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Driving Sustainability: Environmental, Social, and Governance Practices and Financial Implications in India's Automotive Industry

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Abstract:

This study examines the influence of Environmental, Social, and Governance (ESG) reporting on the financial performance of firms in the Indian automobile sector. ESG ratings reflect the extent to which enterprises engage in responsible governance, social welfare, and environmental conservation. The analysis explores the impact of both aggregate and pillar-specific ESG scores on financial indicators such as Return on Equity (ROE), Return on Assets (ROA), and Earnings Per Share (EPS), while addressing endogeneity concerns through the application of panel least squares (PLS) regression with firm-level fixed effects and lagged ESG variables as instruments to mitigate reverse causality. This approach enhances the robustness of causal interpretation between ESG disclosure and financial outcomes. The study covers all automobile companies listed on the Bombay Stock Exchange (BSE) and those included in the BSE 500 index from 2015 to 2023. The findings reveal that ESG initiatives in the Indian automobile sector may not yield immediate or measurable financial gains through conventional metrics like ROA, ROE, and EPS. However, ESG adoption significantly contributes to long-term wealth creation, brand loyalty, and corporate goodwill.

The results emphasise that sustainable business practices enhance organisational resilience and stakeholder confidence. Furthermore, the study aligns with SDG 8, SDG 9, and SDG 12, underscoring the important role of ESG integration in advancing sustainability and long-term financial stability.

Keywords: environmental; social; governance; earnings per share; sustainability index; panel least square; ROA; ROE.

JEL Classification: G30; G32; M14; Q56; C33; L62.

Introduction

Modern market evaluations of organizations assess their financial results alongside their environmental and social duty performance. The number of consumers who choose businesses with ethical and sustainable operations continues to rise while investors use environmental, social, and governance (ESG) ratings to find companies that deliver decreased risk and superior long-term financial outcomes (Chen et al., 2023; Landi et al., 2022). Policymakers should understand all ESG processes to create sustainable development frameworks which preserve market competitiveness (Lipczyńska, 2024).

To support responsible corporate conduct, India has implemented a comprehensive regulatory framework that governs ESG and CSR reporting, particularly for large listed firms (Kaleeswari & Chaudhuri, 2024). The Companies Act, 2013 mandates Corporate Social Responsibility (CSR) spending for qualifying firms, requiring them to allocate at least 2% of their average net profits to socially responsible activities (Gupta, 2022). Additionally, the Securities and Exchange Board of India (SEBI) introduced the Business Responsibility Reporting (BRR) framework in 2012. Later replaced it with the more comprehensive Business Responsibility and Sustainability Report (BRSR) from FY 2022–23, making ESG-related disclosures mandatory for the top 1,000 listed companies by market capitalization (Garg at al., 2025). SEBI has also promoted sustainability benchmarking through thematic indices such as the S&P BSE CARBONEX and S&P BSE GREENEX to improve transparency and reinforce investor confidence (Nazareth & Reddy, 2024). These policy developments have played a crucial role in shaping corporate behaviour, compelling firms—especially in resource-intensive sectors like automotive manufacturing—to align with sustainability commitments and integrate ESG metrics into organizational strategies.

Managers often face a fundamental strategic challenge when they need to determine if ESG initiatives lead to better financial results or if they create extra expenses. The evaluation of corporate performance through ESG ratings occurs by assessing three main dimensions which include environmental (E), social (S) and governance (G) factors (Senadheera et al., 2021). The environmental pillar evaluates a company's environmental impact through resource efficiency and emission reduction practices; the social (S) pillar focuses on employee welfare and diversity and human rights and community involvement; and the governance (G) pillar represents organizational accountability and ethical leadership and transparency (Clementino & Perkins, 2021). The combination of these pillars establishes a complete framework for assessing a company's sustainability and financial stability and accountability (Golubeva, 2022).

As a result, ESG has evolved from a voluntary initiative into a strategic imperative. Research from previous studies demonstrates that ESG implementation leads to improved sustainable business performance and helps organizations meet regulatory standards (Aslam, 2024). The practice of transparent ESG disclosure enables organizations to gain stakeholder trust and maintain corporate reputation and attract investors who focus on social responsibility (Kandpal, 2024). Organizations that achieve high ESG performance levels demonstrate better risk management capabilities and experience lower financing expenses and receive higher market valuations from investors (Zhang et al., 2024). The studies demonstrate that ESG practices deliver sustainable financial performance and market stability and support worldwide sustainability goals. The correlation between superior ESG ratings and financial performance remains uncertain because they might generate expenses that decrease company profits (Liu & Song, 2025).

This issue is particularly significant for the Indian automobile industry, one of the country's fastest-growing and most economically vital sectors. The industry contributes substantially to GDP and employment but is also resource-intensive and environmentally sensitive (George, 2023). Automobile manufacturers face increasing pressure to balance profitability with environmental stewardship and social responsibility amid rising carbon emissions, stricter regulatory frameworks, and evolving consumer preferences toward sustainable mobility solutions (Gehlot & Kumar, 2024). These dynamics make the sector an ideal context for evaluating the extent to which ESG performance drives tangible financial outcomes (Suryadevara et al., 2025).

The Indian automobile industry's transformation aligns closely with the principles of sustainability and several UN Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 12 (Responsible Consumption and Production). By adopting ESG-oriented strategies, automobile firms can contribute to inclusive economic growth, promote cleaner production technologies, and ensure responsible resource utilization, critical for achieving sustainable industrial progress (Jeet & Chittineni, 2025).

Despite the growing significance of ESG, long-term, sector-specific studies examining its financial implications remain limited. Most existing research captures short-term associations and is often constrained by endogeneity issues. To address these gaps, future research must adopt causal and dynamic approaches to uncover the enduring effects of ESG on financial performance (Zumente & Bistrova, 2021).

This study contributes to the existing literature in two key ways. First, it provides sector-specific evidence on the ESG–financial performance nexus using panel data from 2015 to 2023. Return on Equity (ROE), Return on Assets (ROA), and Earnings Per Share (EPS) serve as dependent variables, while firm-specific controls such as leverage, fixed assets, and firm size, along with aggregate and pillar-specific ESG ratings, function as independent variables. Second, the study enhances methodological rigor by employing panel least squares (PLS) regression to mitigate statistical bias and capture both cross-sectional and temporal variations, thereby addressing endogeneity and emphasizing the long-term impacts of ESG investments on financial outcomes.

1. Literature Review

Academic studies have extensively examined the connection between Environmental, Social, and Governance (ESG) practices and corporate financial performance (CFP). Research studies have examined the global automotive industry but they have not concentrated on the Indian automobile sector which operates under different regulatory conditions and market dynamics and social environments. The evaluation of individual sectors remains essential to determine the financial impact of ESG initiatives on Indian automotive companies. The review presents a summary of current research about the ESG-profitability relationship through theoretical frameworks and empirical studies and identifies areas that require further investigation.

Pham et al. (2022) employed the DEA (CCR model) and OLS to evaluate efficiency and ESG performance, finding that environmental and social scores positively influence business performance. They emphasized that one-stage DEA models may lack comprehensiveness and recommended the use of panel data and cross-national samples in future research. Glova & Panko (2025), using panel methodologies such as the general method of moments (GMM) and fixed-effects regression, investigated ESG's effect on Tobin's Q. The study findings showed that social and environmental factors produced negative effects on Tobin's Q but governance demonstrated a minimal positive impact which was statistically insignificant thus suggesting that other variables and non-linear patterns might exist. The researchers suggested investigating how ESG activities affect business stability and stakeholder confidence over an extended period.

Tancke et al. (2023) called for sector-specific research after using a ten-year panel data model and finding a non-significant positive effect of ESG on ROA. This suggests that ESG efforts may not be as instantly helpful as expected. In their analysis of the ESG disclosure practices of five of the top automakers, Waclawik et al. (2025) pointed out that there was a lack of legal requirements for the sharing of environmental data, and they suggested evaluating how environmental regulations affected business performance. In their six-year study of 131 listed businesses, Dincă et al. (2022) found conflicting results about the impact of ESG elements and inconclusive social scores. They also suggested that future modelling incorporate the recently released ESG data for the automobile industry.

Using fixed-effects panel regression, 2SLS-IV, and two-step system GMM, Dinçergök & Pirgaip (2025) came to the conclusion that financial performance is positively impacted by higher ESG ratings, highlighting the significance of taking cultural and country-specific variations into account. Applying fixed and random effects panel regression to the automotive sector, Chandrasekaran (2022) discovered that CSR considerably improves company performance through ESG dimensions and recommended adding more performance metrics to evaluate the long-term effects of CSR. The use of dynamic panel quantile models in future research is advised by Lin et al. (2021), who used dynamic quantile regression with System GMM and discovered that low- and medium-value enterprises react more strongly to sustainability policies than high-value firms.

Using fixed-effects models, found no significant correlation between ESG scores and ROA, highlighting the influence of differences in rating methodology and indicating that longer observation periods and larger samples from emerging economies are required to fully capture ESG effects. Refinitiv ESG ratings and ROA were found to be strongly correlated negatively by Tabur & Bildik (2025) using fixed-effects regression and the Hausman test, while Bloomberg scores displayed diverging patterns. They underlined that worldwide data collected over a ten-year period may mask regional and industry-specific patterns, and they suggested further research into the ways in which various ESG ratings affect the choices made by researchers and investors.

Ioannidis et al. (2025) examined ESG data for 112 banks across 25 countries between 2017 and 2023 using random-effects models, emphasizing the moderating influence of national culture on ESG performance. OLS and linear panel regressions were used by Candio (2024), who found regional variability in the correlations between ESG and financial success and cautioned against making causal inferences. Non-linear and causal models should be used in future research. After addressing endogeneity through baseline and instrumental variable regressions, Handoyo & Anas (2024) came to the conclusion that ESG has no discernible direct influence on business performance, highlighting the possibility that robustness may be limited by certain financial indicators.

Using dynamic panel models using System GMM, Chawarura et al. (2025) found a positive and significant correlation between firm financial returns and overall ESG performance, and they suggested more study be done on all JSE-listed companies. The significance of taking into account regional regulatory environments and multicollinearity between ESG dimensions was highlighted by Martynova & Lukina (2023), who used panel regressions to show that ESG ratings have a positive impact on financial performance in South-West Asia but a negative impact in South-East Asia. Using fixed-effects panel models, Liu and Lee (2025) discovered that overall ESG scores considerably increase firm value; nonetheless, they raised concerns about serial correlation in macro panels with high persistence.

According to the examined research, ESG practices have complex and context-dependent consequences on financial performance. These effects are frequently influenced by regional and cultural characteristics, regulatory settings, and the scientific approaches used. The results highlight how important ESG is for advancing sustainability, ethical business practices, and long-term stakeholder value. They also support SDGs 8 (Decent Work and Economic Growth), 9 (Industry, Innovation, and Infrastructure), and 12 (Responsible Consumption and Production).

This study is especially pertinent since it fills a major research gap by concentrating on the Indian automobile industry, which is important for employment and economic growth and has a substantial social and environmental impact. Using panel data from 2015 to 2023, the study looks at sector-specific ESG – financial performance relationships. This gives useful information to investors, legislators, and company executives for balancing profitability with sustainable development goals.

2. Research Methodology

Research Gap

The existing body of literature reveals notable research gaps regarding the impact of Environmental, Social, and Governance (ESG) performance on financial outcomes within the automobile industry. Most prior studies aggregate data across multiple industries, which conceals the distinct sectoral characteristics and ESG-performance dynamics of automobile firms. Moreover, a significant proportion of existing research relies on correlational rather than causal analyses, lacking advanced econometric models such as panel data regression or fixed-effects models that can capture longitudinal relationships and control for firm-specific heterogeneity.

Another important gap concerns the limited exploration of the separate contributions of the Environmental (E), Social (S), and Governance (G) dimensions on financial performance within the Indian context. While global research provides broad insights, empirical evidence on the Indian automobile sector remains sparse. The introduction of the Business Responsibility and Sustainability Reporting (BRSR) framework by SEBI (2022) marked a turning point in India's ESG disclosure landscape, yet its implications for firm-level financial performance, particularly in emission-intensive sectors like automobiles, remain underexplored.

Additionally, prior studies have seldom incorporated firm-specific control variables such as firm size, firm age, and leverage, which can significantly influence financial outcomes. The present study therefore aims to address these research gaps by providing a sector-specific, India-focused, and methodologically robust investigation of the ESG–financial performance nexus in the automobile sector.

Conceptual Framework and Research Hypotheses

In this study, the aggregate ESG score and its sub-components — E (Environmental), S (Social), and G (Governance), serve as independent variables, while financial performance indicators such as Return on Assets (ROA), Return on Equity (ROE), and Earnings Per Share (EPS) are the dependent variables. To ensure robustness, firm size, firm age, and financial leverage are incorporated as control variables.

Drawing from existing literature, it is hypothesized that ESG performance and its individual dimensions (E, S, G) may exert either a positive or negative influence on financial outcomes depending on firm characteristics and disclosure quality (Abdelmoneim & El-Deeb, 2024). Therefore, the following propositions are tested:

- ESG performance has a statistically significant effect on firm financial performance.
- Each of the E, S, and G dimensions contributes differently to financial outcomes.
- Firm-specific factors (size, age, leverage) moderate the ESG–financial performance relationship.

The research adopts a quantitative and explanatory design, employing panel data regression analysis to establish causal linkages between ESG reporting and firm financial performance over time.

Sample Design and Data Collection

The study focuses on the Indian automobile sector, which holds strategic significance in national sustainability discourse due to its dual role as a driver of economic growth and a major contributor to carbon emissions. This makes it an ideal context for evaluating how ESG integration aligns with sustainable industrial transformation.

The sample comprises fourteen automobile companies listed in BSE sustainability indices, namely the S&P BSE CARBONEX, S&P BSE 100 ESG, and S&P BSE GREENEX, alongside comparable firms from the S&P BSE 500 Index. The time frame (2015–2023) is chosen to capture post-Paris Agreement developments and the evolution of ESG disclosure practices following major regulatory and sustainability shifts in India.

Data Sources: ESG data and firm-level disclosures were collected from credible secondary sources including Bloomberg, Thomson Reuters ESG Data, MSCI ESG Research, and the Dow Jones Sustainability Index (Ferdous et al., 2025; Eng et al., 2022). Financial information was gathered from annual reports, company websites, and BSE/NSE portals. The study further integrates global sustainability reporting frameworks, Global Reporting Initiative (GRI) and Sustainability Accounting Standards Board (SASB), along with India's BRSR guidelines to ensure methodological consistency.

Methodological Approach

A content analysis technique was applied to quantify the extent and quality of ESG disclosure (Chen et al., 2025; Parashar et al., 2025). This approach has been widely used in corporate disclosure and ESG-related studies (Kumari et al., 2024; Syed et al., 2024; Kumari et al., 2025).

To examine the relationship between ESG performance and financial performance, the study employs a panel least squares (PLS) estimation technique with firm-level fixed effects (Khalil et al., 2024). Given the potential issue of endogeneity arising from reciprocal causality, where stronger financial performance may enable firms to invest more in ESG activities, and ESG initiatives may in turn influence financial outcomes, the model incorporates lagged ESG variables as internal instruments (Khatib, 2025; Lee & Suh, 2022). This methodological choice aligns with econometric practices recommended for causal inference in panel settings where sample size constraints limit the use of advanced dynamic system models such as System-GMM or Two-Stage Least Squares (2SLS) (Chizema, 2025; Khatib, 2025). The use of lagged ESG scores helps mitigate simultaneity bias by ensuring that current financial measures are influenced only by past ESG performance rather than contemporaneous flows (Ionașcu et al., 2025). Hausman test results confirmed the suitability of the fixed effect's structure. While diagnostic evaluations including VIF tests for multicollinearity, Breusch–Pagan tests for heteroskedasticity, and Durbin–Watson statistics for autocorrelation. The results of these validated estimator reliability. This approach strengthens the robustness of the results and supports credible interpretation of ESG's dynamic effects on financial performance over the study period.

The study employs a descriptive research design combined with a stratified sampling technique, ensuring balanced representation of firms across the selected sustainability indices. By combining ESG-specific data, firm-level characteristics, and multi-year financial performance indicators, the study seeks to establish a comprehensive understanding of the ESG, performance nexus in the Indian automobile sector.

Overall, this research contributes to filling critical methodological and contextual gaps in ESG-financial performance literature. It also supports India's progress toward Sustainable Development Goals (SDGs) - specifically SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), by empirically examining the role of ESG integration in fostering a sustainable and resilient automobile industry.

3. Data Analysis and Results

The study employs a descriptive research design combined with a stratified sampling technique, ensuring balanced representation of firms across the selected sustainability indices. By combining ESG-specific data, firm-level characteristics, and multi-year financial performance indicators, the study seeks to establish a comprehensive understanding of the ESG–performance nexus in the Indian automobile sector.

Data series should be stationary at the same level for effective estimations (Nagina & Othman, 2024). Thus, all selected variable data series were checked for stationarity through the unit root test in EViews 12. All the original data series for selected variables were found stationary at a 5% significance level. The model 1 is given as eq. (1):

$$ROAit = \alpha0 + \alpha1ESGit + \alpha2Eit + \alpha3Sit + \alpha4Git + \alpha5LEVit + \alpha6FSit + \alpha7FAit + \mu it \quad (1)$$

Chow Test / Redundant fixed effects tests

H0: POLS is the best model.

Ha: FEM is the best model.

As per the chow test statistics (Table 1), H0 is rejected at a 5% significance level. Thus, FEM is selected as the best model for the selected data.

Table 1. Chow test

Effects Test	Statistic	d. f.	Prob.
Cross-section F	13.248331	(11,89)	0.0000
Cross-section Chi-square	104.739104	11	0.0000

Source: Authors' work

Hausman test

H0: REM is the appropriate model.

Ha: FEM is the appropriate model.

Table 2. Hausman test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d. f.	Prob.
Cross-section random	36.791340	7	0.0000

Source: Authors' work

The statistics given in Table 2 confirms that FEM is the appropriate model as H0 is rejected at 5% level of significance.

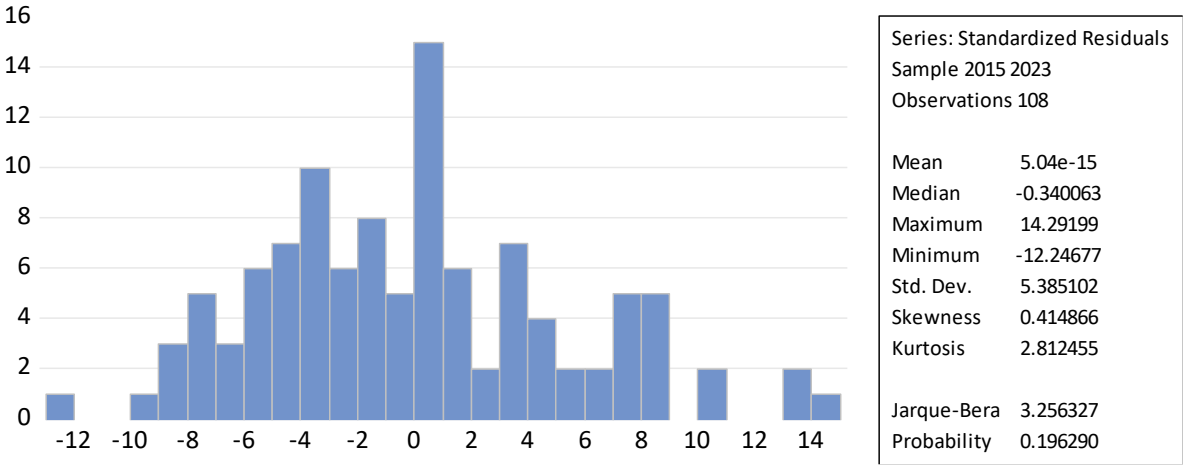
Classic test / Normality test

Classic Test Assumptions (Jarque Bera test results)

H0: Data is normally distributed.

Ha: Data is not normally distributed.

Figure 1. Classic test / Normality test



Source: Authors' work

Figure 1 results confirm that the standardized residuals are normally distributed as Ha is rejected. This further validates the regression results.

Table 3. Regression results (dependent variable: ROA)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	49.46882	7.099696	6.967737	0.0000
ESG_SCORE	-0.052111	0.081533	-0.639134	0.5244
E_SCORE	0.056131	0.043963	1.276791	0.205
S_SCORE	-0.013311	0.058473	-0.227653	0.8204
G_SCORE	0.045902	0.048561	0.945251	0.3471
LEV	0.601958	1.072596	0.561216	0.5761
FA	-0.841061	0.176905	-4.754318	0.0000
FS	0.014763	1.076206	0.013717	0.9891
R-squared	0.848106	Mean dependent var		8.815741
Adjusted R-squared	0.817386	S.D. dependent var		7.320978
S.E. of regression	3.128501	Akaike info criterion		5.277342
Sum squared resid	871.0891	Schwarz criterion		5.749198
Log likelihood	-265.9765	Hannan-Quinn criterion		5.468663
F-statistic	27.60749	Durbin-Watson stat		1.264682
Prob (F-statistic)	0.000000			

Source: Authors' work

Table 3 presents the regression analysis examining the relationship between ESG practices and financial performance (ROA) in India's automotive industry. The model demonstrates a strong overall fit ($R^2 = 0.8481$), indicating that approximately 84.81% of the variation in profitability is explained by the included variables. The F-statistic (27.607, $p < 0.001$) confirms that the model is statistically valid.

Among the independent variables, Firm Size (FS), Environmental (E) Score, and Governance (G) Score show a positive but statistically insignificant relationship with ROA. In contrast, the composite ESG Score, Social (S) Score, and Firm Age (FA) exhibit statistically insignificant effects, with FA showing a significant negative coefficient ($\beta = -0.8411$, $p < 0.001$), suggesting inefficiency in asset utilization. The fixed-effects specification accounts for unobserved firm-specific characteristics, thereby strengthening the reliability of the results.

The Durbin–Watson statistic (1.26) falls within an acceptable range, as supported by many empirical studies, indicating no severe issue of autocorrelation. However, a slight positive serial correlation may exist, which can be explored in future robustness checks. Overall, the findings suggest that while ESG dimensions contribute to sustainable and SDG-aligned business practices, their immediate financial impact on profitability remains statistically weak, implying that ESG-driven benefits are likely to materialize over the longer term. Model 2 is given in Equation (2) as follows:

$$ROE_{it} = \alpha_0 + \alpha_1 ESG_{it} + \alpha_2 E_{it} + \alpha_3 S_{it} + \alpha_4 G_{it} + \alpha_5 LEV_{it} + \alpha_6 FS_{it} + \alpha_7 FA_{it} + \mu_{it} \quad (2)$$

Chow Test / Redundant fixed effects tests

H0: POLS is the best model.

Ha: FEM is the best model.

As per the chow test statistics given in Table 4, H0 is rejected at a 5% significance level. Thus, FEM is selected as the best model for the selected data.

Table 4. Chow test

Effects Test	Statistic	d. f.	Prob.
Cross-section F	5.977259	(11,89)	0.0000
Cross-section Chi-square	59.742742	11	0.0000

Source: Authors' work

Hausman test

H0: REM is the appropriate model.

Ha: FEM is the appropriate model.

Table 5. Hausman test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d. f.	Prob.
Cross-section random	20.033641	7	0.0055

Source: Authors' work

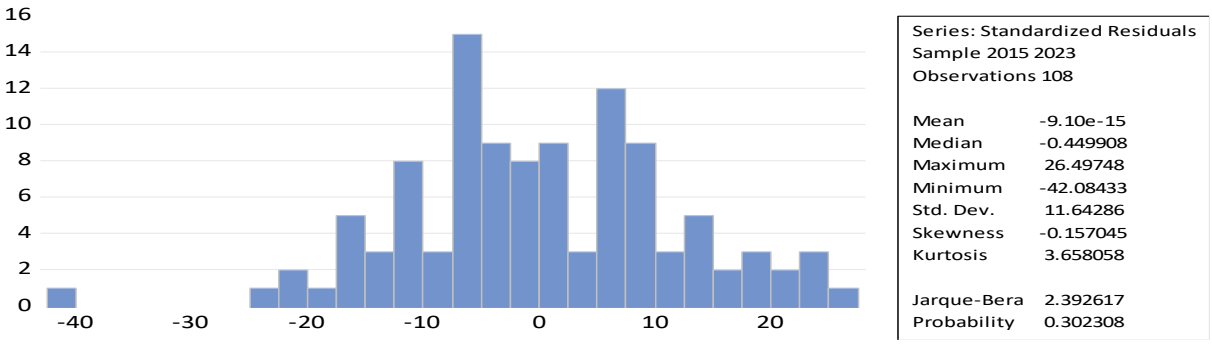
As per Table 5 results, FEM is the appropriate model for the present study

Classic Test Assumptions (Jarque Bera test results)

H0: Data is normally distributed.

Ha: Data is not normally distributed.

Figure 2. Jarque Bera test results



Source: Authors' work

Figure 2 statistics confirm that the standardized residuals are normally distributed as Ha is rejected at 5 % level of significance. This further validates the regression results.

Table 6. Regression results (dependent variable: ROE)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	122.4977	20.85387	5.874099	0.0000
ESG SCORE	-0.097611	0.239487	-0.407582	0.6842
E SCORE	0.050466	0.129131	0.39081	0.697
G SCORE	-0.118551	0.142623	-0.831101	0.4081
FA	0.096767	0.097566	0.991803	0.3236
FS	-0.407673	3.161382	-0.128967	0.8976

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LEV	-4.166536	3.150525	-1.322489	0.1894
R-squared	0.595645	Mean dependent var	17.0444	
Adjusted R-squared	0.513866	S.D. dependent var	13.17968	
S.E. of regression	9.185359	Akaike info criterion	7.432317	
Sum squared resid	7515.472	Schwarz criterion	7.904173	
Log likelihood	-382.3451	Hannan-Quinn criter.	7.626337	
F-statistic	7.28254	Durbin-Watson stat	1.779986	
Prob (F-statistic)	0.000000			

Source: Authors' work

Table 6 presents the regression analysis examining the effect of ESG factors and firm-specific variables on Return on Equity (ROE) in India's automotive industry. The model explains a moderate proportion of variance in ROE ($R^2 = 0.5956$; Adjusted $R^2 = 0.5139$), indicating that approximately 51.39% of variations in ROE are explained by the independent variables. The F-statistic (7.283, $p < 0.001$) confirms the overall statistical validity of the model.

Individually, none of the ESG dimensions (ESG Score, E Score, G Score) exhibit a statistically significant relationship with ROE ($p > 0.05$), implying that ESG practices may not directly influence short-term shareholder returns. The coefficients of E Score ($\beta = 0.0504$) and Firm Age ($\beta = 0.0968$) are positive, suggesting that environmentally responsible actions and organizational maturity might have favourable yet statistically weak effects on ROE. In contrast, Governance Score ($\beta = -0.1186$), ESG composite score ($\beta = -0.0976$), Firm Size ($\beta = -0.4077$), and Leverage ($\beta = -4.1665$) show negative but insignificant relationships, hinting that larger or more leveraged firms may experience slight profitability pressures.

The Durbin–Watson statistic (1.78) falls within the acceptable range (1.5–2.5), indicating no significant autocorrelation. Overall, while the model is statistically sound, it suggests that ESG practices in the Indian automotive sector have yet to translate into measurable short-term improvements in ROE. However, consistent ESG engagement aligns with the UN Sustainable Development Goals (SDGs) by fostering long-term value creation, governance transparency, and environmental stewardship, which are likely to strengthen financial resilience over time. Model 3 is explained in Equation (3) as follows:

$$EPS_{it} = \alpha 0 + \alpha 1 ESG_{it} + \alpha 2 E_{it} + \alpha 3 S_{it} + \alpha 4 G_{it} + \alpha 5 LEV_{it} + \alpha 6 FS_{it} + \alpha 7 FA_{it} + \mu_{it} \quad (3)$$

Chow Test / Redundant fixed effects tests:

H0: POLS is best model

Ha: FEM is the best model

As per the chow test statistics Table 7, H0 is rejected at a 5% significance level. Thus, FEM is selected as the best model for the selected data.

Table 7. Chow test / Redundant fixed effects tests

Effects Test	Statistic	d. f.	Prob.
Cross-section F	27.800296	(11,89)	0.0000
Cross-section Chi-square	160.893134	11	0.0000

Source: Authors' work

Hausman test

H0: REM is the appropriate model.

Ha: FEM is the appropriate model.

Table 8. Hausman test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d. f.	Prob.
Cross-section random	7.685699	7	0.3611

Source: Authors' work

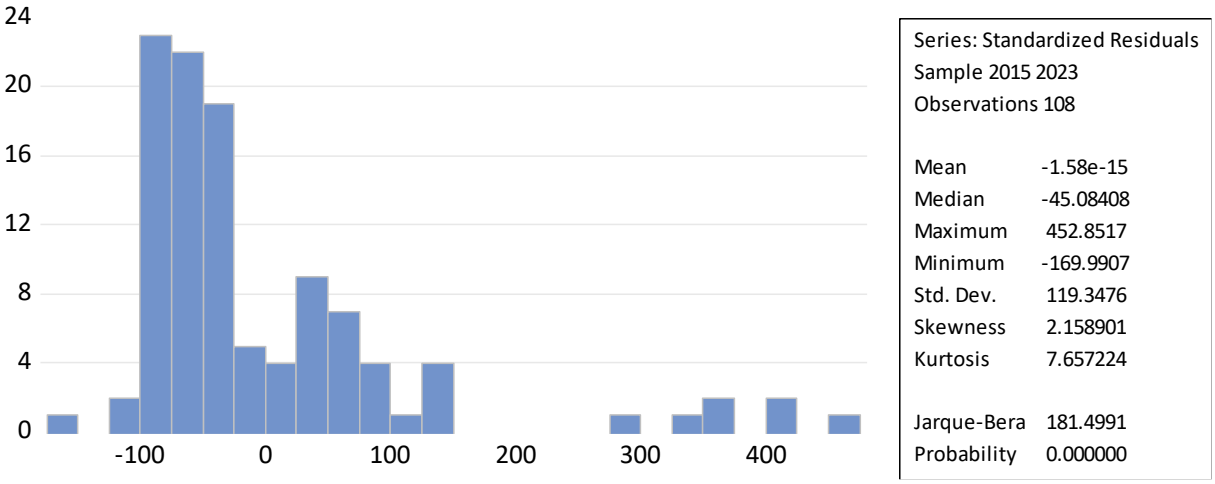
Table 8 statistics confirm that REM is the appropriate model for the data considered under study.

Classic Test Assumptions (Jarque Bera test results)

H0: Data is normally distributed.

Ha: Data is not normally distributed.

Figure 3. Classic Test Assumptions (Jarque Bera test results)



Source: Authors' work

Figure 3 illustrates the results of the normality test conducted using the Jarque–Bera statistic on the standardized residuals. The obtained value of 181.4991 with a p-value of 0.0000 leads to the rejection of the null hypothesis, indicating that the residuals deviate from a normal distribution. However, this deviation does not undermine the validity of the regression outcomes. As highlighted in econometric literature, the Central Limit Theorem (CLT) ensures that with sufficiently large samples, estimators remain consistent and asymptotically normal even when residuals are non-normally distributed (Shukla & Dhar, 2023). Therefore, the non-normality observed in Figure 3 does not compromise the robustness or reliability of the model's statistical inferences.

Table 9. Regression results (dependent variable: EPS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	167.7626	112.7614	1.487767	0.1403
ESG_SCORE	2.251671	1.249459	1.801932	0.0743
E_SCORE	-0.724872	0.69824	-1.038142	0.302
S_SCORE	0.6087	0.566816	1.073887	0.2855
G_SCORE	-0.811456	0.771275	-1.052009	0.2956
FA	-3.047396	2.808109	-1.085222	0.2809

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FS	2.51725	1.909229	1.317254	0.1914
LEV	-10.35022	17.03557	-0.607565	0.545
R-squared	0.883726	Mean dependent var		89.93963
Adjusted R-squared	0.86021	S.D. dependent var		132.8892
S.E. of regression	48.49382	Akaike info criterion		11.12927
Sum squared resid	21973.37	Schwarz criterion		11.27964
Log likelihood	-564.6204	Hannan-Quinn criter.		11.19911
F-statistic	37.57971	Durbin-Watson stat		1.379058
Prob(F-statistic)	0.000000			

Source: Authors' work

Table 9 presents the regression analysis examining the influence of ESG factors and firm-specific characteristics on Earnings Per Share (EPS) in India's automotive industry. The model demonstrates a strong overall explanatory power, with an R^2 of 0.8837 and an Adjusted R^2 of 0.8602, indicating that approximately 86.02% of the variation in EPS is explained by the independent variables. The F-statistic (37.58, $p < 0.001$) confirms that the overall model is statistically significant and well-fitted.

Among the predictors, the ESG composite score ($\beta = 2.2517$, $p = 0.0743$) shows a positive but marginally significant relationship with EPS at the 10% significance level, suggesting that higher ESG performance is associated with improved earnings potential. This implies that firms emphasizing sustainability and responsible governance may experience better investor confidence and market valuation. However, the individual components, E (Environmental), S (Social), and G (Governance) Scores, exhibit statistically insignificant effects, though the signs of coefficients indicate mixed influences. Firm Size (FS) also shows a positive but insignificant relationship with EPS, whereas Firm Age (FA) and Leverage (LEV) demonstrate negative but insignificant coefficients, implying that older or more leveraged firms might face profitability constraints.

The Durbin–Watson statistic (1.38) lies within an acceptable range, indicating no serious issue of autocorrelation. Overall, the results suggest that ESG engagement positively contributes to firm performance as reflected in EPS, aligning with the United Nations Sustainable Development Goals (SDGs), particularly those related to responsible production, sustainable industry growth, and corporate transparency. While the short-term financial impact is limited, these findings highlight ESG as a strategic lever for long-term financial sustainability and stakeholder trust within India's automotive sector.

Table 10. Multicollinearity test through VIF

Variable	VIF	1/VIF
ESG score	13.34	0.074952
S_score	6.57	0.152184
G_score	5.49	0.182216
E_score	3.92	0.255286
FS	1.92	0.521215
FA	1.73	0.577695
LEV	1.24	0.807157
Mean VIF 4.89		

Source: Authors' work

Furthermore, as per the results of Table 10, the multicollinearity test using Variance Inflation Factors (VIF) for each independent variable resulted in no multicollinearity between independent variables as the value of Centered VIF is less than 10 for each variable, as seen in Table. Thus, it is concluded that data is free from the issue of multicollinearity (Kalnins & Praitis Hill, 2025). This multicollinearity test results are applicable for all models.

Table 11. Heteroskedasticity through Breusch–Pagan test

Variable	chi2(1)	Prob > chi2
ROA	2.01	0.1558
ROE	13.75	0.0002
EPS	42.12	0.0000

Source: Authors' work

Table 11 shows that the Breusch-Pagan test results indicate no significant heteroskedasticity for the ROA variable (p-value = 0.1558), as its p-value is above the 0.05 significance level. However, both ROE (p-value = 0.0002) and EPS (p-value = 0.0000) show strong evidence of heteroskedasticity because their p-values are well below 0.05, suggesting that the assumption of constant error variance is violated for these models. This Heteroskedasticity test results are applicable for all models.

4. Overall Findings and Implications

The empirical results derived from the regression models for ROA, ROE, and EPS reveal that ESG performance, while not statistically significant in most models, demonstrates a positive directional influence on financial outcomes in India's automotive industry. This suggests that although the short-term financial benefits of ESG adoption may not be immediately evident, consistent engagement with sustainability practices can enhance long-term profitability and resilience. The Environmental (E) and Governance (G) dimensions show relatively stronger positive associations with financial indicators; however, their effects differ in magnitude due to underlying sectoral realities. In the Indian automotive sector, environmental initiatives often require significant long-term capital expenditure, such as investments in emission reduction technology, electric vehicle (EV) development, supply chain decarbonization, and waste recycling systems, which typically yield returns only over extended time horizons. Consequently, the Environmental pillar may appear statistically weak in short-term financial models. Furthermore, comparatively lenient enforcement of environmental regulations and slower policy execution may reduce immediate investor pressure on environmental compliance.

Conversely, Governance (G) demonstrates more noticeable financial relevance because governance improvements, such as board restructuring, transparent reporting practices, and anti-corruption frameworks, are more immediately visible to capital markets and institutional investors. Automotive firms with stronger governance systems typically attract more favourable analyst evaluations and financing terms, reflecting governance's immediate signalling effect on investor confidence. The Social (S) dimension exhibits a weaker relationship, highlighting that the financial advantages of social responsibility initiatives, such as community development, labour welfare, and diversity practices, tend to accumulate gradually through reputation enhancement and workforce stability rather than short-term profitability metrics.

Firm-specific factors such as size, age, and leverage also exhibit mixed effects, indicating that larger and older firms, though better resourced, might experience operational inefficiencies, while higher leverage tends to dampen profitability outcomes. Many established automobile manufacturers face challenges related to legacy infrastructure and ongoing transition to cleaner technologies, which may temporarily suppress returns.

From a policy and managerial standpoint, these findings emphasize the growing need for deeper integration of ESG principles within India's automotive sector. Policymakers should encourage greater ESG disclosure and transparency through mandatory reporting frameworks, ensuring that firms align with both national sustainability objectives and global standards. Strengthening sector-specific ESG guidelines can enable more accurate assessment of environmental and governance risks that are unique to automotive manufacturing and supply chains.

For managers, the results highlight the importance of embedding ESG within strategic planning and decision-making processes. Emphasizing environmental efficiency, reducing carbon emissions, and strengthening governance practices can enhance investor confidence and market valuation. At the same time, sustained social investments in workforce development, community engagement, and equitable practices can contribute to long-term brand equity and consumer loyalty.

Overall, the study underscores that while ESG initiatives may not yield immediate financial returns, they play a critical role in building sustainable, responsible, and future-ready organizations. Aligning these practices with the United Nations Sustainable Development Goals, particularly SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action), positions the automotive industry as a key driver of sustainable industrial transformation in India. Thus, the findings reinforce that ESG-driven strategies not only enhance corporate resilience and competitiveness but also contribute to national and global sustainability agendas in the long run.

Conclusion

This study examined the relationship between Environmental, Social, and Governance (ESG) performance and financial outcomes in India's automotive industry, addressing a key research gap in sector-specific sustainability-financial dynamics. The regression analyses for ROA, ROE, and EPS revealed that while ESG performance does not exhibit strong short-term statistical significance, the positive directional relationships, particularly between overall ESG scores and EPS, indicate that firms engaging in sustainable and responsible practices are likely to experience long-term financial and reputational gains. The Environmental and Governance dimensions emerged as relatively stronger contributors, reflecting the financial value of operational efficiency, emission reduction, and corporate transparency, whereas the social dimension's impact appears more gradual and intangible.

The findings emphasize that ESG integration aligns more with strategic resilience than immediate profitability, consistent with the principles of sustainable development. Firm-specific characteristics such as size, age, and leverage influence the ESG–financial relationship, suggesting that resource allocation and capital structure management play important roles in realizing sustainability benefits. Overall, the study underscores that continuous ESG commitment enhances stakeholder trust, supports compliance with global sustainability standards, and contributes to achieving the United Nations Sustainable Development Goals, particularly SDG 8, SDG 9, SDG 12, and SDG 13, thereby fostering a sustainable future for India's automotive sector.

Future studies should adopt longitudinal designs to capture the delayed financial impact of ESG investments, especially in environmentally sensitive industries like automotive. Employing advanced econometric models that address causal inference and endogeneity will improve the reliability of results. Comparative analyses across industries and regions can help identify which ESG dimension, environmental, social, or governance, most strongly influences financial performance. Strengthening ESG disclosure standards in emerging economies such as India will allow more accurate evaluation of sustainability outcomes. Integrating ESG and financial metrics will enhance understanding of their relationship and guide firms and policymakers in linking sustainability with long-term financial growth.

Credit Authorship Contribution Statement

All authors contributed to the conceptualization of this study. Chakraborty, J. was responsible for methodology design, data collection, data curation, investigation, formal analysis, visualization, drafting of the original manuscript, and project administration. Nagina, R. contributed to supervision, validation, interpretation of findings, critical review and editing, writing review, final refinement of the manuscript, and handling all journal correspondence. Salam, F. contributed to literature review support, secondary data compilation, and reviewing and editing of manuscript sections. Pritha, I. J., contributed to data organization, manuscript structuring, and review of the conceptual framework. Akter, P. contributed to proofreading, reference management, and final manuscript revisions.

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Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement

The datasets generated and analysed during this study form part of the ongoing PhD research work of the primary author. Due to academic and institutional restrictions, the data cannot be made publicly available at this stage. However, the data may be provided upon reasonable request to the corresponding author, subject to approval and confidentiality considerations.

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