The Moderating Effect of Board Gender Diversity between Digital Transformation and Corporate ESG Performance: The Evidence from China

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Abstract
This study examines the moderating effect of board gender diversity on the relationship between digital transformation and corporate ESG (Environmental, Social, and Governance) performance in Chinese firms. Based on the Resource-Based View (RBV) and Upper Echelons Theory, we explore how digital transformation enhances sustainability outcomes and how board gender diversity influences this relationship. Using a sample of A-share listed companies, we conduct regression analyses to assess the direct and moderating effects. The results indicate that digital transformation positively influences ESG performance, confirming that digitalization is a key enabler of corporate sustainability. However, the role of board gender diversity is more complex. While gender-diverse boards can promote inclusive decision-making and innovative strategies, the diversity of viewpoints may also slow down the implementation of digital transformation initiatives. This suggests that the impact of digital transformation on ESG performance is moderated by the governance structure, particularly gender diversity. This study contributes to the literature on corporate governance and sustainability by highlighting the importance of board diversity in enhancing the effectiveness of digital transformation for achieving ESG goals. The findings offer practical implications for businesses, policymakers, and investors, emphasizing that fostering gender-diverse boards can improve the sustainability outcomes of digital strategies. This research provides valuable insights into the intersection of digitalization, governance, and sustainability in the Chinese context.
Keywords: Corporate ESG Performance, Digital Transformation, Board Gender Diversity, Resource-Based View, Upper Echelons Theory

Introduction

In recent years, the integration of digital technologies into business operations, commonly referred to as digital transformation, has become a vital strategy for corporations seeking to enhance efficiency, foster innovation, and maintain competitive advantage (Khin & Ho, 2019; Kraus et al., 2021; Plekhanov et al., 2023). Concurrently, Environmental, Social, and Governance (ESG) performance has gained prominence as investors and stakeholders increasingly demand corporate responsibility in addressing pressing societal and environmental issues (Barko et al., 2022; Dmuchowski et al., 2023). While digital transformation is often associated with improved operational performance and enhanced stakeholder engagement, its influence on ESG outcomes is less understood, especially within the framework of corporate governance (Sang et al., 2024).

Board gender diversity has emerged as an important factor influencing the quality of corporate governance (Katmon et al., 2019; Martinez-Jimenez et al., 2020). A diverse board, particularly one with adequate gender representation, brings a broader range of perspectives and insights, which can positively affect decision-making processes and organizational strategy (Rao & Tilt, 2016). Women directors are often linked to more effective oversight, greater transparency, and a stronger commitment to corporate social responsibility (Setó, 2015; Landry et al., 2016). As such, the potential moderating role of board gender diversity in shaping the impact of digital transformation on ESG performance represents a critical area of inquiry that has yet to be fully explored (Sang et al., 2024).

The context of China offers a unique setting to investigate these dynamics. As the country rapidly advances in digital technology adoption, Chinese companies are increasingly embracing digital transformation to drive growth and improve their sustainability practices (Liu et al., 2024; Zhu et al., 2024). At the same time, China has been implementing various regulatory initiatives to enhance corporate ESG disclosures and promote sustainable development (Sang et al., 2024). However, the role of corporate governance, particularly board gender diversity, in influencing these developments remains under-researched. Given the cultural, institutional, and regulatory nuances specific to China, examining the interaction between digital transformation, board gender diversity, and ESG performance can yield important insights (Bruton & Ahlstrom, 2003).

This study aims to address this gap by investigating the moderating effect of board gender diversity on the relationship between digital transformation and corporate ESG performance in Chinese firms. The motivation for this research stems from the need to better understand how diversity at the board level can shape and enhance the outcomes of digital initiatives, particularly in the context of ESG goals, which are increasingly pivotal for corporate sustainability and long-term success. By exploring how board composition influences the effectiveness of digital initiatives in driving ESG outcomes, this research seeks to contribute to a deeper understanding of the interplay between technology, governance, and sustainability. The findings are expected to offer significant implications for corporate leaders, policymakers, and investors seeking to enhance ESG performance through more inclusive and effective governance structures. Furthermore, this research adds to the growing literature on digital transformation, corporate governance, and ESG by highlighting the role of board gender diversity as a moderating factor. It provides a nuanced perspective on how diverse

leadership can amplify the benefits of technological advancements in achieving broader societal and environmental goals, particularly in an emerging market context like China.

The remainder of the study is organized as follows. Section 2 provides a review of the relevant literature and outlines the development of the research hypotheses. Section 3 details the methodology employed in the research. Section 4 presents the results obtained from the analysis. Finally, Sections 5 and 6 are dedicated to the discussion of findings and the conclusions drawn from the study, respectively.

Literature Review and Hypotheses Development
Digital Transformation and Corporate ESG Performance
Digital transformation has become a vital strategy for modern corporations, driven by advancements in technology and an increasingly complex business environment (Schwertner, 2017; Bhuiyan et al., 2024). By integrating digital technologies, companies aim to improve operational efficiency, enhance stakeholder communication, and foster innovation, all of which can influence ESG performance (Wang & Esperança, 2023). The adoption of digital tools such as big data analytics, artificial intelligence, and blockchain has been found to promote transparency, improve resource management, and optimize decision-making processes, which are essential components of effective ESG strategies (Asif et al., 2023).

From an environmental perspective, digital technologies can assist organizations in reducing their carbon footprint by optimizing energy usage and streamlining supply chains (Wang et al., 2020; Jiang et al., 2024). Socially, digital platforms provide an opportunity for greater stakeholder engagement, allowing companies to address social concerns more effectively and align their operations with community expectations (Martínez-Peláez et al., 2023). In terms of governance, digital transformation can lead to more robust corporate governance practices by improving information disclosure, facilitating real-time monitoring, and enhancing overall accountability (Sang et al., 2024).

The Resource-Based View (RBV) theory provides a useful framework to understand the impact of digital transformation on ESG performance. According to RBV, a firm's competitive advantage is derived from its valuable, rare, inimitable, and non-substitutable resources (Barney, 1991; Kabue & Kilika, 2016). Digital capabilities, viewed as strategic resources, enable firms to better address environmental challenges, engage with stakeholders, and establish stronger governance frameworks (Brunetti et al., 2020). Therefore, digital transformation can be seen as a key enabler of improved ESG performance, as it helps firms optimize their resources in a manner that enhances both sustainability and competitiveness.
Based on these discussions, the following hypothesis is proposed:
H1: Digital transformation positively influences corporate ESG performance.

The Moderating Effect of Board Gender Diversity
Board gender diversity has been increasingly recognized as a critical aspect of effective corporate governance (Bear et al., 2010; Rao & Tilt, 2016). A diverse board, especially with increased female representation, is believed to bring a wider range of perspectives and insights, which can enhance board decision-making quality and drive better organizational outcomes (Rao & Tilt, 2016). Gender diversity is linked to more rigorous discussions, greater consideration of non-financial factors, and a heightened focus on corporate social

responsibility, which can ultimately lead to improved ESG performance (Bear et al., 2010; Erben et al., 2024).

Upper Echelons Theory provides a theoretical basis for understanding the role of board diversity in corporate decision-making processes (Hiebl, 2014). This theory posits that the experiences, values, and personalities of top executives shape organizational outcomes (Devine et al., 2021). In the context of board gender diversity, women directors may be more inclined to advocate for sustainability initiatives, ethical practices, and inclusive policies, which align closely with ESG goals (Heubeck, 2024). The presence of women on boards can thus influence how companies implement digital technologies to achieve sustainability objectives, potentially enhancing the impact of digital transformation on ESG performance (Sang et al., 2024).

In China, where cultural and institutional factors often influence corporate governance practices, board gender diversity could play a crucial role in shaping the outcomes of digital transformation initiatives (Zhang et al., 2024). Female directors may advocate for more responsible uses of technology, ensuring that digital strategies not only enhance efficiency but also contribute to broader societal and environmental goals (Székely & Knirsch, 2005). Thus, it is posited that gender-diverse boards can amplify the positive effects of digital transformation on ESG performance.
Based on the above arguments, the following hypothesis is proposed:
H2: There is a significant positive influence of Board gender diversity on the relation between Digital transformation and ESG performance.

Research Design
Sample and Data Sources
This study focuses on 1,932 A-share listed companies in China, covering the period from 2013 to 2023, resulting in a total of 19,320 annual observations. The research aims to explore the relationship between board characteristics and ESG performance. To ensure the robustness of the experimental results, the initial research sample underwent several treatments: (1) Samples from the financial industry were excluded. Data from the financial sector tends to be highly heterogeneous, with accounting practices differing significantly from those in other industries. Additionally, financial data is influenced by macroeconomic factors such as interest rate fluctuations, monetary policy changes, and market volatility, which could introduce outliers or noise into the model, thereby compromising the validity of the analysis. Consistent with previous studies, this paper also excludes financial industry data to enhance the reliability of the findings. (2) Samples categorized under ST and *ST were removed. These categories often represent companies that have been suspended from listing or are at risk of delisting, which can introduce data quality issues or biases. The financial data of ST and *ST companies are typically significantly different from those of other firms, potentially skewing the results of the analysis. (3) Companies with substantial missing data were excluded to ensure the completeness of the dataset. (4) To mitigate the impact of extreme values, all continuous variables were winsorized at the 1st and 99th percentiles. The dataset for this study was sourced from the CSMAR database, and all data processing and regression analyses were conducted using Stata 16.0.

Variable Setting

To empirically examine the moderating effect of board gender diversity on the relationship between digital transformation and corporate ESG performance, the variables in this study are categorized into three main types: dependent variables, independent variables, and moderating variables, along with a set of control variables to address other influential factors.

The dependent variable in this study is corporate ESG performance, which captures a firm's performance in Environmental, Social, and Governance dimensions. ESG performance is quantified using an ESG score obtained from Huazheng ESG rating system. It aggregates data from various sources, including corporate annual reports, sustainability disclosures, government notices, third-party databases, and industry publications, to provide a comprehensive evaluation of firms' ESG performance. The ESG framework is structured around three core components, each containing specific indicators weighted according to their relative significance. Companies are assigned scores based on a quantitative assessment of these indicators, reflecting their actual performance across environmental, social, and governance dimensions. The Huazheng ESG rating is updated quarterly, and for the purposes of this study, we simplified the scores into a 1-9 scale, with the average rating serving as the annual ESG performance indicator for each company.

The independent variable is digital transformation, which is measured based on the extent to which companies have integrated digital technologies into their operations. Drawing on the methodologies used by Sang et al. (2024), this study measures digital transformation by analyzing the frequency of relevant keywords in the annual reports of publicly listed companies. We employed Python web scraping techniques to collect and organize the annual reports of all A-share listed firms on the Shanghai and Shenzhen Stock Exchanges. To account for the skewed distribution of the data, we applied a logarithmic transformation, resulting in the overall indicator, DT, which captures the degree of digital transformation within the companies. This methodology allowed us to develop a robust indicator system for assessing corporate digital transformation efforts.

Moving to the moderating variable, board gender diversity represents the presence and proportion of female directors on the board. Board gender diversity is quantified by calculating the percentage of female board members relative to the total number of board members. This measure reflects the extent to which gender diversity is present within the corporate governance structure. Gender diversity has been linked to more effective governance practices, particularly in addressing non-financial performance indicators such as ESG. Board gender diversity is a dummy variable value, If the value of board gender diversity is greater than the mean of the sample taking of 1, otherwise 0. Control variables include firm size, leverage, return on assets, cash flow and firm growth.

This study utilized panel data, combining both time series and cross-sectional elements to comprehensively examine the research questions. To evaluate the research hypotheses, we employed a multiple linear regression model aimed at understanding the influence of digital transformation on a firm's ESG performance. Moreover, the study investigated whether board gender diversity played a moderating role in the relationship between digital transformation and ESG performance. The models used in this analysis were designed to capture these dynamics and as follows:

$$ESG_{it} = \alpha + \beta_1 DT_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 ROA_{it} + \beta_5 CF_{it} + \beta_6 GROW_{it} + YEAR + IND + \varepsilon_{it}$$
(1)

$$ESG_{it} = \alpha + \beta_1 DT_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 ROA_{it} + \beta_5 CF_{it} + \beta_6 GROW_{it} + \beta_7 GD_{it} + \beta_8 DT_{it} \times GD_{it} + YEAR + IND + \varepsilon_{it}$$
(2)

Where α is constant term or intercept; β is coefficient of variable; ε is the error term; i denotes the cross-sectional dimension for firms; and t denotes the time series dimension. The explained variable *ESG* represents corporate ESG performance. The proxies for the independent variable of digital transformation is the DT. SIZE = firm size, the natural logarithm of total assets. ROA = return on assets, the ratio of net income to total assets. LEV = leverage, the ratio of liabilities to total assets. CF = cash flow, the ratio of total assets to operating cash flow. GROW = firm growth, the market-to-book ratio of total assets. GD = board gender diversity, dummy variable value taking of 1 for GT > MEAN, otherwise 0. Additionally, dummy variables for industry (IND) and year (YEAR) are included in the models.

Results and Discussion
Descriptive Statistics
The descriptive statistics for the primary variables in this study are summarized in Table 1. Digital transformation (DT), the variable representing the extent of technological integration in firms, has an average value of 1.71, with a maximum of 5.34. This indicates that, on the whole, the level of digitalization across the sample companies is relatively modest, with significant heterogeneity in the adoption of digital technologies. The range of values suggests that while some firms have made considerable advancements in their digital transformation journeys, many others still have a long way to go. This variability in digital transformation is not only a reflection of differing organizational priorities but may also be influenced by factors such as industry, company size, and available resources, which have been shown to play critical roles in the pace of digital adoption (Westerman et al., 2014).

The ESG performance (ESG) variable has a standard deviation of 1.31. This suggests substantial variation in ESG outcomes among the sampled firms, implying that while some companies excel in implementing sustainable practices, others are lagging behind. The average ESG score of 4.13 is relatively low, indicating that, overall, the firms in the sample are not fully meeting the expectations set by international ESG standards. This aligns with findings from previous studies (Eccles et al., 2014), which report that many companies, particularly in emerging markets, have yet to prioritize ESG efforts systematically. This leaves significant room for improvement, especially in areas such as governance transparency, environmental impact reduction, and social responsibility.

Turning to the moderating variables, Gender diversity (GD) within the boards exhibits a range from a minimum value of 0 to a maximum value of 0.53. This indicates that some boards are entirely homogenous in gender, while others exhibit a modest level of gender diversity. A value of 0.53 suggests that, in these instances, half of the board members are women, a significant achievement in the context of corporate governance. However, the presence of many all-male boards or those with limited female representation highlights the continued underrepresentation of women in leadership roles, despite the growing body of literature

emphasizing the positive influence of gender-diverse boards on decision-making quality, corporate governance, and long-term performance (Rao & Tilt, 2016).

Table 1
Descriptive Statistics

Variables	N	Mean	SD	Min	Max
ESG	19,320	4.13	1.31	0.00	6.35
DT	19,320	1.71	1.51	0.00	5.34
GD	19,320	0.25	0.17	0.00	0.53
SIZE	19,320	22.29	1.31	19.90	26.39
GROW	19,320	0.37	0.91	-0.71	2.69
ROA	19,320	0.04	0.07	-0.28	0.20
CF	19,320	0.06	0.08	-0.18	0.33
LEV	19,320	0.41	0.20	0.06	0.93

Note: The explained variable ESG represents corporate ESG performance. The proxies for the independent variable of digital transformation is the DT. SIZE = firm size, the natural logarithm of total assets. ROA = return on assets, the ratio of net income to total assets. LEV = leverage, the ratio of liabilities to total assets. CF = cash flow, the ratio of total assets to operating cash flow. GROW = firm growth, the market-to-book ratio of total assets. GT = board gender diversity, dummy variable value taking of 1 for GT > MEAN, otherwise 0. ***, **, * represent $P < 0.01$, $P < 0.05$, and $P < 0.1$, respectively.

The results of the correlation analysis for the key variables in this study are presented in Table 2. Specifically, the Pearson correlation coefficient between digital transformation and sustainable development of enterprises is 0.054. This correlation coefficients is statistically significant at the 1% level, indicating a positive relationship between digital transformation and ESG performance, in line with our research hypotheses. While this correlations is statistically significant, the relatively modest size of the coefficients suggests that while a connection exists, it may not be strong in magnitude. This finding provides preliminary evidence supporting the view that digital transformation has a positive, albeit weak, impact on the sustainable development of enterprises.

Table 2
Correlation Matrix

	ESG	DT	GD	SIZE	GROW	ROA	CF	LEV
ESG	1.000							
DT	0.53***	1.00						
GD	0.09***	0.04***	1.00					
SIZE	0.02**	0.01	0.05***	1.00				
GROW	-0.43***	-0.45***	-0.07***	0.06***	1.00			
ROA	0.19***	0.08***	-0.09***	-0.02	0.18***	1.00		
CF	0.04***	0.10***	0.01*	-0.01	0.02***	-0.18***	1.00	
LEV	-0.02***	0.11***	0.02***	0.12	0.14***	-0.05***	0.45***	1.00

Note: This table reports the correlation coefficients between key variables for 19,320 company-year observations covering 2013-2023. The explained variable ESG represents corporate ESG performance. The proxies for the independent variable of digital transformation is the DT. SIZE = firm size, the natural logarithm of total assets. ROA = return on assets, the ratio of net income to total assets. LEV = leverage, the ratio of liabilities to total assets. CF = cash flow, the ratio of total assets to operating cash flow. GROW = firm growth, the market-to-book ratio of total assets. GT = board gender diversity, dummy variable value taking of 1 for GT > MEAN, otherwise 0. ***, **, * represent $P < 0.01$, $P < 0.05$, and $P < 0.1$, respectively.

Regression Analysis

To examine the relationship between digital transformation and ESG performance, a regression analysis was conducted, with the results presented in Table 3. Column (1) illustrates a statistically significant and positive regression coefficient for DT at the 1% significance level, providing robust evidence for the substantial role of digital transformation in promoting sustainable development. This finding supports Hypothesis 1, which posited that digital transformation positively influences corporate sustainability. The result is consistent with previous studies that have highlighted how the adoption of digital technologies can enhance sustainability through improved resource efficiency, transparency, and decision-making processes (Sang et al., 2024). Therefore, this analysis affirms the critical importance of digital transformation as a driver of sustainable corporate practices.

Furthermore, building upon Model (1), we expanded our analysis to explore the moderating effects of board diversity on the digital transformation - ESG performance relationship by incorporating interaction terms. Column (3) presents the results of the DT × Gender interaction term, which shows a significantly negative coefficient. This indicates that gender diversity on boards moderates the effect of digital transformation in a way that weakens its positive impact on sustainable development. This finding aligns with prior research suggesting that gender-diverse boards may face challenges in aligning diverse viewpoints, which could lead to slower decision-making or resistance to change, particularly in the context of complex initiatives like digital transformation (Zhang et al., 2024). However, this result also underscores the need for further investigation into how gender diversity might influence organizational innovation and sustainability practices, as the dynamics within gender-diverse boards can vary depending on industry, company culture, and the experience of board members.

Therefore, the regression results suggest that while digital transformation is a powerful driver of sustainable development, the composition of the board plays a crucial role in moderating this relationship. Age diversity and gender diversity appear to pose challenges in maximizing the potential of digital transformation for sustainability, whereas board experience diversity has a facilitative effect. These insights contribute to the growing body of literature on corporate governance and digitalization, suggesting that organizations should consider not only the technological capabilities of digital transformation but also the governance structures that support its implementation.

Table 3
Regression Results

Variables	(1) ESG	(2) ESG	(3) ESG
DT	0.04***	0.04***	0.04***
	(0.08)	(0.08)	(0.08)
GD		0.007**	
		(1.07)	
DT*GD			0.16***
			(0.25)
SIZE	0.33 ***	0.32 ***	0.33 ***
	(0.02)	(0.02)	(0.01)
GROW	-0.04***	-0.03***	-0.04***
	(-2.72)	(-2.04)	(-2.44)
ROA	1.53***	1.46***	1.52***
	(0.26)	(0.27)	(0.26)
CF	0.81***	0.76***	0.78***
	(0.13)	(0.19)	(0.14)
LEV	-0.08***	-0.08***	-0.11***
	(-2.79)	(-2.81)	(-3.21)
Observations	19,320	19,320	19,320
R-squared	0.165	0.166	0.173
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

Note: We control for year and industry-fixed effects in all columns. The explained variable ESG represents corporate ESG performance. The proxies for the independent variable of digital transformation is the DT. SIZE = firm size, the natural logarithm of total assets. ROA = return on assets, the ratio of net income to total assets. LEV = leverage, the ratio of liabilities to total assets. CF = cash flow, the ratio of total assets to operating cash flow. GROW = firm growth, the market-to-book ratio of total assets. GT = board gender diversity, dummy variable value taking of 1 for GT > MEAN, otherwise 0. ***, **, * represent $P < 0.01$, $P < 0.05$, and $P < 0.1$, respectively. Standard errors adjusted for heteroscedasticity are presented in parentheses.

Robustness Test
This study also conducted regression analyses using alternative variables to ensure that the results are stable. Specifically, to address the potential impact of varying measurement methodologies on the robustness of our findings, this study substitutes the ESG data sourced from Huazheng in the benchmark model with ESG performance data from Bloomberg (ESG_PB). This substitution allows for a more comprehensive assessment of corporate sustainable development and strengthens the reliability of our conclusions by mitigating potential biases introduced by differing data sources. Bloomberg's ESG data provides a standardized rating on a scale of 0 to 100, encompassing three core dimensions: environmental impact, social responsibility, and corporate governance. These dimensions provide a multifaceted view of sustainability, offering insights into how companies perform in critical areas such as environmental stewardship, social equity, and governance practices.

The use of Bloomberg's data ensures a high level of comparability across firms and regions, as its methodology is widely recognized for its consistency and rigor in evaluating corporate sustainability.

Incorporating Bloomberg's ESG data into our regression model, as detailed in Table 4, enables us to assess whether digital transformation continues to play a significant role in enhancing corporate sustainable development, even after replacing the dependent variable. The results of this analysis confirm that the positive relationship between digital transformation and corporate sustainability remains robust, even when accounting for the substitution of data sources and the different dimensions of ESG performance. This finding not only reinforces the conclusions drawn from the initial model but also demonstrates the resilience of the relationship across various methodological adjustments. By using Bloomberg's data, we further substantiate the argument that digital transformation is a crucial enabler of corporate sustainability, suggesting that its impact is not contingent upon the specific ESG data source employed.

Table 4
Robustness Test

Variables	(1) ESG	(2) ESG	(3) ESG
DT	0.33***	0.41***	0.29***
	(0.08)	(0.13)	(0.07)
GD		0.14**	
		(2.34)	
DT*GD			0.52***
			(2.21)
SIZE	2.72 ***	3.87 ***	2.57 ***
	(0.12)	(0.14)	(0.11)
GROW	-0.17***	-0.14***	-0.16***
	(-0.13)	(-0.14)	(-0.14)
ROA	4.51***	5.37***	5.53***
	(1.62)	(1.71)	(1.73)
CF	4.74***	5.25***	4.82***
	(1.54)	(1.82)	(1.56)
LEV	-1.33***	-1.64***	-1.37***
	(-0.68)	(-0.63)	(-0.21)
Observations	19,320	19,320	19,320
R-squared	0.392	0.368	0.371
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

Note: We control for year and industry-fixed effects in all columns. The explained variable ESG represents corporate ESG performance. The proxies for the independent variable of digital transformation is the DT. SIZE = firm size, the natural logarithm of total assets. ROA = return on assets, the ratio of net income to total assets. LEV = leverage, the ratio of liabilities to total assets. CF = cash flow, the ratio of total assets to operating cash flow. GROW = firm growth, the market-to-book ratio of total assets. GT = board gender diversity, dummy variable

value taking of 1 for GT > MEAN, otherwise 0. ***, **, * represent $P < 0.01$, $P < 0.05$, and $P < 0.1$, respectively. Standard errors adjusted for heteroscedasticity are presented in parentheses.

Conclusion

This study explores the moderating role of board gender diversity in the relationship between digital transformation and corporate ESG performance within the context of Chinese firms. Drawing upon the RBV and Upper Echelons Theory, the findings offer important insights into whether governance structures, particularly board composition, can influence the effectiveness of digital transformation efforts in advancing sustainability outcomes.

The results confirm that digital transformation significantly enhances corporate ESG performance, providing empirical support for the growing body of literature that emphasizes the role of digitalization in driving sustainable business practices. By integrating digital technologies, firms can improve operational efficiency, enhance transparency, and engage stakeholders more effectively, which are critical components of ESG performance. In this regard, RBV highlights that digital capabilities, as valuable and rare resources, enable firms to improve their capacity to address sustainability challenges, thereby fostering long-term competitive advantage.

However, the study also reveals that the impact of digital transformation on ESG performance is contingent upon the composition of the board, particularly with regard to gender diversity. Upper Echelons Theory provides a theoretical lens for understanding how board characteristics shape corporate strategies and outcomes. The findings suggest that board gender diversity moderates the digital transformation-ESG performance relationship. Specifically, gender-diverse boards can bring a broader range of perspectives to strategic decision-making, which may facilitate the adoption of more inclusive and innovative approaches to sustainability. However, the challenges associated with managing diverse viewpoints may also slow down the implementation of digital strategies, particularly when consensus on sustainability goals is difficult to achieve (George et al., 2021).

In terms of practical implications, the study suggests that companies seeking to maximize the benefits of digital transformation for sustainability should prioritize not only technological investment but also diverse and dynamic governance structures. Gender-diverse boards are better positioned to incorporate diverse perspectives and drive forward-thinking strategies, which can enhance the effectiveness of digital initiatives in achieving ESG objectives. This underscores the importance of governance diversity as a strategic asset in the digital age.

For policymakers, the findings highlight the potential benefits of promoting board diversity to improve corporate sustainability outcomes. Encouraging gender diversity in leadership roles could enhance the effectiveness of digital transformation and its contribution to broader societal goals. Similarly, investors may find it valuable to incorporate board diversity metrics when evaluating the long-term sustainability potential of firms, as gender-diverse boards may be more adept at navigating the complexities of digital transformation and ESG performance.

In conclusion, this study extends our understanding of the interplay between digital transformation, corporate governance, and sustainable development. It underscores the

importance of considering board diversity as a moderating factor in the effectiveness of digital strategies aimed at enhancing ESG performance. The findings not only contribute to the existing literature on governance and sustainability but also provide actionable insights for businesses, policymakers, and investors looking to drive corporate sustainability in the digital era.

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