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The Impact of ESG Scores on Corporate Financial Performance: The Case of Global Automotive Companies

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Sustainability, Global Automobile Industry, ESG, CFP, Panel Data Analysis, Bidirectional Relationship

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ABSTRACT

Environmental, social, and governance (ESG) practices are increasingly important in the automotive industry, yet their relationship with corporate financial performance (CFP) remains inconsistent. This study examined the relationships between individual ESG dimensions and CFP, including whether financial performance supports subsequent ESG improvements. A longitudinal design analyzed 16 global automotive companies during 2015–2023, yielding 144 firm-year observations. ESG scores and 12 financial indicators were obtained primarily from Bloomberg. Analyses employed generalized least squares regression, Arellano–Bond dynamic panel estimation, and structural equation modeling. Environmental scores were positively associated with current liquidity, interest coverage, and market valuation, but negatively associated with asset turnover. Lagged environmental scores positively predicted returns on assets and equity. Governance scores showed mixed relationships, including positive associations with operating cash flow and asset turnover, negative associations with current liquidity, and a positive lagged association with Tobin's Q. Social scores were generally insignificant across most specifications. Structural equation modeling identified significant associations involving environmental and governance dimensions, consistent with potential feedback between sustainability and financial performance. ESG–CFP relationships vary by dimension, financial indicator, and timing. Automotive companies should prioritize environmental and governance initiatives while recognizing financial tradeoffs and the limitations of causal interpretation.

INTRODUCTION

Research on the relationship between environmental, social, and governance (ESG) factors and corporate financial performance (CFP) has gained increasing attention in recent years, particularly in industries with substantial environmental and social impacts, such as the automotive industry. Businesses have undergone a significant transformation in their transition from corporate social responsibility (CSR) to ESG practices (Gigauri & Vasilev, 2023; Kandpal et al., 2024). CSR emerged in the mid-20th century, initially emphasizing corporate philanthropy and ethical business practices (Waddock & Graves, 1997). Over time, the concept expanded to encompass broader social and environmental concerns in response to increasing stakeholder expectations and regulatory requirements (Orlitzky et al., 2003). The transition to ESG reflects a growing emphasis on standardized approaches to measuring corporate sustainability performance. ESG has evolved into a comprehensive sustainability assessment framework that integrates quantitative evaluation methods with specific environmental, social, and governance indicators (Khan et al., 2016).

This transition has been driven by increasing market demand for transparent sustainability information and growing investor recognition of the financial implications of ESG factors

(Friede et al., 2015). ESG gained prominence in the early 2000s and attracted greater attention following the 2008 global financial crisis, when investors increasingly sought comprehensive risk assessment frameworks. Unlike traditional CSR approaches, ESG explicitly integrates sustainability considerations into corporate strategies and investment decisions (Henisz et al., 2019).

The global automotive industry faces distinctive ESG challenges, particularly regarding emissions regulations, electric vehicle (EV) innovation, and supply chain management (Sussams, 2018). The industry contributes substantially to greenhouse gas emissions and faces increasing pressure to reduce its environmental footprint while adapting to evolving consumer preferences and regulatory frameworks (Lin et al., 2020). Japan, China, South Korea, the United States, and Germany are among the world's major automotive manufacturing countries, with manufacturers operating extensive global production networks. ESG reporting has become increasingly important in the automotive industry as companies recognize its potential implications for financial performance and stakeholder perceptions (Granelli & Rådeström, 2023).

Previous research examining the relationship between ESG and CFP has produced mixed and sometimes contradictory findings. A comprehensive meta-analysis by Friede et al. (2015), covering more than 2,000 empirical studies, identified a generally positive association between ESG performance and financial outcomes. The findings indicated that positive ESG–CFP relationships were observed across different asset classes, geographical regions, and methodological approaches. However, Granelli and Rådeström (2023) demonstrated that the financial implications of individual ESG dimensions within the automotive industry were more complex. ESG research has increasingly emphasized cross-country comparisons and the disaggregation of ESG ratings into their constituent dimensions (Dinçergök & Pirgaip, 2025; Tancke et al., 2023). Similarly, van Emous et al. (2021) highlighted the importance of country-specific characteristics in shaping the relationship between carbon emissions reductions and financial performance. Khan et al. (2016) examined industry-specific sustainability indicators, demonstrating that the financial relevance of ESG factors varied across industries, including automotive manufacturing.

The automotive industry faces unprecedented challenges in adopting sustainable business practices amid growing environmental concerns and increasingly stringent regulatory requirements (Granelli & Rådeström, 2023). Although ESG performance has become an important indicator of corporate sustainability, its relationship with CFP remains contested, particularly within the automotive industry (Wang & Sarkis, 2017). Competing theoretical perspectives offer different predictions regarding this relationship. Stakeholder Theory suggests that companies addressing the interests and expectations of diverse stakeholder groups can generate long-term value and achieve stronger financial performance (Freeman, 1984; Waddock & Graves, 1997). Conversely, Shareholder Theory emphasizes shareholder wealth maximization and raises concerns that ESG-related expenditures may reduce financial returns when their economic benefits do not outweigh their costs (Friedman, 1970). Empirical evidence provides partial support for these competing perspectives. The meta-analysis conducted by Orlitzky et al. (2003) identified a positive association between corporate social performance and financial performance; however, industry-specific studies have demonstrated considerable heterogeneity. In the automotive industry, Granelli and Rådeström (2023) found that ESG scores were negatively associated with Tobin's Q but had no statistically significant relationship with return on assets (ROA), suggesting that market-based and accounting-based financial performance indicators may respond differently to ESG initiatives.

Several factors may explain these inconsistent findings. Methodological challenges include variations in ESG measurement approaches, differences in financial performance indicators, and potential endogeneity in the ESG–CFP relationship (Wang & Sarkis, 2017).

Furthermore, ESG investments may involve substantial initial expenditures, with financial benefits emerging over longer periods, highlighting the importance of longitudinal analyses (Waddock & Graves, 1997). Firm-specific characteristics, including company size and financial slack, may also moderate the relationship between ESG and CFP (Lin et al., 2019). Although numerous studies have reported positive associations between ESG and CFP, the direction of causality and the underlying mechanisms remain insufficiently understood. Accordingly, this study addresses three research questions: (1) Do ESG scores influence CFP indicators among global automotive companies? (2) Does CFP influence ESG scores among global automotive companies? (3) Is the relationship between ESG scores and CFP bidirectional and mutually reinforcing?

The primary objective of this study is to examine the potential bidirectional relationship between ESG scores and CFP among global automotive companies. Specifically, the study aims to investigate the effects of ESG performance on CFP, determine whether CFP influences subsequent ESG performance, and assess whether a mutually reinforcing relationship exists between these variables. The analysis focuses on major automotive manufacturers from leading vehicle-producing countries during the 2015–2023 period. It examines disaggregated ESG scores and their relationships with accounting-based and market-based financial performance indicators, incorporating cross-country comparisons to identify potential geographical variations in the ESG–CFP relationship (van Emous et al., 2021). Furthermore, the study investigates potential bidirectional relationships between ESG performance and financial outcomes while considering industry-specific factors, including emissions regulations and developments in the electric vehicle market (Lin et al., 2020).

From a theoretical perspective, this study addresses an important research gap by examining competing explanations derived from Stakeholder Theory and Slack Resources Theory within an industry where ESG considerations are increasingly integrated into business operations (Orlitzky et al., 2003). Unlike previous studies that have treated ESG performance as a single composite construct, this research disaggregates ESG scores into environmental, social, and governance dimensions to provide a more detailed understanding of their respective relationships with financial performance (Granelli & Rådeström, 2023). This disaggregated approach is particularly relevant to the automotive industry, which faces distinctive sustainability challenges, including substantial carbon emissions, complex labor practices throughout global supply chains, and corporate governance structures that influence product safety and innovation (Ray et al., 2024).

Empirically, the study employs a longitudinal panel dataset covering 16 major automotive companies from 2015 to 2023, representing approximately 70% of global vehicle production. By applying cross-sectional generalized least squares (GLS) regression, Arellano–Bond dynamic panel estimation, and structural equation modeling (SEM), the research seeks to address methodological limitations associated with previous cross-sectional studies and investigate potential bidirectional relationships between ESG and CFP (McWilliams & Siegel, 2000). The examination of 12 CFP indicators organized into six constructs provides a comprehensive assessment of financial performance compared with approaches relying on a single financial indicator (Granelli & Rådeström, 2023).

From a practical perspective, the study offers implications for multiple stakeholder groups. Corporate executives may use the findings to inform ESG investment priorities, strategic decision-making, and resource allocation (Porter & Kramer, 2006). Investors and financial analysts may benefit from industry-specific evidence when constructing investment portfolios and assessing financial and sustainability-related risks within the automotive sector (Friede et al., 2015). Policymakers may also use the findings to evaluate whether ESG-related regulations can support environmental objectives while maintaining economic competitiveness (Cortez & Kelly, 2025). Given the automotive industry's substantial contribution to carbon

dioxide (CO_2) emissions and its ongoing transition toward decarbonization, the findings may contribute to identifying strategies that balance environmental sustainability with corporate financial viability. Such insights are relevant to broader efforts to achieve global climate targets and the United Nations Sustainable Development Goals (SDGs) (Lin et al., 2020; Ray et al., 2024).

METHOD

Theoretical Framework

Stakeholder Theory suggests that firms can improve corporate financial performance (CFP) by addressing stakeholder interests, thereby reducing risks, strengthening corporate reputation, and enhancing access to resources (Friede et al., 2015). Accordingly, higher environmental, social, and governance (ESG) performance is expected to be associated with greater profitability and improved risk-adjusted financial outcomes (Wang & Sarkis, 2017). The integrated theoretical framework adopted in this study is illustrated in Figure 1.

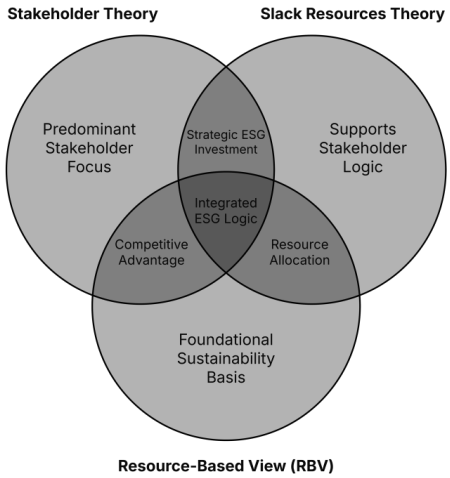


Figure 1. Theoretical framework

Slack Resources Theory suggests that financially successful firms can allocate surplus resources to environmental, social, and governance (ESG) initiatives, implying that stronger financial performance may lead to subsequent improvements in ESG performance (Waddock & Graves, 1997). These investments may, in turn, enhance operational efficiency and corporate legitimacy, creating a potentially mutually reinforcing relationship between ESG and corporate financial performance (CFP) (Waddock & Graves, 1997). Accordingly, this study employed lagged variables and dynamic panel specifications to examine potential bidirectional relationships between ESG and CFP among automotive companies.

The Resource-Based View (RBV) suggests that ESG-related resources and capabilities can contribute to sustained competitive advantage when they are valuable, rare, difficult to imitate, and nonsubstitutable (Barney, 1991). ESG investments addressing financially material sustainability issues may strengthen organizational capabilities and improve accounting-based and market-based financial performance (Khan et al., 2016). Accordingly, the RBV provides a theoretical basis for examining variations in the financial implications of ESG dimensions, particularly those related to emissions management, product safety, labor practices, supply chain governance, and investments in vehicle electrification (Khan et al., 2016).

Collectively, the integrated theoretical framework suggests three relationships. First, stronger ESG performance is expected to be positively associated with CFP through improved risk management, operational efficiency, revenue growth, and access to capital (Friede et al.,

2015). Second, stronger CFP is expected to support subsequent improvements in ESG performance through the availability of financial slack, indicating a potentially bidirectional relationship (Waddock & Graves, 1997). Third, the strength of the ESG–CFP relationship may vary across ESG dimensions, particularly when sustainability investments contribute to strategically valuable organizational capabilities. Environmental and governance dimensions associated with emissions management, product safety, supply chain integrity, and investment efficiency may therefore exhibit stronger relationships with financial outcomes in the automotive industry (Khan et al., 2016).

Hypothesis Development

The hypotheses address the potential impacts of ESG on CFP, the reverse causation of CFP on ESG, and the concurrent bidirectional relationship between these variables in the global automotive industry, moderated by industry dynamism and market conditions. The relationship between ESG performance and CFP in automotive manufacturing receives strong conceptual support from both legitimacy theory and stakeholder theory. Companies require their actions to match societal expectations for them to keep their "social license to operate" (Dowling & Pfeffer, 1975). Stakeholder theory supports success through long-term achievement by demanding that companies address employee needs and customer interests alongside community well-being (Waddock & Graves, 1997). Automotive companies that fund ESG initiatives build their legitimacy while fostering better stakeholder relationships which can result in better financial outcomes. This theoretical foundation supports the hypothesis that higher ESG scores are positively associated with better CFP in the global automotive industry, as illustrated in Figure 2.

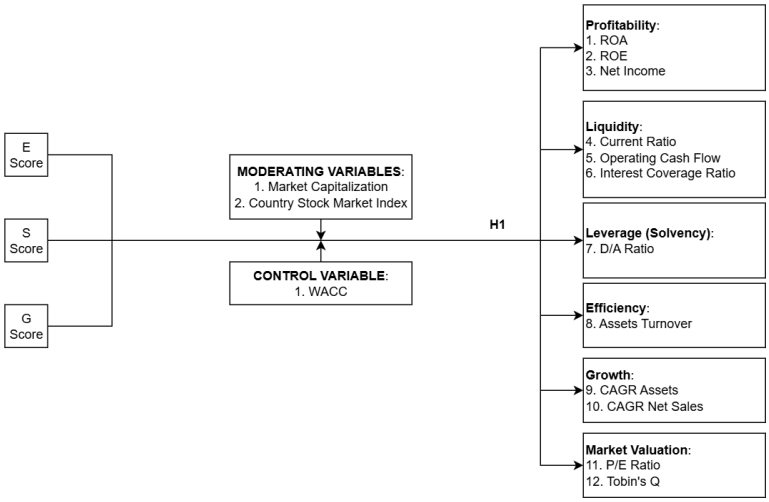


Figure 2. Hypothesis 1: relationship between ESG and CFP

H_1: ESG scores have a positive relationship with CFP in the global automotive industry, moderated by industry dynamism, cost of capital, and market condition.

Premium financial returns from the RBV theory enable companies to invest their surplus resources into environmental and social initiatives according to Waddock and Graves (1997). Firms that generate profits receive increased pressure from society to prove their dedication to sustainability according to legitimacy theory (Dowling & Pfeffer, 1975). Automotive companies that demonstrate stronger financial performance have better capabilities to support sustainable technology development and governance structure implementation (Lin et al., 2020). New research on automotive companies reveals that businesses achieving financial success demonstrate improved ESG scores (Ray et al., 2024). The capital-intensive sector characteristics along with theoretical underpinnings demonstrate how financial performance directly impacts organizational capability to enhance ESG performance, as shown in Figure 3.

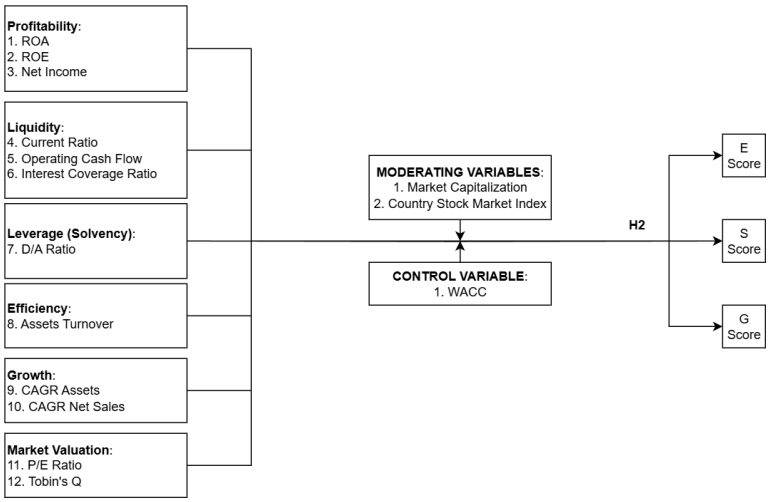


Figure 3. Hypothesis 2: relationship between CFP and ESG

H_2: CFP has a positive relationship with ESG scores in the global automotive industry, moderated by industry dynamism, cost of capital, and market condition.

A theoretical foundation using RBV, legitimacy theory, stakeholder theory, and slack availability of resources demonstrates that ESG and CFP follow an interactive relationship model (Figure 4). RBV demonstrates how distinctive ESG capabilities generate financial performance improvements yet slack resources theory shows better financial results create opportunities for ESG investments. According to legitimacy theory organizations need societal approval which ESG activities provide while stakeholder theory shows better financial outcomes result from managing diverse stakeholder interests through ESG initiatives (Khan et al., 2016; Waddock & Graves, 1997).

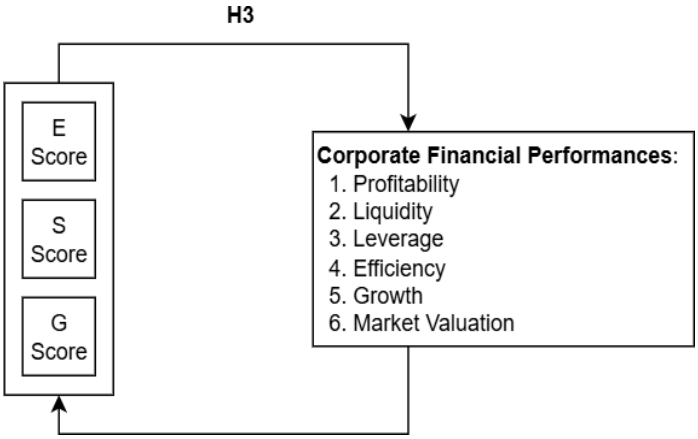


Figure 4. Hypothesis 3: bidirectionality between ESG and CFP

H_3: There exists a bidirectional relationship between ESG scores and CFP in the global automotive industry.

Data Collection

The study sample comprises 16 major global automotive companies listed on different stock markets across the globe, selected based on their market capitalization and industry significance. All companies included in the sample were actively traded on their respective stock exchanges during the study period. The sample includes four U.S.-based manufacturers (Tesla, General Motors, Ford Motor, and Stellantis), seven Japanese companies (Nissan Motor, Toyota Motor, Mitsubishi Motors, Mazda Motor, Honda Motor, Suzuki Motor, and Subaru),

three German automakers (Mercedes-Benz AG, BMW Group AG, and Volkswagen AG), and two South Korean manufacturers (KIA Motors and Hyundai Motors).

This diverse geographical representation ensures comprehensive coverage of the global automotive industry, encompassing companies from developed markets with varying ESG disclosure practices and regulatory environments. The study covered the years between 2015 and 2023, providing a nine-year panel dataset that captures both pre-and post-pandemic financial and ESG performance dynamics. Chinese automotive companies were dropped from the sample due to uncontrolled volatility across all ESG scores, which could introduce measurement errors and compromise the reliability of the empirical analysis. The selected firms represent both traditional internal combustion engine manufacturers and companies transitioning toward electrification, providing a balanced perspective on ESG performance across different strategic positions within the industry.

The Bloomberg Terminal became the primary source of ESG scores and CFP metrics. To achieve the reliability and integrity of the dataset, the ESG information was cross verified with the EOL database (Japanese manufacturers only) and against the financial statements and disclosures available on official investor relations websites for each manufacturer (Friede et al., 2015). The selected ESG metrics were broken down into environmental, social, and governance aspects, and the independent impact of each of these metrics on the financial performance of the company could be examined in detail. The data of each manufacturer per year were added together, which allowed building strong longitudinal and cross-sectional data to continue the empirical testing.

The work used the ESG scoring framework offered by Bloomberg that relies on a mixture of reported quantitative data, aggregation of themes, and scoring of all three ESG pillars on equal footing. Companies that scored 10 on disclosure were said to have reported well on their ESG regardless of the industry. This guarantees an opportunity to compare and be consistent across the sample, reducing biases that could exist in reporting practices specific to the sector or geography (Granelli & Rådeström, 2023). The obtained data comprised key financial measures, i.e. profitability, liquidity, leverage, efficiency, growth, and market capitalization, and the data on a weighted average cost of capital and the corresponding stock index returns that were utilized as moderating variables. The purpose of data selection was to include dynamic and industry-wide trends in ESG and financial results and provide a quality empirical basis to support the methodological analysis (Lin et al., 2020).

METHOD

The analysis began with descriptive statistics to examine central tendencies and temporal patterns in environmental, social, and governance (ESG) scores and corporate financial performance (CFP) indicators from 2015 to 2023. Three econometric techniques were employed to examine the ESG–CFP relationship: cross-sectional generalized least squares (GLS) regression, Arellano–Bond dynamic panel estimation, and structural equation modeling (SEM) (Sussams, 2018).

Cross-sectional GLS regression was employed to account for heteroskedasticity and potential cross-sectional correlations in the error terms when estimating relationships between ESG dimensions and financial indicators. The Arellano–Bond estimator was used to examine dynamic relationships by incorporating lagged variables and addressing potential endogeneity and serial correlation in the panel data. This approach accounted for temporal changes in ESG strategies and financial outcomes across firms (Khan et al., 2016).

SEM was employed to examine direct and indirect relationships among ESG performance, financial indicators, and relevant mediating variables. The combined analytical approaches provided complementary evidence on contemporaneous and dynamic associations

between ESG performance and CFP. These methods were consistent with previous research examining ESG outcomes in the automotive industry (Granelli & Rådeström, 2023).

Although the Arellano–Bond estimator was used to address potential endogeneity, the one-year lag may not have fully captured the longer-term financial returns associated with ESG investments. Major sustainability initiatives in the automotive industry, including electric vehicle development and low-carbon manufacturing facilities, may require two to four years to generate financial returns (Zahid et al., 2022). Consequently, the analysis may have captured short-term investment costs while underestimating longer-term financial benefits, potentially biasing the estimated ESG–CFP relationship toward null or negative associations.

ESG-CFP Modelling

The author examines the impact of ESG scores on CFP in the global automotive industry using regression models that capture the complex relationships between ESG and CFP, considering the disaggregated ESG scores as well as the moderating effects of industry dynamism and market conditions. The ESG score is disaggregated into its component parts: Environmental (E), Social (S), and Governance (G) scores, which allows the examination of the individual impacts of each ESG component on CFP.

Regression Model 1:

$$CFP_{it} = \beta_0 + (\beta_1 * E_Score_{it}) + (\beta_2 * S_Score_{it}) + (\beta_3 * G_Score_{it}) + (\beta_4 * Industry_{it}) + (\beta_5 * Market_{it}) + (\beta_6 * (E_Score_{it} * Industry_{it})) + (\beta_7 * (E_Score_{it} * Market_{it})) + (\beta_8 * (S_Score_{it} * Industry_{it})) + (\beta_9 * (S_Score_{it} * Market_{it})) + (\beta_{10} * (G_Score_{it} * Industry_{it})) + (\beta_{11} * (G_Score_{it} * Market_{it})) + u_i + e_{it}$$

where i refers to firms and t refers to years. The second model series uses disaggregated ESG measurements and dynamic panel estimation. This detailed model enables researchers to study the delayed impact of individual ESG elements on CFP by revealing the complete relationship between distinct ESG performance characteristics and financial outcomes throughout time. Khan et al. (2016) recommend analyzing the materiality of ESG factors and this model implements this methodology.

Regression Model 2:

$$\Delta CFP_{it} = \beta_0 + (\beta_1 * \Delta E_Score_{it}) + (\beta_2 * \Delta S_Score_{it}) + (\beta_3 * \Delta G_Score_{it}) + (\beta_4 * Industry_{it}) + (\beta_5 * Market_i) + (\beta_6 * (\Delta E_Score_{it} * Industry_i)) + (\beta_7 * (\Delta E_Score_{it} * Market_i)) + (\beta_8 * (\Delta S_Score_{it} * Industry_i)) + (\beta_9 * (\Delta S_Score_{it} * Market_i)) + (\beta_{10} * (\Delta G_Score_{it} * Industry_i)) + (\beta_{11} * (\Delta G_Score_{it} * Market_i)) + (\gamma * CFP_{i,t-1}) + u_i + e_{it}$$

CFP-ESG Modelling

The regression models 3.1, 3.2, and 3.3 study the relationship between CFP and separate E, S, and G scoring metrics. Stakeholder theory and resource-based view support these models which demonstrate that better ESG performance enhances financial results (Waddock & Graves, 1997; Orlitzky et al., 2003). Context-specific ESG impacts become better understood through the combination of industry and market variables with CFP interactions while reflecting contingency theory (Wang & Sarkis, 2017). The models examine both individual business characteristics and time-dependent elements which resolve potential endogeneity issues and track ESG-CFP relationships (Hayakawa, 2012). The analytical approach to ESG scores reveals their individual contribution to financial performance which contributes to discussions about ESG materiality (Khan et al., 2016).

Regression Model 3.1 (E Score):

$$E_Score_{it} = \beta_0 + (\beta_1 * CFP_{it}) + (\beta_2 * Industry_i) + (\beta_3 * Market_i) + (\beta_4 * (CFP_{it} * Industry_i)) + (\beta_5 * (CFP_{it} * Market_i)) + u_i + e_{it}$$

Regression Model 3.2 (S Score):

$$S_Score_{it} = \gamma_0 + (\gamma_1 * CFP_{it}) + (\gamma_2 * Industry_i) + (\gamma_3 * Market_i) + (\gamma_4 * (CFP_{it} * Industry_i)) + (\gamma_5 * (CFP_{it} * Market_i)) + v_i + f_{it}$$

Regression Model 3.3 (G Score):

$G_Score_{it} = \delta_0 + (\delta_1 * CFP_{it}) + (\delta_2 * Industry_i) + (\delta_3 * Market_i) + (\delta_4 * (CFP_{it} * Industry_i)) + (\delta_5 * (CFP_{it} * Market_i)) + w_i + g_{it}$

The regression models 3.4, 3.5, and 3.6 extend the static GLS specifications by incorporating dynamic panel estimation through the Arellano-Bond with 1-year lag, which accounts for the persistence and path-dependency inherent in ESG performance over time. While the GLS models (3.1, 3.2, and 3.3) capture cross-sectional variation and contemporaneous relationships, the dynamic specifications recognize that current ESG scores are influenced by historical performance, reflecting the cumulative nature of environmental, social, and governance investments. This dynamic framework addresses two critical econometric concerns: the potential endogeneity of CFP as a determinant of ESG scores and the serial correlation in ESG performance that arises from the long-term, path-dependent nature of sustainability initiatives.

Regression Model 3.4 (E Score):

$E_Score_{it} = \beta_0 + (\beta_1 * CFP_{it}) + (\beta_2 * Industry_i) + (\beta_3 * Market_i) + (\beta_4 * (CFP_{it} * Industry_i)) + (\beta_5 * (CFP_{it} * Market_i)) + (\gamma * E_Score_{i,t-1}) + u_i + e_{it}$

Regression Model 3.5 (S Score):

$S_Score_{it} = \gamma_0 + (\gamma_1 * CFP_{it}) + (\gamma_2 * Industry_i) + (\gamma_3 * Market_i) + (\gamma_4 * (CFP_{it} * Industry_i)) + (\gamma_5 * (CFP_{it} * Market_i)) + (\gamma * S_Score_{i,t-1}) + v_i + f_{it}$

Regression Model 3.6 (G Score):

$G_Score_{it} = \delta_0 + (\delta_1 * CFP_{it}) + (\delta_2 * Industry_i) + (\delta_3 * Market_i) + (\delta_4 * (CFP_{it} * Industry_i)) + (\delta_5 * (CFP_{it} * Market_i)) + (\gamma * G_Score_{i,t-1}) + w_i + g_{it}$

In all models, i refers to firms and t refers to years.

RESULTS AND DISCUSSION

Descriptive Statistics

The descriptive statistics provide an overview of key financial and ESG variables for 16 global automotive companies from 2015 to 2023 (Table 2). Each company is tracked annually, resulting in a total of 144 observations per variable. The analysis focuses on the central tendency, variability, and range of each indicator, which collectively explains the heterogeneity that characterizes this industry.

The mean values for the ESG components—environmental (3.67), social (3.66), and governance (5.62) scores—suggest that governance measures are relatively more developed among automotive firms, reflecting strong compliance and board structure. However, standard deviations indicate notable variance across firms, with governance also displaying the highest maximum value. These statistics are consistent with prior studies that reveal substantive heterogeneity in ESG adoption and reporting in the automotive industry (Ray et al., 2024).

Profitability ratios of ROA (mean 3.41%) and ROE (mean 9.36%) display considerable dispersion. The standard deviations and wide minimum-to-maximum ranges show that while some automakers experienced high profitability, others faced significant losses, reflecting the cyclical nature of the sector and external shocks, such as technological disruptions or changes in trade policy. Net income and operating cash flow also vary drastically, indicating that some firms have robust earnings capacity, while others encounter periods of negative net income, a trend periodically observed in global auto markets (Lin et al., 2020).

Measures of financial structure such as the current ratio (mean 1.30) and debt-to-assets ratio (mean 32.17%) illustrate that while most firms maintain reasonable short-term liquidity and moderate leverage, a broad spectrum of capital structures exists. The variability in these ratios hints at differing strategic orientations and risk appetites among firms. Market capitalization is especially dispersed, with some firms such as Toyota Motor and Tesla representing a much higher market value than peers like Mazda Motor or Subaru, reflecting

distinct investor perceptions and strategic positions. Growth and productivity variables like asset turnover, asset growth, and net sales growth also show marked differences among firms, ranging from declines to rapid expansion. These indicators suggest that the industry contains both mature and growth-oriented companies adapting to shifting markets and regulatory landscapes. The presence of variables like market index and foreign exchange exposure further contextualizes the results in a global operational environment, where firms like Nissan Motor are influenced by both domestic and international economic forces.

Multicollinearity and Heteroskedasticity Tests

The multicollinearity and heteroskedasticity analysis were performed for financial indicators (Table 3). Multicollinearity checks showed a mean VIF of 1.31 for all variables, indicating a low risk of correlations among explanatory variables. This allows for reliable estimation of coefficients without bias from multicollinearity across the different financial dimensions. Heteroskedasticity was assessed by applying adjusted chi-square statistics to the residuals of regressions for each financial outcome. The test found evidence of heteroskedasticity among most profitability metrics, such as ROA, ROE, and net income, as well as for ICR, debt to asset ratio, asset turnover, both growth rates (CAGR of assets and net sales), and both market-based measures, P/E ratio and Tobin's Q. In contrast, the current ratio and operating cash flow variables did not display significant heteroskedasticity. This pattern indicates that error term variances are not uniform for many of the key performance indicators, especially those most influenced by market conditions or operating leverage, while some liquidity measures maintain more consistent error variances.

Table 3. Multicollinearity and heteroskedasticity

Dependent Variables	Multicollinearity Mean VIF	Heteroskedasticity (p-value) chi^2	Prob > chi^2 (adjusted)
Profitability			
ROA	1.31	4.32	0.038
ROE	1.31	13.75	0.000
Net income	1.31	33.87	0.000
Liquidity			
Current ratio	1.31	3.42	0.065
Operating cash flow	1.31	1.33	0.192
Interest coverage ratio	1.31	9.73	0.002
Leverage			
Debt to asset ratio	1.31	16.87	0.000
Efficiency			
Asset turnover	1.31	7.97	0.005
Growth			
CAGR of assets	1.31	47.61	0.000
CAGR of net sales	1.31	49.77	0.000
Valuation			
P/E ratio	1.31	139.22	0.000
Tobin's Q	1.31	59.43	0.000

Together, the results reveal a dataset with low collinearity and variable degrees of error variance across financial outcomes. The presence of heteroskedasticity is not universal, but is concentrated on strategic profit, growth, leverage, and valuation indicators, aligning with the greater volatility and sensitivity typical of these measures in the global automotive sector. This heterogeneity in error variance reinforces the importance of robust estimation approaches for statistical inference in the subsequent analysis.

Mean Estimation

The ESG components demonstrate steady growth during each successive year. The automotive industry demonstrated its sustainability commitment by increasing escore from 2.17 in 2015 to 5.15 in 2023 along with sscore growth from 2.53 to 4.78 and gscore improvement from 4.87 to 6.16. The financial performance metrics demonstrate different directional trends throughout the years. The ROA metrics displayed a movement between 1.56% and 5.60% while ROE registered wider variation starting from 4.39% and reaching 14.52%. The profit margin (profmar) experienced continuous growth over the period from 3.35% in 2015 to reach 6.46% in 2023. Net income progressed substantially from an initial 4,377 million to a final 8,547 million.

Liquidity measures remained relatively stable. The financial metrics showed consistent current ratio (curr) values between 1.21 and 1.36 and quick ratio (quick) values that rose from 0.84 to 0.93. Operating cash flow (ocf) increased substantially from 6,879 million to 12,599 million while free cash flow (fcf) grew from 1,617 million to 4,243 million. The interest coverage ratio (icr) exhibited a range between 18.85 and 36.67. Asset turnover (asto) demonstrated steady performance in the range of 0.71-0.86 but accounts receivable turnover (arto) experienced an increase from 8.62 to 12.75. Inventory turnover (ito) decreased from 7.56 to 6.80 over the periods.

Capital structure indicators experienced multiple changes over time. The debt-to-assets ratio (dta) declined by 4.31 percentage points from 32.46% to 28.15% while the debt-to-equity ratio (dte) plummeted from 134.01% to 90.37%. The compound annual growth rate (cagr) exhibited fluctuations spanning from 3.53% to 13.48% and fixed assets growth (cagrfa) and net sales growth (cagrns) displayed comparable patterns of change. Market-based indicators demonstrate significant changes. Book value per share (bvps) experienced a rise from 42.23 to 74.11 throughout the period. Price-earnings ratio (peratio) exhibited notable price fluctuations during 2020. The Q ratio (tobinsq) oscillated between 1.10 and 2.11 throughout the period. Market capitalization (mktcap) experienced substantial expansion from an initial value of 51,057 million to reach 97,142 million. During the observed period the weighted average cost of capital increased from 6.64% to 8.38% while the market index grew from 3,267 to 5,701 points.

The Impacts of Disaggregated ESG Scores on CFP

In the cross-section GLS (Table 4), only the environmental and governance pillars show significant relationships with certain financial indicators, while the lagged Arellano–Bond results (Table 5) indicate that higher environmental and governance scores in the previous year improve current profitability but may reduce firm value as measured by Tobin's Q.

Table 4. Cross-section GLS of ESG scores to CFP

Dependent variable	escore	sscore	gscore
(1) roa	0.691 (0.610)	-0.433 (0.608)	-0.604 (0.804)
(2) roe	0.012 (0.998)	0.099 (0.973)	-2.347 (0.781)
(3) netinc	-1,544.835 (0.178)	436.920 (0.542)	-359.096 (0.862)
(4) curr	0.317*** (0.000)	-0.071 (0.146)	-0.576*** (0.000)
(5) ocf	-1,096.562 (0.537)	618.902 (0.576)	8,338.709** (0.009)
(6) icr	34.583** (0.009)	1.608 (0.845)	-3.335 (0.889)
(7) dta	10.643** (0.003)	-2.010 (0.364)	-12.394 (0.053)
(8) asto	-0.299*** (0.000)	0.091* (0.019)	0.546*** (0.000)
(9) cagra	5.043 (0.418)	0.045 (0.991)	-14.363 (0.201)
(10) cagrns	0.973 (0.877)	6.708 (0.087)	-11.016 (0.331)
(11) P/E_ratio	2.423 (0.595)	-5.625* (0.048)	-14.478 (0.078)
(12) tobinsq	0.394** (0.003)	-0.083 (0.314)	-0.124 (0.604)
Observations	144	144	144
Number of firm	16	16	16

Note: coefficients with p-values in parentheses; ***p<0.001, **p<0.01, *p<0.05.

The environmental score in the GLS estimates is positively and statistically significantly correlated with the current ratio and asset turnover, meaning that a better environmental performance of the firms is associated with the strong short term liquidity and efficient utilization of the assets. This trend is similar to slack resources perspective that allows financially sound companies to invest in environmental projects which ultimately increase operational efficiency and cash flow generating ability (Waddock & Graves, 1997). The environmental initiatives (e.g., emissions reduction, eco efficiency) under the stakeholder theory and legitimacy perspectives decrease regulatory and reputational risk, facilitating operations that are less volatile, and consequently, the liquidity and turnover (Dowling & Pfeffer, 1975; van Emous et al., 2021). The RBV sees the environmental capabilities as firm specific intangible resources that optimize resource utilization and process innovation, which is converted into better asset utilization (Cortez & Cudia, 2011).

The disaggregated models indicate that there is no statistically significant value of the S score in both GLS and Arellano Bond specifications, which means that in this sample, the social activities do not directly affect contemporaneous accounting performance or lagged accounting performance or market-based measures. This dampened effect can be indicative of the fact that most social efforts are viewed by capital markets as generic or non-material and that they do not directly lead to productivity or cost benefits, which aligns with the point that only strategically aligned initiatives are value relevant (Khan et al., 2016). In the light of a stakeholder theory, it can also imply that social expectations in the international automotive industry are already at a minimum level and therefore, only marginal increases can make a difference in distinguishing firms financially (Orlitzky et al., 2003). From RBV perspective, it is evident that, when social projects can be easily imitated or not entrenched in core processes, they cannot be considered as rare and inimitable resources, and they will not contribute much to a competitive advantage (Barney, 1991).

In the GLS cross section estimates, the G score has negative and significant relationship with the current ratio and positive relationship with the current operating cash flow and asset turnover indicating that superior governance practices are related with increased efficiency in using working capital and assets but a little higher liquidity constraint. Such trends may be understood as the sign of successful monitoring and capital discipline: enhanced governance restricts managerial discretion, agency costs, and idle resources, which is making cash flow and operating efficiency better and boosts performance despite reducing liquidity reserves, which are perceived to be conservative (Kim et al., 2012). Regarding the perspective of a stakeholder theory, good governance arrangements indicate responsibility and openness, enhancing relationships with creditors and shareholders, and this is not inconsistent with the findings that an increase in ESG/governance quality decreases the cost of capital of firms (Apergis et al., 2022). Superior governance under the RBV has been viewed as an organizational skill that coordinates other resources in a better and efficient way that can boost the operational performance and cash generating ability (Henisz et al., 2019).

Table 5. One-year lag Arellano-Bond of ESG scores to CFP

Dependent variable	L.escore	L.sscore	L.gscore
(1) roa	0.449*** (0.000)	-0.064 (0.902)	-2.076** (0.009)
(2) roe	1.794*** (0.000)	1.009 (0.533)	-5.384* (0.033)
(3) netinc	50.832 (0.939)	855.951 (0.101)	3.074 (0.997)
(4) curr	0.049* (0.018)	0.007 (0.668)	0.018 (0.486)
(5) ocf	-936.901 (0.209)	82.521 (0.895)	-687.812 (0.485)
(6) icr	-0.380 (0.930)	-1.589 (0.641)	-10.489* (0.039)

Dependent variable	L.escore	L.sscore	L.gscore
(7) dta	-0.572 (0.299)	-0.097 (0.834)	1.218 (0.074)
(8) asto	-0.023 (0.212)	0.006 (0.659)	-0.037 (0.100)
(9) cagra	-3.952 (0.142)	-0.071 (0.975)	-5.858 (0.088)
(10) cagrns	-1.749 (0.508)	1.010 (0.640)	0.732 (0.824)
(11) P/E_ratio	-3.972 (0.767)	-2.057 (0.837)	-1.252 (0.936)
(12) tobinsq	-0.037 (0.635)	0.067 (0.281)	0.052*** (0.000)
Observations	112	112	112
Number of firm	16	16	16

Note: coefficients with p-values in parentheses; ***p<0.001, **p<0.01, *p<0.05.

The lagged E score of the Arellano Bond model with one year lag has a positive and significant correlation with ROA and ROE, which means that previous environmental engagement becomes reflected in the next year in higher accounting profitability. This feedback effect promotes the concept of a virtuous cycle of environmental responsibility and financial performance where initial slack resources enable firms to invest in environmental measures, which yield efficiency and cost reductions which in turn lead to increased profitability in the future (Chiek et al., 2021). It is consistent with meta analytic results that ESG (especially environmental projects, which are material to the industry) were more likely to pay off in the long run when strategically entrenched (Khan et al., 2016). Among the international automotive companies, which have to deal with the risk of transition and the current restricting emissions, proactive environmental practices can therefore be viewed as long-term profitability and competitiveness-oriented strategic investments (Ray et al., 2024).

The dynamic Arellano Bond results indicate that lagged G score has a negative and significant correlation with both the return on assets and the return on equity, but a positive and significant correlation with both the interest coverage and Tobin's Q. The negative correlation between lagged governance and ROA, ROE can be that in the short-term stricter governance standards can raise compliance and monitoring costs, or risk taking limits, and accounting profitability is lowered (Lin et al., 2020). Nonetheless, the fact that the governance improved the interest coverage ratio indicates that the enhancements in governance enhance the ability of firms to cover their debts, in line with the preferences of creditors to have strong oversight and risk management (Zahid et al., 2022). The positive lagged relationship with Tobin's Q indicates that capital markets reward the improvement of governance by assigning higher valuation than book assets, and that governance can be considered a value-relevant intangible that reduces information asymmetry and risk in future cash flows (Granelli & Rådeström, 2023). In general, these ambivalent outcomes are consistent with slack resources and RBV where reforms in governance initially consume resources and reduce short term returns but eventually develop unique capabilities that improve firm value and financial resilience.

The Impact of CFP on Disaggregated ESG Scores

In both the cross-section GLS and one-year-lag Arellano–Bond models, only the environmental and governance pillars exhibit significant relationships with corporate financial performance, and these effects are economically meaningful and theoretically consistent with stakeholder theory, slack resources theory, and the resource-based view, whereas the social pillar remains financially neutral. This pattern suggests that, for global automotive firms, value-relevant ESG is primarily driven by environmental capabilities and governance quality, with social policies acting more as a hygiene factor than a source of competitive advantage in the short to medium term (Granelli & Rådeström, 2023).

The absence of significant social coefficients in both GLS and Arellano–Bond regressions suggests that social activities neither improve nor harm short-term profitability or market valuation in a statistically detectable way within this sample and horizon. This muted financial impact aligns with the argument that much social engagement remains generic and not tightly

linked to competitive positioning; unless social initiatives are material to the core business model and embedded in operations, they tend not to translate into measurable productivity gains or cost reductions (Lin et al., 2020). Stakeholder theory would predict benefits from strong employee and community relations, but once a sector like automotive has institutionalized a minimum standard of labor, safety, and community engagement, incremental improvements may do little to differentiate firms financially, especially in global portfolios where investors focus more on climate and governance risk (Orlitzky et al., 2003). From a resource-based-view angle, the insignificance of social scores can be read as evidence that most social programs in this context do not yet constitute rare, valuable, and inimitable resources, but rather standardized practices that competitors can quickly replicate. Without deep integration into HR systems, innovation processes, and brand architecture, social policies risk being perceived as compliance-driven or reputational "add-ons" whose financial returns are diffuse and long-dated, in contrast to the more tangible cost and risk benefits associated with environmental upgrades and governance reforms (Barney, 1991).

The positive and significant association of the environmental score with current ratio and asset turnover in the GLS specification (Table 6) indicates that firms with stronger environmental performance simultaneously maintain healthier liquidity and utilize their assets more efficiently. This pattern can be interpreted through slack resources theory: firms with better financial conditions are more able to invest in environmental technologies and process innovations, and these investments in turn feedback into improved cash-flow generation and operational efficiency (Waddock & Graves, 1997; Chiek et al., 2021). From a stakeholder-legitimacy perspective, proactive environmental management reduces regulatory, reputational, and transition risks in a highly scrutinized sector, stabilizing operations and supporting smoother inventory and receivables management, which naturally strengthens liquidity and turnover ratios in the short run (Sussams, 2018).

Table 6. Cross-section GLS of CFP to ESG scores

Variables	(1) E Score	(2) S Score	(3) G Score
roa	-15.416*** (0.000)	-19.057*** (0.000)	-32.048*** (0.000)
roe	1.339*** (0.000)	2.006*** (0.000)	4.762*** (0.000)
netinc	-0.006*** (0.000)	-0.008*** (0.000)	-0.008*** (0.000)
curr	327.019*** (0.000)	-202.067*** (0.000)	361.323*** (0.000)
ocf	0.003*** (0.000)	-0.001*** (0.000)	0.003*** (0.000)
icr	0.008 (0.473)	-0.832*** (0.000)	0.198*** (0.000)
dta	-0.409*** (0.000)	-7.437*** (0.000)	-1.705*** (0.000)
asto	168.438*** (0.000)	148.411*** (0.000)	247.302*** (0.000)
cagra	-0.091*** (0.000)	-0.132*** (0.000)	-0.130*** (0.000)
cagrns	-0.007*** (0.000)	0.003*** (0.000)	-0.012*** (0.000)
peratio	0.069*** (0.000)	-0.281*** (0.000)	0.534*** (0.000)
tobinsq	-25.637*** (0.000)	-17.172*** (0.000)	-24.161*** (0.000)
Observations	144	144	144
Number of firm	16	16	16

Note: coefficients with p-values in parentheses; ***p<0.001, **p<0.01, *p<0.05.

The GLS findings of a negative relationship between governance scores and the current ratio but positive associations with operating cash flow and asset turnover indicate that stronger governance is linked to tighter working-capital management and more disciplined use of assets. In agency-theoretic and stakeholder-theory terms, effective boards, internal controls, and audit quality constrain managerial discretion, reduce wasteful empire-building, and cut idle cash buffers, which compresses liquidity ratios but enhances cash-flow productivity and asset efficiency (Kim et al., 2012; Zahid et al., 2022; Wang & Sarkis, 2017). From the slack-resources perspective, good governance acts as a monitoring mechanism that reallocates slack from

unproductive balances (e.g., excess cash or inventory) towards value-creating projects, thereby improving operating performance even when headline liquidity appears leaner (Waddock & Graves, 1997; Henisz et al., 2019).

Table 7. One-year lag Arellano-Bond of CFP to ESG scores

Variables	(1) E Score	(2) S Score	(3) G Score
L.escore	0.696*** (0.000)		
L.sscore		0.103 (0.617)	
L.gscore			0.290* (0.027)
L.netinc	-0.000 (0.931)	-0.000* (0.023)	-0.000 (0.396)
L.icr	0.000 (0.945)	0.007 (0.228)	-0.012*** (0.000)
Observations	112	112	112
Number of firm	16	16	16

Note: coefficients with p-values in parentheses; ***p<0.001, **p<0.01, *p<0.05.

The Arellano–Bond results, where the lagged environmental score is positively and significantly related to ROA and ROE, underscore a dynamic "virtuous cycle" in which past environmental engagement materializes into higher accounting profitability in the subsequent year. This lagged payoff is highly consistent with the resource-based view: environmental know-how, eco-design, and low-carbon process innovations become firm-specific, hard-to-imitate capabilities that reduce material, energy, and compliance costs and eventually enhance returns on the asset base (Barney, 1991; Cortez & Cudia, 2011; van Emous et al., 2021). Meta-evidence that industry-material ESG dimensions drive superior long-term financial outcomes suggests that, in the automotive industry where emissions and climate policy are central, environmental scores capture precisely those strategically embedded capabilities that markets and stakeholders reward over time (Friede et al., 2015; Khan et al., 2016; Cortez & Kelly, 2025).

In the dynamic Arellano–Bond model, the negative and significant coefficients of lagged governance on ROA and ROE, coupled with positive and significant effects on interest-coverage and Tobin's Q, point to an important intertemporal trade-off. In the short run, strengthening governance systems may raise monitoring, compliance, and reporting costs, and may also curtail aggressive risk-taking and earnings management, thereby depressing accounting returns despite healthier fundamentals (Lin et al., 2020; Kim et al., 2012; Cortez & Kelly, 2025). Yet creditors and equity markets appear to interpret higher governance scores as risk-reducing; better interest-coverage suggests improved debt-servicing capacity, consistent with evidence that strong ESG and governance reduce the cost of debt and equity by lowering perceived default and agency risk (Apergis et al., 2022; Zahid et al., 2022).

Bidirectionality between ESG and CFP

The SEM results for the environmental, social, and governance scores are presented in Tables 8, 9, and 10, respectively. Higher environmental scores are significantly associated with stronger cash flow from operations and higher asset turnover, supporting the slack-resources view that financially successful firms can reinvest excess resources in environmental initiatives that further enhance operational efficiency and internal cash generation (Cortez & Cudia, 2011).

Table 8. Structural equation modelling results for E score

	E score						
Independent variables	**Cov**	**P>|z|**	**LR chi²**	**RMSEA**	**CFI**	**TLI**	**SRMR**
Profitability							
Return on assets	0.9780	0.049*	0.000	0.000	1.000	1.000	0.000
Return on equity	4.2416	0.002**	0.000	0.000	1.000	1.000	0.000
Net income	4321.0950	0.000***	.	.	1.000	.	0.000
Liquidity							
Current ratio	0.0483	0.208	0.000	0.000	1.000	1.000	0.000
Cash from operating activities	5948.1280	0.000***	.	.	1.000	.	0.000
Interest coverage ratio	-1.8228	0.725	0.000	0.000	1.000	1.000	0.000

	E score						
Independent variables	**Cov**	**P>|z|**	**LR chi²**	**RMSEA**	**CFI**	**TLI**	**SRMR**
Leverage							
Debt-to-asset ratio	6.7091	0.009**	0.000	0.000	1.000	1.000	0.000
Efficiency							
Asset turnover ratio	-0.1158	0.001**	0.000	0.000	1.000	1.000	0.000
Growth							
CAGR assets	-5.0276	0.031*	0.000	0.000	1.000	1.000	0.000
CAGR net sales	-8.9338	0.002**	0.000	0.000	1.000	1.000	0.000
Valuation							
Price earnings ratio	-8.8108	0.392	0.000	0.000	1.000	1.000	0.000
Tobin's Q ratio	0.0047	0.984	0.000	0.000	1.000	1.000	0.000

***p<0.001, **p<0.01, *p<0.05.

The significant positive covariances between E and ROA, ROE, net income, and asset growth in the SEM also suggest a virtuous cycle in which environmental capabilities become valuable, rare, and inimitable resources that reinforce long-run competitiveness, consistent with the resource-based view and evidence on material environmental initiatives in automotive firms (Khan et al., 2016). From a stakeholder-theory perspective, the positive links between E and liquidity/profitability indicators imply that meeting environmental expectations helps maintain legitimacy with regulators, customers, and communities, lowering compliance and transition risks in emissions-intensive sectors such as automotive manufacturing (van Emous et al., 2021).

Table 9. Structural equation modelling results for S score

	S score						
Independent variables	**Cov**	**P>|z|**	**LR chi²**	**RMSEA**	**CFI**	**TLI**	**SRMR**
Profitability							
Return on assets	0.1880	0.721	0.000	0.000	1.000	1.000	0.000
Return on equity	0.1082	0.952	0.000	0.000	1.000	1.000	0.000
Net income	1351.9270	0.0001***	.	.	1.000	.	0.000
Liquidity							
Current ratio	0.0056	0.882	0.000	0.000	1.000	1.000	0.000
Cash from operating activities	2569.3680	0.035*	.	.	1.000	.	0.000
Interest coverage ratio	-5.3866	0.293	0.000	0.000	1.000	1.000	0.000
Leverage							
Debt-to-asset ratio	3.3997	0.078*	0.000	0.000	1.000	1.000	0.000
Efficiency							
Asset turnover ratio	-0.0438	0.208	0.000	0.000	1.000	1.000	0.000
Growth							
CAGR assets	1.3927	0.54	0.000	0.000	1.000	1.000	0.000
CAGR net sales	2.3665	0.386	0.000	0.000	1.000	1.000	0.000
Valuation							
Price earnings ratio	10.6664	0.294	0.000	0.000	1.000	1.000	0.000
Tobin's Q ratio	0.3246	0.164	0.000	0.000	1.000	1.000	0.000

***p<0.001, **p<0.01, *p<0.05.

The SEM indicates only one significant path for the social dimension, namely a positive association between S and operating cash flow, while other profitability, growth, and valuation indicators remain insignificant. This isolated result suggests that social practices may support internal morale and stakeholder trust enough to stabilize cash generation, but they do not systematically translate into higher profitability or market value unless they are strategically material, echoing arguments that generic CSR often fails to produce a financial premium (McWilliams & Siegel, 2000). In theoretical terms, stakeholder obligations appear to be fulfilled at a hygiene level in global automotive firms, so incremental social improvements

rarely become distinctive firm resources in the RBV sense, limiting their contribution to sustainable competitive advantage and observable CFP (Orlitzky et al., 2003).

Table 10. Structural equation modelling results for G score

	G score						
Independent variables	**Cov**	**P>|z|**	**LR chi²**	**RMSEA**	**CFI**	**TLI**	**SRMR**
Profitability							
Return on assets	-0.1990	0.624	0.000	0.000	1.000	1.000	0.000
Return on equity	0.6534	0.615	0.000	0.000	1.000	1.000	0.000
Net income	1619.3790	0.008**	.	.	1.000	.	0.000
Liquidity							
Current ratio	-0.0734	0.009**	0.000	0.000	1.000	1.000	0.000
Cash from operating activities	3881.5230	0.000***	.	.	1.000	.	0.000
Interest coverage ratio	-5.1245	0.174	0.000	0.000	1.000	1.000	0.000
Leverage							
Debt-to-asset ratio	5.5570	0.000***	0.000	0.000	1.000	1.000	0.000
Efficiency							
Asset turnover ratio	-0.1111	0.000***	0.000	0.000	1.000	1.000	0.000
Growth							
CAGR assets	-1.1006	0.222	0.000	0.000	1.000	1.000	0.000
CAGR net sales	-0.6700	0.687	0.000	0.000	1.000	1.000	0.000
Valuation							
Price earnings ratio	-4.0872	0.583	0.000	0.000	1.000	1.000	0.000
Tobin's Q ratio	-0.0340	0.842	0.000	0.000	1.000	1.000	0.000

***p<0.001, **p<0.01, *p<0.05.

Governance scores show significant links with operating cash flow, asset turnover, and the debt-to-asset ratio, while also being significantly related to net income, indicating that stronger governance coincides with more efficient asset use, stricter leverage discipline, and higher accounting performance. These findings fit resource-based and slack-resources views in which robust governance systems act as higher-order capabilities that allocate capital more efficiently, reduce agency costs, and convert existing financial resources into superior operating outcomes (Zahid et al., 2022). From a stakeholder-theory lens, tighter governance satisfies the monitoring and transparency demands of creditors and investors, which can improve access to external finance and reduce the cost of capital, reinforcing the positive governance–profitability loop documented in the ESG–CFP literature for capital-intensive industries (Apergis et al., 2022).

Practical Implications

The Mann–Whitney U tests show that both social and governance scores are significantly higher for non-Japanese firms (0) than for Japanese firms (1), while environmental scores do not differ statistically between the two groups. This implies that international automotive companies, on average, have stronger social and governance practices than their Japanese counterparts, even though all operate under similar global competitive and regulatory pressures (Japan Automobile Manufacturers Association [JAMA], 2024). Mann–Whitney U was employed instead of the Kruskal–Wallis test because the country split is strictly binary (Japanese = 1; non-Japanese = 0), and Mann–Whitney provides a more direct and powerful test of median differences between two independent groups under non-normal distributions. In the context of ESG scores that are often bounded, skewed, and affected by rating-agency discretization, a rank-based two-sample test is methodologically appropriate and avoids the stronger distributional assumptions of parametric t-tests, thereby increasing the robustness of cross-country comparisons (Friede et al., 2015).

The higher social and governance scores among non-Japanese firms suggest that stakeholder and governance expectations are more stringently reflected in ESG ratings outside Japan, which has practical implications for multinational investors and managers. From a

stakeholder-theory and legitimacy perspective, foreign automotive firms may be more proactive in formalizing social policies and governance structures that signal responsiveness to global stakeholders, including ESG-oriented investors and international creditors (Henisz et al., 2019). This pattern is consistent with evidence that stronger ESG and governance practices are associated with lower cost of capital and improved risk management, reinforcing incentives for non-Japanese firms to differentiate themselves on these dimensions (Wang & Sarkis, 2017).

From a slack-resources and resource-based view, the cross-country differences revealed by the Mann–Whitney results indicate that non-Japanese firms may have accumulated and strategically deployed slack into more codified social and governance capabilities, which then function as valuable, difficult-to-imitate organizational resources (Barney, 1991; Waddock & Graves, 1997). For Japanese automakers, the practical implication is that informal stakeholder practices and implicit governance norms—often emphasized in domestic institutional contexts—may not translate into equally high ESG scores, potentially weakening their visibility to global ESG investors despite underlying operational strengths (Cortez & Cudia, 2011).

CONCLUSION

This study concluded that the relationship between environmental, social, and governance (ESG) performance and corporate financial performance (CFP) in the global automotive industry was bidirectional and varied across ESG dimensions. Environmental scores were positively associated with liquidity, measured by the current ratio, and operational efficiency, measured by asset turnover, while exhibiting positive lagged relationships with profitability, measured by return on assets (ROA) and return on equity (ROE). These findings supported the hypothesis of a mutually reinforcing ESG–CFP relationship. Governance scores demonstrated mixed contemporaneous associations, showing negative relationships with liquidity but positive relationships with operating cash flow and asset efficiency, alongside favorable long-term associations with interest coverage and Tobin's Q. Social scores were statistically insignificant across most model specifications, suggesting a limited direct contribution to financial performance. Structural equation modeling (SEM) indicated significant positive bidirectional relationships between the environmental and governance dimensions and CFP, providing empirical support for the complementary mechanisms proposed by Stakeholder Theory and Slack Resources Theory. These findings suggested that corporate executives should prioritize financially material environmental and governance initiatives while maintaining essential social responsibility practices. Investors could incorporate disaggregated environmental and governance scores into assessments of financial resilience during the transition toward vehicle electrification, while policymakers could strengthen ESG disclosure requirements by emphasizing financially material indicators and harmonized international reporting standards. The study was limited by the exclusion of Chinese automotive manufacturers, reliance on consolidated parent-company data, potential survivorship bias, and the use of a one-year lag that may not have fully captured ESG investment payback periods of two to four years. Future research should compare the automotive industry with other capital-intensive sectors, employ event-study approaches to examine ESG rating changes, integrate longitudinal panel analyses with qualitative case studies, investigate battery supply chain transparency and circular manufacturing practices, and assess ESG–CFP dynamics across complete business cycles, including periods of systemic economic disruption.

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CONFLICT OF INTEREST

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GENERATIVE ARTIFICIAL INTELLIGENCE USAGE STATEMENT

The author states that no generative artificial intelligence was used in the preparation of this article.

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