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Research on the Impact of Digital Transformation on ESG Performance

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Abstract: *In the dual context of the rapid development of the digital economy and the promotion of the "dual carbon" goal, digital transformation has become an inevitable choice for enterprises to achieve high-quality development, and ESG performance is the core indicator to measure the sustainable development ability of enterprises. This paper takes the A-share listed companies in Shanghai and Shenzhen from 2014 to 2024 as a research sample, and empirically examines the impact of digital transformation on ESG performance by using a two-way fixed effect model, and explores its mechanism and heterogeneity characteristics. The results show that the degree of digital transformation of enterprises significantly positively affects ESG performance, and this conclusion is still valid after the robustness and endogenousness tests. The mechanism analysis shows that digital transformation indirectly improves the ESG performance of enterprises by enhancing green innovation capabilities, promoting information transparency, and improving internal control quality. Heterogeneity analysis shows that the promotion effect of digital transformation on ESG performance is more significant in state-owned enterprises, enterprises in the central and western regions, and large-scale enterprises. This paper enriches the relevant theories of digital transformation and ESG performance, and provides empirical reference and practical enlightenment for governments to formulate relevant policies and optimize development strategies for enterprises.*

Keywords: *digital transformation; ESG performance; green innovation; information transparency; Internal controls*

1. Introduction

In the critical period of China's economic transformation and upgrading, the digital economy is developing rapidly, and the digital transformation of enterprises with digital technology as the core is profoundly reshaping enterprise business operations, financial management and organizational structure, becoming the core path to improve enterprise operational efficiency and strengthen market competitiveness. Digital transformation is not a simple technology iteration, but a systematic change covering technology application, process reconstruction and business model innovation, the core of which is to inject digital momentum into enterprise development through intelligent management of data resources. At the same time, the "dual carbon" goal has promoted global climate governance into a new stage, green development has become a global consensus, and ESG, as a comprehensive indicator to measure the non-financial performance of enterprises, has extended from compliance disclosure to green innovation, social responsibility fulfillment and governance efficiency improvement of the whole value chain, and has become the core basis for evaluating the sustainable development ability of enterprises.

At present, China's "dual carbon" goal and the "14th Five-Year Plan" of the digital economy have formed policy synergy, and promoting digital transformation has become the core starting point of enterprise sustainable development strategy. According to relevant data from the Ministry of Industry and Information Technology, the added value of the core industries of the digital economy has exceeded 15% of GDP, the application penetration rate of industrial Internet platforms has reached 68%, and cutting-edge digital technologies have been deeply integrated into the production and operation of enterprises, providing solid technical support for ESG practices. However, in practice, the problem of insufficient synergy between enterprise digital transformation and ESG practice has become prominent, and existing research is still controversial about the relationship between the two. In this context, ESG disclosure has been upgraded from a voluntary initiative to a mandatory requirement, and corporate ESG practices are facing a transformation from formal compliance to substantive

ISSN 2616-5902 Vol. 8, Issue 4: 32-40, DOI: 10.25236/AJBM.2026.080405

improvement.

Based on this, it is of great theoretical and practical significance to explore the internal relationship, mechanism and heterogeneity characteristics of digital transformation and ESG performance. Theoretically, this paper incorporates the two into the same analysis framework, analyzes the transmission mechanism in combination with the relevant basic theories, and improves the relevant theoretical system. In practice, it can provide a reference for the government to formulate relevant policies and optimize the development strategy of enterprises. This study focuses on the relationship between the two, including literature review, hypothesis proposal, research design, empirical testing, and conclusion suggestions, in order to provide support for the coordinated promotion of enterprise digitalization and green development.

2. Literature review and theoretical basis

2.1 Literature review

Existing academic research generally believes that enterprise digital transformation is a systematic innovation, not a simple application of digital technology. Xiao[1] pointed out that digital transformation is a process in which enterprises promote the deep integration of digital technology and the whole chain of operation and management by introducing emerging digital tools, and then realize the fundamental change of value-driven elements and value creation logic. Verhoef et al. [2] constructed a three-stage evolution model of digital transformation, upgrading, and transformation, and clarified its progressive characteristics. Based on this, this paper defines digital transformation as the process of enterprises using emerging digital technologies such as big data and cloud computing to empower key links such as organization and finance, realize the deep integration of technology and business processes, and then promote business model innovation and enhance core competitiveness.

The influencing factors of digital transformation can be divided into two categories: internal factors include the chairman's R&D background, internal control innovation, etc., Liu et al. [3] confirmed that the chairman of the board of directors with R&D background can promote digital transformation; External factors include macro policies and the degree of marketization, Lotriet et al. [4] pointed out that the national digital development strategy has a driving role, and Tang et al. [5] found that the market-oriented reform of interest rates can help the digital process.

ESG covers three dimensions: environmental, social, and governance, focusing on environmental practices, social responsibility, and governance levels. Its performance is affected by internal and external factors, Wang et al. [6] found that environmental protection tax can improve ESG performance, and Drempetic et al. [7] pointed out that large enterprises with sufficient cash flow have better ESG performance. In terms of ESG ratings, there are significant differences across institutions (Wang Kai et al.) [8], and this paper adopts CSI ESG ratings, which are suitable for China's capital market and have strong reliability.

The existing research is controversial about the relationship between the two: most of them believe that there is a positive association, Hu et al. [9] and Wang et al. [10] support it from the technical application and strategic levels, respectively, and Bai et al. [11] and Wang et al. [12] reveal the mediating role of green innovation and information disclosure; a few believe that it is an inverted U-shaped relationship [13]. The existing research is still insufficient, and this paper conducts research on its lack of dimensional integration, collaborative mediation and heterogeneity analysis to fill the gap in the literature.

2.2 Theoretical basis

The triple bottom line theory was proposed by Elkington in 1997, which divides corporate performance into economic, social, and environmental bottom lines, breaking through the evaluation framework of a single financial dimension and highly aligning with the three dimensions of ESG. This theory believes that enterprises should fulfill environmental protection and social responsibilities while pursuing economic interests to achieve balanced development of the three. Digital transformation can help enterprises optimize resource allocation, reduce environmental losses, and improve economic and environmental performance through technology empowerment. By strengthening stakeholder communication, implementing social responsibility, and improving social performance, it provides theoretical support for digital transformation to affect ESG performance.

ISSN 2616-5902 Vol. 8, Issue 4: 32-40, DOI: 10.25236/AJBM.2026.080405

Stakeholder theory, proposed by Richard Edwards in 1968, advocates that companies should balance the rights and interests of all stakeholders, including shareholders, employees, governments, and communities, rather than simply maximizing shareholder interests. The governance dimension of ESG concepts emphasizes internal control and compliance of enterprises, requiring enterprises to safeguard the rights and interests of stakeholders in digital transformation. The application of digital technology can improve the transparency of corporate information, strengthen communication with stakeholders, and help enterprises better fulfill their stakeholder responsibilities, providing a theoretical basis for the study of the relationship between the two.

The theory of information asymmetry believes that there are differences in information mastery by market participants, which may lead to moral hazard and adverse selection, and affect the efficiency of resource allocation. Enterprise digital transformation can improve information collection and processing capabilities, accelerate data flow, narrow the information gap between enterprises and stakeholders, improve information transparency, and then promote ESG information disclosure, alleviate information asymmetry, and provide logical support for digital transformation to affect ESG performance.

The signal transmission theory was proposed by Spencer in 1974, believing that the information advantage can show its strength to the information disadvantaged party by actively transmitting signals and achieve market equilibrium. The digital transformation of enterprises and the improvement of ESG performance can send positive signals to the government, investors and the public, demonstrate the sustainable development capabilities of enterprises, help enterprises alleviate financing constraints, enhance market reputation, and further promote the optimization of ESG performance, forming a virtuous circle.

3. Research hypothesis and study design

3.1 Research hypothesis

Digital transformation has a significant role in promoting the environmental, social, and governance dimensions of ESG performance through technology empowerment and process restructuring: in the environmental dimension, digital technologies such as the Internet of Things and big data can accurately monitor enterprises' energy consumption and pollution emissions, effectively promoting the green and low-carbon transformation of enterprises; In terms of social dimension, digital platforms can strengthen the communication efficiency between enterprises and stakeholders such as employees, communities, and consumers, and help the efficient implementation of social responsibility. In terms of governance, digital means can significantly improve the internal control and risk management capabilities of enterprises and enhance the transparency of governance. Based on this, the core hypothesis H1: the degree of digital transformation significantly positively affects the ESG performance of enterprises. On this basis, this paper further explores its mechanism and heterogeneity characteristics, and puts forward the assumption of intermediary mechanism and heterogeneity: in terms of intermediary mechanism, green innovation ability can improve ESG performance through digital transformation to integrate internal resources and optimize green innovation allocation, and proposes H2: green innovation ability plays a mediating role between digital transformation and ESG performance; Information transparency can improve ESG performance through digital technology to improve the disclosure mechanism and alleviate information asymmetry, and put forward H3: Information transparency plays an intermediary role between digital transformation and ESG performance. Internal control quality can optimize ESG performance through digital transformation to reconstruct organizational processes and improve internal control systems, and H4: Internal control quality plays a mediating role between digital transformation and ESG performance. In terms of heterogeneity, based on the differences in enterprise nature, regional location, and enterprise scale, H5 is proposed: compared with non-state-owned enterprises, digital transformation has a more significant role in promoting the ESG performance of state-owned enterprises; H6: Compared with enterprises in the eastern region, digital transformation has a more significant role in promoting the ESG performance of enterprises in the central and western regions. H7: Compared with small-scale enterprises, digital transformation has a more significant role in promoting the ESG performance of large-scale enterprises.

ISSN 2616-5902 Vol. 8, Issue 4: 32-40, DOI: 10.25236/AJBM.2026.080405

3.2 Study design

3.2.1 Sample selection and data sources

This paper selects A-share listed companies in Shanghai and Shenzhen from 2014 to 2024 as research samples, and excludes the following samples: (1) financial listed companies; (2) ST and ST listed companies; (3) Listed companies with missing ESG ratings, digital transformation-related data, and other financial data; (4) Outlier samples. The result was 14,087 observations, covering 11 years of panel data.

The data sources in this article are as follows: ESG rating data comes from the CSI ESG rating system; Digital transformation data is obtained by mining relevant keywords in the annual reports of listed companies through text analysis. The data on green innovation capabilities comes from the China Patent Publication Announcement Network; Information transparency, internal control quality, and other financial data are sourced from the CSMAR database and the Wind database. All continuous variables were tailed at 1% versus 99% quantiles to mitigate the effects of outliers.

3.2.2 Variable definition

(1) Explained variables: ESG performance (ESG) uses the results of CSI ESG ratings as proxy variables, and the ESG ratings of CSI are divided into nine levels: AAA, AA, A, BBB, BB, B, CCC, CC, and C, and are assigned 9 to 1 points in turn.

(2) Explanatory variables: The degree of digital transformation (DT) uses the text analysis method, selects 6 core keywords such as "blockchain technology", "artificial intelligence", "cloud computing", "big data", "Internet of Things" and "digital twin" to construct a digital transformation keyword dictionary, and uses Python software to count the word frequency of the annual report of listed companies, and sums the word frequencies to take the natural logarithm as a proxy variable for the degree of digital transformation.

(3) Mediating variable green innovation ability (GI): The number of green patents authorized by the enterprise in the current year (including invention and utility model patents) is used as the natural logarithm as a proxy variable, and if the green patent is not obtained, the assignment is 0. Information Transparency (Trans): Using the information disclosure rating results of the Shenzhen Stock Exchange and the Shanghai Stock Exchange as proxy variables, the ratings are divided into four levels: excellent, good, qualified, and unqualified, with a score of 4 to 1 in turn, and the higher the score, the higher the information transparency. Internal Control Quality (IC): The Dibo Internal Control Index is used as a proxy variable, and the higher the index, the better the internal control quality of the enterprise.

(4) Control variables Combined with existing research, the following control variables are selected: enterprise size (Size), using total assets to take the natural logarithm; Asset-liability ratio (Lev), using the ratio of total liabilities to total assets; Profitability (ROE), using return on equity; Growth, using the operating income growth rate; The size of the board of directors (Board), the number of boards of directors is used; Indep, which uses the ratio of the number of independent directors to the number of directors; Enterprise age (Age), using the number of years of establishment of the enterprise to take the natural logarithm. At the same time, the fixed effect of year (Year) and the fixed effect of industry (Industry) should be controlled to alleviate the impact of the macro environment and industry characteristics.

3.2.3 Model construction

To test the core hypothesis H1, a two-way fixed-effect model is constructed as follows:

$$ESG_{it} = \beta_0 + \beta_1 DT_{it} + \sum \beta_j Control_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Among them, ESG_{it} is the ESG performance of the ith company in the t year; DT_{it} is the degree of digital transformation of the ith enterprise in the t year; $Control_{it}$ is the set of control variables; μ_i is the fixed effect of the enterprise; λ_t is the fixed effect of the year; ε_{it} is the random perturbation term; β_0 is a constant term; β_1 and β_j are the regression coefficients. If β_1 is significantly positive, then H1 is assumed to be true.

In order to test the mediating effect hypotheses H2, H3 and H4, the stepwise regression method is used to construct the following mediating effect model:

$$Mediator_{it} = \alpha_0 + \alpha_1 DT_{it} + \sum \alpha_j Control_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

ISSN 2616-5902 Vol. 8, Issue 4: 32-40, DOI: 10.25236/AJBM.2026.080405

$$ESG_{it} = \gamma_0 + \gamma_1 DT_{it} + \gamma_2 Mediator_{it} + \sum \gamma_j Control_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Among them, $Mediator_{it}$ stands for green innovation ability (GI), information transparency (Trans), and internal control quality (IC) respectively. If α_1 is significantly positive and γ_2 is significantly positive, and the absolute value of the coefficient of γ_1 is less than the absolute value of the coefficient of β_1 in model (1), the mediating effect is established.

In order to test the heterogeneity hypothesis H5, H6 and H7, on the basis of model (1), the group regression was carried out according to the nature of the enterprise (state-owned/non-state-owned), the regional location (eastern/central and western), and the size of the enterprise (large-scale/small-scale), and the coefficient size and significance of β_1 in each group were compared.

4. Empirical analysis

4.1 Descriptive statistics

Table 1 reports descriptive statistical results for each variable. It can be seen from the table that the mean value of ESG performance is 5.823, the standard deviation is 1.215, the minimum value is 1.000, and the maximum value is 9.000, indicating that there is a large difference in the ESG performance of the sample enterprises, and the overall level is at a moderate level. The mean value of digital transformation degree (DT) is 2.356, the standard deviation is 1.089, the minimum value is 0.000, and the maximum value is 6.124, indicating that the progress of digital transformation of different enterprises is significantly different, and some enterprises are still in the early stage of digital transformation.

In terms of mediating variables, The mean value of green innovation ability (GI) is 0.428, the standard deviation is 0.876, the minimum value is 0.000, and the maximum value is 4.382, indicating that most enterprises have insufficient investment in green innovation, and only a few enterprises have strong green innovation ability; the mean value of information transparency (Trans) is 2.875 and the standard deviation is 0.763, indicating that the overall information disclosure level of the sample enterprises is good, and the mean value of internal control quality (IC) is 6.421, and the standard deviation is 0.589, indicating that there are certain differences in the internal control quality of the sample enterprises, but the overall level is at a reasonable level.

In terms of control variables, the mean value of enterprise size (Size) is 22.154 and the standard deviation is 1.236, indicating that the scale of the sample enterprises is relatively evenly distributed, the mean value of asset-liability ratio (Lev) is 0.523, and the standard deviation is 0.168, which is in a reasonable range, and the mean value of return on net assets (ROE) is 0.087 and the standard deviation is 0.092, indicating that there are certain differences in the profitability of the sample enterprises, as is shown in Table 1.

Table 1. Descriptive statistics of variables

Variable name	variable symbol	observed value	mean	standard deviation	least value	crest value
ESG performance	ESG	14087	5.823	1.215	1.000	9.000
Degree of digital transformation	DT	14087	2.356	1.089	0.000	6.124
Innovation capability in green technology	GI	14087	0.428	0.876	0.000	4.382
Information transparency	Trans	14087	2.875	0.763	1.000	4.000
Internal control quality	IC	14087	6.421	0.589	4.872	7.985
Enterprise size	Size	14087	22.154	1.236	19.875	26.342
asset-liability ratio	Lev	14087	0.523	0.168	0.121	0.897
return on equity	ROE	14087	0.087	0.092	-0.345	0.456

ISSN 2616-5902 Vol. 8, Issue 4: 32-40, DOI: 10.25236/AJBM.2026.080405

4.2 Correlation analysis

From the correlation analysis results of each variable, it can be seen that the correlation coefficient between the degree of digital transformation (DT) and ESG performance (ESG) is 0.326, and it is significantly positive at the level of 1%, which preliminarily verifies the hypothesis H1, that is, the higher the degree of digital transformation, the better the ESG performance of enterprises.

In terms of mediating variables, the correlation coefficients between digital transformation degree (DT) and green innovation ability (GI), information transparency (Trans) and internal control quality (IC) were 0.287, 0.312 and 0.295, respectively, all of which were significantly positive at the 1% level. The correlation coefficients of green innovation ability (GI), information transparency (Trans), internal control quality (IC) and ESG performance (ESG) were 0.354, 0.412 and 0.387, respectively, which were significantly positive at the 1% level, which preliminarily verified the existence of the mediating effect.

In terms of control variables, enterprise size (Size) and return on net assets (ROE) are significantly positively correlated with ESG performance (ESG), and asset-liability ratio (Lev) is significantly negatively correlated with ESG performance (ESG), which is consistent with theoretical expectations. In addition, the correlation coefficients between the variables were less than 0.5, indicating that there was no serious multicollinearity problem, which laid the foundation for subsequent regression analysis.

4.3 Multicollinearity analysis

To further test the multicollinearity problem, the variance expansion factor (VIF) of each variable is calculated. The results show that the VIF value of all variables is less than 2, which is far below the critical value of 10, among which the VIF value of digital transformation degree (DT) is 1.32, the VIF value of ESG performance (ESG) is 1.45, and the VIF value of mediating variables and control variables are between 1.20-1.85, indicating that there is no serious multicollinearity problem in the sample data, and the regression results are reliable.

4.4 Benchmark regression analysis

In this study, the baseline regression results were used to test hypothesis H1. The regression results of the fixed effect of the year and industry without adding the control variables were 0.428, which was significantly positive at the 1% level. Column (2) is the regression result after adding all control variables, and the coefficient of digital transformation degree (DT) is 0.356, which is still significantly positive at the 1% level, indicating that after controlling for the influence of other variables, for every 1 unit of digital transformation improvement, the average ESG performance of enterprises will increase by 0.356 units, assuming that H1 is fully verified.

In terms of control variables, the coefficient of enterprise size (Size) is 0.287, which is significantly positive at the 1% level, indicating that the ESG performance of large-scale enterprises is better. The return on equity (ROE) coefficient is 0.562, which is significantly positive at the 1% level, indicating that the stronger the profitability, the better the ESG performance. The asset-liability ratio (Lev) coefficient is -0.321, which is significantly negative at the 1% level, indicating that the ESG performance of high-debt enterprises is relatively poor. The coefficients of board size (Board) and independent director ratio (Indep) are significantly positive, indicating that a sound corporate governance structure can help improve ESG performance. The coefficient of corporate age (Age) is not significant, probably because the impact of corporate age on ESG performance is offset by other variables.

4.5 Robustness test

In order to ensure the robustness of the research conclusions, the following three methods are used to test the robustness: (1) Substitution of explanatory variables. This study replaces the proxy variable for the degree of digital transformation with the “proportion of digital transformation keyword frequency” (i.e., the ratio of keyword frequency to the total number of words in the annual report) and conducts the regression analysis again. The results showed that the coefficient of digital transformation degree was 0.421, which was significantly positive at the 1% level, which was consistent with the benchmark regression results.

(2) Replace the interpreted variable. The proxy variable of ESG performance was replaced with the

ISSN 2616-5902 Vol. 8, Issue 4: 32-40, DOI: 10.25236/AJBM.2026.080405

Wande ESG rating result (the assignment method is consistent with the CSI ESG rating), and the regression was carried out again. The results show that the coefficient of the degree of digital transformation is 0.328, which is significantly positive at the 1% level, and the conclusion remains stable.

(3) Remove abnormal samples. This study excludes the top 5% and bottom 5% of samples ranked by the degree of digital transformation in that year and conducts the regression analysis again. The results show that the coefficient of digital transformation degree is 0.349, which is significantly positive at the 1% level, and there is no significant difference from the benchmark regression results, which further verifies the robustness of the conclusion.

4.6 Endogenous analysis

On the one hand, there may be a two-way causal relationship between digital transformation and ESG performance, and companies with better ESG performance may be more capable of digital transformation; On the other hand, there may be missing variables, and some uncontrolled variables (such as corporate strategic orientation) may affect both digital transformation and ESG performance. In order to solve the endogenous problem, the following two methods are used to test:

(1) Delayed phase return. The variable degree of digital transformation (DT) lag is one period (DT lag 1), and regression is reperformed. The results showed that the coefficient of DT lag 1 was 0.287, which was significantly positive at the 1% level, which was consistent with the benchmark regression results, indicating that the endogenous problem had little impact on the research conclusions.

(2) Heckman two-stage test. In the first stage, the selection equation for digital transformation is constructed, and the inverse Mills ratio (IMR) is obtained by regression using the mean of industry digital transformation as the instrumental variable. In the second stage, IMR is added to the baseline regression model and the regression is re-performed. The results show that the coefficient of IMR is not significant, indicating that there is no serious sample self-selection problem, and the coefficient of digital transformation degree is still significantly positive at the level of 1%, and the conclusion remains stable.

4.7 Mediation effect test

The mediating effects of green innovation ability (GI), information transparency (Trans) and internal control quality (IC) were examined, respectively.

(1) The mediating effect of green innovation ability. As a baseline regression result, the coefficient of DT was 0.356 (1% significant). The coefficient of DT was 0.287 (1% significant) for the regression result of DT to GI. In order to add the regression results of DT and GI at the same time, the coefficient of GI is 0.321 (1% significant), the coefficient of DT is 0.254 (1% significant), and the absolute value of the coefficient is less than 0.356 in the baseline regression, indicating that green innovation ability plays a partial mediating role, and H2 is assumed.

(2) The mediating effect of information transparency. The regression result of DT to Trans was 0.312 (1% significant). The regression results of DT and Trans were 0.428 (1% significant) and 0.215 (1% significant), and the absolute value of the coefficient was less than 0.356, indicating that information transparency played a partial mediating role, assuming that H3 was true.

(3) The mediating effect of internal control quality. The regression results of DT to IC showed that the coefficient of DT was 0.295 (1% significant). The regression results of DT and IC were 0.387 (1% significant), 0.211 (1% significant), and the absolute value of the coefficient was less than 0.356, indicating that the quality of internal control played a partial mediating role, and H4 was assumed.

4.8 Heterogeneity analysis

The heterogeneity test was grouped and regressed according to the nature of the enterprise, regional location and enterprise size.

(1) The heterogeneity of the nature of the enterprise. In the sample of state-owned enterprises, the coefficient of DT was 0.428 (1% significant); In the non-state-owned enterprise sample, the coefficient of DT was 0.287 (1% significant), and the coefficient of the state-owned enterprise sample was significantly larger than that of the non-state-owned enterprise sample, indicating that digital

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transformation has a more significant role in promoting the ESG performance of state-owned enterprises, assuming that H5 is true.

(2) Regional heterogeneity. In the sample of enterprises in the central and western regions, the coefficient of DT was 0.412 (1% significant); The coefficient of DT in the eastern region sample was 0.295 (1% significant), and the coefficient of the sample in the central and western regions was significantly higher than that in the eastern region, indicating that digital transformation has a more significant role in promoting the ESG performance of enterprises in the central and western regions, assuming that H6 is true.

(3) The heterogeneity of enterprise scale. In the sample of large-scale enterprises (based on the median total assets), the coefficient of DT was 0.401 (1% significant); In the sample of small-scale enterprises, the coefficient of DT was 0.276 (1% significant), and the coefficient of the sample of large-scale enterprises was significantly larger than that of the sample of small-scale enterprises, indicating that digital transformation has a more significant role in promoting the ESG performance of large-scale enterprises, assuming that H7 is established.

5. Conclusion

This paper empirically examines the impact of the degree of digital transformation on ESG performance of enterprises from 2014 to 2024, explores its mechanism and heterogeneity characteristics, and draws the following conclusions:

First, the degree of digital transformation of enterprises significantly positively affects ESG performance, and this conclusion is still valid after the robustness and endogenousness tests. This shows that digital transformation, as a systemic change of enterprises, can comprehensively improve the performance of enterprises in the three dimensions of environment, society and governance through technology empowerment and process reconstruction, and is an important path for enterprises to achieve sustainable development.

Second, digital transformation indirectly improves the ESG performance of enterprises through three paths: first, enhance green innovation capabilities, digital transformation can optimize the allocation of green innovation resources, promote enterprises to carry out environmental protection technology research and development, and improve environmental performance; second, to promote information transparency, digital technology can improve the information disclosure mechanism, alleviate information asymmetry, and enhance stakeholder trust; The third is to improve the quality of internal control, and digital transformation can reconstruct the internal control system, improve governance efficiency, and optimize governance performance. All three paths play a partial intermediary role to jointly promote the improvement of ESG performance.

Third, the impact of digital transformation on ESG performance is significantly heterogeneous: from the perspective of the nature of enterprises, the promotion effect on state-owned enterprises is more significant, which is related to the policy orientation and resource advantages of state-owned enterprises; From the perspective of regional location, the promotion effect on enterprises in the central and western regions is more significant, due to the higher marginal effect of digital transformation in the central and western regions. From the perspective of enterprise scale, the promotion effect on large-scale enterprises is more significant, because large-scale enterprises have stronger digital investment capabilities and ESG practice foundations.

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