“Do ESG and SDG-9 innovations enhance financial performance? Empirical evidence from India’s Top 100 listed firms (2019–2023)”

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DO ESG AND SDG-9 INNOVATIONS ENHANCE FINANCIAL PERFORMANCE? EMPIRICAL EVIDENCE FROM INDIA'S TOP 100 LISTED FIRMS (2019–2023)

Abstract

Sustainable innovation has become an important driver of corporate value creation in emerging economies like India, where firms increasingly align their operations with Environmental, Social, and Governance (ESG) practices and Sustainable Development Goal 9 (SDG-9). Despite this rising importance, the financial impact of ESG and SDG-9 innovations on firm performance remains underexplored in the Indian context. This study aims to empirically examine the impact of ESG and SDG-9 innovations on firm value, profitability, and shareholder returns among the top 100 listed Indian companies during the period 2019–2023. Using panel data drawn from the Bloomberg and Refinitiv databases, the study applies multiple regression models and random-effects estimations to evaluate the relationships between innovation indicators (ESG and SDG-9 scores) and financial metrics such as Tobin's Q, Return on Assets (ROA), and Return on Equity (ROE). The findings reveal that ESG innovation scores do not have a statistically significant effect on firm value and profitability. In contrast, SDG-9 innovation exhibits a positive and significant relationship with both ROA and ROE, indicating that companies integrating infrastructure, industrialization, and innovation goals achieve superior financial performance. On average, firms reporting SDG-9 innovations show a 4.27-point higher ROE and 0.51-point improvement in ROA than non-reporting firms. These results highlight that SDG-9 aligned innovation contributes directly to financial value creation, whereas ESG innovation yields more intangible or long-term benefits, offering critical insights for managers, investors, and policymakers promoting sustainable business growth in India.

Keywords ESG, SDG-9, innovation, profitability, sustainability, ROA, ROE

JEL Classification G30, G32, M14, Q56, L25

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INTRODUCTION

Over the past few years, sustainable development has changed not only to be an idealistic dream but also a corporate strategy in the global scene. The inclusion of the Environmental, Social, and Governance (ESG) has taught a new definition of how firms are evaluated, not just based on profitability but also based on the effectiveness in environmental stewardship, social contribution, and the efficacy of governance (Eccles et al., 2014; Friede et al., 2015). This shift in emerging markets like India has sped up as new regulations, investor activism, and stakeholder expectations are given more consideration. Business Responsibility and Sustainability Reporting (BRSR) is an institutionalization of sustainability disclosure and accountability mandated by the Securities and Exchange Board of India (SEBI) in the top 1,000 listed companies (Joshi & Joshi, 2024; Singhania & Saini, 2023).

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Despite this development, a major uncertainty remains regarding the financial impact of ESG adoption. Empirical evidence worldwide has shown mixed results such that some find positive relationships between ESG performance and firm profitability or valuation (Friede et al., 2015; Bansal & DesJardine, 2014), others have found weak or inconsequential relationships in particular in emerging markets with less developed systems of governance and untested cultures of reporting (Husted & de Sousa-Filho, 2017; Whelan et al., 2021). In the context of the Indian market, previous literature (Sinha & Jha, 2025; Bhattacharya & Bloch, 2004; Kumar & Prakash, 2020) demonstrates conflicting evidence as to whether sustainability practices are converted into financial results, measurable as Return on Assets (ROA), Return on Equity (ROE), or Q of Tobin.

Similar to ESG, the Sustainable Development Goal 9 (SDG-9) of the United Nations, which is aimed at industry, innovation, and infrastructure, has become a separate, yet complementary model of sustainable industrial change (United Nations, 2015). The companies that seek innovative solutions in accordance with SDG-9 are more prone to incorporate sustainability into technological modernization and industrial efficiency (UNCTAD, 2020). It has been shown that these innovation-based approaches may help to boost competitiveness, increase operational effectiveness, and create value in the long run (Porter & Kramer, 2011). Nonetheless, the financial performance impact of SDG-9 innovation is not empirically tested, especially in the context of an emerging economy like India, where infrastructure limitations and inconsistent regulatory implementation make it difficult to spread sustainable innovation.

The gap reflects a more general scientific issue, which is to understand more clearly whether and how sustainability-oriented innovations, targeted at sustainability via the ESG and SDG-9 frameworks, influence the value and profitability of firms in emerging markets. Although the ESG initiatives might bring reputational and stakeholder benefits in the long term, SDG-9 innovations might yield more short-term financial rewards in terms of productivity and technological benefits (Sahoo & Dash, 2020). However, little is known of their relative financial impact in the same model of analysis. This relationship is thus core in the area of both developing academic theory and managerial practice on the financial implications of sustainable innovation in developing economies.

1. LITERATURE REVIEW

A large number of research studies have already been done to examine the impact of innovations on the operational efficiency of companies. However, not many studies exist on the impact of ESG and SDG-9 innovations on Indian firms, mainly because SDG-9 is a new concept, and Indian firms are yet to adopt SDG-9 in their corporate structure. Herein, the literature on innovations and profitability, both on domestic and global firms, with related concepts and theories, is explored. Innovation has long been regarded as a critical determinant of corporate financial performance. Theoretical foundations, such as Schumpeter's (1934) theory of economic development, emphasize the role of innovation in creating competitive advantages, driving market dynamics, and enhancing firm profitability. Empirical research across global markets has further explored the link between financial performance and innovation, focusing on metrics such as Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q.

A broad consensus exists that innovation enhances firm value by promoting efficiency, differentiation, and adaptability to market changes (Porter, 1985). Studies by Hall et al. (2005) and Griliches (1998) highlight that R&D investments, as a proxy for innovation, contribute significantly to a firm's market value and profitability. However, these benefits are often contingent on the nature of the industry, market maturity, and regional factors. For instance, high-tech and knowledge-intensive industries exhibit a stronger positive correlation between innovation and financial performance compared to traditional sectors (Cohen & Levinthal, 1990). Integrating Environmental, Social, and Governance (ESG) considerations into corporate innovation strategies has added complexity to this relationship. Research by Eccles et

al. (2014) demonstrates that ESG initiatives often lead to enhanced stakeholder trust and long-term value creation, but their immediate financial impact may vary. In a comprehensive meta-analysis of more than 2,000 empirical studies, Friede et al. (2015) found that roughly 90% reported either a positive or neutral link between environmental, social, and governance (ESG) practices and financial performance. They further highlighted that this relationship is not uniform, with its strength influenced by factors such as geographical context, industry characteristics, and the prevailing regulatory environment.

In recent years, SDG-9, ie, innovation, infrastructure, and industrialization, has received attention. Such innovations are those of SDG-9 in nature and focus on being sustainable, inclusive, and resilient. Companies prioritising SDG-9 initiatives also tend to wield higher reputational capital, according to research (UNCTAD, 2020). However, studies such as Husted and de Sousa-Filho (2017) concluded that financial returns from these types of innovations are, by nature, temporary in nature. and only reach the full scale combined with a broader organization-wide strategy. Innovation-Driven Strategies: India's economic growth and industrialization have provided a strong infrastructure for innovation-driven strategies. The situation is that India offers its own quirks to any firm in terms of the challenges and opportunities for innovation, due to the diversity of the market with respect to demographics, regulatory environment, resource constraints, etc.

Research on the impact of innovation on financial performance in India results is inconclusive. Studies carried out by Bhattacharya and Bloch (2004) also suggest a positive impact of R&D investment, for example, on profitability in Indian firms, specifically firms operating in sectors such as pharmaceuticals and information technology. However, they also said the relationship is weaker in traditional sectors where structural and operational inefficiencies are higher. It was observed that applying innovation-led strategies had a positive impact on Firm value and market competitiveness. Yet, also common to the study was that innovation efforts are frequently sidelined in smaller firms due to a lack of finance and poor infrastructure. From a regulatory standpoint, highlighting the SEBI (Securities and Exchange Board of India) guidelines on Business Responsibility, Sustainability Reporting (BRSR), as India is gradually moving towards integrating ESG practices into its fold. This, coupled with pressing for innovation in ESG (Environmental-Social-Governance), i.e., adopting sustainability into core operations, has captured the attention of Indian businesses looking to comply with international standards and bring foreign investments to their shores. Financial Implication of ESG Practices: Research conducted in the Indian context shows that companies with strong ESG practices are less risky to operate and lose value, but also feature a stronger brand, which, as Bansal and DesJardine (2014) show, has more market share influence on the overall performance of the company. However, they also warned that ESG initiatives could be costly and dilutive to short-term profits.

It includes the role of ESG innovation in both influencing consumer perceptions and driving investor decision-making. Kumar and Prakash (2020) found that Indian firms that score well on environmental, social, and corporate governance (ESG) parameters are likely to be lapped up by long-haul investors and valuation gains over the shorter term. The study, however, also found that the effects of ESG innovation on financial performance were considerably dependent on industry, and sectors like IT and consumer goods benefited much more from it than capital-intensive industries like manufacturing. Indian companies have also become increasingly strategic about SDG-9 innovation, at the intersection of infrastructure development, industrialization, and technological advancement. Thus, the government initiatives such as "Make in India" and "Digital India" have only reinforced the need for SDG-9 innovation to drive more competitive economic growth.

SDG 9 innovation in India has been found to positively impact firm value and profitability in previous SDG-9 research. For example, Sahoo and Dash (2020) showed that firms investing in sustainable infrastructure and clean technologies reveal higher operational efficiencies and get easy access to green financing. Secondly, these innovations are also in keeping with the changing preferences of the Indian consumer, who is now more likely to see a product's sustainability while mak-

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ing a purchase (Ghosh-Jerath et al., 2021). But leveraging SDG-9 innovations in India could still be a problem. Inadequate infrastructure, regulatory impediments, and limited availability of skilled labor are some of the major obstacles to the implementation of SDG-9 initiatives. Moreover, the financial rewards of SDG-9 innovations typically take years to materialize, in many cases requiring firms to find a balance between short-term profitability and long-term sustainability goals. A similarity we have noticed is across a comparative analysis of ESG and SDG-9 innovations within the Indian context. ESG innovations: these contribute to broader societal and environmental objectives since they most often result in indirect financial benefits, such as improved brand reputation (Bansal & Roth, 2000). By contrast, solutions of SDG9 may show a more immediate effect in financial performance, benefitting from cost-saving and income-generating in newer markets along with a commitment to green financing (UNCTAD 2020).

Tobin's Q, introduced in the 1960s by economist James Tobin as an approximation of a firm's value, is the ratio of a company's stock price to its replacement cost. Studies have found that firms with higher ESG scores tend to receive a valuation premium in the market (i.e., have much larger Tobin´s Q), suggesting investors are willing to pay more for companies incorporating sustainability issues into their business environments. Similarly, Lunawat and Lunawat (2022) looked at the relationship between ESG performance and Tobin's Q among a sample of National Stock Exchange-listed firms in India. This supported the conjecture that firms with comprehensive information disclosure performed better, thereby investors are willing to pay a premium for sustainable and ethical companies. This is especially pertinent in India, where there has been a history of corporate governance scandals that have dampened investor confidence, and so better governance remains one of the most important pillars of ESG.

Profitability is measured by two major parameters, namely ROA (Return on Assets) and ROE (Return on Equity). ROA (Return on Assets) is one of the most important profitability ratios. This provides an idea as to how effectively a company is able to turn its assets into profits. The significant impact of ESG on the firm's profitability has mixed empirical evidence. For example, Margolis et al. (2009) meta-analysis of research on Corporate Social Performance (CSP) and financial performance found a small positive association between the two dimensions. In contrast, Whelan et al. (2021) argued that ESG investments could lead to long-term profitability, but they may not always produce noticeable short-term results. In India, the relationship between ESG and ROA has been less than conclusive. By analysing Indian firms between 2014 and 2019, (Sinha & Goel, 2023) found that ESG scores had a positive but weak correlation with profitability. The governance pillar had a much stronger effect on ROA, compared to the other two parameters, namely environmental and social, which had only moderate impacts. This result also matches with the recent evidence on some emerging markets, where governance aspects in terms of transparency and good leadership are a partial driver of firm profitability (Boubaker et al., 2020).

The return on equity shows how well a company can generate profits from its shareholders' investments. PAT (profit after tax) is considered one of the essential measures of financial performance and is also used as a measure of how efficiently management uses equity capital. Over the past couple of years, sustainable investing, or ESG, has become a must-have when it comes to evaluating ROE, as in the longer period, stronger ESG companies can deliver higher ROE through increased operational efficiencies, lower risks, and a better match with stakeholder values. As an example, companies implementing eco-friendly tariffs can lower their costs (such as energy use) and, at the same time, satisfy regulations, which in turn increases profit margin (Friede et al., 2015). Also, solid governance structures – identifiable decision-making, ethical leadership, etc. – may lead to confidence among investors that will lower the cost of capital and thus enhance the return on equity. The connection is complicated: ESG investments typically involve high initial costs, and the effect of ESG on ROE may depend on industry, macro-level factors, and firm size.

Hence, both ESG and SDG-9 innovations are increasingly viewed as complementary strategies for achieving sustainable growth and profitability. The firms integrating ESG practices with SDG-9 initiatives are better positioned to create long-term value and navigate the complexities of the Indian

market. This paper provides a detailed study of the relationship between ESG and SDG-9 innovations on firm value and profitability.

In summary, prior research highlights a growing interest in understanding how innovation, especially through ESG and SDG-9 initiatives, affects corporate financial performance. While ESG practices may improve reputational and long-term value, SDG-9 innovations are more likely to drive direct financial benefits, particularly in emerging markets like India. However, empirical evidence specific to the Indian context remains limited and fragmented. This study empirically examines the impact of ESG and SDG-9 innovation scores on firm value, profitability, and shareholder returns among the top 100 listed Indian companies during the period 2019–2023. By integrating multiple financial indicators (Tobin's Q, ROA, and ROE) with innovation-related variables, the research aims to offer actionable insights for managers, investors, and policymakers operating in emerging markets. This study aims to empirically examine the impact of ESG and SDG-9 innovations on firm value, profitability, and shareholder returns among the top 100 listed Indian companies during the period 2019–2023.

The following hypotheses summarize the assumptions of the proposed relationship between innovation and the profitability of firms:

H1: Innovation scores have a positive and significant impact on firm value (Tobin's Q).

H2: Innovation scores have a positive and significant impact on firm profitability (ROA).

H3: Innovation scores have a positive and significant impact on shareholder return (ROE).

2. METHODS

This study uses an empirical, quantitative research design using secondary data to evaluate the relationship between sustainable innovation indicators – Environmental, Social, and Governance (ESG) innovation scores and Sustainable Development Goal 9 (SDG-9) innovation scores – and corporate financial performance. The research framework follows a panel data approach to capture firm-level variations across time and entities, ensuring both cross-sectional and temporal validity. This study uses a panel regression approach, drawing on data from multiple cross-sections over a defined time period. While panel regression is a powerful analytical tool, it often faces issues such as heteroskedasticity and endogeneity, which can distort results if left unaddressed. To overcome these challenges, we apply the Generalized Method of Moments (GMM), using the two-step GMM (2SGMM) technique developed by Hansen (1982). This method extends several well-known estimation approaches, including least squares (LS), instrumental variables (IV), and maximum likelihood (ML), and is known for its robustness even when models are not perfectly specified.

That said, previous research has shown that 2SGMM can be prone to bias in smaller datasets. To counter this, Hansen (1996) suggested refined alternatives such as iterative GMM (ITGMM) and the continuously updated GMM (CUE). In our analysis, we adopt an interactive approach to incorporate these refinements and ensure more reliable and accurate estimates.

A multiple regression analysis was conducted to explore the relationships and model equations among the variables – Tobin's Q (TQ), Return on Assets (ROA), Return on Equity (ROE), ESG innovation (INN), Sustainable Development Goal 9 (SDG-9), the natural logarithm of total assets (Log_TA), and leverage (LEV).

The models proposed are

$$TQ_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (1)$$

$$TQ_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (2)$$

$$ROA_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (3)$$

$$ROA_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (4)$$

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$$ROE_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (5)$$

$$ROE_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (6)$$

The Securities and Exchange Board of India (SEBI) has mandated that the top 1,000 listed companies, ranked by market capitalization, report their ESG-related information in accordance with the BRSR Core 2023 framework (Joshi & Joshi, 2024; Nial & Parashar, 2024; Singhania & Saini, 2023). Therefore, for this study, data on the top 100 listed companies from the Bloomberg database, based on market capitalization as of Apr 2024, in line with BRSR Core 2023, were used.

The innovation parameters for these companies are taken from the Refinitiv database, which is part of the LSEG workspace. For a detailed analysis, the article uses panel data for 5 years from 2019 to 2023.

2.1. Definition and description of variables

Before testing the hypothesis, it was essential to establish and outline the research variables and data. These specific variables are detailed in Table 1.

2.1.1. Dependent variables

1. Tobin's Q ratio (TQ)

TQ is the ratio of market value to book value. The ratio is used to assess whether a company is overpriced or underpriced. According to Busch and Hoffmann (2011), Tobin's Q reflects market signals, reputation effects, financial risks, and intangible assets. In addition, a positive Tobin's Q reveals that a company is highly likely to grow and find good projects with higher investment opportunities due to resource-efficient allocation and investment behavior (Kwon et al., 2018). It implies that companies with a high Tobin's Q will generate superior returns and create higher value for their stakeholders. Hence, Tobin's Q is a holistic indicator that includes market perception and a firm's capabilities, and provides insights into the firm's potential for future performance and growth.

Mathematically, Tobin's Q is calculated as follows:

$$TQ = \frac{\begin{pmatrix} Equity \\ market\ value \end{pmatrix} + \begin{pmatrix} Liabilities \\ market\ value \end{pmatrix}}{\begin{pmatrix} Equity\ book \\ value \end{pmatrix} + \begin{pmatrix} Liabilities \\ book\ value \end{pmatrix}}. \quad (7)$$

The Tobin's Q values of companies are taken from the Bloomberg database.

2. Return on Assets (ROA)

Return on Assets (ROA) is widely employed in empirical research as a primary measure of firm profitability, as it captures the effectiveness with which a company leverages its assets to generate net income (Bailey, 2022). A higher ROA is typically interpreted as a sign of superior operational efficiency and prudent resource utilization, reflecting the firm's capability to convert its asset base into sustainable earnings (Tutcu et al., 2024).

The ROA is calculated using the following formula:

$$ROA = \frac{Net\ Income}{Total\ Assets}. \quad (8)$$

The above values are taken from the LSEG workspace.

3. Return on Equity (ROE)

Return on Equity (ROE) is a vital metric for shareholders, as it reveals how effectively a company transforms its invested capital into profits. It serves as a comprehensive performance indicator because it is shaped by multiple factors, including a firm's earning capacity, financial leverage, cost of debt, and tax obligations. The DuPont analysis framework further breaks down ROE into components such as profitability, asset turnover, and equity multiplier, offering deeper insight into the drivers of shareholder returns (Investopedia, 2024).

The ratio reflects the productivity of capital employed in the firm. ROE is calculated using the following formula:

$$ROE = \frac{Net\ Income}{Total\ Equity}. \quad (9)$$

2.1.2. *Independent variables*

The following two independent variables are used in the study.

1. Environmental Innovation score

The environmental innovation score reflects a company's ability to help customers reduce environmental costs and impacts while creating market opportunities through eco-friendly technologies, sustainable processes, or environmentally conscious product designs. Reported as a percentage, this score is sourced from Refinitiv's ESG database within the LSEG Workspace (Refinitive, 2022).

2. SDG 9 Industry, Innovation, and Infrastructure score

This variable identifies whether a company actively supports the United Nations Sustainable Development Goal (SDG) 9 – Industry, Innovation, and Infrastructure. SDG 9 emphasizes the importance of building resilient infrastructure, advancing sustainable industrialization, and fostering innovation (United Nations, 2015). In this study, the data for this variable are drawn exclusively from companies' reported initiatives and commitments related to SDG 9 within the broader SDG framework.

The variable is defined in binary terms; True is 1 and False is 0.

All these scores are taken from the Refinitiv database of the LSEG workspace.

2.1.3. *Control variables*

The following two variables are taken as the control variables in the study.

1. Total Assets (Log_TA)

A firm's total assets are taken as a control variable. Papers have taken the Log Natural for these values since the total asset values were very high. The data are taken from the LSEG workspace in million INR.

2. Leverage (LEV)

Leverage is defined as the ratio between total debt and total assets of a company. The data are taken from the LSEG workspace in percentages.

$$LEV = \frac{Total\ Debt}{Total\ Assets}. \tag{10}$$

Both these variables – total assets and leverage – are taken as control variables in earlier research (Chairani & Siregar, 2021; Giannopoulos et al., 2022; Naeem et al., 2022; Aydoğmuş et al., 2022).

2.2. Models

The hypothesis is tested using two models, as per an earlier study by Aydoğmuş et al. (2022). The above models have also been used by Chairani and Siregar (2021), Giannopoulos et al. (2022), and Naeem et al. (2022).

Table 1. Summary of variables

S.N.	Variables	Symbol	Nature of Variable	Description and Formulae	Data source
1	Tobin's Q	TQ	Dependent variable	(Equity market value + Liabilities market value) / (Equity book value + Liabilities book value)	Bloomberg database
2	Return on Assets	ROA	Dependent variable	Net income/ Total Assets	LSEG workspace
3	Return on Equity	ROE	Dependent variable	Net income/ Total Equity	LSEG workspace
4	Environmental Innovation score	INN	Independent variable	Environmental Innovation score	Refinitiv score, from LSEG workspace
5	SDG 9 Industry, Innovation and Infrastructure	SDG 9 score	Independent variable	SDG 9 Industry, Innovation and Infrastructure	Refinitiv score, from LSEG workspace
6	Total Asset	Log_TA	Control variable	Logarithm of Total Assets	LSEG workspace
7	Leverage	LEV	Control variable	Total debt/ Total Assets	LSEG workspace

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Model A

H1: Innovation scores have a positive and significant impact on firm value.

Firm value is defined through Tobin's Q ratio. Hence, the variables and regression equations for the analysis are as follows:

Dependent variables: Tobin's Q; TQ
Independent variables: Innovation INN; SDG-9.
Control variables: Log_TA; LEV
Regression equations:

$$TQ_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (11)$$

$$TQ_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (12)$$

Model B

H2: Innovation scores have a positive and significant impact on profitability.

A firm's profitability is defined through ROA. Hence, the variables and regression equations for the analysis are as follows:

Dependent variable: ROA
Independent variables: Innovation INN; SDG 9
Control variables: Log_TA; LEV
Regression equations:

$$ROA_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (13)$$

$$ROA_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (14)$$

Model C

H3: Innovation scores have a positive and significant impact on shareholder return.

A firm's shareholder return is defined through ROE. Hence, the variables and regression equations for the analysis are as follows:

Dependence variable: ROE
Independent variables: Innovation INN; SDG 9
Control variables: Log_TA; LEV
Regression equations

$$ROE_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (15)$$

$$ROE_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (16)$$

3. RESULTS

In this study, data analysis is performed on short data panels and typically uses fixed and random effects models (Wooldridge, 2010). This indicates that the fixed effects estimator is often chosen when the number of periods is small compared to the number of individuals. The paper uses the Hausman test to examine whether fixed effects are more appropriate than random effects for TQ and ROA. The Breusch-Pagan LM test was applied to check for cross-sectional dependence of the error terms. It was found that the model has cross-sectional dependence. However, because of the short time series and large cross-sectional panel units, this is not a complicating factor in the research design.

The descriptive statistics are shown in Table 2. Of the total 500 data points, only 378 points are reported by the companies. The average TQ is calculated as 3.42, which is more than 1. A TQ value more than 1 indicates that a firm's market value is more than the book value of the firm. Hence, a TQ value of more than 3 shows that the market value of the firm is 3 times the book value of the firm. The ROA of firms is 8.07, which also shows a higher return on assets. Also, a ROE value of 14.75 indicates a higher return on equity. These values are expected since the top 100 firms were selected based on market capitalization for our research.

However, an Innovation value of 33.68 % indicates that these firms are not focused on innovation. Also, out of 500 data points, only 207 points have shown positive SDG 9. The balance of 293 data points does not report SDG 9 innovation. The logarithm of TA shows 13.53 lakhs, and the leverage shows 24.59 %. The debt portion is around 25% of equity.

Table 2. Descriptive statistics

	N	Mean	Standard Deviation	Median	Minimum	Maximum
Dependent Variables						
TQ	378	3.42	3.88	1.81	0.74	25.23
ROA	378	8.07	9.97	5.31	–34.9	96
ROE	378	14.75	22.91	15	–225	109
Independent Variables						
INN	378	33.68	31.08	31.5	0	97
Control Variables						
Log_TA	378	13.53	1.59	13.52	9.93	17.9
LEV (%)	378	24.59	24.23	15.47	0	89.2

Independent Variable	Yes	No
SDG 9	207	171

3.1. Correlation analysis

Table 3 provides a correlation matrix for the variables analyzed.

Table 3. Pearson correlation matrix

	TQ	ROA	ROE	INN	Log_ TA	LEV
TQ						
ROA	0.549					
ROE	0.325	0.280				
INN	0.014	–0.035	–0.076			
Log_TA	–0.163	–0.163	–0.070	0.086		
LEV	–0.151	–0.187	–0.181	0.039	0.082	

The table shows a high correlation between TQ, ROA, and ROE, which is expected as these factors are related. However, only TQ has a positive correlation between INN compared to a negative correlation between ROA & ROE with INN. These results show that the ESG innovation score does not have a major impact on the return of the companies, though it has an impact on the market value of the companies. TA has a negative correlation with TQ, ROA, and ROE, which indicates that company size does not impact the financial measurements of the companies. However, there is a positive correlation between TA and INN, which indicates that large firms focus on innovation. Similarly, the LEV has a negative correlation with TQ, ROA, and ROE, which indicates that unlevered firms tend to have higher profitability. The positive correlation between LEV and TA shows that large-sized firms have higher leverage compared to smaller ones.

3.2. Regression results

Model A

In this model, the hypothesis that innovation scores have a positive and significant impact on firms' value was tested. The firm value is defined through Tobin's Q ratio. Hence, the variables and regression equations for the analysis are as follows:

(a) Dependence variables: Tobin's Q; TQ

(b) Independent variables: ESG Innovation INN; SDG-9

(c) Control variables: Log_TA; LEV

Table 4. Random effect regression results, Model A

Dependent variables	TQ	TQ
	Coef (z-value)	Coef (z-value)
	Equation 1	Equation 2
Intercept	8.943 (5.298)***	9.088 (5.37)***
INN	0.0041 (0.639)	–
SDG 9_Yes	–	–0.3003 (–0.762)
Log_TA	–0.3778 (–3.0319)**	–0.3666 (–2.9498)**
LEV	–0.0224 (–2.7553)**	–0.02222(–2.7356)**
Fixed Effect Model	NO	NO
Random Effect Model	Yes	Yes
Observation	378	378
Number of Years	5	5
R-Square	0.046	0.047
Adj R-Square	0.038	0.039
Chi-square (p-value)	0.0003	0.00035
Hausman test (p-value)	0.9034	0.813
Breusch-Pagan LM (p-value)	0.2612	0.2947

Note: p < 0.1; ** p < 0.05; *** p < 0.01.

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Table 4 presents the results of Model A, examining the impact of various independent variables on Tobin's Q (TQ), a measure of firm market valuation. The coefficients and z-values in each model indicate the strength and significance of these relationships.

The regression equations are defined, and the results are:

$$TQ_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (17)$$

$$TQ_{it} = 8.9431 + 0.0041 INN_{it} - 0.3778\ Log\_TA_{it} - 0.0224 LEV_{it} + \varepsilon_{it}. \quad (18)$$

$$TQ_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (19)$$

$$TQ_{it} = 9.088 - 0.3003\ SDG9_{it} - 0.3666 - 0.0222 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (20)$$

As seen from Equations (17) to (20), the ESG innovation (INN) has a positive impact on the TQ of the company. But the SDG-9 innovation shows a negative impact on the TQ. As seen earlier, the mean TQ of these companies is more than 3, indicating that these companies have a higher market valuation, and ESG innovation has a positive impact on the market value of companies.

Based on the above results, our first hypothesis, that innovation scores have a positive and significant impact on firm value, is partially established.

Model B

In this model B, the hypothesis that innovation scores have a positive and significant impact on profitability was tested. A firm's profitability is defined through ROA. Hence, the variables and regression equations for the analysis are as follows:

Dependence variable: ROA
Independent variables: ESG Innovation INN; SDG 9
Control variables: Log_TA; LEV

Table 5. Random effect regression results, Model B

Dependent variables	ROA	ROA
	Coef (z-value)	Coef (z-value)
	Equation 5	Equation 6
Intercept	14.810 (3.408) ***	14.4188 (3.3043) ***
INN	–0.02075 (–1.2722)	
SDG 9_yes		0.5068 (0.4988)
Log_TA	–0.3164 (–0.9864)	–0.3580(–1.1169)
LEV	–0.0717 (–3.429) ***	–0.0726 (–3.466) ***
Fixed Effect Model	No	NO
Random Effect Model	Yes	Yes
Observation	378	378
Number of Years	5	5
R-Square	0.400	0.036
Adj R-Square	0.032	0.028
Chi-Square (p-value)	0.0013	0.000
Hausman test (p-value)	0.6542	0.7116
Breusch-Pagan LM (p-value)	0.4466	0.4262

Note: * p < 0.1; ** p < 0.05; *** p < 0.01.

Table 5 presents the results of four models analyzing the impact of various independent variables on Return on Assets (ROA), a key measure of firm profitability.

The regression equations are defined, and the results are:

$$ROA_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (21)$$

$$ROA_{it} = 14.8102 - 0.0207 INN_{it} - 0.3164 Log\_TA_{it} - 0.0717 LEV_{it} + \varepsilon_{it}. \quad (22)$$

$$ROA_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (23)$$

$$ROA_{it} = 14.4188 + 0.5068 SDG9_{it} - 0.03580 Log\_TA_{it} - 0.0726 LEV_{it} + \varepsilon_{it}. \quad (24)$$

As seen from Equations (21)-(24), ROA has a negative relationship with ESG innovation (INN), though a positive relationship with SDG 9 innovation. These results show that the companies following ESG innovation do not have any impact on the financial performance. But companies reporting SDG-9 innovations do have an impact on the firms' ROA.

Based on the above results, the second hypothesis that innovation scores have a positive and significant impact on profitability is not rejected.

Model C

In this model, the hypothesis that innovation scores have a positive and significant impact on shareholder return was tested. A firm's shareholder return is defined through ROE. Hence, the variables and regression equations for the analysis are as follows:

Dependence variable: ROE
Independent variables: Innovation INN; SDG-9
Control variables: Log_TA; LEV

Table 6. Random effect regression results, Model C

Dependent Variables	ROE	ROE
	Coef (z-value)	Coef (z-value)
	Equation 5	Equation 6
Intercept	–	–
INN	–0.0077(-0.2102)	–
SDG 9_yes	–	4.267 (1.808)
Log_TA	–3.1364 (–4.321) ***	–3.1782(–4.4114)***
LEV	–0.1477 (–3.121) **	–0.1507(–3.198) **
Fixed Effect Model	Yes	Yes
Random Effect Model	NO	No
Observation	378	378
Number of Years	5	5
R-Square	0.078	0.0867
Adj R-Square	0.061	0.069
F-statistics (p-value)	0.000	0.0000
Hausman test (p-value)	0.0026	0.00361
Breusch-Pagan LM (p-value)	0.431	0.6827

Note: * p < 0.1; ** p < 0.05; *** p < 0.01.

The regression equations based on the above results are as follows:

$$ROE_{it} = \beta_0 + \beta_1 INN_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (25)$$

$$ROE_{it} = \beta_0 - 0.0077 - 3.136 Log\_TA_{it} - 0.01477 LEV_{it} + \varepsilon_{it}. \quad (26)$$

$$ROE_{it} = \beta_0 + \beta_1 SDG9_{it} + \beta_2 Log\_TA_{it} + \beta_3 LEV_{it} + \varepsilon_{it}. \quad (27)$$

$$ROE_{it} = \beta_0 + 4.2667 SDG9_{it} - 3.1782 Log\_TA_{it} - 0.1507 LEV_{it} + \varepsilon_{it}. \quad (28)$$

As seen from Equations (25)-(28), the ESG innovation has a negative impact on ROE, but in contrast, the SDG-9 innovation has a positive impact on ROE.

Based on the above results, the third hypothesis that innovation scores have a positive and significant impact on shareholder return is not rejected.

4. DISCUSSION

The study examined the relationship between innovation, as measured by ESG innovation scores (INN) and SDG-9 innovation, and corporate financial performance using Tobin's Q (TQ), Return on Assets (ROA), and Return on Equity (ROE) as key indicators. The results indicate nuanced relationships, underscoring the differentiated impact of innovation types on firm valuation and profitability. As suggested by the results, the positive relationship between ESG innovation (INN) and Tobin's Q had low statistical significance, highlighting that such activities are still relatively valuable but do not induce a sizeable or significant effect on market value. This positive relationship can be explained by investor sentiment that ties innovation with high growth potential and competition in the market. On the other hand, the innovation SDG 9, focusing on infrastructure and industrialization, indicators, and sustainability, did not have a significant impact on Tobin's Q, which is also consistent with the study by Eccles. Analyzing delayed stock returns surrounding ESG-related innovations (including those corresponding with SDG-9) and how markets are slower to incorporate this information into firm values (Bansal & Clelland, 2004). In conclusion, the results emphasize that although innovation is widely accentuated as an essential element of corporate growth, it may take time for innovation to be priced into market valuation due to varying external factors, including shared perception of the usefulness of ESG and market conditions.

The study found that ESG innovation (INN) was inversely correlated with ROA. One explanation for this seemingly paradoxical result relates to the

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cost of innovation and the fact that sustained innovation for any company can take a toll on the immediate financials of a firm without providing a sure return in the short term (Hall & Lerner, 2010). On the other hand, SDG-9 innovation had a positive and direct influence on ROA, but the influence was not significant. This implies that investments in sustainable development may indirectly provide long-term support for companies' operational efficiency and profitability, yet with insignificant short-term benefits. The findings underscore the ambivalence of innovation: the adoption of new practices may bring about short-run profitability gains, but any positive effects may be offset by the financial costs and operational disruptions associated with new and unproven practices.

ESG innovation (INN) was negatively associated with ROE, suggesting that investments in innovation have the potential to dilute returns to shareholders over the short term. Executing innovations like this can be risky, as previous work (Rothaermel et al., 2007) shows that innovation investments may not return similar financial benefits. In contrast to the prior, SDG 9 innovation had a positive and statistically significant effect on ROE, supporting the notion that sustainability and industrial innovation initiatives may create value for shareholders. These results are consistent with the increased acceptance of the ESG ideas in capital markets since the sustainable innovations appeal to socially responsible investors and other stakeholders (Friede et al., 2015). Control variables such as firm size (Log_TA) and leverage (LEV) also exhibited significant relationships with the dependent variables. Firm size negatively influenced TQ, ROA, and ROE, suggesting that larger firms might face diseconomies of scale or lower operational efficiency. Leverage consistently showed a negative relationship with all financial indicators, indicating that firms with higher debt levels are less profitable and valued lower in the market, corroborating findings from Modigliani and Miller (1958).

4.1. Practical implications

The study's findings have important implications for corporate managers and policymakers. Firms investing in general innovation should manage stakeholder expectations, as the financial returns from such investments may not materialize immediately. Policymakers could encourage SDG-9 innovation by offering incentives, recognizing its potential to positively impact profitability and shareholder returns. Moreover, fostering investor awareness about the long-term benefits of sustainable innovations could enhance market recognition and valuation of such initiatives.

CONCLUSION

This study aims to empirically examine the impact of ESG and SDG-9 innovations on firm value, profitability, and shareholder returns among the top 100 listed Indian companies during the period 2019–2023. Using Tobin's Q, ROA, and ROE as performance indicators and applying panel data regression techniques, the results show a nuanced relationship: ESG innovation scores did not have a significant or consistent impact on financial performance, whereas SDG-9 innovations showed a positive and statistically significant influence on profitability and shareholder return. These findings suggest that while ESG-driven innovation may be valuable for long-term strategic positioning and reputational gains, SDG-9-related initiatives are more likely to deliver immediate and measurable financial benefits in the Indian market context. This reinforces the growing importance of infrastructure, industrialization, and innovation-focused strategies for firms operating in emerging economies. For corporate leaders and policymakers, the results highlight the need to prioritize SDG-9-aligned innovation to enhance competitiveness and sustainable financial performance. Investors, too, may benefit from incorporating SDG-9 metrics into decision frameworks. However, the study is limited by the availability and consistency of ESG and SDG-9 disclosures, as many firms are still in the early stages of adopting standardized sustainability reporting practices. Future research could investigate sector-specific impacts, explore longitudinal effects over a longer time horizon, or examine the role of mediating variables such as R&D intensity or government policy incentives.

AUTHOR CONTRIBUTIONS

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