Research Article

Don Bosco Institute of Technology Delhi Journal of Research
Year 2025, Volume-2, Issue-1 (Jan - Jun)

An Analysis of Indian Firm Levels' Digital Finance, ESG Performance, and Financial Performance: A Road Map to Long-Term Sustainability

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ARTICLE INFO

Keywords: *Digital Finance, India, Sustainability, ESG, Financial Performance, Digital Finance.*

doi: 10.48165/dbitdjr.2025.2.01.04

ABSTRACT

This research aims to investigate the processes for using digital finance to address the sustainability triple-bottom-line challenge, as digital finance is essential for attaining sustainability. Within the context of digital finance, this article investigates the inner workings of the relationship between financial performance and ESG (environmental, social, and governance) factors. Indirectly improving both short- and long-term financial success for organizations, digital finance promotes ESG performance, according to the research. Furthermore, the key enabler for ESG and short-term financial success is the depth of digital finance adoption. According to the results of the mechanism study, improving green innovation and bolstering digital transformation would strengthen the favorable correlation between digital finance and ESG. Furthermore, according to heterogeneity study, big businesses and SOEs (state-owned enterprises) have a stronger positive effect on ESG and financial performance when it comes to digital finance use depth, but small firms and non-SOEs have a stronger positive effect on ESG when it comes to coverage breadth. By outlining potential avenues for sustainable behavior, this article deepens our understanding of digital money.

INTRODUCTION

Recent years have seen a surge in study on the relationship between digital finance, ESG performance, and financial success, especially as it pertains to Indian enterprises. A combination of factors, including the growing importance of ESG principles from regulators and stakeholders and the widespread use of digital financial technology, is forcing companies to reevaluate their long-term goals.[1] Corporate governance, profitability, and sustainability in a globe with one of the fastest-growing economies are all profoundly affected by this dynamic interaction. [2] The concept of digital

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Received 25.01.2025; Accepted 12.04.2025

finance, which includes all forms of electronic payment and related services, has recently become quite popular in India. As a result of digital finance, companies are able to make better decisions in real time, increase operational efficiency, and extend financial inclusion. This is in response to government programs like Digital India and the increasing number of fintech platforms. The extent to which a company has embraced digital finance, as well as its depth and breadth, are now critical performance metrics for measuring digital transformation. [3]

The importance of sustainability is growing among both local and international stakeholders, and Indian companies are putting more emphasis on ESG performance to catch up to global standards. [4] ESG performance is a measure of how well a company incorporates responsible business practices, strong governance, and environmental protection into its daily operations. A sign of long-term strength and competitiveness in today's international economy, it also serves as a measure of corporate accountability. [5,6] To this day, financial performance is still the gold standard by which company plans are judged. Several important metrics are used to assess profitability, operational efficiency, and value creation, including Return on Assets (ROA) and Economic Value Added (EVA). If Indian businesses want to attract investors, fuel expansion, and survive competitive challenges, they must maintain strong financial performance. [7]

For Indian companies, the future lies in the dynamic triangle of digital finance, environmental, social, and governance (ESG) performance, and profits. With its potential to improve resource management, transparency, and innovation, digital finance may be a game-changer when it comes to ESG performance. [8,9] By increasing trust among investors, decreasing vulnerability to risk, and strengthening relationships with existing customers, robust ESG policies may improve financial results. For Indian businesses to thrive in this age of digital disruption and environmental consciousness, it is essential to dissect these connections.[10] In order to investigate these links, this research looks at data collected from individual firms, concentrating on measures like financial performance indicators, ESG indices, and digital finance inclusion indices. As a result of its examination of the interaction between these factors, this study sheds light on how Indian companies might adapt to the increasingly competitive global market. [11]

RESEARCH METHODOLOGY

Digitalization enhances corporate social responsibility (CSR) and corporate governance by making information more accessible and transparent, which in turn helps stakeholders safeguard their rights and interests. It also allows enterprises to earn green assurances and excellent trust, which are beneficial for corporate governance. Digital finance also aids in lowering agency costs and increasing goodwill, all of which contribute to ESG.

Second, businesses may access capital to finance environmentally friendly innovations thanks to digital finance's expanded funding sources and easing of financing limits. In the end, we want to steer output toward greener targets. Hence, digital finance will produce solid ESG, and the following is the first hypothesis:

H1: *ESG performance is favorably impacted by digital finance.*

There has been conflicting findings from the available research on the effects of digital finance on financial performance, despite the fact that this sector is fundamental to contemporary economic growth. Notwithstanding the contentious history of the subject, we maintain that digital finance enhances financial performance via processes including resource information advantage and technological advantage.

Second, digital finance is reliant on IT (i.e., blockchain, big data, etc.), according to the literature. Digital finance is a byproduct of technological advancements in the digital realm; it makes use of the long-tail impact of technological platforms to drastically cut marginal costs; this, in turn, may boost market vitality by reducing financing limits and increasing the breadth of services. We develop the second hypothesis in light of the study in the following way:

H2: *Financial performance is favorably impacted by digital finance.*

As mentioned in Hypotheses 1 and 2, we believe that digital finance is essential for increasing financial performance and ESG performance of organizations. A socially responsible digital finance strategy that bolsters ESG performance gives businesses an edge in the market. At the same time, stakeholder theory provides further support for the holistic approach to studying ESG and financial performance. This theory posits that in order for digital finance to be successful, it must address the legitimate concerns of all parties involved, including the economy, society, and the environment, in order to establish long-term strategies for improving financial outcomes.

The research concludes that digital finance may have an indirect effect on financial success via ESG performance. To improve agency costs and reputation, we argue that digital finance may help businesses perform better in ESG metrics. Optimisation of manufacturing and service processes may increase total factor productivity, which in turn can enhance the survival advantages and benefits enjoyed by organizations. Consequently, we conclude that ESG encompasses the ways in which digital finance may enhance the financial performance of organizations and provide the following third hypothesis:

H3: *Digital finance and financial performance are mediated by ESG performance.*

However, digital finance may also help advance ESG by easing the digital transition of the company. For digital finance to be developed and used effectively in company activities, digital technology must be implemented. As a result, digital transformation of organizations is now needed. via digital transformation, stakeholder satisfaction is enhanced via more timely and transparent information sharing, which in turn boosts employee happiness and job productivity through optimizing office procedures. As a result, companies are able to increase their ESG performance by fostering goodwill and trust. So, it is suggested that H4 be used.

H4: *Green innovation and digital transformation are two ways to maximize the benefits of digital finance.*

The governance structure, resource endowment, and strategic posture of a corporation are all impacted by ownership. SOEs have higher social responsibility and obtain more policy support because of their political links. They also receive more resources. Digital financing, on the other hand, may help non-SOEs overcome financial obstacles like investment budget limits, which is crucial to their survival and growth in the face of fierce market competition. Therefore, hypothesis 5 is proposed

H5: *The effects of digital finance on ESG and financial performance vary depending on the size and ownership structure of the company.*

Variables

A firm's ESG performance (*ESG*) is measured using the IESG (Environmental, Social and Governance Database of Listed Company) Database from the INRDs (Indian Research Data Services) platform. IESG referred to the design ideas of the internation- ally important ESG rating databases: MSCI (Morgan Stanley Capital International) ESG database and Bloomberg's ESG Rating System and combined them with the Indian- specific context. The firm ESG index, as the explained variable, ranges from 6 to 6, while the mean value is a mere 2.3076 (the mean values of sub-category indicators of ESG are as follows: charity, volunteer activities, and social controversy are 0.3346; corporate gover- nance is 0.3486; diversity is 0.2668; employee relations is 0.5876; environment is 0.3348; and products is 0.4252), implying that Indian firms are still relatively behind in implementing environmental and social governance.

Using regional transaction data, we can examine the relationship between the development and use of digital finance inside enterprises and the establishment of regional technology platforms. In order to measure the digital finance level of enterprises, most existing research uses the digital finance index of the city or province where the firms are situated. Having said that, it is important to note that continued attention and study are focused on the digital finance index on a firm-by-firm basis. "The Digital Finance Institute at Peking University has developed a sub-evaluation index that incorporates the Digital Coverage Index (DfI), the Digital Usage Index (DfII), and the Digitalization Degree Index (DfIII). Digital finance in India is still in its early stages of growth, with a mean Df value of 5.2899, up from 4.2451 in 2011 and 5.7708 in 2021. Manageable factors. Employing firm size (Size), labor intensity (Labor), ownership concentration (Con), and state-owned enterprises (SOE) as control variables allows us to capture organizational aspects. For the definitions, see the table.

Table 1: Descriptive statistics and variables

Variables	Definitions	Mean	SD	Min	Max
ESG	The INRDs platform's ESG performance index	2.308	0.959	-1.580	5.604
Df	The logarithm of the digital finance inclusion index at the municipal level	5.282	0.455	3.193	5.885
EVA	The value contributed to an economy as a logarithm	15.394	0.232	0.000	15.834
ROA	Distribution of net profit relative to total assets	0.044	0.050	-0.467	0.482
DfI	Exponentiation of the coverage breadth index	5.290	0.446	1.856	5.918
Size	The value of a company's assets as a logarithm	14.225	1.446	10.823	19.083
DfIII	The digital degree index's logarithm	5.253	0.465	1.221	6.365
DfII	Logarithm of the index for the depth of use	5.253	0.465	2.639	5.870
Labor	Employees as a percentage of revenue	0.010	0.011	0.000	0.188
Con	The biggest shareholder's shareholding ratio	0.376	0.155	0.034	0.865
SOE	A single-value dummy variable that signifies whether an entity is state-owned or not	0.672	0.470	0.000	1.000

Data Sources

The companies that are part of the A stock markets on the Shenzhen and Shanghai Stock Exchanges are surveyed in this article. The INRDs platform is used to gather ESG and innovation data, the CnOpenData database is used to extract data on the degree to which firms have digitalized, and the CSMAR database is used to gather general information on financial performance and control factors. The Institute of Digital Finance at Peking University provides the data for digital finance. After excluding ST and PT samples, those with too many missing data, and the financial sector, the remaining study sample includes 425 listed businesses spanning 4675 company years, from 2013 to 2023. Descriptive statistics for the variables are shown in Table 1. As we can see, the range of ESG values is from 1.580 to 5.604, with 2.308 as the lowest and 0.959 as the standard deviation. The findings demonstrate that ESG varies throughout companies. With a mean ROA of 0.044 and a standard deviation of 0.050, we can see that listed companies' profitability varies significantly. firms' economic added value varies substantially, with a mean value of 15.394 and a range of 0 to 15.834. This indicates that the sample of listed firms has a rather high economic added value. Indian cities prioritize the growth of digital finance, as shown by the mean, standard deviation, minimum, and maximum values of DF, which are 5.282, 0.455, 3.193, and 5.885, respectively. The sample level is moderate to higher level.

Economic Requirements

we take into account the features of the dataset and the impact of endogeneity caused by the bias in omitted variables. To investigate how digital banking affects ESG and financial performance, this research uses a two-way fixed-effect panel data model.

$$y_{it} = \alpha + x_{it}\beta + z_{it}\sigma + \gamma_t + \mu_i + \varepsilon_{it}$$

ESG, ROA, and EVA are the discussed variables, and their corresponding symbols are y_{it}. While zit serves as a control variable, x_{it} is the explanatory variable (Df), and sub-indicators DfI, DfII, and DfIII are used to delve further into the diverse role mechanisms of digital finance. Time is represented by γ_t, individual fixed effects by μ_i, and the random error by ε_{it}. Parameters that need to be estimated are α, β, and σ. For each year and company, the subscripts i and t stand in for them.

An overarching theoretical goal of this effort is to forge a connection between digital finance, ESG, and bottom-line results. Truant et al. said that ESG takes into account the firm's performance in the areas of environment, social responsibility, and governance, which represent the firm's sustainability, while Zhang et al. argued that financial success is both necessary and desirable for a firm's survival. As a result, studying the connection between digital finance and financial performance including ESG factors is essential. In doing so, it may aid a company's economic development in a manner that is good for society, the environment, and corporate governance. In particular, the article evaluates ESG's mediating influence using the stepwise regression method. We employ models that are

$$Y_{it} = \alpha + x_{it}\beta + z_{it}\sigma + \gamma_t + \mu_i + \varepsilon_{it}$$

$$ESG_{it} = \alpha + x_{it}\beta + z_{it}\sigma + \gamma_t + \mu_i + \varepsilon_{it}$$

$$Y_{it} = \alpha + x_{it}\beta + ESG_{it}\chi + z_{it}\sigma + \gamma_t + \mu_i + \varepsilon_{it}$$

The financial performance variables, ROA and EVA, respectively, are denoted by Y_{it}.

RESULTS

Findings from the Benchmark Regression

Table shows Equation regression results. Digital banking improves ESG but hurts ROA and EVA, according to Model 1, Model 3, and Model 5. Thus, H1 is accurate and H2 is incorrect: digital finance will enhance ESG performance in India but not their financial outcomes in the near or distant future. Digital banking increases investment costs, market volatility, and competition, which hurts corporate profitability. Digital finance improves business ESG owing to social inclusion, environmental sustainability, and governance transparency.

Digital finance subvaluations include coverage breadth (DfI), usage depth (DfII), and digitization degree (DfIII). The three components' effects are then examined. Digital money has altered ESG, Model 2 says DfI and DfII boost ESG. One exception is DfIII. ESG gains from coverage and usage expansion, the statistics show. Digital finance's long-tail effect dynamically finances strong ESG. Growing digital financial digitization affects ESG. This may be because Indian digital technology is evolving fast enough to provide digital banking services. About internet banking's impact on profits. Model 4 shows that DfI and DfIII considerably lower ROA, whereas DfII enhances it. According to Model 6, DfIII dramatically decreases EVA, but DfI and DfII have no effect. The full impact of digital finance on the firm's financial performance has yet to be determined, but its breadth will hurt short-term profits without changing long-term outcomes. These results show how expanding digital financial usage may boost organizations' financial resources and bring immediate financial rewards.

Table 2: Findings from benchmark estimation

Variables	Df	DfI	DfII	DfIII	Size	Labor	SOE	Con	Constant	Fixed Effect
Model 1 (ESG)	0.337 ***(0.032)	0.314*** (0.080)	0.428*** (0.081)	-0.260 ***(0.041)	0.236 ***(0.034)	-2.417 (2.115)	-0.017 (0.096)	-0.189 (0.198)	-2.795 *** (0.415)	Yes
Model 2 (ESG)	-.010 ***(0.002)				0.223 *** (0.034)		-.027 (0.003)	-.108 (0.191)	-2.571 *** (0.425)	Yes
Model 3 (ROA)	-0.005 *** (0.002)	-0.010 ** (0.004)	0.011 ** (0.005)	-0.007 ***(0.002)	-0.010 ***(0.002)	-1.126 ***(0.117)	-0.003 (0.015)	-0.015 (0.011)		Yes
Model 4 (ROA)		-0.003 (0.004)	0.006 (0.004)	-.005 **(0.002)	-.011 ***(0.002)	-.107 ***(0.117)	-.005 (0.015)			Yes
Model 5 (EVA)					0.002 (0.002)	-0.542 *** (0.111)	-0.010 (0.015)		15.404 *** (0.022)	Yes
Model 6 (EVA)										Yes

The tables illustrate that ESG mediates the relationship between Df and ROA and EVA, two metrics of short- and long-term financial performance. The extremely substantial and negative Df coefficients for ROA and EVA contrast with ESG's positive ones. In contrast, ROA and EVA ESG coefficients are positively significant, matching the findings. These results complement H3, which reveals that digital finance directly hurts short- and long-term financial performance while indirectly improving it via ESG. ESG partially mitigates digital finance's financial performance inhibitory impact. Digital financial service companies may boost profits by subscribing to ESG. ESG improvement may lower debt financing costs and increase financial flexibility, benefiting a company's bottom line.

Due to the variety of DF sub-dimensions, we used ESG to study how Df affects short- and long-term financial performance. ESG and short-term financial performance-ROA DfII coefficients are 0.386 and 0.009. ESG may boost ROA and digital finance adoption depth. Significantly, DfI has 0.420 ESG and 0.012 ROA. Digital finance coverage breadth hurts short-term financial performance, but ESG mitigates it. DfIII's ESG and ROA coefficients are strong at 0.186 and 0.007. Digital finance's digitalization reduces ROA, therefore ESG may damage it. DfI and DfII have no direct impact on EVA, but ESG may positively and indirectly affect it, which is crucial for long-term financial success. ESG performance may improve digital finance's coverage, use, and long-term profitability. ESG may worsen the link between digital financial digitalization and EVA, hence DfIII hurts EVA directly and indirectly. ESG links digital finance to bottom-line performance. First, digital finance development needs the use of digital technological instruments, which demands a huge investment and may drain organizations' financial resources in the short and long run. Second, India has world-class digital finance and infrastructure. Digital financial coverage may improve economic, social, governance, and environmental growth.

ESG boosts short- and long-term financial success. This means ESG activities show the firm's commitment to social and environmental sustainability and give present and future financial returns. We found similar ESG consequences. Digital finance may strengthen ESG performance and a company's social, economic, and environmental sustainability. ESG disclosure reduces the knowledge gap between corporations and their stakeholders, fostering trust and a green guarantee for businesses, improving financial performance and market competitiveness. Eco-conscious investors solely fund socially and ecologically responsible businesses. ESG demands a substantial investment and takes time to show, therefore long-term financial success must be considered. Green firms beat their competitors by taking advantage of greener business prospects, improving employee happiness, saving money, decreasing risk, improving reputation, and receiving better financing.

Table 3: Evidence from ESG-related mediating effects studies on digital finance and near-term financial outcomes

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**
	ROA				**ESG**				**ROA**			
Panel A: Stepwise Regression Estimation												
ESG									0.003*** (0.001)	0.003*** (0.001)	0.003 *** (0.001)	0.003*** (0.001)
Df	−0.010 ***(0.002)				0.390***(0.027)				−0.011*** (0.002)			
DfI		−0.010***(0.002)				0.420***(0.028)				−0.012 ***(0.002)		
DfII			0.010 ***(0.001)				0.386*** (0.030)				0.009 ***(0.001)	
DfIII				−0.008 ***(0.001)				−0.186 *** (0.017)				−0.007*** (0.001)
Control Vars.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: mediating effects analysis												
Mediating variable: ESG	**Total effects**				**Indirect effects**				**Direct effect**			
	-0.010	-0.011	-0.010	-0.008	0.001	0.001	0.001	-0.0001	-0.011	-0.012	-0.009	-0.007
	Proportion of Total effect mediated				**Indirect to direct effect**				**Total to direct effect**			
	10.00	9.091	10.00	12.500	9.091	8.333	11.111	14.286	90.909	91.909	111.111	114.286

Table 4. The findings of the ESG mediating effects studies on digital finance and long-term financial performance cannot be ignored.

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**
	EVA				**ESG**				**EVA**			
Panel A: Stepwise Regression Estimation												
ESG									0.003 *** (0.001)	0.003 *** (0.001)	0.003 *** (0.001)	0.003 *** (0.001)
Df	−0.005 *** (0.001)				0.390 *** (0.027)				−0.006 *** (0.001)			
DfI		−0.003 (0.004)				0.420*** (0.028)				−0.004(0.003)		
DfII			−0.006 (0.004)				0.386 *** (0.030)				−0.007 (0.005)	
DfIII				−0.004 ** (0.002)				−0.186 *** (0.032)				−0.005 *** (0.002)
Control Vars.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: mediating effects analysis												
Mediating variable: ESG	**Total effects**				**Indirect effects**				**Direct effect**			
	-0.005	-0.003	-0.006	-0.004	0.001	0.001	0.001	-0.0001	-0.006	-0.004	-0.007	-0.005
	Proportion of Total effect mediated				**Indirect to direct effect**				**Total to direct effect**			
	20.00	33.33	16.667	25.00	16.667	25.00	14.286	20.00	83.333	75.00	85.714	80.00

Robustness Tests

Even if incorporating control variables and adjusting for the two-way fixed effects in the benchmark regression helps with endogeneity, reverse causality, measurement errors, and missing variables may still influence regression robustness. Use instrumental variable (IV) estimation to reduce inherent difficulties. Following endogeneity suggestions, we utilize a 2SLS regression approach to show internet penetration using provincial mobile phone penetration as an instrumental variable. Table proves IVs work. Df affects ESG, ROA, and EVA similarly to benchmark results. The findings seem robust after endogeneity correction.

Table 5: Results of the endogeneity test

Variables	**Df**	**Phone**	**Control Vars**	**Fixed Effect**	**Kleibergen-Paap LM Statistic**
Phase II (ESP)	1.127 *** (0.102)	-	Yes	Yes	384.511
Phase I (ESP)	-1.251 *** (0.264)	0.366 *** (0.016)	Yes	Yes	21.868
Phase II (ROA)	-0.019 *** (0.005)	-0.501 *** (0.105)	Yes	Yes	395.889
Phase I (ROA)	-	-	Yes	Yes	-
Phase II (EVA)	-	-	Yes	Yes	524.156
Phase I (EVA)	0.327 *** (0.095)	-	Yes	Yes	545.852

Tables provide three additional robustness tests that support the aforementioned conclusions. First, alter the regression model. Following, we fitted the sample data using quantile regression. Second, we excluded uncommon explanatory factors. A 1% double-tailed retraction was applied to digital finance, ESG, and financial performance variables to eliminate outliers. Third, a first-order lagged digital financial level replaced the digital finance variable. Tables reveal that the digital finance coefficient sign matches baseline values, confirming the study's robustness.

Table 6: Extensive findings from ESG robust estimate

Variables	Df	DfI	DfII	DfIII	Control Vars	Fixed Effect
Quantile Regression (0.1)	0.465 *** (0.085)	0.765 *** (0.233)	0.174 (0.232)	-0.04266	Yes	Yes
Quantile Regression (0.5)	0.322 *** (0.078)	0.307 *** (0.101)	0.418 *** (0.127)	-0.247 *** (0.065)	Yes	Yes
Quantile Regression (0.9)	0.410 *** (0.149)	0.388 *** (0.227)	0.286 (0.285)	-0.155 (0.158)	Yes	Yes
Exclude Odd Values	0.339 *** (0.032)	0.433 *** (0.094)	0.464 *** (0.087)	-0.336 *** (0.044)	Yes	Yes
Lagging ESG by First-Order	0.457 *** (0.033)	0.255 * (0.132)	0.755 *** (0.095)	-0.279 *** (0.041)	Yes	Yes

Table 7: Conclusions on ROA estimate that are robust

Variables		Df	DfI	DfII	DfIII	Control Vars.	Fixed Effects
Quantile Regression (Q)	**0.1**	−0.004 ** (0.002)	−0.006 (0.006)	0.015 *** (0.005)	−0.009 *** (0.003)	Yes	Yes
	0.5	−0.007 ** (0.003)	−0.011 (0.009)	0.018 *** (0.007)	−0.012 *** (0.003)	Yes	Yes
	0.9	−0.010 ** (0.005)	−0.031 *** (0.010)	0.027 *** (0.008)	−0.009 (0.011)	Yes	Yes
Exclude Odd Values of Variables		−0.009 *** (0.001)	−0.011 *** (0.004)	0.011 *** (0.004)	−0.007 *** (0.002)	Yes	Yes
Lagging ROA by First-Order		−0.015 *** (0.002)	−0.009 ** (0.005)	0.011 ** (0.005)	−0.003 ** (0.002)	Yes	Yes

Table 8: Reliable estimate outcomes for EVA

Variables		Df	DfI	DfII	DfIII	Control Vars.	Fixed Effects
Quantile Regression (Q)	**0.1**	0.001 (0.034)	−0.001 (0.001)	0.004 (0.003)	−0.002 ** (0.001)	Yes	Yes
	0.5	−0.001 *** (0.000)	−0.001 (0.001)	0.002 * (0.001)	−0.001 ** (0.000)	Yes	Yes
	0.9	−0.004 * (0.002)	−0.010 (0.086)	0.004 (0.106)	−0.001 ** (0.000)	Yes	Yes
Exclude Odd Values of Variables		−0.005 *** (0.001)	−0.003 (0.003)	0.004 (0.003)	−0.004 ** (0.002)	Yes	Yes
Lagging EVA by First-Order		−0.002 ** (0.001)	−0.005 (0.004)	0.003 (0.004)	−0.003 * (0.002)	Yes	Yes

Analyzing the Mechanism

This paper presents empirical evidence that digital finance promotes ESG and that ESG may successfully reduce the negative implications of digital finance on financial performance. It combines digital finance, ESG, and financial performance into a theoretical framework. According to Table, green innovation is calculated as the logarithm of "1 + the patent applications of green inventions and green utility models." This metric is used to quantify digital finance's impact on environmental, social, and governance (ESG) metrics via green innovation and company digital transformation." Our research use text analysis methods to evaluate the firm's digital transformation. In particular, we extract terms and frequency distributions pertaining to digital transformation in the following areas from annual report texts: AI, big data, cloud computing, blockchain, and digital technology application. The next step is to compile and analyze the word frequencies from the aforementioned respects. The data in Table lend credence to H4.

Table 9: The influence mechanism of digital on ESG.

Variables	Df	SA	GInno	Dig	Control Vars.	Fixed Effects	Sobel Test
Total Effects (ESG)	0.390 *** (0.027)	-	-	-	Yes	Yes	
Green Innovation (GInno)	0.110 *** (0.023)	-	-	-	Yes	Yes	2.256 ** (0.024)
Green Innovation (ESG)	0.382 *** (0.027)	-	0.085 *** (0.018)	-	Yes	Yes	
Digital Transformation (Dig)	0.822 *** (0.028)	-	-	-	Yes	Yes	10.070 *** (0.000)
Digital Transformation (ESG)	0.290 ** (0.029)	-	-	0.110 *** (0.014)	Yes	Yes	

In relation to the function of green innovation, the results shown in columns (2) and (4), together with column (3)'s indication of a substantial and beneficial effect of Df on GInno, suggest that digital financing encourages green innovation. It shows that digital finance encourages ESG by supporting environmentally friendly innovations. By increasing access to capital for research and development (R&D), decreasing energy use, cutting emissions via more efficient manufacturing and service, and greening technology, digital finance clearly has a positive impact on green innovation. In addition to improving their ESG performance, it reduces environmental impact on businesses.

In relation to the function of digital transformation in firms, Column (5) shows that digital finance has a positive and statistically significant effect on digital transformation (Digi). It shows that digital finance improves ESG by increasing enterprises' digital transformation, combining the data from columns (2) and (6). In order for digital finance to progress, digital information technology must be in place, and for digital financial growth to take place, businesses must increase their level of digitization. The paperless office is one step in the digital transformation of the company that aims to improve corporate governance by standardizing process management and lowering energy usage.

Analysis of Heterogeneity

A long tail exists in digital finance. Research emphasizes its importance for small businesses. Small businesses—a large share of the market—are believed to drive social and economic improvement. Larger companies benefit more from resource economies and scale. Based on the median business size, we split the sample into small and large businesses. The following table shows how digital finance affects ESG, ROA, and EVA for different firm sizes.

Table 10: Regression findings for varying business sizes

Variables		Df	DfI	DfII	DfIII	Control Vars.	Fixed Effect
Large-Scale Firms Group	**ESG**	0.470 *** (0.051)	0.283 * (0.145)	0.753 *** (0.132)	-0.371 *** (0.067)	Yes	Yes
	ROA	-0.010 *** (0.002)	-0.011 ** (0.005)	0.012 ** (0.005)	-0.008 *** (0.002)	Yes	Yes
	EVA	-0.011 *** (0.004)	-0.010 (0.009)	0.014 (0.009)	-0.011 ** (0.005)	Yes	Yes
Small-Scale Firms Group	**ESG**	0.230 *** (0.040)	0.637 *** (0.119)	0.120 (0.111)	-0.305 *** (0.056)	Yes	Yes
	ROA	-0.008 *** (0.002)	-0.010 (0.007)	0.010 (0.007)	-0.000018	Yes	Yes
	EVA	-0.002 *** (0.000)	-0.000002	0.001 (0.001)	-0.001 (0.001)	Yes	Yes

The results provide credence to H5, showing that digital financing has a more favourable influence on ESG in big enterprises, but a more negative effect on ROA and EVA. When looking at the Df sub-dimensions, it is clear that the depth of digital finance use has a greater impact on increasing the ESG and ROA of big enterprises. When it comes to improving the ESG of small businesses, the digital financial covering breadth is superior. One benefit of digital finance is the increased availability of capital for both established companies and startups.

Ownership

Among the many institutional factors that could influence digital finance results, the nature of a company's ownership structure has the potential to impact its strategic orientation, governance structures, and the distribution of resources. The influence of digital finance is mitigated because of political linkages, which provide state-owned enterprises (SOEs) preferential treatment from the government and control over the distribution of resources. State-owned enterprises (SOEs) are oriented toward societal and political objectives. Increased market dynamism and socioeconomic progress in India are consequences of non-SOEs. Table displays the results of our analysis of the varied effects of digital finance on ESG, ROA, and ESG across different forms of ownership.

Table 11: Differences in ownership and the impact on regression findings

Variables		Df	DfI	DfII	DfIII	Control Vars.	Fixed effect
SOEs	**ESG**	0.370 *** (0.039)	0.269 ** (0.114)	0.578 *** (0.106)	-0.303 *** (0.054)	Yes	Yes
	ROA	-0.011 *** (0.002)	-0.015 *** (0.005)	0.016 *** (0.004)	-0.009 *** (0.002)	Yes	Yes
	EVA	-0.006 *** (0.002)	-0.005 (0.006)	0.007 (0.006)	-0.000015	Yes	Yes
Non-SOEs	**ESG**	0.265 *** (0.058)	0.803 *** (0.163)	0.146 (0.149)	-0.399 *** (0.075)	Yes	Yes
	ROA	-0.008 *** (0.003)	-0.004 (0.009)	0.001 (0.010)	-0.003 (0.004)	Yes	Yes
	EVA	0.001 (0.002)	0.002 (0.005)	0.003 (0.006)	0.002 (0.002)	Yes	Yes

Digital finance improves ESG and decreases ROA in SOEs but has little impact on EVA in non-SOEs, supporting H5. ESG-wise, digital finance coverage breadth benefits non-SOEs in the Df sub-dimensions. Non-SOEs have more competitive incentives and are more creative and adaptive. This lets companies adapt quicker to customer demand for more digital financial products and services. Digital finance use depth (DfII) is considerably greater in sovereign wealth enterprises (SOEs) than in non-SOEs, boosting ESG and ROA. [12] However, non-SOEs' digital finance use depth coefficient is negligible. Differences exist between the results and. Our study expands on earlier work and emphasizes digital financial components, which may contribute. This shows that SOEs may enhance their ESG and ROA by using digital finance more, meaning that they consistently emphasize social and environmental responsibility. State-owned businesses (SOEs) may increase digital finance use, which can boost social, environmental, and short-term economic growth. Non-SOEs may expand digital finance coverage, improving social and environmental governance.

CONCLUSION

This research examines how digital finance affects ESG and financial performance, focusing on kinds, nonlinearity, and heterogeneity. Digital finance improves ESG (coefficient: 0.337) but has no direct effect on short- and long-term financial performance (ROA: 0.010, EVA: 0.005). ESG indirectly improves financial performance, with digital finance adoption depth being the main driver. In contrast, digital finance coverage breadth favorably influences ESG and indirectly affects financial performance. Digital finance promotes ESG via green innovation and digital transformation, according to mechanism analysis. Heterogeneity research demonstrates that digital finance use depth favors major enterprises and SOEs more than coverage breadth for small firms and non-SOEs.

These findings have policymaker and firm ramifications. The report emphasizes linking digital finance activities with ESG targets, notably by funding green innovation and digital transformation. To obtain sustained advantages, policymakers should target major enterprises and SOEs to increase digital finance use depth and small firms and non-SOEs to increase coverage breadth. businesses should also tailor their digital finance business models to their strengths—large businesses optimizing scale impacts and small firms increasing long-tail impact. Despite these contributions, the paper admits data scope limits and calls for wider, comparative research across countries and better financial success indicators in future studies.

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