

Article

Sustainability Uncertainty and Digital Transformation: Evidence from Corporate ESG Rating Divergence in China

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Abstract

ESG serves as a key metric for measuring corporate sustainability, but divergence among rating agencies has led to uncertainty in such an assessment. This investigation identifies ESG rating divergence as a critical catalyst for corporate digital transformation, establishing empirical analysis through a robust positive correlation between the heterogeneity in sustainability assessments and organizational digitalization intensity. Comprehensive robustness examinations and endogeneity controls substantiate the persistent significance of this relationship. Mechanistically, such divergence drives technological adaptation by restructuring the R&D team composition and elevating capital allocation toward innovative initiatives. Contextual heterogeneity manifests through amplified effects in firms with elevated analyst scrutiny and stringent internal governance, whereas pollution-intensive enterprises exhibit significant effect suppression. These findings collectively advance theoretical frameworks concerning ESG evaluation economics and digital transformation drivers, while furnishing actionable implementation blueprints for corporate digitization strategists.

Keywords: sustainability uncertainty; ESG rating divergence; corporate digital transformation; R&D personnel structure; R&D intensity



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1. Introduction

ESG is an important indicator for measuring corporate sustainability, reflecting their performance in terms of environmental impact, social responsibility, and corporate governance [1–3]. With the increasing emphasis from regulatory agencies and investors on a company's sustainable development capabilities, more and more institutions are starting to conduct ESG ratings to help investors and stakeholders identify a company's sustainable business abilities [4]. However, accurately assessing a company's ESG performance poses significant challenges, as there are widespread discrepancies in ESG ratings for the same company among different rating agencies [5–7]. Particularly in China, the ESG rating market is currently in a rapid development phase, and is yet to establish a unified official rating standard [8,9]. Mainstream ESG rating agencies in China include SynTao, CASVI, Huazheng, and Wind, each employing distinct rating methodologies and indicator systems [10,11]. Due to the absence of mandatory unified standards, companies often undergo assessments from multiple agencies, resulting in ESG rating divergence phenomena [6,12]. These discrepancies in ESG ratings create confusion for investors and stakeholders when making decisions, and also jeopardize corporate credibility and financial

activities [13]. Thus, the issue of ESG rating divergence has attracted increasing attention from academia and industry.

Currently, a large body of research directly treats rating scores as a proxy variable for a company's ESG performance, overlooking the existence of rating differences and their potential interference with research results [14]. Moreover, the existing literature on the economic consequences of ESG rating divergence is scarce, and mainly focuses on the negative effects brought about by such discrepancies, limiting a deeper understanding of ESG issues within companies [4,6]. Representative studies have revealed that larger discrepancies in ESG ratings result in higher financing costs for companies, increased greenwashing behavior, and negative impacts on the stock market [4,15,16]. In addition, in the limited research on ESG rating divergence, academia has predominantly explored the underlying factors contributing to such discrepancies, attributing them to differences in data sources, measurement methods, and subjective biases among rating agencies [5,17,18].

Although current research helps to clarify the determinants of ESG rating divergence and their negative economic consequences, these studies pay little attention to the potential positive effects of such discrepancies [4,6]. Digital transformation, as a crucial objective of modern corporate strategic transition, is an important approach to facilitating sustainable development [19,20]. However, whether ESG rating divergence stimulates corporate digital transformation remains an under-researched topic. Our study aims to explore the mechanisms through which ESG rating divergence influence a company's digital transformation, with the goal of filling the gap in existing research. To achieve this, we use Chinese A-share listed companies as our research sample and attempt to provide empirical evidence on the impact of ESG rating divergence on a company's digital transformation, utilizing a company's R&D personnel structure and R&D investment as mechanisms of influence. Additionally, we further investigate from the perspectives of external attention, internal control level, and company nature to explore how ESG rating divergence generate heterogeneity in a company's digital transformation, particularly in companies with high analyst attention, those where the chairman concurrently serves as the CEO, and pollution-intensive companies.

Our study makes several potential contributions. Firstly, we develop the literature on ESG rating divergence. The existing literature on ESG rating divergence primarily focuses on the antecedents and negative economic consequences of ESG [1,4–6], with limited attention given to the positive effects brought about by such discrepancies. Our findings reveal the catalytic role of ESG rating divergence in corporate digital transformation, contributing to a deeper understanding of ESG in academia and industry. Moreover, our study may make marginal contributions to the research on corporate digital transformation. Assisting companies in their digital transformation is a significant issue in modern corporate development, attracting extensive attention from academia and industry. Based on the dimensions of ESG rating divergence, we discover new antecedent conditions that promote a company's digital transformation. We also confirm the importance of a company's R&D personnel structure and R&D investment as influential factors in the impact of ESG rating divergence on a company's digital transformation, providing valuable guidance for company managers in formulating digital transformation strategies. Lastly, our study provides reference for academia and industry in understanding sustainable governance at the company level in emerging capital markets. We reveal the important roles played by analyst attention as an external focus level, and by chairman–CEO duality as an internal control level, in a company's digital transformation process. Therefore, improving external regulatory systems and internal governance structures are key to promoting sustainable corporate governance in emerging markets. Additionally, stricter supervision and appropriate assistance for pollution-intensive companies are crucial measures in improving their

digital governance. Overall, our study provides insights into the sustainable development of emerging markets and serves as a reference for the formulation and implementation of related government policies.

The remainder of the paper is organized as follows: Section 2 provides a theoretical analysis and hypothesis development. Section 3 discusses the data sources and variable definitions. Section 4 presents the main empirical results. Section 5 discusses the paper and concludes.

2. Literature Review and Research Hypotheses

2.1. Literature Review of Corporate Digital Transformation

In the 1990s, emerging technologies represented by internet technology began to be applied, driving the growth of the digital economy. This context gave rise to the development of enterprise digital transformation. Chun et al. [21] argue that traditional U.S. industries with higher firm-specific stock returns began to adopt information technology more intensively in the late 20th century. Over the past decade, the concept of digitalization has evolved through contributions from various sectors, including academia, becoming a significant form of economic development that influences all aspects of society [22]. Previous studies have found that enterprise digital transformation is a complex process of change driven by both external and internal factors. In terms of external factors, first, environmental elements such as socio-cultural shifts and technological advancements provide cognitive support and technological foundation for digital transformation. Chen and Tian [23] argue that enterprise digital transformation depends on the interaction between environmental uncertainty and resource orchestration. Second, market elements such as market competition and consumer demand also put pressure on enterprises to decide whether to engage in digital transformation [24]. Furthermore, policy incentives constitute an important external driver influencing enterprise digital transformation behavior. Governments can encourage such transformation through supportive policies and measures, such as financial assistance, tax incentives, and innovation inducements. Regarding internal factors, digital transformation is driven by managerial and organizational elements. Porfirio et al. [25] argue that managerial characteristics significantly influence the digital transformation process, while managerial capabilities also impact a company's strategic perception, organizational structure, and business model [26]. The supportive attitudes held by executives and the organization's technological capabilities also serve as prerequisites for advancing digital transformation [27,28].

2.2. Literature Review of ESG Rating Divergence

The existing studies primarily examine the negative effects of ESG rating divergence on capital market. Scholars have argued that divergence introduces uncertainty about corporate sustainability, signals a higher operational risk, increases risk premiums demanded by investors and creditors, as well as increases the volatility of stock return [2,4,11,29]. From the perspective of information, some scholars believe that ESG rating divergence aggravates market information asymmetry and weakens the predictive value of ESG disclosures, leading to the increase in bond issue spread, the decline of analyst forecast quality, and the rise in audit fees [8,9,12,15]. In addition, a limited number of studies explore corporate responses to ESG rating divergence, such as enhancing green investment or engaging in active earnings management [6,10].

Overall, while ESG research has a long history, the economic consequences of ESG rating divergence remain underexplored. Prior work focuses on equity and debt financing, but not yet on the impact of digital transformation. Additionally, studies that focus on the

impact of corporate ESG performance on corporate digital transformation overlook the role of multiple ESG ratings and their inconsistencies.

2.3. Research Hypotheses

From an institutional theory perspective, ESG rating divergence generates complex and dynamic external institutional pressures for corporations [8,9]. This divergence fundamentally reflects the coexistence of multiple evaluation standards within the institutional environment, creating a legitimacy paradox for companies [15,29]. When rating agencies employ divergent methodologies and weighting systems, companies face significant challenges in simultaneously satisfying all evaluation criteria, resulting in their ESG practices being caught in a double bind [6,12].

This inherent contradiction activates institutional monitoring mechanisms [2,8]. Investors and regulators often adopt the most stringent rating standards as benchmarks, establishing binding constraints on corporate behavior [11,15]. Concurrently, rating divergence provides institutional actors with intervention opportunities. Through public scrutiny, shareholder proposals, and other means, these actors amplify the negative implications of the divergences, compelling firms to align with higher standards. Compounding these pressures, the divergence in ESG ratings among companies may ultimately drive greater emphasis on information transparency and disclosure practices [30]. These companies may also focus more on managing environmental, social, and corporate governance risks to enhance their ESG performance and reduce inconsistencies in third-party ESG ratings, thereby increasing confidence among investors and stakeholders [6].

Against this backdrop, digital transformation may serve as a critical mechanism for companies seeking to enhance ESG performance [23,31]. From an institutional theory perspective, information asymmetry reflected in ESG rating divergence constitutes a significant “external pressure”, compelling firms to improve information disclosure quality through digital means to address legitimacy challenges. Under the resource dependence theory lens, corporations experiencing substantial rating divergence may engage in resource reconfiguration as an “internal response”. This manifests as strategic investments in digital technologies to establish more precise real-time data collection and analytical capabilities [32,33]. Such investments fundamentally represent strategic realignments in critical resource dependencies. Meanwhile, the dynamic capability theory elucidates how organizations achieve “dynamic adaptation” through digital tools—converting data-driven insights into organizational capacities for continuous ESG performance improvement [34,35]. This enables strategic agility within institutional environments characterized by evolving rating standards.

On one hand, digital technologies can enhance the transparency and credibility of companies’ ESG data [35]. The transparency and credibility of ESG data have always been concerns for investors and stakeholders, as the collection and analysis processes are often subject to human factors [36]. Through digital technologies, companies can disclose ESG-related data in a more transparent manner, enabling more precise ESG evaluations by rating agencies. Additionally, the improvement of digital technology ensures the security and credibility of companies’ ESG data [37], reducing the difficulties faced by rating agencies in the investigation process and enabling them to issue more rigorous ESG rating reports [34].

On the other hand, digital technologies can help companies better measure and improve their ESG performance [34]. Digital technologies can assist companies in accurately assessing their own ESG performance and identifying and addressing relevant issues through data analysis. For example, companies can use big data analytics to identify and monitor potential risks in environmental protection, social responsibility, and corporate governance [38,39], and take timely measures to improve and mitigate negative outcomes, thereby enhancing their ESG performance [34].

Based on the above analysis, companies with high ESG rating divergence may be more motivated to actively develop digital technologies to improve their ESG performance and reduce future inconsistencies in ESG-related issues raised by rating agencies. Therefore, we propose hypothesis H1, as follows:

Hypothesis 1. *ESG rating divergence promotes corporate digital transformation.*

However, large ESG rating divergence may also have adverse effects on corporate digital transformation. Companies with significant ESG rating divergence face greater information uncertainty, which may create difficulties in financing [1,17]. ESG ratings are important indicators considered by many financial institutions and investors. Due to the uncertainty caused by rating discrepancies, many financial institutions may be more cautious about providing financing to these companies. As a result, companies with high rating discrepancies may face restricted access to financing channels and increased financing costs, which could negatively impact their digital transformation.

In addition, digital transformation requires companies to obtain various resources, including technology, talent, and data [33,38–40]. Rating discrepancies by rating agencies regarding a company's ESG performance may lead potential partners, suppliers, and customers to adopt a reserved attitude towards the company's sustainability performance, reducing their willingness to collaborate [41–43]. Furthermore, companies with significant ESG rating divergence may face challenges in talent recruitment and retention. Some talent may be more inclined to join or stay with companies with higher ESG ratings, putting companies with high rating discrepancies at a disadvantage in talent competition [36,44].

Moreover, companies with large ESG rating divergence may face trust and reputation risks in the market [45–48]. Investors and other stakeholders are increasingly concerned about ESG performance, and they often refer to rating results to assess a company's sustainability capabilities [4,14,15,49]. Rating discrepancies may raise doubts among investors regarding a company's sustainability capabilities, reducing their trust in the company. This could have a negative impact on the company's brand image and market competitiveness, thereby affecting the progress and effectiveness of digital transformation. Based on this, we formulate a rival hypothesis H2.

Hypothesis 2. *ESG rating divergence inhibits corporate digital transformation.*

Therefore, whether ESG ratings promote or hinder corporate digital transformation is a question that requires empirical investigation.

3. Data Sources and Variable Definitions

3.1. Sample Selection and Data Sources

The initial sample comprised annual data spanning 2016–2022 for all Chinese A-share listed companies. The sample selection process rigorously excluded all observations categorized as ST or PT listed companies, along with entities operating in the financial and real estate sectors due to their distinctive regulatory frameworks. Furthermore, any records containing incomplete information for essential control variables were systematically eliminated, yielding a refined dataset of 12,366 firm-year observations. For empirical measurements, corporate ESG ratings were acquired from the Wind database, whereas digital transformation metrics and supplementary variables were extracted from the CS-MAR Economic Financial Database. To ensure statistical robustness, all continuous variables underwent 1–99% percentile winsorization to minimize potential distortion from outlier values.

3.2. Model Specification and Variable Definitions

To test the relationship between ESG rating divergence and corporate digital transformation, we constructed the following regression model:

$$\text{Digi_Tran}_{i,t} = \beta_0 + \beta_1 \text{ESGdiverge}_{i,t-1} + \text{Controls}_{i,t} + \varepsilon_{i,t}. \quad (1)$$

The specific variable definitions are presented in Table 1. The dependent variable (Digi_Tran) represents the level of corporate digital transformation, whereas the independent variable (ESGdiverge) quantifies the divergence in ESG ratings derived from discrepancies among major rating agencies' ESG assessments for the preceding fiscal year. Based on data availability and the influence of ESG rating agencies, we select ESG ratings from four providers: SynTao, CASVI, Huazheng, and Wind. We adopt the standard deviation of ESG ratings across agencies ($= \sqrt{\sum |X_i - \mu|^2 / n}$) as a measure of ESG rating divergence, following the approach used by Christensen et al. [4]. Taking company A as an example, let μ represent the mean ESG rating score of A, and X_i denote the A's ESG rating assigned by each agency. Given scores of 2, 4, 6, and 8, the mean value μ is 5, with an ESG rating divergence (standard deviation) of approximately 2.24.

Our control variables (Controls) primarily include company size (Size), operating cash flow (Cash), leverage (Lev), firm age (Firm_Age), ownership concentration (Top1), state ownership (SOE), board size (Boardsize), proportion of independent directors (Indeboard), and asset return on investment (ROA). The regression model further incorporates both industry and year fixed effects to control for sectoral heterogeneity and temporal variations, with standard errors clustered simultaneously at the firm and temporal dimensions to ensure robust inference.

Table 1. Specification of variables.

Variable	Definition
Dependent and independent variable	
Digi_Tran	CSMAR database quantifies the use of artificial intelligence, blockchain, cloud computing, big data, and digital technology by companies based on the information disclosed in their annual reports.
ESGdiverge	The standard deviation of ESG ratings.
Control variable	
Size	The natural logarithm of total assets of the company.
Cash	Operating cash flow divided by total assets.
Lev	Total liabilities divided by total assets.
Firm_Age	The number of years since the company went public.
Top1	The proportion of shares held by the largest shareholder of the company.
SOE	The value is 1 if the company is a state-owned enterprise, and 0 otherwise.
Boardsize	The number of members on the board of directors.
Indeboard	The number of independent directors divided by the total number of directors on the board.
ROA	Net profit divided by total assets.

4. Results

4.1. Descriptive Statistics

Table 2 presents descriptive statistics for the main variables. As shown in the table, the mean of digital transformation level (Digi_Tran) is 16.198, with a standard deviation of 31.082, a minimum value of 0.000 and a maximum value of 181.000, indicating a large variation in the degree of digital transformation among different companies. The mean of ESG rating divergence (ESGdiverge) is 0.906, with a standard deviation of 0.646, a minimum value of 0 and a maximum value of 4.243, indicating a substantial difference in ESG rating divergence among different companies.

Table 2. Descriptive statistics.

Variable	Obs	Mean	SD	Median	Min	Max
Digi_Tran	12,366	16.198	31.082	4.000	0.000	181.000
ESGdiverge	12,366	0.906	0.646	0.849	0.000	4.243
Size	12,366	22.520	1.335	22.325	20.067	26.309
Cash	12,366	0.009	0.070	0.006	−0.207	0.260
Lev	12,366	0.426	0.188	0.423	0.066	0.894
Firm_Age	12,366	11.691	7.607	10.000	2.000	28.000
Top_1	12,366	33.041	14.633	30.550	8.230	71.540
SOE	12,366	0.349	0.477	0.000	0.000	1.000
Boardsize	12,366	10.161	2.700	10.000	5.000	19.000
Indeboard	12,366	0.383	0.074	0.375	0.250	0.600
ROA	12,366	0.035	0.071	0.037	−0.297	0.201

SD is the standard deviation, Min is the minimum value, and Max is the maximum value.

4.2. Baseline Regression

To examine the impact of ESG rating divergence on corporate digital transformation, this study conducted regression estimation for Model (1), and the results are shown in Table 3. In column (1), controlling only for industry and year fixed effects, the coefficient for the core explanatory variable, ESGdiverge, is estimated to be 1.384, which is significantly positive at the 1% level. In column (2), additional control variables are included in the baseline regression model, and the coefficient for ESGdiverge is estimated to be 0.866, which is significantly positive at the 5% level. This suggests that a higher level of ESG rating divergence is associated with a greater degree of digital transformation in companies, supporting the research hypothesis H1 that ESG rating divergence promotes the level of corporate digital transformation.

Table 3. Baseline result.

	(1) Digi_Tran	(2) Digi_Tran
ESGdiverge	1.384 *** (3.875)	0.866 ** (2.442)
Controls	NO	YES
Ind FE	YES	YES
Year FE	YES	YES
Obs	12,366	12,366
Adj_R ²	0.427	0.438

Robust t-statistics are in parentheses. ** $p < 0.05$, *** $p < 0.01$.

4.3. Robustness Check

4.3.1. Addressing Endogeneity Concerns

The relationship between ESG rating divergence and corporate digital transformation may be subject to endogeneity concerns. Companies with larger ESG rating divergence and those with smaller divergence may have significant differences in observable firm characteristics, which lead to variations in the level of digital transformation. Alternatively, there may be a reverse causality issue between ESG rating divergence and corporate digital transformation. To address these potential endogeneity issues, we employ the instrumental variable (IV) approach to conduct a 2SLS regression test.

Specifically, we use the average ESG rating divergence of firms in the local area as the instrument variable (IV) [30,50]. In the first stage, we regress ESG rating divergence (ESGdiverge) on this instrument variable. In the second stage, we regress the digital transformation level (Digi_Tran) on the ESG rating divergence estimated from the first stage.

Table 4 displays the instrumental variable regression outcomes. The first-stage regression results in Column (1) demonstrate a statistically significant positive relationship between the regional peer firms' average ESG rating divergence and individual firms' ESG rating divergence. Column (2) reveals that the instrumented ESG rating divergence from the first stage maintains its significant positive influence on corporate digital transformation in the second-stage estimation. These robust empirical results effectively mitigate potential endogeneity issues concerning the impact of ESG rating divergence on firms' digital transformation initiatives.

Table 4. Addressing Endogeneity Concerns.

	(1) First Stage ESGdiverge	(2) Second Stage Digi_Tran
ESGdiverge		3.436 * (1.724)
IV	0.913 *** (17.295)	
Controls	YES	YES
Ind FE	YES	YES
Year FE	YES	YES
Obs	12,366	12,366
Adj_R ²	0.073	0.436

Robust t-statistics are in parentheses. * $p < 0.1$, *** $p < 0.01$.

4.3.2. Alternative Independent Variable

In the main analysis, this study measures ESG rating divergence by the standard deviation of ratings from different rating agencies. To ensure the robustness of our research conclusions, we refer to Kimbrough et al. [51] and use the mean absolute deviation of ratings from different rating agencies to re-measure ESG rating divergence (ESGdiverge2), and then re-conduct the regression analysis. The regression results, as shown in column (1) of Table 5, indicate a coefficient of 1.191 for ESGdiverge2, which is significantly positive at the 5% level. The findings align with the core regression outcomes, thereby confirming the reliability of our research findings.

Table 5. Robustness check.

	(1) Digi_Tran	(2) Digi_Tran	(3) Digi_Tran
ESGdiverge2	1.191 ** (2.409)		
ESGdiverge		1.153 ** (2.219)	1.707 ** (2.469)
Controls	YES	YES	YES
Ind FE	YES	YES	YES
Year FE	YES	YES	YES
Obs	12,366	7352	4389
Adj_R ²	0.438	0.403	0.432

Robust t-statistics are in parentheses. ** $p < 0.05$.

4.3.3. Spatial Sample Replacement

To further verify the robustness of the positive effect of sample selection on ESG rating divergence, we exclude special samples that may have a significant impact on empirical results. The regression results, as shown in column (2) of Table 5, indicate that after excluding samples from municipalities with rapid economic development and special administrative significance (i.e., deleting data of companies with registered offices in Beijing,

Tianjin, Shanghai, and Chongqing from the total sample), the coefficient for ESGdiverge is 1.153, which is significantly positive at the 5% level. This is consistent with the main regression results, further demonstrating the robustness of our research conclusions.

4.3.4. Temporal Sample Replacement

To address the potential confounding effects of COVID-19, we exclude observations from the 2020–2022 period and undertake robustness tests on the positive relationship. As evidenced in Table 5 column (3), the coefficient of ESGdiverge (1.707) remains statistically significant at the 5% level, confirming that the positive impact of ESG rating divergence on corporate digital transformation persists despite temporal sample adjustments.

4.4. Mechanism Test

ESG rating divergence leads to inconsistent perceptions of a company's ESG performance among investors and stakeholders, leading to uncertainty in the company's sustainable development [4,36]. Therefore, companies with high ESG rating divergence are more motivated to increase R&D investment in digital technology and hire more R&D personnel for digital technology development. They employ digital solutions to deliver enhanced accuracy and real-time data gathering and analytical capacities, helping companies better measure and improve their ESG performance and reducing the degree of rating divergence among rating agencies [6,52]. Thus, we hypothesize that the mechanism by which high ESG rating divergence promotes corporate digital transformation is that such companies are more motivated to hire more R&D personnel and invest more funds in R&D. Our specific mechanism deduction diagram is shown in Figure 1.

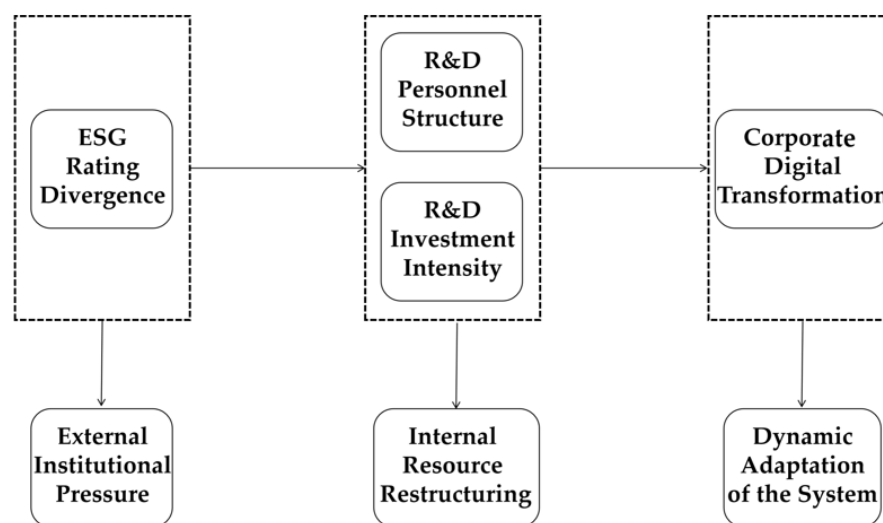


Figure 1. Research Framework Diagram.

To test the mechanism mentioned above, we refer to the studies by Griffin et al. [53], and Sun et al. [54] as well as use the proportion of R&D personnel (RDP) and R&D intensity (RD, defined as the ratio of R&D investment to operating income) of the company as intermediate variables for 2SLS regression. Specifically, column (1) of Table 6 presents the regression results of ESG rating divergence (ESGdiverge) on the proportion of R&D personnel (RDP), indicating ESG rating divergence has a significantly positive association with proportion of R&D personnel in the company. Column (2) of Table 6 reports the regression results of the proportion of R&D personnel fitted by ESG rating divergence on the degree of corporate digital transformation (Digi_Tran). Combining columns (1) and (2) of Table 6, we can infer that ESG rating divergence promotes corporate digital transformation by optimizing the structure of R&D personnel in the company. Moreover,

columns (3) and (4) of Table 6 report the results of 2SLS regression using R&D intensity (RD) as an intermediate variable, confirming our hypothesis that ESG rating divergence promotes corporate digital transformation by increasing the company's R&D investment.

Table 6. Mechanism testing.

	(1) RDP	(2) Digi_Tran	(4) RD	(3) Digi_Tran
ESGdiverge	0.360 ** (2.303)		0.169 ** (2.492)	
RDP		2.662 * (1.878)		
RD				5.677 * (1.946)
Controls	YES	YES	YES	YES
Ind FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Obs	11,146	11,146	11,286	11,286
Adj_R ²	0.441	−0.070	0.385	−0.016

Robust t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$.

4.5. Heterogeneity Analysis

ESG rating divergence may have different impacts on different types of companies, and there are differences in the strategies and costs of digital transformation for different types of companies [4,55]. We explore the heterogeneous effects of ESG rating divergence on corporate digital transformation from the perspectives of external attention, internal control level, and corporate nature, which also help to better clarify the role of ESG rating divergence.

4.5.1. External Attention of the Company

The promoting effect of ESG rating divergence on corporate digital transformation may have heterogeneous effects on companies that receive different levels of attention from analysts. As professional information intermediaries, analysts significantly enhance corporate information transparency through their continuous tracking activities. By conducting in-depth financial analysis, on-site due diligence, and executive interviews, analysts transform firm-specific information into disseminable research outputs, thereby amplifying the company's visibility in capital markets. Through more comprehensive and in-depth research, analysts amplify market scrutiny on corporate ESG performance and rating discrepancies, thereby stimulating broader discourse among stakeholders [56,57]. This means that the impact of ESG rating divergence on corporate reputation and brand image will be more significant [48], thereby increasing the motivation of companies to reduce discrepancies. In addition, due to higher demand, companies need to pay more attention to their ESG performance and take action to improve their rating results [58,59]. To win recognition from analysts and investors, companies tend to increase R&D investment and hire more R&D personnel to develop digital technologies to improve their ESG performance. Thus, firms experiencing higher analyst attention demonstrate a significantly amplified effect of ESG rating divergence in promoting corporate digital transformation.

To verify this hypothesis, we use the median number of research reports issued by analysts on companies as a boundary to construct the virtual variable "Analyst". When the number of research reports issued by analysts on a company is greater than the median of the sample, Analyst is equal to 1, otherwise it is equal to 0 [47]. We include the interaction term E_A between Analyst and ESG rating divergence in the baseline regression model, and the regression results in column (1) of Table 7 show that the coefficient of the interaction term E_A is significantly positive, indicating that the promoting effect of ESG rating

divergence on corporate digital transformation will be more significant in companies with higher analyst attention.

Table 7. Heterogeneity analysis.

	(1) Digi_Tran	(2) Digi_Tran	(3) Digi_Tran
ESGdiverge	−0.190 (−0.307)	0.243 (0.661)	1.115 *** (2.623)
E_A	1.208 ** (1.968)		
E_D		1.936 *** (3.702)	
E_P			−1.378 *** (−2.766)
Controls	YES	YES	YES
Ind FE	YES	YES	YES
Year FE	YES	YES	YES
Obs	6666	11,985	12,366
Adj_R ²	0.455	0.439	0.438

Robust t-statistics are in parentheses. ** $p < 0.05$, *** $p < 0.01$.

4.5.2. Internal Control Level of the Company

In companies where the chairman and CEO are the same person (i.e., dual-hatted executives), the promoting effect of ESG rating divergence on corporate digital transformation may be stronger. This is because as a dual-hatted executive, they have a stronger control over the company and can directly influence and promote the company's decision-making and strategic direction [60,61]. When a company's ESG rating is larger, dual-hatted executives have a stronger motivation to strengthen R&D of digital technologies to reduce ESG rating divergence and improve the company's ESG performance. In addition, dual-hatted executives can better understand the ESG challenges and issues faced by the company [61,62], and are more likely to grasp the importance of digital transformation in solving these problems.

They can directly allocate additional resources—such as increased R&D funding and expanded technical personnel—toward developing and implementing digital technologies to enhance corporate ESG performance. In addition, dual-hatted executives usually have more comprehensive decision-making and resource allocation powers, which can promote the implementation of digital transformation more quickly and ensure its consistency with ESG goals. To verify this hypothesis, we constructed the virtual variable “Duality”. Duality equals 1 if the chairman and CEO of the company are the same person, otherwise it equals 0. We include the interaction term E_D between Duality and ESG rating divergence in the baseline regression model, and the regression results in column (2) of Table 7 show that the coefficient of the interaction term E_D is significantly positive, indicating that the promoting effect of ESG rating divergence on corporate digital transformation will be more significant in dual-hatted companies.

4.5.3. Corporate Nature

The economic consequences brought about by ESG rating divergence may have heterogeneous effects on different types of companies. Specifically, in pollution-intensive companies, the promoting effect of ESG rating divergence on digital transformation may be weakened. This is because pollution-intensive companies need to solve more complex technical problems and face higher cost pressures, as well as strict supervision and attention from governments, regulatory agencies, social organizations, and the public, as well as the influence of factors such as technical feasibility and transformation speed [63,64]. These

factors may make pollution-intensive companies pay more attention to solving pollution problems themselves, while reducing the resources and efforts invested in digital transformation [65]. Therefore, in pollution-intensive companies, the representativeness of ESG rating divergence may be weakened, and digital transformation may face more challenges and difficulties.

To verify this hypothesis, we constructed a virtual variable “Pollu” for pollution-intensive companies. Referring to the research of Shi et al. [64] as well as Gao and Wen [65], we identified companies whose main business belongs to the mining industry, manufacturing industry, electricity, heat production, and supply industry as pollution-intensive companies. Pollu equals 1 if the company is classified as a pollution-intensive company, otherwise it equals 0. We include the interaction term E_P between Pollu and ESG rating divergence in the baseline regression model, and the regression results in column (3) of Table 7 show that the coefficient of the interaction term E_P is significantly negative, indicating that the promoting effect of ESG rating divergence on corporate digital transformation is weakened in pollution-intensive companies.

5. Conclusions, Discussion, Implications, and Limitations

5.1. Conclusions

The present study utilizes a sample of Chinese A-share listed companies from 2016 to 2022 to investigate the impact of ESG rating divergence on corporate digital transformation. The results indicate that ESG rating divergence significantly promotes companies’ digital transformation efforts, and this finding persists after conducting robustness tests such as endogeneity analysis, variable substitution, and temporal and spatial sample replacement. Mechanism tests reveal that ESG rating divergence facilitates digital transformation by optimizing companies’ R&D personnel structure and promoting R&D investment. Heterogeneity analysis further suggests that the positive effect of ESG rating divergence on digital transformation is more pronounced in companies with higher analyst coverage and stronger internal controls, while it is suppressed in pollution-intensive firms.

5.2. Discussion

While closely aligned with mainstream research concerning ESG rating divergence, our study demonstrates substantive differentiation. Unlike Avramov et al. [2] concentrating on the influence of ESG uncertainty on investment decisions and Christensen et al. [4] investigating cognitive roots of rating divergence, this study pioneers the disclosure of ESG divergence’s strategic driving mechanism for corporate digital transformation, thereby extending the research perspective from capital market reactions to substantive corporate behavioral levels. Regarding explanatory mechanisms, whereas Wang et al. [11] and Mio et al. [29] examine stock volatility and capital cost effects, respectively, this research establishes a theoretical framework of institutional pressure innovation response through dual mediating channels including R&D personnel structure optimization and increased R&D investment, which remains unaddressed in Zhou et al. [6]’s green innovation study. Notably, this work contributes novel insights to institutional theory by demonstrating ESG rating divergence as an informal institutional pressure source that resolves legitimacy crises through enhanced information disclosure transparency via digital tools, a finding transcending Serafeim and Yoon [15]’s market reaction focused discussion. From the resource dependence theory dimension, the identified moderating effects of analyst coverage and internal control quality reveal how digital investments reconfigure corporate dependence on external evaluation resources, exhibiting greater strategic initiative than the audit fee mechanism examined by Ling et al. [8]. The breakthrough in dynamic capability theory is evidenced by the inhibitory effect on pollution intensive enterprises, providing empirical

support for capability evolution path dependence, a discovery theoretically complementing Mao et al. [10]’s research on earnings management behaviors. Collectively, these innovations construct a multi-level theoretical system elucidating ESG divergence’s impact on corporate strategic transformation, addressing the extant literature gap concerning micro behavioral mechanisms.

5.3. Theoretical Implications

This study elucidates the driving mechanisms through which ESG rating divergence influences corporate digital transformation, providing significant empirical and theoretical extensions to institutional theory, resource dependence theory, and dynamic capability theory.

5.3.1. Implications to Institutional Theory

The research demonstrates that ESG rating divergence functions as an institutional pressure source, compelling firms to adopt digital transformation strategies in response to information asymmetry and legitimacy crises. Specifically, rating discrepancies amplify monitoring pressures from external stakeholders (e.g., analysts and regulators), driving organizations to enhance information disclosure transparency through digital tools to address institutional logic conflicts. This mechanism validates how “fragmented evaluation standards” in institutional environments dynamically shape organizational behavior, enriching institutional theory’s explanation of informal pressure transmission pathways.

5.3.2. Implications to Resource Dependence Theory

The findings reveal that firms respond to ESG rating divergence by restructuring R&D personnel configurations and increasing R&D investments, embodying the core proposition of resource dependence theory—that organizations strategically reconfigure resources to manage critical external dependencies. The effect is particularly pronounced in firms with greater analyst coverage and stronger internal controls, indicating that digital investments represent proactive adaptations to reduce reliance on traditional ESG evaluation resources. This discovery expands resource dependence theory’s application in technology-driven strategic adjustments.

5.3.3. Implications to Dynamic Capability Theory

The study identifies digital transformation as a concrete manifestation of dynamic capabilities: firms convert ESG rating disparities into data analytics capabilities and achieve continuous performance improvement through R&D system upgrades. The suppressed effect in pollution-intensive industries further demonstrates that dynamic capability development is constrained by existing resource bases, providing new evidence for “capability evolution path dependence”. These findings systematically explain how digital tools empower strategic agility in complex institutional environments, deepening the interaction between dynamic capability theory and institutional contexts.

5.4. Practical Implications

From a policy perspective, this study offers insights into the formulation and improvement of ESG-related policies. Governments and regulatory bodies can draw upon these research findings to further emphasize and promote ESG rating systems in companies, thereby fostering their digital transformation. Additionally, governments can strengthen regulation on pollution-intensive companies to mitigate their negative environmental impact and encourage their active participation in digital transformation for sustainable development. Moreover, the results of this study have practical implications for corporate management. Executives can consider ESG rating divergence as an important reference

indicator and pay particular attention to analyst coverage and internal control levels to drive digital transformation more effectively. By optimizing their R&D personnel structure and increasing R&D investment, companies can enhance their innovation capabilities and technological proficiency, better adapting to the challenges and opportunities of digital transformation. Furthermore, the divergence in ESG ratings stems from rating agencies' adoption of differentiated indicator systems and methodologies, which represents both an objective characteristic of the current market phase and a reflection of the necessary pluralism in ESG assessment. Mechanistically enforcing standardization risks eroding agencies' professional judgment-based evaluation capacities, potentially stifling innovation in ESG rating systems. A more effective approach involves mitigating discrepancies through enhanced information disclosure quality and transparency, while simultaneously encouraging rating agencies to disclose their methodologies and strengthen industry collaboration. Therefore, our findings offer valuable policy implications for ESG governance in other countries and emerging markets. Specifically, China's pioneering efforts in standardizing ESG disclosures provide emerging economies with a reference template for incremental reform. These markets may adopt their voluntary-to-mandatory transition approach to advance market innovation and regulatory development in parallel. We recommend that regulators in emerging economies prioritize foundational data quality by establishing localized ESG metrics classification frameworks, thereby curbing rating agencies' discretionary metrics selection.

5.5. Limitations

This study presents two methodologically interconnected limitations. First, the temporal constraint originates from selecting 2016 as the sample start year. This decision stems from a fundamental technical requirement: calculating ESG rating divergence necessitates parallel assessments from at least two agencies. Before 2016, China lacked sufficient concurrent rating capacity to satisfy this prerequisite, preventing access to earlier data. This data limitation not only constrained the study's timeframe but more significantly risks omitting formative characteristics of China's evolving ESG assessment system. As the ESG rating market matures, future research with extended time series can better validate the robustness of current findings. Second, the contextual specificity of conclusions reflects China's distinct institutional environment. Key features including policy-market synergy, structural prominence of state-owned enterprises, and unique economic development stages collectively shape how ESG rating divergence influences corporate digitalization. While this context-dependent nature demonstrates practical relevance, it necessitates careful consideration of institutional differences for international generalization. Subsequent research should address this by establishing cross-national comparative frameworks. Such approaches would systematically examine how institutional environments moderate the ESG-digitalization transmission mechanism, thereby differentiating universal patterns from region-specific pathways.

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