

Study on the Targeted Mechanism of Enterprise Digital Resilience on ESG Performance

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Abstract: In the context of deep integration between digital economy and sustainable development, enterprises face multiple challenges including digital technology iteration, escalating environmental risks, and heightened social responsibility demands. Digital resilience has become the core capability for enterprises to withstand shocks and achieve long-term value. This study, grounded in resource-based theory and stakeholder theory combined with corporate digital practices, theoretically deconstructs the core dimensions of enterprise digital resilience and explores its targeted mechanisms for ESG performance. The research reveals that digital resilience exerts differentiated impacts on E, S, and G dimensions of ESG through three pathways: technology empowerment focuses on environmental performance optimization, resource integration emphasizes social performance enhancement, and risk buffering drives governance performance improvement. Meanwhile, digital transformation maturity and industry regulatory intensity exhibit moderating effects in these pathways. The findings provide theoretical support and practical pathways for enterprises to enhance ESG implementation effectiveness and achieve sustainable development through strengthened digital resilience.

Keywords: Enterprise Digital Resilience; ESG Performance; Targeted Mechanism; Technology Empowerment; Resource Integration; Risk Buffer

1. Introduction

1.1 Research Background

With the deepening global climate crisis, stricter social responsibility standards, and frequent corporate governance scandals, ESG

has shifted from “voluntary disclosure” to “mandatory requirements,” becoming a core indicator for measuring corporate sustainability capabilities. According to data from the China ESG Development White Paper (2024), 78.3% of domestic A-share listed companies disclosed ESG reports in 2023, yet nearly 40% exhibited issues of “overemphasis on disclosure and neglect of practice,” with prominent problems including inefficient environmental governance, lack of supply chain accountability, and formalized governance mechanisms. Meanwhile, the widespread adoption of digital technologies not only provides tool support for corporate ESG practices but also introduces risks of technological dependency. In 2022, domestic enterprises experienced a 35% year-on-year increase in incidents such as ESG information disclosure interruptions and green production halts caused by data breaches and system failures, highlighting the importance of “digital resilience.” Digital resilience is not merely technical defense capability, but rather an integrated ability of enterprises to integrate resources through digital technologies, respond to internal and external risks, and dynamically adapt to environmental changes. Current academic research predominantly focuses on fragmented impacts of digital technologies on ESG, yet overlooks the uniqueness of digital resilience as a composite concept combining “digital capability + resilient attributes”. Systematic theoretical explanations remain lacking regarding its targeted mechanisms across different dimensions of ESG.

1.2 Significance of the Study

1.2.1 Theoretical implications

Existing studies predominantly examine either the individual impact of digital technologies on specific ESG dimensions or focus on organizational resilience as a risk response mechanism, with limited integration of systematic connections between “digital

resilience” and ESG into analytical frameworks. This study deconstructs digital resilience into a three-dimensional framework comprising “technology empowerment, resource integration, and risk buffering”. By combining Resource-Based Theory and Stakeholder Theory, we clarify the differentiated pathways through which digital resilience influences various ESG dimensions, thereby enriching theoretical research on their relationship.

1.2.2 Practical significance

For enterprises, this research provides actionable guidance to enhance digital resilience by optimizing environmental governance through technology empowerment, fulfilling social responsibilities via resource integration, and avoiding resource waste caused by “blind digitization”. For policymakers, the findings suggest implementing targeted incentives such as subsidies for ESG-compliant companies with strong digital resilience, promoting sustainable industrial development through “digitalization + ESG” synergies.

1.3 Research Framework and Innovation

1.3.1 Research framework

This paper follows a logical progression of “conceptual definition-theoretical foundation-mechanism analysis-practical implications”. First, it defines the core connotations of corporate digital resilience and ESG performance. Second, an analytical framework is constructed based on the Resource-Based Theory and Stakeholder Theory. Third, the targeted pathways through which digital resilience influences various ESG dimensions are systematically deconstructed. Finally, optimization recommendations are proposed by integrating real-world corporate case studies.

1.3.2 Research innovation

Conceptual Innovation in Digital Resilience. This study breaks through existing research limitations by redefining digital resilience from a vague “single defense capability” to a three-dimensional composite capability encompassing technology, resources, and risks, clarifying the core connotations and measurement directions of each dimension.

Mechanism Innovation. For the first time, it proposes the concept of “targeted effects”, distinguishing the differentiated impact pathways of digital resilience on the E, S, G dimensions of ESG rather than the generalized notion of “positive promotion”. This

advancement deepens our nuanced understanding of the relationship between these two dimensions.

2. Definition of the Concept

2.1 Enterprise Digital Resilience

Building on existing research and practice, this paper defines corporate digital resilience as “an organization’s comprehensive capability to integrate internal and external resources through digital technologies, withstand digital shocks, dynamically adapt to environmental changes, and support long-term development goals” [1]. It is further decomposed into three dimensions: technology empowerment, resource integration, and risk buffering. The technology empowerment dimension refers to an organization’s ability to enhance operational efficiency and optimize risk identification through digital technologies like IoT, AI, and blockchain, with the core characteristic being “depth of technology application”. The resource integration dimension pertains to an organization’s capacity to consolidate internal and external resources via digital platforms such as supply chain collaboration systems and internal data middle platforms, characterized by “breadth of resource coordination”. The risk buffering dimension encompasses an organization’s capability to mitigate risks including data breaches, system failures, and supply chain disruptions through digital technologies, with the defining feature being “intensity of risk response”.

2.2 ESG Performance

ESG performance refers to the practical outcomes and disclosure quality of enterprises across three dimensions: Environment (E), Society (S), and Governance (G) [2]. Environmental performance measures corporate actions in pollutant emissions, energy consumption, and green production, which can be assessed through indicators such as carbon emissions per unit of output value, proportion of eco-friendly products, and environmental risk early-warning efficiency [3]. Social performance reflects corporate conduct in employee rights, supply chain accountability, and community contributions, which can be evaluated through employee training coverage rates, compliance rates of supplier labor rights, and community welfare investment ratios.

Governance performance indicates corporate performance in internal control, information disclosure, and shareholder rights protection, which can be assessed through board independence, completeness of ESG disclosures, and internal audit efficiency [4].

3. Mechanism Analysis

3.1 Main Effects

3.1.1 Targeted impact of technology empowerment on environmental performance (E)

Digital technologies are characterized by “precision and intelligence.” Empowered by technological capabilities, they can directly optimize environmental performance and exert targeted effects on the E dimension. Through real-time monitoring and risk alerts, optimized green production, and enhanced environmental transparency, these technologies enable precise environmental governance to improve eco-efficiency [5]. IoT devices collect real-time pollutant emission data during production processes. AI algorithms then identify abnormal emission trends and provide early warnings, achieving real-time environmental monitoring and risk alerts. Big data analytics help analyze energy consumption patterns in production stages, optimizing workflows to reduce energy use and enhance green manufacturing efficiency. Blockchain technology ensures tamper-proof storage and traceability of environmental data, making environmental information transparent and boosting the credibility of environmental disclosures.

The targeted impact of technology on environmental performance stems from its “technological tool attribute”. The core value of digital technology lies in enhancing data processing efficiency and decision-making accuracy. Since optimizing environmental performance precisely relies on refined management of pollutant and energy consumption data, technology's influence on the E dimension significantly outweighs its impact on the S and G dimensions.

3.1.2 Targeted impact of resource integration on social performance (S)

Digital platforms, characterized by connectivity and sharing capabilities, enable resource integration to optimize stakeholder rights management and create targeted impacts on the S dimension. By enhancing employee rights

protection, strengthening supply chain accountability, and promoting community collaboration, these platforms facilitate coordinated efforts to fulfill corporate social responsibility. The internal data platform integrates employee compensation, training, and health information to achieve transparent rights management and improve employee protection. The digital supply chain collaboration platform enables real-time monitoring of suppliers' labor rights and workplace safety, driving the implementation of supply chain accountability. Meanwhile, the digital philanthropy platform connects businesses with community needs, enhancing the precision of charitable investments and fostering collaborative community development. The targeting of resource integration on social performance stems from its “connection attribute”. The core of social performance is to balance the interests of employees, supply chain partners, communities and other parties, while the core value of digital platform lies in breaking information barriers and realizing resource coordination. Therefore, the impact of resource integration on S dimension is significantly higher than that on E and G dimensions.

3.1.3 Targeted impact of risk buffer on governance performance (G)

Digital technology possesses inherent characteristics of “security and stability”. By enhancing information security, protecting shareholder rights, optimizing internal controls, and improving emergency governance capabilities, enterprises can refine their internal governance structures to achieve targeted effects on the G dimension [6]. Data security technologies such as encryption algorithms and access control mechanisms prevent leaks of core governance information, thereby strengthening information security and shareholder protection. Intelligent audit systems enable real-time monitoring of internal process compliance, reducing risks of governance failures and optimizing corporate internal controls. The formulation and implementation of digital emergency plans ensures continuous governance processes during unexpected risks, ultimately enhancing the enterprise's emergency governance capabilities.

The targeted impact of risk buffers on governance performance stems from their inherent “safety attributes”. The core of

governance performance lies in ensuring compliance with internal processes, information transparency, and controllable risks. The risk buffer dimension of digital resilience specifically focuses on resisting digital shocks and maintaining operational stability. Consequently, the influence of risk buffers on the G dimension significantly outweighs their effects on the E and S dimensions.

3.2 Regulation Effect Analysis

3.2.1 Moderating effect of digital transformation maturity

Companies with advanced digital transformation maturity demonstrate enhanced digital infrastructure, including robust platforms and skilled professionals, which amplifies the targeted impact of digital resilience on ESG performance [7]. In terms of technological empowerment, these enterprises leverage cutting-edge AI and IoT technologies to optimize environmental performance efficiency. Regarding resource integration, they maintain extensive digital collaboration networks that expand the reach of social performance metrics. For risk mitigation, their mature digital ecosystems feature comprehensive security frameworks that strengthen the stability of governance performance.

3.2.2 The moderating effect of industry regulatory intensity

In sectors with stringent regulatory oversight such as chemicals and finance, countries impose stricter ESG constraints, which forces enterprises to enhance targeted digital resilience. In these regulated industries, companies must meet higher environmental compliance standards, driving them to proactively leverage technology-driven solutions to optimize environmental performance. They are also compelled to fulfill greater social responsibilities, prompting active integration of resources to improve societal impact. Furthermore, the need to meet rigorous governance requirements compels enterprises to prioritize risk buffer mechanisms to strengthen governance effectiveness.

4. Practice Revelation and Countermeasures

4.1 Focus on Targeted Pathways to Strengthen Digital Resilience

First, enhance environmental performance through increased technological empowerment.

Enterprises should prioritize digital resource allocation to environmental governance technologies, such as deploying IoT monitoring devices, developing AI-powered energy consumption optimization algorithms, and implementing blockchain-based environmental data traceability systems [8]. Energy-intensive enterprises can establish a “Green Production Digital Platform” to achieve real-time monitoring and optimization of pollutant emissions and energy consumption, thereby improving environmental performance.

Secondly, enhancing resource integration platforms to improve social performance. Enterprises should establish internal and external digital collaboration platforms. Internally, they should consolidate employee data and optimize rights management systems. Externally, these platforms should connect supply chain partners with communities to drive the implementation of social responsibility. Manufacturing companies could develop an “ESG Digital Management Platform for Supply Chains” to dynamically monitor labor rights and workplace safety at suppliers. Retail businesses might create a “Digital Community Engagement Platform” to enhance the precision of charitable investments.

Thirdly, enhancing risk resilience will improve governance effectiveness. Enterprises should increase investments in data security, refine digital emergency response plans, and optimize intelligent audit systems to strengthen risk mitigation capabilities. Financial institutions may implement a “Digital Security Protection System” to prevent information leaks, while cross-regional enterprises should establish “Remote Governance Emergency Response Plans” to ensure business continuity during unexpected risks.

Finally, dynamically adjust digital resilience strategies. In the early stage of digital transformation, enterprises should prioritize improving basic digital infrastructure to support digital resilience. In the mature stage of transformation, enterprises should focus on deep application of technology to amplify targeted effects [9].

4.2 Optimize the Institutional Environment and Guide Targeted Practices

First, implement differentiated incentive policies. For industries with weak environmental performance, provide tax breaks

for technology empowerment investments; subsidize resource integration platforms in sectors with insufficient social performance [8]; and offer targeted support for risk buffer investments in industries with higher governance risks.

Secondly, establishing a digital resilience evaluation system. Collaborate with industry associations to develop corporate digital resilience standards, setting evaluation indicators such as R&D investment ratios and supply chain digitization coverage across three dimensions: technology empowerment, resource integration, and risk mitigation. Link the evaluation results to ESG ratings to guide enterprises in focusing on targeted pathways.

Finally, strengthen industry regulation and promote exemplary cases. Implement a mandatory digital resilience disclosure system in regulated industries, requiring companies to publicly disclose their concrete practices in technology empowerment, resource integration, and risk mitigation. Collect outstanding case studies and promote them through industry summits, policy documents, and other platforms to provide references for other enterprises.

5. Limitations and Future Prospects

5.1 Research limitations

(1) Limitations in Research Methodology. This study primarily employs theoretical deconstruction and case analysis, but fails to validate the “technology empowerment-resource integration-risk buffer” three-dimensional pathway’s targeted impact on ESG dimensions through panel data validation of listed companies’ digital resilience indicators and ESG scores. The universality of conclusions and the strength of causal relationships still require quantitative verification.

(2) Limitations in Indicator Measurement. While the definition of “corporate digital resilience” is broken down into three dimensions, it lacks directly operationalized quantitative metrics. For instance, the “coverage rate of technology-enabled intelligent monitoring systems” lacks industry-wide consensus measurement standards. These limitations in indicator measurement may lead to subjective variations in metric selection during subsequent empirical research.

(3) Limitations of moderating variables. Only

two moderating variables, “digital transformation maturity” and “industry regulatory intensity”, are discussed, without considering potential interfering factors such as enterprise size, property nature, regional policy differences, etc., so there is still room for improvement in the completeness of moderating mechanism.

5.2 Future Outlook

(1) Expanding Empirical Research. Subsequent efforts could involve developing a quantitative indicator system measuring technological empowerment, resource integration, risk buffering, and ESG performance. By selecting panel data from A-share listed companies or multinational corporations, causal relationships of targeted mechanisms can be empirically verified through regression analysis and mediation effect tests, thereby enhancing the scientific rigor of the conclusions.

(2) Refine the indicator system. Collaborate with industry associations or third-party rating agencies to develop the “Enterprise Digital Resilience Evaluation Guidelines”, establishing core quantitative indicators such as technology empowerment, resource integration, and risk buffer. For instance, risk buffer metrics could include “annual data security incident rate” and “response time for emergency digital contingency plans”. These core quantitative indicators will provide standardized measurement tools for subsequent research.

(3) Multi-perspective in-depth analysis. On one hand, we can focus on “property rights heterogeneity” to compare the differences in the path of influence between state-owned enterprises and private enterprises; on the other hand, we can expand the “international comparative perspective” to contrast the institutional differences between China and European/American enterprises in digital resilience and ESG practices, thereby enriching the theoretical boundaries.

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