

Digital Transformation and Corporate ESG Performance: A Literature Review on Mechanisms of Action

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Abstract

Digital transformation has also become one of the most important drivers of the sustainable development of enterprises under the influence of the digital economy. Being an assessment tool that assesses the overall performance of enterprises in environmental, social responsibility, and corporate governance, ESG has gained popularity among scholars and practitioners alike. Even though an increasing body of literature investigates the effect of digital transformation on corporate ESG performance, the results regarding the main effect have been inconclusive, and additional research on transmission paths and boundary conditions is possible. In accordance with the literature-review methodology, this paper selects appropriate articles in the CNKI and Web of Science databases published in 2018-2025. It summarizes the present studies along three dimensions: main effect, mediating transmission paths, and moderating boundary conditions, examines the reasons behind empirical divergences, identifies the gaps in research, and gives the directions to be followed in future research. The research reveals that digital transformation influences corporate ESG performance mostly via three channels: resource allocation, internal governance, and green innovation, and that these effects are conditioned by various internal and external variables. Most of the available research works center their attention on major A-share listed companies, whereas the mechanisms of testing small- and medium-sized companies require further study. This paper will serve as the basis of further empirical research and the practice of coordinated digital-green development in enterprises.

Keywords

digital transformation, ESG performance, financing constraints, internal control, green innovation

1. Introduction

Since the digital technologies are increasingly intertwined with the real economy, digital transformation is not restricted to updating of hardware devices but is a system-wide change in the production processes of enterprises, their organizational structures, and the ways they allocate resources. ESG takes the overall assessment of the sustainable-development status of enterprises on such aspects as environment, social responsibility, and corporate governance. Since the introduction of appropriate regulation laws in the capital market of China, ESG has turned out to be one of the key measures of corporate activities quality. As used in this paper, ESG performance is defined as the overall performance of firms based on the environmental, social and governance dimensions and the evaluation data are largely based on third party ratings and publicly

available corporate documents; digital transformation is the use of digital technologies by companies to transform the organization systems and should not be perceived to be synonymous with purchasing technologies [1].

In an international context, the United Nations has helped to disseminate ESG ideas into the world capital markets and other organizations like EU Corporate Sustainability Reporting Directive (CSRD) have also enhanced the requirements of sustainable-disclosure in the activities of multinational corporations. Wang et al. (2023) based on the evidence of Chinese A-share listed company, indicate that digital transformation enhances environmental performance, social responsibility, and corporate governance, however, the promotional effect has a delay period of about two years and is stronger in central and western regions, pollution-intensive industries, and non-state-owned enterprises. In the country, since the amendment of the Code of Corporate Governance of Listed Companies in 2018, the Shanghai and Shenzhen stock exchanges have in turn released ESG disclosure guidelines and the count of ESG reports published by A-share listed companies has been increasing steadily, even though variations among companies in their results and quality of disclosures are large. According to Xiao [2], the research on domestic ESG cannot merely copy the foreign experience but should rather be based on the actual conditions of Chinese companies.

In terms of the connection between digital transformation and corporate ESG performance, current empirical research has not achieved consensus. An A-share sample confirms that digitalization increases overall comprehensive ESG scores of firms [1]; simultaneously, Kuang [3] and others have found an inverted-U threshold relationship between them. The discrepancies in the research findings are not only due to the diversity of the theoretical views but also because of the impact of sample choice and indicator measuring. Most empirical investigations focus on big listed companies; there is significantly less experience evidence on small- and medium-sized enterprises (SMEs). Disruption between theoretical hypotheses and empirical tests and lack of comparative analysis of various transmission channels also remain. Based on this, the current paper will be a systematic review of the available literature, clarify the major effect of digitalization on ESG, the mediating paths, and the moderating limits of their effects, summarize the outstanding gaps, and refer to the future directions of studies in the area.

2. Mechanisms Through Which Digital Transformation Affects Corporate ESG Performance

2.1 Main Effect: Theoretical Deduction and Empirical Evidence on Digital Transformation and ESG Performance

The impact of digital transformation on corporate ESG represents a natural point of departure in the study of this issue. The available literature divides all the hypotheses into two groups, namely, a linear positive effect and a non-linear threshold effect.

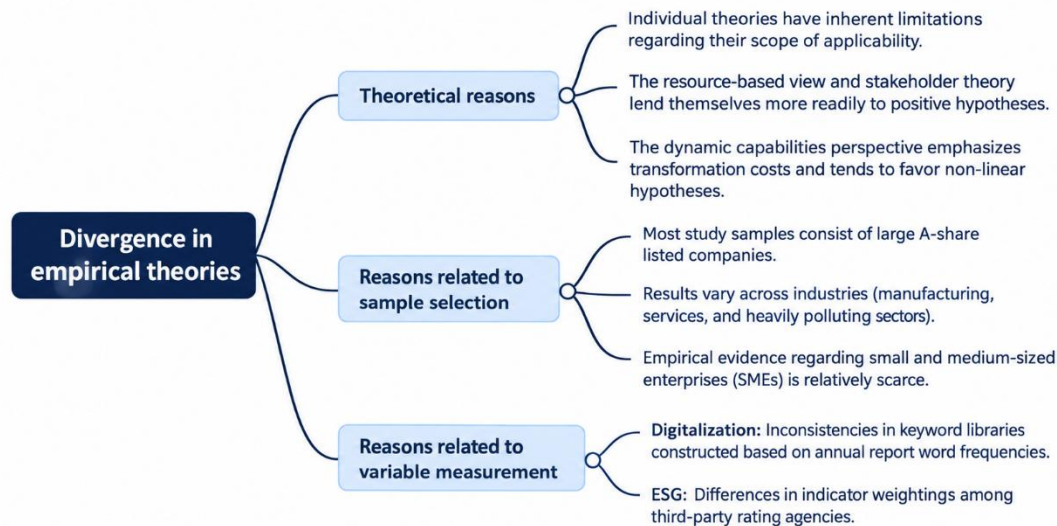
Based on resource-based view and stakeholder theory, digitalization may assist companies in creating heterogeneous resources, minimizing internal and external information asymmetry, and facilitating the introduction of environmental governance systems and social-responsibility systems and thus the research hypothesis of positive promotional influence [1]. The dynamic-capability theory, nonetheless, implies that digital change entails transformation costs due to business restructuring and talent iteration; when such costs go beyond the carrying capacity of the firm, they squeeze out investments in green and social-responsibility areas and result in excessive digitalization and do not necessarily have to be linear. In general, a single theory cannot be used as an explanation of all empirical phenomena; an integrative analytical framework that can handle multiple outcomes has not been developed yet.

Empirical research mostly confirms the positive elevating influence of digital transformation on ESG. According to Hu et al. [1], using information on A-share listed companies, it is confirmed that digital transformation is related to significant increases in the total score of ESG of the companies involved; Liu and Wu [3] also note that this elevating effect is more pronounced in private companies and in highly polluting industries; Jin et al. [4], using a manufacturing sample, also confirm that the most significant impact of digitalization on environmental-dimension performance is achieved. Meanwhile, other studies also notice threshold properties: Kuang [5] observes an inverse U between digital transformation and ESG performance, where the promotional effect switches to inhibition when a critical level is reached. Estimates of turning points

across various studies are quite different, and the estimates are affected by the duration of samples, sources of ESG rating data, and ways of building indicators of digitalization. The positive conclusion has considerable empirical evidence, but the nonlinear hypothesis is disputed; much research examines only one form of hypothesis and does not know if discrepancies can be traced to theoretical assumptions or to the flaws of empirical design.

The divergences in the empirical conclusions may be explained through the synthesis of the current review by three factors. To begin with, the resource-based view and stakeholder theory tend to result in positive hypotheses more easily than the dynamic-capability perspective does, which focuses on transformation costs and tends to make nonlinear judgments; theoretical foundations of the research are also different. Secondly, sampling: current empirics are based primarily on large listed companies; resource endowments of large companies, SMEs, manufacturing, and services vary significantly, and results cannot be used interchangeably at leisure. Finally, measurement of variables: in many cases, digitalization is built using word-frequency analysis of annual reports, and the keyword libraries used in different studies vary; different third-party ESG rating weights are also set differently, introducing measurement-level bias [6]. Theoretical fragmentation, sample heterogeneity, and non-unified measurement all decrease comparability between different studies. The causes of divergences in empirical findings on digital transformation and ESG could be grouped into three levels, theory, sample selection, and variable measurement, as shown in Figure 1.

Figure 1: Reasons for divergences in empirical conclusions



2.2 Mediating Mechanisms: Multiple Transmission Paths from Digital Transformation to ESG Performance

The digital transformation does not change firm ESG rates directly but is mediated by three pathways - resources, governance, and innovation - with each pathway explaining the logic behind a different classical theory.

2.2.1 Resource Path: Easing Financing Constraints and Optimizing Resource Allocation

Based on the resource-based perspective, competitive advantage stems in the heterogeneous resources of an organization. The digitalization may decrease the information asymmetry between companies and financial organizations, loosen financing restrictions, maximize internal and external use of resources, and offer financial assistance to ESG projects that have long payback times, including the control of pollution and employee rights protection [7]. As noted by Zhao [7], digital transformation coupled with digital finance could also expand the external financing opportunities and enhance the resource context of ESG practice. The empirical basis of this route is mostly provided by big listed companies, but smaller businesses are more severely affected by a lack of financing, and it is not yet clear whether digitalization can really help in improving the financing situation of SMEs in an empirical manner. In most of the studies that confirm that the

mediating effect is significant, they do not break down the internal mechanism through which the digital technologies transform the heterogeneous resources [8].

2.2.2 Governance Path: Strengthening Internal Control and Reducing Agency Costs

When integrated with the theory of upper-echelons, digitalization will make it possible to trace and monitor the operations carried out by the organization, minimize the moral hazard of managers and adverse selection, lower agency costs, and at the same time enhance the level of information disclosure, which would be more responsive to the demands of various stakeholders and promote the adoption of ESG systems. Song et al. [9] state that digital transformation can enhance the quality of accounting information as well as increase the strength of internal supervisory mechanisms. The current empirical samples also have a bias towards large well-established companies; SMEs do not have as strict internal governance frameworks, and it remains uncertain if digitalization can achieve the same governance-optimization effects in SMEs.

2.2.3 Innovation Path: Iterating Dynamic Capabilities and Driving Green Innovation

The innovation path is based on dynamic-capability theory as a long-term pathway by which digitalization influences ESG. Companies need to be able to constantly sense, integrate and reorganize resources to be able to respond to the changing external environment; digitalization is an iteration of dynamic capabilities that supports process change, energy savings, emission reduction, and other green innovations and enhances the environmental performance at the source of production [4]. Jin et al. [4] support this claim using a manufacturing sample confirming that digitalization can be very efficient in the promotion of corporate green innovation. The path has obvious practical limits: the influence is more pronounced in highly polluting industries and in those enterprises with sufficient R&D reserves; SMEs, which do not have the necessary R&D funds and digital workforce, will not transform digitalization into green-innovation productivity regardless of the completion of digitalization [10]. There are some existing studies that have brought up the idea of new-quality productive forces but there is still inadequate development of progressive logic among the dynamic capabilities, new-quality productive forces and green innovation.

2.2.4 Integration and Comparison of Multiple Mediating Paths

The three paths of resources, governance and innovation cannot be considered completely disjointed in corporate practice, but most empirics examine only one mediating relationship and seldom put various paths into one framework to compare them; it is not clear whether those paths are complementary or substitutive empirically [11]. Considering the functional positioning the resource path deals with the funding sources of ESG practice, the governance path affects the subjective willingness of firms to implement ESG, and the innovation path is the capacity to perform high ESG in the long term. The prevailing path differs depending on the situation: dirty industries tend to use the innovation path more to pay dividends, and resource-constrained SMEs are more limited by the resource path. The direct inference of SME models based on the summaries of large enterprises is bound to be explanatory failure.

2.3 Moderating Effects: Boundary Conditions of Digital Empowerment of ESG

The influence of digital transformation in ESG is not always constant as internal conditions of the firm, external institutional environment and firm characteristics moderate the relationship.

2.3.1 Internal Firm Factors as Moderators

Upper-echelons theory suggests that the orientation of resource allocation is dictated by managerial value preferences. In case management is too keen on short-term gains, digital resources will focus on increasing capacity, which will displace ESG-focused investments and make the impact of digitalization empowering. Through the lens of dynamic-capabilities, the results of digitalization largely rely on the ability of the company to ingest and alter resources; the governance and green values of digital technologies cannot be released without digital talent and organizational learning structures [12]. The current studies have more emphasis on the personal backgrounds of the top managers and fewer on the middle level implementation groups and overall organizational effectiveness; most of the empirical results are reporting only meaningful moderating relationships and giving no detail about the underlying mechanisms [8].

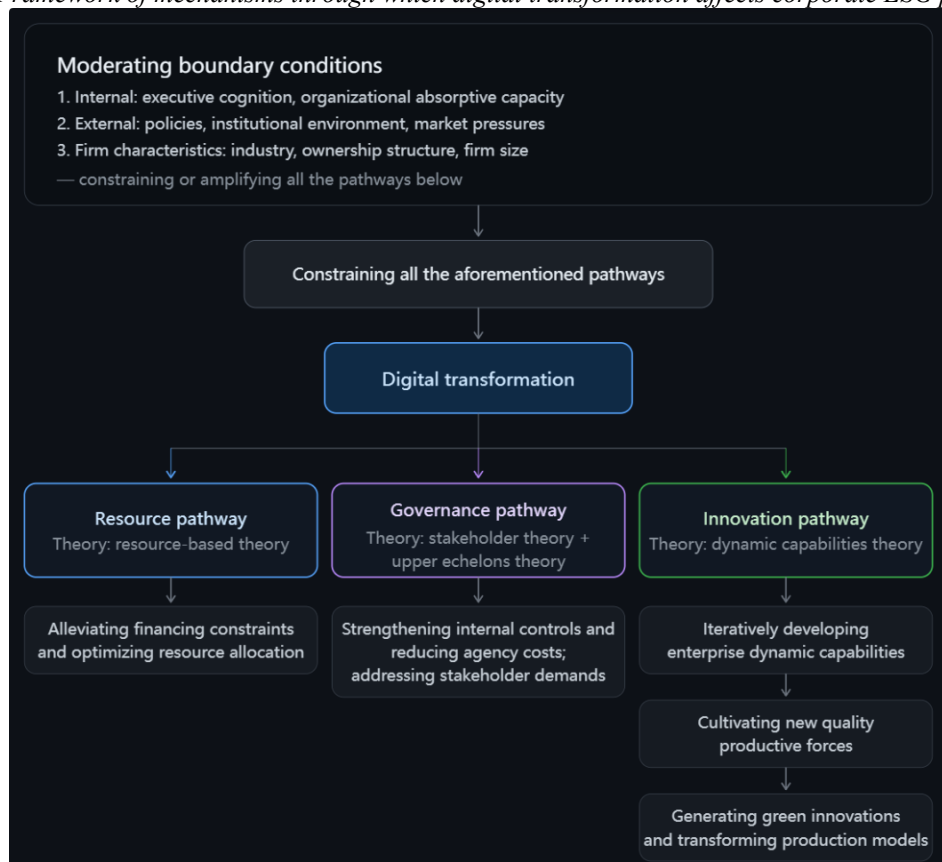
2.3.2 External Firm Factors as Moderators

According to the institutional-theory analysis of the issue, external policy, regulation, and market supervision change the strength of digitalization consequences. Wang and Zhang [13], using the quasi-natural experiment of a national and local tax administration merger, conclude that external institutional pressures like tax enforcement force companies to adopt digitalization to regularize the process of running a business and increase ESG standards. The government subsidies can reduce the cost of digital transformation and steer green digital resources. External pressure exerted by the people and regulators increases the green governance value of digitalization in areas that are highly marketized and regulated. Available studies, nevertheless, focus on companies whose shares are listed in institutionally established areas, whereas studies on weak institutional areas and SMEs do not differentiate between the two types of policies (cost-saving incentives or compliance controls) and even some empirical results have no previous theoretical foundation.

2.3.3 Firm-Characteristic Factors as Moderators

The ESG empowerment of digital transformation is quite heterogeneous. The manufacturing sector and other heavy polluters require urgent reduction of emissions, which is why the benefits of digital optimization of production processes are manifested in full [4]; state-owned enterprises have a fairly solid ESG base, so the marginal benefit of digitalization is small, but it is larger with private enterprises [1]. Yang and Han [10] observe that the existing heterogeneity tests are largely reliant on the listed-company samples; the comparative research focused on SMEs is rare, and most of the heterogeneity findings are post-regression post-hoc inductions, which do not have a previous theoretical prediction, and thus, can lead to the disconnection between observed phenomena and theoretical examination. The three pathways of resources, governance, and innovation are impacted by digital transformation in corporate ESG performance, whereas internal and external factors and characteristics of firms act as moderating boundary conditions that may either limit or enhance these transmission paths; the general logic of action is displayed in Figure 2.

Figure 2: Framework of mechanisms through which digital transformation affects corporate ESG performance



2.4 Overall Assessment of Mechanism Research

Generalizing the literature on main effects, mediation, and moderation, the discipline has developed a fairly comprehensive analytical system, but gaps are also evident. Firstly, several studies indicate theory-empirics disconnect; individual theories have their own limitations, and unified integrative analytic systems are absent. Secondly, empirical samples are based on large listed companies with the applicability of the current analytical framework to SMEs still to be tested. Thirdly, empirical data on interactive connections between various mediating paths and on variations of the dominant path across different contexts is limited [8].

The small and medium enterprises (SMEs) are a significant part of the real economy, but they have some built-in shortcomings in terms of financing, personnel, and control; it is not always easy to achieve the activation levels of the resources, control, and innovative ways. The theories that have been developed using large companies cannot easily account for the practical challenges facing SMEs. SMEs have consequently been a significant and ignored testing ground in the area, where major research gaps exist [14].

3. Conclusion

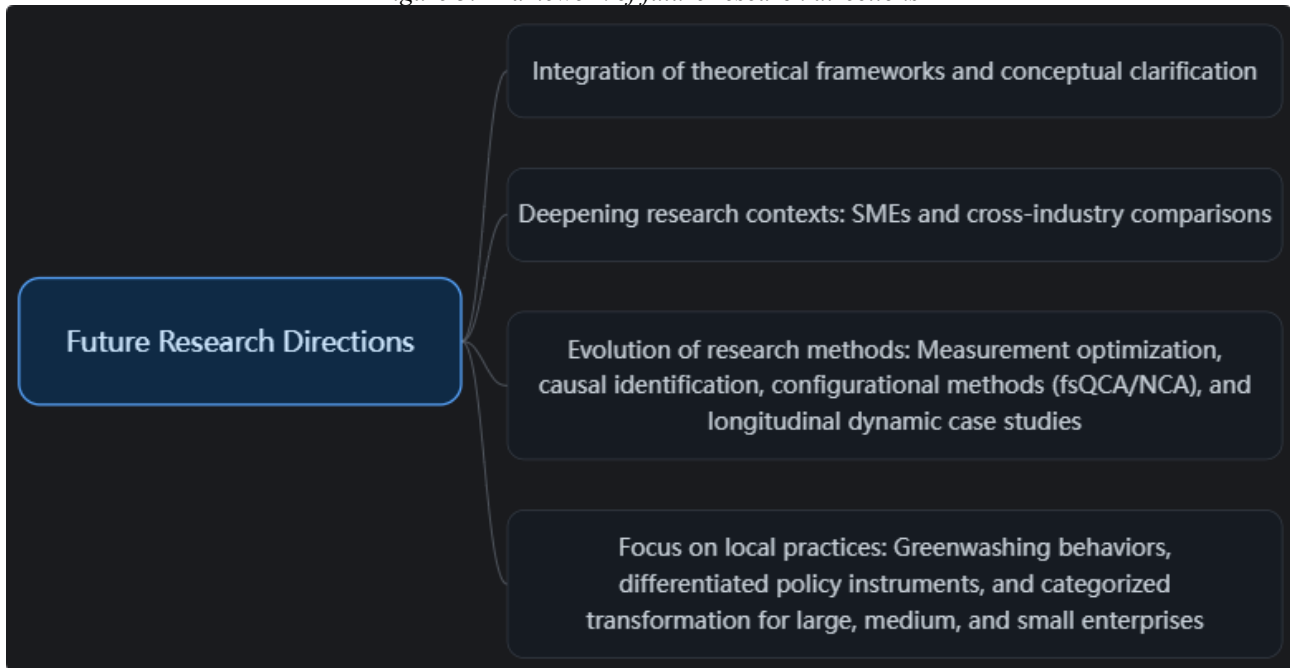
3.1 Research Summary

The paper is a systematic review of the literature of digital transformation and corporate ESG performance between 2018 and 2025, and it comes up with the following conclusions. To begin with, the current studies have developed two main hypotheses, which are linear positive and non-linear threshold, and empirical differences arise due to theoretical fragmentation, different choices of the sample, and non-standardized measurements of core variables; each kind of empirical result has its own contextual limits. Secondly, the effects of digital transformation on ESG occur in three mediating pathways: resource allocation, internal governance, and green innovation, each with an activation threshold that can be practiced. Thirdly, the moderating effect of digitalization is constrained by internal organizations, external institutional settings, and industry and ownership attributes; most heterogeneity analyses do not have previous theoretical reasoning. Fourthly, there is a bias in the existing study samples towards large listed companies and mechanisms tests conducted under the SME setting demonstrate obvious gaps.

3.2 Prospects for Future Research

In view of the gaps in the studies mentioned above and considering the domestic environment and the practical challenges of Chinese companies, further development in this area may be achieved in four areas: theoretical integration, downward extension of the scope of research, repeated application of research methods, and alignment with the local practice. Combining the current research shortcomings, future studies can be furthered in four directions depicted in Figure 3.

Figure 3: Framework of future research directions



3.2.1 Integration of Theoretical Frameworks and Deepened Clarification of Core Concepts

The future studies must be based on the specific institutional environment of China and develop integrative analytical model that would be able to incorporate linear and nonlinear empirics, thus reducing theoretical fragmentation. Additional elaboration about hierarchical relationships between dynamic capabilities, new-quality productive forces, and green innovation is necessary, conceptual connotations and extensions should be provided. Based on a holistic perspective of capability-motivation analysis, numerous mediating mechanisms of resources, governance and innovation should be incorporated into one system to make up the weakness of a single theory, finish the localization and adaptation of Western classical theory and increase the explanatory power of the framework [15].

3.2.2 Downward Extension of Research Contexts: Strengthening SME and Cross-Industry Comparative Research

The majority of available empirical evidence comes as a result of big A-share listed companies, whereas experience evidence on digitalization-ESG of SMEs is limited [10,14]. Further studies ought to broaden the view of research to cover SMEs, experiment the circumstances under which the three mediating paths are valid and the thresholds of their activation in SME samples, and contrast structural variations in transmission mechanisms with those of big corporations. The cross-industry comparison must also be enhanced to address the excess focus of the current research on manufacturing, and add evidence to commerce and services, and identify industry-specific transmission mechanisms and constraints.

3.2.3 Iteration and Upgrading of Research Methods: Measurement Optimization, Causal Identification, and Configurational Perspectives

To begin with, the core variable measurement systems should be optimized. There is a trend today to measure digital transformation through text analysis of annual report word frequency, which is prone to measurement bias, i.e., emphasis on statements rather than substance. Later studies may integrate multi-source information into a holistic digitalization index that considers both strategic articulation and implementation effects; consideration must also be given to the disturbances caused by the disparities in third-party ESG rating weightings to enhance the comparability of empirical findings across studies [6].

Secondly, enhance designs of causal identification. Much other literature has employed traditional panel fixed-effects models; endogeneity is also an area in which improvement is possible. Increased use of difference-in-differences and quasi-experimental designs based on natural experiments may reduce estimation bias due to reverse causality and omitted variables [8].

Thirdly, present the concept of configurational and dynamic analysis. Conventional regression focuses on the net effect of variables and is ineffective to represent multi-factor interactions and equifinal causal pathways. Configurational approaches like fsQCA and NCA are able to define several equifinal paths to good ESG performance. Digital transformation and ESG improvement are dynamic evolutionary process that require a higher level of dynamic panels and longitudinal case studies to capture temporal changes in effects at various stages of transformation and overcome the constraints of the static research paradigm [16].

3.2.4 Extended Research Oriented Toward Local Practice

In the first place, both positive and negative consequences of digitalization ought to be considered. In addition to the fact that digitalization increases substantive ESG performance, the underlying processes behind how digitalization can repress or instigate corporate ESG greenwashing should also be explored. Sun et al. [17] using data on Chinese A-share listed companies over the period between 2012 and 2021, report that digital transformation has an important role in curtailing ESG greenwashing via the pathways of green technology innovation promotion, alleviation of internal and external information asymmetry as well as commercial credit improvement; the governance effect is reinforced by investor attention in the form of retail online opinions and institutional on-site visits. The next wave of study should consequently not take it as granted that digitalization will always enhance ESG, but rather differentiate between substantive enhancement and symbolic disclosure. Conversely, the application of research results to practice must be enhanced: schemes of differentiated digital-green collaboration transformations depending on the size of enterprises, large, medium, and small, and considering the industry endowments should be developed; under the influence of local industrial policies, studies should explore the ways in which government subsidies and environmental regulations can precisely direct the dual digital-green transformation of enterprises and therefore provide empirical grounds to optimize the policy tools [11].

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Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgment

This paper is an output of the science project.

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