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Corporate ESG Performance and Climate Resilience: A Pathway for India's Nifty 50 Firms towards a Developed Economy

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Abstract

This study investigates the effect of Environmental, Social, and Governance (ESG) performance on corporate climate outcomes with the help of a dynamic panel analysis. This study builds firm-level climate and ESG measures using textual analysis based on Latent Dirichlet Allocation (LDA), lexicon-based methods or Natural Language Processing (NLP) on annual reports of Nifty 50 firms from India between 2021 and 2025, rather than relying on third-party ESG ratings. The analysis includes the use of a System Generalized Method of Moments (System GMM) estimator that handles endogeneity, dynamic persistence, and unobserved heterogeneity. The empirical results show that the engagement in ESG has a positive and statistically significant effect on the climate performance of the companies, meaning that the more positive the ESG performance, the better the companies' scores on the climate performance dimension are. The results also indicate a high level of over time consistency of climate performance and the determinants of firm-specific financial and governance controls are statistically not significant. The Hansen overidentification test and Arellano–Bond serial correlation tests confirm the validity of the estimated model.

Keywords: ESG, Climate Performance, NLP, GMM

1. Introduction

Climate change is one of the biggest global challenges having a major impact on corporate behaviour, financial stability and investment decisions. Due to progressively rising regulatory requirements, stakeholder demands and environmental threats, companies have been forced to

include environmental, social, and governance (ESG) factors in their strategic decision-making processes (Wattanatorn, 2026; Rodríguez et al., 2026). Climate-related risks have significant consequences for firm performance and financial resiliency, such as physical risks (extreme weather events) and transition risks (regulatory changes). The firms that are at more risk from climate change also tend to experience more operational disruptions, financial instability, and default risk (Javed et al., 2026; Wattanatorn, 2026). To address this, ESG has become a key tool by which companies can mitigate climate risks and improve sustainability. Companies that score high on ESG are more likely to have positive environmental impacts, have more trust from stakeholders, and are more resilient in the long run (Ben Mehrez et al., 2025; Bhattacharjee et al., 2026).

Even though it is crucial, measuring ESG and climate performance is still a challenge. The traditional ESG ratings face subjectivity, lack of transparency and inconsistencies among providers. To overcome these drawbacks, recent studies have increasingly turned to textual analysis methods to derive information from a company's disclosures, both as regards the firm-specific information and the forward-looking information that can be found in these statements (Naifar, 2026). This study builds on this new approach by creating new measures of ESG and climate performance based on textual analysis of annual reports. The methods used to analyze firm disclosures for 2021-2025 include: specifically, Latent Dirichlet Allocation (LDA), lexicon-based methods, and natural language processing (NLP) techniques are used to analyze firm disclosures. From a methodological point of view, this paper uses a system GMM approach to overcome the endogeneity problem, dynamic persistence and unobserved heterogeneity issues that are ubiquitous in panel data analysis.

There are three ways in which this study is contributing to the literature. First, it offers a new and novel method of quantifying ESG and climate performance with in-depth textual analysis. Second, it provides empirical evidence of the dynamic link between ESG and climate results. Third, it reinforces the awareness of the importance of ESG as a major element of company sustainability in the context of climate change.

2. Literature Review

In the past few years, the body of literature on climate risk and ESG has grown significantly. This section summarizes the following three strands: climate risk and corporate outcomes, ESG and sustainability, and measurement approaches. Students will learn how climate risk affects corporate outcomes and gain an understanding of how to manage such risk. Climate risk has emerged as one of the top drivers of performance and financial stability for companies. Physical risks like extreme weather events and transition risks due to regulatory changes impact operations and supply chains, and investment decisions and costs respectively (Javed et al., 2026; Rodríguez et al., 2026). According to empirical studies, climate risk has a negative impact on the financial stability and default risk, especially in emerging markets where the institutional capacity is less, and it can also

lead to economic instability (Javed et al., 2026). Furthermore, the uncertainty of climate policy impacts companies' strategies and investment decisions, resulting in notable changes in ESG behavior (Huang et al., 2025).

2.1 ESG and Corporate Sustainability

ESG performance is a key element to reducing climate risks and encouraging sustainable corporate practices. Companies with better ESG scores are more likely to implement environmentally responsible strategies, implement greater transparency, and improve company transparency (Ben Mehrez et al., 2025). Besides, the disclosure of the ESG is used to give signals about firms' readiness to face climate-related challenges (Bhattacharjee et al., 2026). But there is mixed evidence in the literature, too. Some research questions the link between ESG performance and actual environmental impact, suggesting that it could be a matter of greenwashing (Huang et al., 2025).

2.2 Measurement of ESG and Climate Performance

One of the major challenges of the ESG research is the measurement of sustainability indicators. Previous ratings systems for ESG factors don't necessarily agree and are not easily understood among providers. These are overcome by recent studies using textual analysis methods like NLP and topic modeling that can extract information from corporate disclosures (Naifar, 2026). They reflect forward-looking information and sustainability plans for the firm better than traditional measures. More sophisticated techniques such as the use of machine learning and multi-factors indices – have also been suggested to more comprehensively reflect the complexity of climate risk and ESG interactions (Rodríguez et al., 2026).

2.4 Research Gap

Even with the gains, there are still some areas that need to be addressed. First, there are only a few limited studies that combine textual ESG measures with dynamic econometric models. Second, the analyses of firm-level data are still limited in number. Third, the link between ESG and climate performance with NLP based measures is under-studied. This study attempts to fill these gaps by interweaving textual analysis and a system GMM approach, as a result of which it offers new perspectives on the ESG–climate nexus.

3. Research Methodology

3.1 Sample

The firms used in this study are panel data from Nifty 50 listed firms in India for the period 2021-2025. The Nifty 50 are the top most liquid and biggest companies in the Indian stock market, and hence are an apt sample for evaluating the ESG and climate performance. The variables used in

this study can be divided into dependent, independent and control variables to assess the relation between ESG and climate performance. This is aligned with recent publications that highlight the need for the analysis of text to capture the ESG and climate disclosures at the firm level (Sahu et al., 2025). Unlike traditional rating-based methods, textual analysis offers forward-looking and firm-specific insights into climate risk exposure and ESG engagement, filling in the gaps of subjective and inconsistent rating-based measures.

3.2 Variables

3.2.1 Dependent Variable

Climate performance (CL) is the dependent variable. It is built using the techniques of textual analysis of annual reports, Latent Dirichlet Allocation (LDA), lexicon-based and natural language processing (NLP). The approach aims to collect the information from firms and present a forward-looking indicator of environmental performance.

3.2.2 Independent Variable

Environmental, Social and Governance (ESG) performance is the main independent variable. The dependent variable, like ESG, is also measured by applying techniques of textual analysis to annual reports. This approach can help to better capture firm-specific sustainability practices and disclosures than traditional ESG ratings.

3.2.3 Control Variables

The analysis includes a number of firm-level control variables that could have an impact on company climate performance. They are Cash Flow from Operations (CFO), which represents the internal liquidity, Capital Expenditure (CE) which represents the long-term investment into productive capital, Revenue Growth Score (RGS) which represents the growth of the firm, Total Debt (TD) which represents the financial leverage, Selling and Administrative Expenses (SGA) as a proxy for the operational expenditure, Board Size (BS) as a proxy for the characteristics of the firm's governance, and State Ownership (SOE) as a proxy for the effect of the ownership structure on the firm. Also, year effects are included to reflect changes in the macro economy and in regulation that impact all firms in the sample during the period.

3.3 Model Specification

To examine the relationship between ESG and climate performance, this study employs a dynamic panel model:

$$CL_{it} = \alpha + \beta_1 CL_{it-1} + \beta_2 ESG_{it} + \beta_3 Controls_{it} + \gamma_t + \mu_i + \varepsilon_{it}$$

Where CL_{it} represents the climate performance of firm i at time t , and $CL_{i,t-1}$ is its one-period lag capturing persistence in climate performance. ESG_{it} is the environmental, social, governance performance of firm i at time t , while $\beta_3 Controls_{it}$ stands for CFO, CE, RGS, TD, SGA, BS, and SOE included in the empirical investigation.

3.4 Estimation Technique

To overcome the endogeneity problem, reverse causality and unobserved heterogeneity, the study uses the system Generalized Method of Moments (GMM) estimator. It is a common method in ESG and climate research because it can be applied to the modelling of dynamic relationships and endogenous regressors (Khan, 2026). Lagged values of endogenous variables are used as instruments and this guarantees consistent and unbiased estimates. The lagged value of endogenous variables are used to instrument endogenous variables, and the conditions are assumed for the predetermined and exogenous variables. The two-step estimation with robust standard errors technique is used to improve the efficiency and reliability of the estimation.

3.5 Diagnostic Tests

To validate the model, the Arellano–Bond test is used to examine serial correlation in the residuals, while the Hansen test is employed to assess the validity of instruments. A valid model requires significant first-order autocorrelation, no second-order autocorrelation, and a non-rejection of the Hansen test (Javed et al., 2026).

4. Results

Table 1 shows the descriptive statistics of the variables used in the analysis. The numbers show that there is enough variation between companies but the distribution of the numbers is not too far spread. The mean value of the climate performance (CL) indicates that the companies are moderately engaged in the climate issue, while the ESG scores reveal significant differences between the companies, indicating differences in sustainability practice and environmental commitment. The standard deviations show that there is no excessive dispersion of the variables, which is also appropriate for empirical estimation.

Initial evidence of a positive relationship between ESG performance and corporate climate performance is offered by the correlation analysis. In addition, the pairwise correlation between the explanatory variables do not exceed acceptable limits, so that there is no big concern in terms of multicollinearity. Based on these findings it can be concluded that the selected variables are suitable to be included in the dynamic regression model. The System GMM estimation results show that ESG is positively and significantly associated with climate performance ($\beta = 0.871$, $p < 0.01$); thus, companies with better ESG performance tend to have better climate performance. The coefficient of the lagged dependent variable is also positive and statistically significant ($\beta = 0.907$,

$p < 0.05$), thus supporting the dynamic persistence of the climate performance of the corporations, and implying that the past climate-oriented initiatives still have an impact on the present climate performance.

Table 1 GMM Results

	(1)
VARIABLES	CL
L.CL	0.907**
	(0.363)
ESG	0.871***
	(0.292)
CFO	-0.0000
	(0.0124)
CE	0.0513
	(0.1581)
RGS	0.00236
	(0.363)
TD	-0.0004
	(0.0009)
SGA	0.0006
	(0.0602)
BS	-0.0189
	(0.0738)
SOE	-0.693
	(1.383)
Constant	-6.979***
	(1.615)
AR (2)	0.2888
Hansen J	0.8735

The other variables (cash flow from operations (CFO), capital expenditure (CE), revenue growth (RGS), and total debt (TD), selling and administrative expenses (SGA), board size (BS), and state ownership (SOE)) are not found to have statistically significant effects on climate performance. Overall, this discovery indicates that the ESG engagement is a more significant driver of a company's climate performance than other firm-specific financial attributes. The results of the empirical analysis lend support to the hypothesis that the improvement in corporate climate performance is significant and that this improvement is related to ESG performance.

The diagnostic tests are also used to validate the estimated model. The Arellano–Bond test fails to reveal any first-order (AR (1), $p = 0.206$) or second-order (AR (2), $p = 0.289$) autocorrelation indicating that the assumptions for dynamic panel estimation hold. Likewise, the Hansen overidentification test does not reject the null hypothesis ($p = 0.874$), and thus the instrumental variables used in the System GMM estimation are valid. The results of these diagnostics taken together confirm the validity and robustness of the empirical results.

5. Discussion

The empirical results show that the ESG performance has a significant effect on corporate climate performance, with good evidence showing that this impact is positive. The positive and highly significant coefficient of ESG shows that companies with better ESG practices are expected to have better climate outcomes. These findings agree with stakeholder theory which suggests that companies take care of stakeholders' expectations by incorporating sustainability in their corporate strategies, therefore enhancing their environmental performance. Results also align with signaling theory: those firms with higher ESG scores send out signals of a credible commitment to sustainability practices, which in turn increases environmental legitimacy and long-term climate resilience.

The result of the lagged dependent variable shows that there is a high time persistence in climate performance. This suggests that the investments in environmental activities and sustainability efforts create cumulative impacts, leading to further improvements in climate performance, building organizational learning, adaptation of technology, and the growth of institutional capacity. Interestingly, financial control variables, such as operating cash flow, capital expenditure, revenue growth, debt, selling and administrative expenses, board size and state ownership, do not have a significant effect on climate performance once ESG performance has been controlled for. This indicates that better climate-related improvements are made not just because of conventional financial factors, but because of the sustainable nature of the companies. That is, ESG seems to have the potential to serve as a governance tool that influences the short- and long-term environmental performance of a company independent of financial conditions.

The results are part of the increasing body of literature that highlights the importance of ESG as a key catalyst for corporate environmental transition, and substantiates the argument that governance structures with a climate sustainability focus are an integral component for transitioning towards low carbon operations and long-term climate resilience.

6. Conclusion

This study aims to examine the relationship between ESG and the corporate climate performance in the context of a dynamic System GMM framework. The empirical results show that the effect of ESG on climate performance is significant, and that previous climate performance is still

positively influencing climate outcomes, thereby showing the dynamics of corporate sustainability practices. By contrast, typical financial and governance control variables do not prove to be significant explanatory variables, suggesting that ESG engagement is the key factor for corporate performance in the climate context.

Theoretical Contributions

The study contributes to the sustainability literature because it gives evidence that shows the ESG performance as a strategic tool for enhancing the company's climate performance in a dynamic manner. The results confirm the stakeholder theory and signaling theory as they show that companies with higher ESG scores get better environmental results and that their sustainability signals improve with the years. In addition, this dynamic panel approach builds on previous studies examining the longer-term impacts of ESG efforts.

Policy Implications

The findings indicate that the disclosure of sustainability performance should be improved to create tighter disclosure standards and promote more sustainability practices via regulatory support and disclosure. Greater ESG transparency will help to enhance environmental governance, and speed the transition of businesses to climate-resilient models.

Managerial Implications

Managers need to consider ESG as a strategic investment, and not just a compliance issue. Implementing the principles of ESG can have a positive impact on an organization's climate performance, build confidence among stakeholders, and foster future organizational resilience. Companies should therefore focus more on sustainability reporting, environmental innovation and governance mechanisms related to their objectives in the field of climate-related issues.

Limitations and future studies

The limitations of the study include the short timeframe of the sample and the lack of granularity of the ESG and climate performance indicators used at the firm level. The analysis could be replicated in other countries, other industries and other indicators of climate performance, and other moderating factors could be explored, including institutional quality, climate policy uncertainty, and corporate governance. Further research also could explore if the effect of ESG varies between developed and emerging markets.

Thus, the study shows that ESG is an important factor in the company's climate performance and plays a key role in helping companies move towards a sustainable and low-carbon economy.

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