The Impact of Digital Transformation on Corporate Green Investment—Empirical Evidence from A-Share Listed Companies

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Abstract. In the context of advancing global carbon neutrality and sustainable development, accelerating digital transformation and enhancing green financial support are crucial for driving the green low-carbon transition. This study empirically investigates the impact of digital transformation on green investment and its underlying mechanisms using data from A-share listed companies between 2009 and 2023. The findings reveal that: (1) Digital transformation significantly boosts green investment, with results remaining robust after addressing endogeneity and other tests. (2) The promoting effect varies across different groups, being more pronounced in eastern regions, high-tech industries, and non-heavy pollution sectors. (3) Additionally, digital transformation increases corporate green investment by reducing financing constraints and information asymmetry. (4) Moderation analysis indicates that both the intensity of environmental regulation and green awareness positively influence this relationship, with the former having a more substantial impact. This research provides empirical support and pathways for government agencies to develop a regional framework for synergistic digital and green development and to optimize green investment incentives.

Keywords: Digital transformation, green investment, mechanism analysis, green awareness.

1. Introduction

In the digital economy era, digital transformation has emerged as a core strategy for enhancing corporate competitiveness. It optimizes environmental performance (Li, 2025), increases supply chain transparency, and improves resource utilization efficiency, thereby fostering sustainable development. The report from the 20th National Congress of the Communist Party of China highlights the need to "accelerate the development of the digital economy and promote the deep integration of the digital and real economies". The convergence of next-generation information technologies with various industries creates digital productivity and the digital economy, which are vital for developing a modern economic system. According to *the Research Report on the Development of China's Digital Economy (2024)*, in 2023, China's digital economy reached 53.9 trillion yuan, accounting for 42.8% of GDP, contributing 66.45% to GDP growth. *The Top 10 Trends in the Information and Communication Technology (ICT) Industry by 2025*, published by the China Academy of Information and Communications Technology, indicates that the integration of digital and traditional economies will continue to unleash demand potential, with projections suggesting that by 2030, the scale of China's digital economy will exceed 80 trillion yuan. As the digital economy becomes the driving force behind corporate strategic transformation, digital transformation reshapes the trust relationship between companies and their stakeholders. On a deeper level, it transitions corporate operations from a "black box" to "glass box" governance. This shift in transparency alleviates agency problems and transforms competition from resource possession to data governance capabilities, signifying a fundamental change for companies from passive responses to proactive empowerment through the creation of data-driven information ecosystems.

In the context of increasing global climate change and resource constraints, green investment has become a critical area for promoting sustainable economic and social development. *The China Environmental Economics Research (2023)* asserts that sustainable development serves not only as a strategic pivot for implementing the national dual-carbon strategy but also plays a crucial role in achieving high-quality economic growth and ecological civilization. *The China Green Finance*

Development Report (2023) reveals that in 2023, the balance of green loans grew by approximately 36% year-on-year, with green bond issuance exceeding 1.2 trillion yuan. Various policies influence corporate green investment; specific government policies and incentives drive companies toward green investments (Chitimiea et al., 2021), while carbon tax policies encourage such investments (Tong et al., 2022). Policy guidance establishes institutional constraints and market incentives that shape corporate strategic choices regarding green investment. Strict environmental regulations compel high-polluting industries to innovate technologies to reduce emissions, while market mechanisms like carbon trading and green credit effectively guide capital toward clean technologies. This policy mix not only encourages companies to incorporate green transformation into their long-term strategic frameworks but also prompts management to reassess environmental risk exposure and embed ESG governance throughout operational processes. In this context, policy stability becomes a key factor for companies in planning technology iterations and resource allocation, shifting industrial competition from cost-oriented strategies to sustainable development capabilities.

Digital transformation is an internal change that not only enhances operational efficiency and influences financial investments but also elevates levels of green investment (Zhang et al., 2025). *The Overall Layout Plan for Digital China Construction (2023)* explicitly sets the goal of coordinated development between digitalization and greening, requiring deep integration of digital technologies into low-carbon transformations across industries. The government supports the establishment of green data centers and smart energy management systems, prioritizing digital infrastructure in green investment. *The White Paper on Digital Technology Empowering the Dual Carbon Goals (2023)* shows that industrial internet platforms have reduced carbon emissions intensity by 5%-8% in key industries, with the scale of digital green financial products growing annually by over 50%. Digital technologies play a crucial role in enhancing environmental awareness and promoting green investment (Chen et al., 2024), enabling companies to monitor their carbon footprints in real-time, optimize energy efficiency, and internalize environmental costs into operational parameters, thus shifting green innovation from passive compliance to proactive value creation. Data-driven supply chain transparency allows companies to establish comprehensive lifecycle environmental management systems, while the integration of AI and the Internet of Things accelerates clean technology innovations. Digital transformation not only enhances corporate core competitiveness but also drives green investment toward systemic change, ultimately creating a virtuous cycle of sustainable development and economic benefits.

This paper organizes the relevant literature in Section Two, constructs a theoretical model and defines data and variables in Section Three, verifies hypotheses using empirical methods in Section Four, and provides conclusive insights in Section Five.

2. Literature Review

Digital transformation has emerged as a central theme in the global strategic evolution of enterprises, prompting extensive discussion in recent years. Early studies primarily focused on the direct effects of digital technologies on operational efficiency (Teece et al., 1997). Empirical research consistently shows that digital transformation enhances companies' information processing capabilities and resource allocation efficiency. Piccoli et al. (2024) emphasize that digital transformation strengthens core competencies by prioritizing digital resources, making digital technology a key component in defining value propositions. For instance, Sousa & Rocha (2019) found that digital learning improves the collaborative efficiency of technological resources and human capital. Bican & Brem (2020) pointed out that digital business models enhance the sustainability of resource allocation across value chains through technological integration and process reengineering. Akter et al. (2024) highlighted improvements in the accuracy of human resource allocation due to digital technologies. In contrast to the rich body of research available internationally, studies in China focusing on industrial transformation and management efficiency have only emerged in the past two years. Tian and Li (2022) found that the integration of digital technologies with the

real economy promotes the flow of capital and technology into high-tech sectors. Liu et al. (2021) confirmed that digital investments significantly enhance the output elasticity of capital and labor, optimizing the structure of input factors.

Recently, government policies have also played a crucial role in guiding and influencing sustainable development. In the context of government support for green investment, several researchers have utilized macro data to elucidate the role of policy tools in promoting green transformation at a macro level. Wen et al. (2023) found that green finance enhances the quality of economic growth by supporting green innovation. The influence of macro policies also transmits through market mechanisms to specific industries. For example, green bond policies compel brown enterprises to undertake green transformations by affecting financing costs (Bouchmel et al., 2024), while the issuance of green bonds lowers financing costs for peer companies and enhances overall industry performance. In contrast to these macro-level studies, some research focuses on micro-level corporate behavior. Liao (2018) noted that public demands can indirectly encourage companies to increase green investment, while provincial-level green governance has been shown to directly promote corporate green investment (Wang & Wang, 2023). Xie et al. (2021) found that the green transformation of the manufacturing sector is influenced by institutional logics and resource allocation paths, suggesting that policies should adapt to differences in corporate attention allocation. Furthermore, Chen et al. (2021) emphasized the positive moderating effects of environmental taxes and subsidy policies on the long-term performance of green investments.

Several researchers are currently examining the impact of digital transformation on green investment. Some studies explore this relationship from an environmental perspective. Li et al. (2022) demonstrated that corporate digital transformation significantly drives green initiatives by enhancing environmental performance, with the digital economy facilitating green technological innovation to reduce urban carbon emissions. Razzaq et al. (2023) highlighted a synergistic effect between digital finance, renewable energy technologies, and green development. Other scholars have approached this topic from an economic standpoint. For instance, Wang et al. (2020) argued that the digital economy promotes industrial upgrades through green technological innovation, asserting that it can enhance the overall productivity of green initiatives in industry. Lin et al. (2022) emphasized that digital finance can improve both the quantity and quality of green technological innovation, thereby promoting green investment. Additionally, some studies investigate social factors, focusing on the impact of digital technologies on governance models and public interests. Certain scholars have suggested that the interplay between environmental regulation and digital inclusive finance can mitigate environmental pollution (Ding et al., 2022). Others have noted that digital empowerment can foster green investment by enhancing corporate transparency and the efficiency of R&D expenditures (Liao et al., 2024).

In summary, existing research on digital transformation and green investment still has notable gaps. First, much of the literature focuses on green technologies and bonds; this paper aims to contribute by examining the area of green investment. Second, it introduces environmental regulation intensity as a moderating variable, addressing a gap in research related to institutional contexts. Furthermore, this study explores regional and industrial differences, enhancing the understanding of transformation mechanisms across various environments and sectors.

3. Model Specification, Data, and Variables

3.1 Model Specification

The model employed in this study is primarily the Fixed Effects Model (FE). The specific model is expressed as follows.

$$GreenInvestor_{it} = \beta_0 + \beta_1 \ln DigitalTrans_{it} + \beta_2 X_{it} + T_t + \pi_i + \varepsilon_{it} \quad (1)$$

$GreenInvestor_{it}$ represents the level of green investment for firm i in year t. $\ln DigitalTrans_{it}$ denotes the natural logarithm of the level of digital transformation for firm i in

year t. X_{it} includes the main control variables that influence green investment, encompassing economic variables such as asset structure and corporate governance factors. Additionally, this study incorporates time dummy variables and firm dummy variables to control for unobservable factors at both the time and firm levels. T_t represents the time dummy variable, π_i indicates the firm dummy variable, and ε_{it} is the random disturbance term.

3.2 Data

This study utilizes data from A-share listed companies on the Shanghai and Shenzhen stock exchanges from 2009 to 2023. The initial sample is processed according to the following criteria: (1) exclusion of companies classified as ST (special treatment) and similar categories; (2) removal of samples with missing variable observations; (3) to mitigate the impact of outliers, the main continuous variables are winsorized at the 1% level on both ends.

In line with the methodology of Jiang et al. (2023), this study extracts thematic fund information and stock investment details from the CSMAR database's fund market series module, counting the number of green investors associated with each company in a given year. Additionally, referencing the approach of Wu et al. (2021), data on digital transformation is obtained from the annual reports of A-share listed companies from 2009 to 2023. Instrumental variables are constructed at the industry-year level to address potential endogeneity issues.

For control variables, various characteristics are collected, including return on equity, Tobin's Q, cash flow ratio, fixed asset ratio, net profit margin, inventory ratio, and accounts receivable ratio.

Regarding mechanism variables, the SA index is employed as a proxy for financing constraints, as suggested by Hadlock & Pierce (2010); a higher SA index indicates greater financing constraints faced by the company. Following the methodology of Wei et al. (2012), a micro-database of corporate data is constructed, using trading information of individual stocks to measure the degree of information asymmetry.

For moderating variables, provincial government work reports are analyzed to calculate provincial green awareness by constructing an absolute index of total word frequency and the relative frequency of key phrases. Additionally, this study adopts Liu 's (2023) method to measure the intensity of environmental regulation by dividing the amount invested in waste gas and wastewater treatment by the industrial output value for that year.

3.3 Variables

(1) Dependent Variable: Green Investment

This study adopts the methodology of Jiang et al. (2023) to extract data from the CSMAR database's fund market series. It identifies fields containing keywords such as environmental protection, green, and renewable energy development. The identified list of green funds is matched with the top ten shareholders of listed companies. If a match is found, the entity is classified as a green investor. Subsequently, the number of green investors associated with each company in a given year is recorded.

(2) Core Independent Variable: Digital Transformation

Annual reports provide critical insights into a company's financial health, market performance, and future direction. Following the approach of Wu et al. (2021), this study utilizes Python web scraping techniques to collect annual reports from all A-share listed companies on the Shanghai and Shenzhen stock exchanges for the years 2009 to 2023. Using the Java PDFBox library, text content from these reports is extracted, excluding non-core business descriptions. After filtering and categorizing keywords, individual indicators are generated. To address the right-skewness of keyword frequency affecting regression results, the total word frequency is adjusted by adding one and taking the natural logarithm to create a comprehensive digital transformation index.

(3) Mechanism Variables: Financing Constraints and Information Asymmetry

Digital transformation can mitigate information asymmetry issues, effectively addressing financing constraints (Zhou et al., 2025). This study constructs the SA index as a proxy for measuring

financing constraints, following the methodology of Hadlock & Pierce (2010). To evaluate the degree of information asymmetry, principal component analysis is conducted on liquidity ratio (LR), illiquidity ratio (ILL), and return reversal indicator (GAM), based on the approach of Wei et al. (2012), resulting in a comprehensive information asymmetry index.

(4) Moderating Variables: Green Awareness and Environmental Regulation Intensity

This study calculates provincial green awareness using the methodology of Teng et al. (2018), which includes computing absolute index total word frequency and the relative frequency of key phrases, followed by applying the SYS-GMM model. For the other moderating variable, environmental regulation intensity is measured by the amount invested in waste gas and wastewater treatment in the company's region relative to the industrial output value for that year, based on Liu 's (2023) method.

(5) Other Control Variables

This study selects the following control variables based on the research of Zhang et al. (2024): First, economic variables such as return on equity, Tobin's Q, and cash flow ratio. Second, asset structure variables, including fixed asset ratio, inventory ratio, and accounts receivable ratio. Third, corporate governance variables, such as the growth rate of the net profit margin (He, 2010). Descriptive statistics for the main variables in this study are presented in the table below.

Table 1. Descriptive Statistics of Variables

Variable Name	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Number of Green Investors	42343	0.5494	0.7742	0.0000	4.3820
ln(Digital Transformation)	42343	1.4414	1.4307	0.0000	6.3063
Return on Equity	42343	0.0454	0.1729	-2.1749	0.4179
Tobin's Q	42343	2.0612	1.3992	0.7946	17.6759
Cash Flow Ratio	42343	0.0464	0.0704	-0.2262	0.2822
Fixed Asset Ratio	42343	0.2091	0.1586	0.0015	0.7723
Growth Rate of Net Profit Margin	42343	-0.4046	3.8668	-37.0267	19.5594
Inventory Ratio	42343	0.1412	0.1323	0.0000	0.7720
Accounts Receivable Ratio	42343	0.1197	0.1028	0.0000	0.5065

4. Empirical Results

4.1 Baseline Regression Results

This study empirically analyzes the impact of digital transformation on corporate green investment. Column (1) presents results without control variables or fixed effects, while Column (2) incorporates time and firm fixed effects, and Column (3) includes additional control variables. The regression results in Table 2 indicate that digital transformation positively influences corporate green investment, with significance at the 1% level. By optimizing operational methods, digital transformation provides sustained motivation for green investment. As the application of digital technologies deepens, the number of institutions choosing to engage in green investments continues to grow steadily, even when accounting for industry differences. This suggests that digitalization not only enhances resource efficiency but also enables investors to more intuitively evaluate the benefits of environmental projects through data analysis. When environmental information is quantifiable, green value becomes a clear basis for investment, attracting more capital into sustainable development. This integration shifts the narrative of green investment from a moral imperative to an economically essential path.

The results for other control variables also align with expectations. Companies with strong profitability are more likely to attract green investors due to their resource availability, while high-growth firms may command a valuation premium that reflects the long-term benefits of green investments. Cash flow is identified as a critical factor supporting research and development in green

technologies. Furthermore, asset-intensive companies may struggle to attract green investment due to high transformation costs and limited flexibility.

Table 2. Digital Transformation and the Number of Green Investors

	(1)	(2)	(3)
ln(Digital Transformation)	0.0560*** (0.0026)	0.0288*** (0.0042)	0.0274*** (0.0042)
Other Control Variables	No	No	Yes
Time Fixed Effects	No	Yes	Yes
Firm Fixed Effects	No	Yes	Yes
Constant	0.4688*** (0.0050)	0.5079*** (0.0066)	0.3211*** (0.0165)
Observations	42343	42343	42343
Adjusted R^2	0.0107	0.4999	0.5275

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

4.2 Robustness Tests

(1) Robustness Testing

This study conducts three types of robustness tests to validate the impact of digital transformation on the number of green investors. First, the core independent variable, digital transformation, is lagged by one period. The results in Column (1) indicate that the significance level remains consistent with the baseline model, suggesting that the positive effect is persistent over time and not influenced by immediate effects. Next, a cluster analysis at the firm level is performed, and the results in Column (2) show no substantial change in significance, demonstrating the robustness of the estimates against heteroscedasticity and intra-group correlation. Finally, a two-sided winsorization is applied to all continuous variables at the 1% quantile, and the results in Column (3) remain significant, further confirming the reliability of the core conclusions.

Table 3. Robustness Test Results

	(1)	(2)	(3)
L.ln(Digital Transformation)	0.0144*** (0.0044)		
ln(Digital Transformation)		0.0274*** (0.0057)	0.0270*** (0.0041)
Other Control Variables	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Constant	0.3264*** (0.0184)	0.3211*** (0.0236)	0.2739*** (0.0166)
Observations	36107	42343	42343
Adjusted R^2	0.5539	0.5275	0.5294

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

(2) Treatment of Endogeneity

Endogeneity issues primarily stem from factors such as reverse causality, omitted variable bias, and measurement error, which can lead to biased estimation results. Therefore, it is essential to employ appropriate methods to address these concerns. This study utilizes an instrumental variable approach to mitigate endogeneity, selecting the annual average of digital transformation across industries as the instrumental variable. This variable serves as an industry-year macro indicator, exhibiting strict exogeneity and significantly influencing corporate digital transformation, thus meeting the relevance requirement.

The first-stage regression results indicate that industry digital transformation significantly promotes corporate digital transformation. The second-stage results demonstrate that corporate digital transformation significantly drives green investment. The over-identification test shows that the Kleibergen-Paap rk LM statistic is 1272.042, which significantly rejects the null hypothesis at the 1% level, confirming that the instrumental variable is identifiable. Additionally, the weak instrument test reveals that the Cragg-Donald Wald F statistic is 2421.428, far exceeding the Stock-Yogo critical value of 16.38 for the 10% significance level, thereby confirming that there is no issue with weak instruments.

Table 4. Results of Endogeneity Treatment

	First Stage	Second Stage
	ln(Digital Transformation)	Green Investment
ln(Digital Transformation)		0.0460*** (0.0175)
ln(Digital Transformation IV)	0.5383*** (0.0144)	
Other Control Variables	Yes	Yes
Over-identification Test		1272.042***
Weak Instrument Test [10%]		2421.428*** [16.38]
Time Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	42343	42343
R2		0.0560

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

4.3 Heterogeneity Analysis

(1) Regional Heterogeneity Analysis

Given the significant differences in policies and economic development across the eastern, central, and western regions, this study follows the approach of Shen et al. (2021) to categorize the sample into three major regions. The eastern region includes Beijing and 11 other provinces and municipalities, the central region comprises Shanxi and 8 additional provinces, while the western region encompasses Inner Mongolia and 11 other provinces and municipalities. The findings indicate that the impact of digital transformation on green investment exhibits notable regional heterogeneity. The positive effect is most pronounced in the eastern region, attributed to its advanced digital infrastructure and market mechanisms, which effectively facilitate technology spillovers and resource optimization, fostering a synergistic interaction between digital and green initiatives. In contrast, the central region, dominated by traditional manufacturing, experiences limited synergistic effects between digital transformation and green development due to path dependency, resulting in diminishing marginal returns and insignificant impacts. Although the western region faces challenges related to digital penetration and industrial foundations, it still demonstrates potential for gradual green transformation, driven by policy support and ecological compensation mechanisms. This gradient difference underscores the crucial moderating roles of regional development stages, industrial structures, and institutional environments in the synergy between digital and green initiatives.

Table 5. Results of Heterogeneity Analysis by Region

	(1)	(2)	(3)
	Eastern Region	Central Region	Western Region
ln(Digital Transformation)	0.0303*** (0.0048)	0.0078 (0.0107)	0.0229** (0.0116)

Other Control Variables	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Constant	0.2472***	0.3676***	0.2939***
	(0.0199)	(0.0424)	(0.0414)
Observations	29891	6798	5635
Adjusted R^2	0.5351	0.5102	0.5462

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

(2) Heterogeneity Analysis Based on High-Tech Industries

This study classifies high-tech industries according to the China Securities Regulatory Commission's 2012 industry classification, focusing specifically on companies with codes C25-C29. The findings reveal that the positive impact of digital transformation on green investment is more pronounced in high-tech sectors, attributed to their technology-intensive nature. High-tech firms leverage their technological capabilities and agile R&D systems to integrate emerging technologies, such as digital twins, allowing for precise optimization of green innovation processes. In contrast, non-high-tech industries, while enhancing environmental governance efficiency through digitalization, demonstrate only incremental improvements in green transformation due to limited technological absorption capacity, making structural breakthroughs challenging. This disparity arises from systematic differences in technological intensity, innovation capabilities, and resource structures across industries.

Table 6. Results of Heterogeneity Analysis by Industry Type

	(1)	(2)
	High-Tech Industries	Non-High-Tech Industries
ln(Digital Transformation)	0.0259***	0.0200***
	(0.0057)	(0.0062)
Other Control Variables	Yes	Yes
Time Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Constant	0.3155***	0.2427***
	(0.0242)	(0.0235)
Observations	24778	17523
Adjusted R^2	0.5345	0.5368

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

(3) Heterogeneity Analysis Based on Heavily Polluting Industries

This study classifies heavily polluting industries according to the China Securities Regulatory Commission's 2012 industry classification, drawing on the framework established by Pan et al. (2019). The findings reveal that the positive impact of digital transformation on green investment varies across industries. Non-polluting industries can effectively integrate environmental resources through digital technologies, such as utilizing data monitoring to optimize energy efficiency and implementing intelligent systems for waste management. These advancements enhance environmental standards without significantly increasing costs. In contrast, heavily polluting industries face considerable challenges due to the substantial investment required to upgrade pollution control equipment and the difficulties associated with transitioning existing production technologies. Consequently, the improvements from digital technologies in these industries are limited, with their green transformation largely driven by regulatory pressures rather than proactive innovation. This discrepancy primarily arises from differences in environmental regulatory pressures and technological requirements across industries.

Table 7. Results of Heterogeneity Analysis by Pollution Level

	(1)	(2)
	Heavily Polluting Industries	Non-Polluting Industries
ln(Digital Transformation)	0.0028 (0.0093)	0.0325*** (0.0047)
Other Control Variables	Yes	Yes
Time Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Constant	0.3083*** (0.0345)	0.2569*** (0.0193)
Observations	9498	32803
Adjusted R^2	0.5279	0.5358

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

(4) Mechanism Analysis

This study employs the methodology of Huang et al. (2021) to examine the mediating role of financing constraints in the relationship between digital transformation and green investment, utilizing the SA index. The findings reveal that digital transformation effectively reduces the SA index, thereby alleviating corporate financing constraints. This improvement is largely attributed to enhanced information transparency, which lowers investment risks and expands financing channels, thereby boosting investor confidence in green projects. Furthermore, the reduction in financing constraints amplifies the effectiveness of green policies, such as fiscal subsidies, further promoting green investment.

The research also draws on the approach of Yu et al. (2012) to analyze the impact of information asymmetry using the ASY index. The results demonstrate that digital transformation significantly decreases the level of information asymmetry, enabling companies to disclose environmental data in real-time. This transparency allows investors to more accurately assess project value and risk. Such increased openness not only reduces decision-making risks but also encourages financial institutions to provide more funding, creating a virtuous cycle that ultimately drives the expansion of green investment.

Table 8. Mechanism Analysis Results

	(1)	(2)
	SA Index	ASY
ln(Digital Transformation)	-0.0022*** (0.0005)	-0.0369*** (0.0022)
Other Control Variables	Yes	Yes
Time Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Constant	-3.8587*** (0.0023)	-0.0408*** (0.0090)
Observations	42343	42342
Adjusted R^2	0.9522	0.7009

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

(5) Moderating Effects

This study utilizes the methodology of Teng et al. (2018) to construct a provincial-level green attention index. The regression results in Column (1) indicate that this index significantly interacts with digital transformation to promote green investment. Digital transformation enhances the quality of environmental information disclosure, effectively reducing information asymmetry and alleviating financing constraints. In regions with higher green attention, policies are more focused on incorporating digital disclosures into regulatory frameworks. This creates a mechanism whereby

digital technology increases information transparency, improves financing conditions, and ultimately fosters green investment. Consequently, regions with high attention can better leverage the advantages of corporate digitalization, reinforcing the effect of alleviating financing constraints through environmental information disclosure.

The study also draws on the approach of Liu (2023) to measure environmental regulation intensity by the ratio of regional pollution control investments to industrial output. The regression results indicate that this ratio significantly enhances the synergistic effect of digital transformation on green investment. Digital transformation employs technologies such as the Internet of Things to improve the accuracy of environmental data collection, while stringent environmental policies require companies to disclose more comprehensive information. Together, these factors amplify the effects of information transparency. This synergy between policy and technology effectively enhances the role of digital transformation in promoting green investment.

Table 9. Moderating Effect Results

	(1)	(2)
	Provincial Green Attention	Environmental Regulation Intensity
ln(Digital Transformation)	0.0268*** (0.0041)	0.0276*** (0.0041)
Provincial Green Attention # ln(Digital Transformation)	0.0002* (0.0001)	
Provincial Green Attention	0.0001 (0.0001)	
Environmental Regulation Intensity # ln(Digital Transformation)		7.6514*** (1.5182)
Environmental Regulation Intensity		2.7533 (2.5405)
Other Control Variables	Yes	Yes
Time Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Constant	0.2671*** (0.0211)	0.2712*** (0.0171)
Observations	42327	42276
Adjusted R^2	0.5291	0.5295

Notes: (1) ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively; (2) Robust standard errors are reported in parentheses.

5. Conclusions

This study analyzes data from A-share listed companies between 2009 and 2023, alongside fund market series data from the CSMAR database, to investigate the impact of digital transformation on green investment and its underlying mechanisms. The key conclusions are as follows: (1) Digital transformation significantly enhances green investment. Empirical results indicate a strong positive correlation between digital transformation and green investment; (2) The promoting effect is particularly pronounced in high-tech industries, non-polluting sectors, and companies located in the eastern region; (3) Digital transformation alleviates corporate financing constraints, increases information transparency, and positively influences green investment; (4) Additionally, this effect is more significant in regions with high levels of green attention or stringent environmental regulations, with the impact of strengthened regulations being especially noteworthy.

The findings of this study offer important policy implications. First, local governments should integrate digitalization and green investment into their policy frameworks, focusing on improving the quality of information disclosure, while financial institutions should prioritize support for companies

with advanced digital capabilities. Second, differentiated policies should be implemented based on industry type. Strengthening environmental regulations and providing targeted support for non-high-tech and heavily polluting industries, as well as establishing information-sharing platforms to facilitate project connections in central and western regions, is crucial. Third, corporate financing constraints and information asymmetry indirectly affect both digital transformation and green investment; thus, companies should consider developing adaptive financing products and standardizing environmental data disclosure to enhance investor confidence. Finally, the government should promote green awareness and environmental standards, increase investments in digital infrastructure, and lower barriers for corporate transformation, thereby maximizing the role of digitalization in driving green investment.

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