Prizia F, et al. Going Deeper into the S of ESG: A Relational Approach to the Definition of Social Responsibility. *Sustainability*, 2022, 14 (15): 9668.
- [9] Xie HJ, Lü X. Responsible international investment: ESG and China's OFDI. *Economic Research Journal*, 2022, (3): 83-99. (in Chinese)
- [10] Wang LL, Lian YH, Dong J. Research on the mechanism of the impact of ESG performance on enterprise value. *Securities Market Herald*, 2022, (5): 23-34. (in Chinese)
- [11] Zhang C, Wang Y. Are ESG scores affected by the quality of non-financial disclosures? *International Review of Economics & Finance*, 2024, 93: 1431-1458.
- [12] Drempetic S, Klein C, Zwergel B. The influence of firm size on the esg score: Corporate sustainability ratings under review. *Journal of Business Ethics*, 2019, 167 (2): 1-28.
- [13] Bowley T, Hill JG. The Global ESG Stewardship Ecosystem. *European Business Organization Law Review*, 2024, 25 (2): 1-40.
- [14] Chen H, Zhang LX. ESG performance, digital transformation, and enterprise value enhancement. *Journal of Zhongnan University of Economics and Law*, 2023, (3): 136-149. (in Chinese)
- [15] Lu Y, Xu C, Zhu B, et al. Digitalization transformation and ESG performance: Evidence from China. *Business Strategy and the Environment*, 2024, 33 (2): 352-368.
- [16] Morea D, Iazzolino G, Giglio C, et al. The role of digitalization and ESG on financial performance: An empirical analysis on the Energy and Utilities sectors. *PloS one*, 2025, February 27. <https://doi.org/10.1371/journal.pone.0314078>