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ORIGINAL ARTICLE

The impact of ESG performance on greenhouse gas emission performance in Latin America

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ABSTRACT

This study sought to examine the relationship between Environmental, Social, and Corporate Governance (ESG) performance and greenhouse gas (GHG) emission performance. Using a sample of Latin American companies, we analyzed the influence of ESG performance on GHG emission performance through both the overall ESG score and the individual scores attributed to the three ESG dimensions. ESG practices are complex, involving a broad group of stakeholders, each with different interpretations of their impact on organizations and society. Consequently, ESG reports include a variety of indicators and themes. Despite the growing recognition of ESG practices as key indicators of sustainable performance, a gap remains in Latin American studies regarding a more specific examination of the relationship between these criteria and corporate GHG emissions. These findings are relevant not only to the academic community but also to policymakers, regulators and business leaders seeking to address urgent climate challenges and promote sustainable practices. Research on this issue can help these agents better understand and assess future opportunities and risks related to ESG practices, evaluate efforts and results in GHG mitigation, allocate capital resources strategically, enhance legitimacy, and gain stakeholder support. Companies adopting sustainable practices have the potential to create positive impacts on employment and on local communities, generating significant social and economic benefits for their regions. In addition, firms in areas with higher ESG scores and better GHG mitigation performance may gain a competitive advantage, attracting environmentally conscious investors and consumers. The robust findings of this research are attributed to the efficacy of the hierarchical econometric model, which captures variations across multiple levels. These findings confirm the positive relationship between higher ESG scores and improved GHG emission performance. They also demonstrate a predominance of corporate-related characteristics in sustainability performance and emissions control, with national and temporal variations playing smaller roles. These results contribute to academic knowledge and suggest practical implications for addressing challenges associated with climate change, providing insights that can guide public policies and corporate strategies.

Keywords: ESG performance, greenhouse gas emissions, corporate sustainability.

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Desempenho ESG e seu impacto no desempenho das emissões de gases de efeito estufa na América Latina

RESUMO

O objetivo desta pesquisa foi examinar a relação entre performance em governança ambiental, social e corporativa (environmental, social, and corporate governance [ESG]) e o desempenho em emissões de gases de efeito estufa (GEE). Com uma amostra composta por empresas da América Latina, este estudo se propõe a analisar a influência do desempenho ESG, por meio do score geral e dos scores isolados atribuídos às três dimensões ESG, no desempenho de emissões de GEE das firmas. As práticas ESG são complexas, pois envolvem um amplo grupo de partes interessadas, cada uma com interpretações diversas sobre seus impactos nas organizações e na sociedade. Portanto, os relatórios ESG incluem uma variedade de indicadores e temas diversos. Apesar do crescente reconhecimento das práticas ESG como indicadores-chave de desempenho sustentável, ainda existe uma lacuna na América Latina no que diz respeito a estudos que analisem especificamente a relação entre esses critérios e as emissões corporativas de GEE. Essas descobertas são relevantes não só para a comunidade acadêmica, mas para autoridades políticas, reguladores e líderes empresariais que buscam enfrentar desafios climáticos urgentes e promover práticas sustentáveis. A pesquisa pode auxiliá-los a entender e avaliar melhor as oportunidades e os riscos futuros relacionados às práticas ESG, inferir os esforços e resultados na mitigação de GEE, alocar recursos de capital de modo estratégico, aumentar sua legitimidade e obter apoio das partes interessadas. Empresas que adotam práticas sustentáveis têm o potencial de exercer impactos positivos tanto no nível de emprego quanto na comunidade local, gerando significativos resultados no bem-estar social e econômico das regiões, uma vez que empresas em regiões com melhores pontuações ESG e melhor desempenho na mitigação de GEE podem obter uma vantagem competitiva, atraindo investidores e consumidores atentos a esses temas. O robusto resultado obtido na pesquisa é atribuído à eficácia do modelo econométrico hierárquico, que captura variações em múltiplos níveis. Os resultados desta pesquisa confirmam a relação positiva entre pontuações mais elevadas em critérios ESG e melhores pontuações na emissão de GEE. Os resultados também destacam a predominância das características empresariais no desempenho de sustentabilidade e controle de emissões, com variações nacionais e temporais assumindo papéis menores. Tal descoberta contribui com o conhecimento acadêmico e sugere implicações práticas na abordagem dos desafios associados às mudanças climáticas e proporciona insights que podem orientar políticas públicas e estratégias corporativas.

Palavras-chave: *desempenho ESG, emissão de gases de efeito estufa, sustentabilidade empresarial.*

1 INTRODUCTION

Organizations are under increasing pressure to disclose comprehensive information about their environmental responsibility, particularly concerning carbon or greenhouse gas (GHG) emissions (Alsaifi et al., 2020; Baboukardos, 2017). Firms classified as significant GHG emitters contribute substantially to climate change (Intergovernmental Panel on Climate Change – IPCC, 2023), creating risks that affect production systems, supply chains and financial performance (Jinga, 2021). The growing public demand for environmental responsibility also highlights the need for large investors to pressure companies to disclose information and adopt effective measures to reduce GHG emissions (Azar et al., 2021; Sprengel & Busch, 2011).

In this context, it is essential for companies to conduct a thorough assessment of the impact of their operations on the ecosystem, with a particular focus on carbon emissions (Bui et al., 2019). This need is becoming increasingly relevant due to growing stakeholder interest in obtaining detailed information about corporate behavior regarding GHG emissions (Saha et al., 2021).

At the same time, companies are increasingly moving away from a traditional 'shareholder wealth maximization' model to one that emphasizes social, environmental and sustainability considerations. Among the various initiatives addressing this shift, John Elkington's corporate sustainability model stands out. The author proposes a framework emphasizing three pillars: a) people, b) planet, and c) profit, which became known as the 3Ps or the triple bottom line. Elkington's model is a major theoretical contribution that underpins several initiatives, including key global disclosure mechanisms such as the Global Reporting Initiative (GRI) and the reports 'The Materiality of Social, Environmental, and Corporate Governance Issues to Equity Pricing' (United Nations Environment Programme Finance Initiative [UNEPFI], 2004) and 'Who Cares Wins: Connecting Financial Markets to a Changing World' (World Bank Group [WBG], 2004), published by the United Nations (UN) in 2004 (Galindo

et al., 2023). In particular, it is worth mentioning that the term environmental, social, and corporate governance (ESG) was first mentioned in the Who Cares Wins report.

Previous studies have explored the influence of ESG strategies in reducing GHG emissions and addressing climate change (Jinga, 2021; Luo & Tang, 2022). Luo and Tang (2022) argue that a company's ESG reports have tangible effects on carbon mitigation based on two competing perspectives. The first perspective suggests a positive association between ESG reporting and the reduction of carbon emissions. This happens because ESG reports increase awareness among stakeholders about carbon reduction initiatives by companies (Luo et al., 2012). In turn, this provides investors and other stakeholders with detailed information about climate risks, facilitating the interpretation, assessment and integration of these risks and liabilities (Bolton & Kacperczyk, 2021). Moreover, this information can be used to compare competitors in terms of their exposure to climate risks and opportunities, as well as their commitment to reducing emissions, and the resulting performance (Schiemann & Sakhel, 2019).

GHG emissions in Latin America have been increasing since the 1970s at a rate that exceeds the global average, while per capita emissions are rising at an even faster pace (Mittmann & Mattos, 2020). Belloc and Molina (2023) indicate that most Latin American countries are among the nations with the poorest environmental performance. The abundance of natural resources in the region, combined with weak state regulations on environmental issues, has led companies to fail to recognize the need to adopt environmentally responsible practices (Abreu et al., 2023).

Although climate change mitigation strategies across Latin America have happened in a fragmented way among regions, market-based initiatives are beginning to emerge (Oliveira et al., 2020). Latin American markets are interested in the success of global mitigation initiatives because there could be severe consequences for them in the future if GHG emissions continue to rise. These implications are related to potential impacts on the predominant economic activities in the region, particularly agriculture (La Torre et al., 2009).

In this context, this study aims to examine the relationship between ESG scores and GHG emissions, assessing the commitment and effectiveness of companies in reducing carbon emissions. A higher score indicates a greater effort by the company to reduce its emissions. With a sample composed of Latin American companies, this study proposes to analyze the effect of ESG performance, through overall scores as well as individual scores attributed to the three ESG dimensions, on the GHG emission performance, which reflects a company's commitment and effectiveness in reducing carbon emissions. A better understanding of this relationship will contribute to the development of strategies to promote environmental transparency and sustainable practices in companies.

Although the importance of ESG practices as key indicators of sustainable performance has grown, the Latin American region lacks detailed research on the relationship between ESG criteria and corporate GHG emissions. With Latin American companies playing an important role in sectors such as energy, agriculture and mining, understanding how their ESG practices affect emissions is essential in order to promote a transition towards a more sustainable economy in the region. Exploring this gap will provide insights for governments, investors and managers and contribute to developing more conscious and transparent corporate strategies that are in line with the environmental and social challenges in Latin America.

The results in this study confirm the positive relationship between higher ESG scores and improved GHG emission performance. This finding contributes to academic knowledge and indicates the practical implications for addressing the challenges associated with climate change. In a global context where climate change poses an imminent threat, companies play a crucial role in mitigating GHG emissions and promoting sustainable practices. The results indicate that organizations with better ESG performance are more effective in reducing GHG emissions.

By demonstrating this positive relationship, this study provides insights that can inform public policies and corporate strategies. These findings are relevant not only to the academic community but also to policymakers, regulators and business leaders seeking to face urgent challenges related to climate change and promote sustainable practices. Through transparency, incentives and guidelines, governments, regulators and companies will be able to integrate effective ESG practices in their operations and contribute to mitigating GHG emissions.

In addition, this study is in line with the UN Sustainable Development Goals (SDGs) and contributes to several of its targets, namely the promotion of strong institutions (SDG 16), incentives to affordable and clean energy (SDG 7), climate action (SDG 13), and the promotion of responsible consumption and production (SDG 12). Promoting ESG practices and reducing GHG emissions is in line with the SDG 17 target, advocating collaboration among businesses, governments, and society.

2 THEORETICAL FRAMEWORKS

2.1 Stakeholder Theory and Sustainable Management

Stakeholder Theory, developed by Freeman (1984), highlights the importance of identifying and addressing the needs and expectations of all groups involved in an organization, extending beyond shareholders to include customers, employees, suppliers, and local communities. Clarkson (1995) divides stakeholders into two categories. Primary stakeholders (e.g., customers, employees, suppliers) are essential to the organization's survival, while secondary stakeholders (e.g., NGOs, media, and the general public) are not directly involved in transactions with the organization.

Literature on this theory demonstrates a convergence of these concepts, underscoring the need for companies to adopt a holistic approach that takes into account not only financial interests but also the environmental and social impacts of their operations (Freeman, 1984). In the context of climate change and GHG emission reductions, governments, investors, customers, NGOs, and suppliers are considered the most relevant stakeholders for companies (Busch & Hoffmann, 2007).

The growing debate on climate change has intensified pressure from nonprofit initiatives and organizations for companies to report their efforts toward a low-carbon economy, highlighting a shift in the perception and awareness of corporate environmental responsibility (Hahn et al., 2015). This awareness is shown through adopting various measures to mitigate GHG emissions and communicating these actions to stakeholders (Luo & Tang, 2022).

In line with this context, Wright and Nyberg (2017) emphasize the interdependence between governments and companies in addressing the climate crisis. The authors suggest that companies are responsible for innovating in decarbonization, while governments establish legal obligations and promote sustainable energy sources, reflecting a shift in business practices and defining their respective roles in mitigating climate change.

The willingness of companies to adopt GHG emission reduction and offset strategies is also linked to perceived pressures from regulators, the media, and creditors (Yunus et al., 2020). The trajectory of climate regulation, from the Kyoto Protocol (United Nations Framework Convention on Climate Change – UNFCCC, 1997) to more recent initiatives like the Paris Agreement, demonstrates the evolution of environmental policy instruments and their growing influence on organizations. The carbon credit market established under the Kyoto Protocol (Minardi, 2023) and the targets set at the Conferences of the Parties (COPs) have driven companies to adopt more sustainable practices. Additionally, initiatives such as the Global Compact and the SDGs emphasize the need for an integrated approach that addresses environmental, social, and economic aspects (United Nations Global Compact – UNGC, 2024).

Sprengel and Busch (2011) argue that the Dow Jones Sustainability Index is a response to this pressure, as institutional investors base their decisions in part on these evaluations. According to the authors, this encourages companies to adopt environmentally conscious strategies regarding GHG emissions and their corresponding mitigation strategies. These factors underscore the critical importance of environmental considerations in the investment landscape and consumer decisions. As a result, companies are increasingly driven to adopt more sustainable practices in their operations (Luo & Tang, 2014).

In summary, Stakeholder Theory emphasizes the need to balance and align the interests of all parties involved in an organization, making it a key framework given the growing importance of ESG scores (Alda, 2021). Prominent authors such as Clarkson (1995) and Freeman (1984) highlight the importance of accounting for the diverse interests of stakeholders. This relationship reinforces the strategic importance of environmental and social responsibility in corporate operations, since responding to external expectations can have significant implications for a company's reputation and economic performance. In this context, ESG scores have consolidated their relevance as tools to translate these principles into tangible corporate practices (Kotsantonis & Serafeim, 2019).

2.2 Carbon Performance

Concerns about addressing climate change at both the government and company levels have grown over recent decades due to its impacts on society (Moya-Clemente et al., 2019). Scientific evidence indicates that excessive carbon emissions reduce corporate value (Luo & Tang, 2014; Matsumura et al., 2013). For instance, Matsumura et al. (2013) suggest that each metric ton of carbon emitted results in a $212.00 loss in value for the emitting company.

Carbon risk, which is associated with climate change and global warming, has the potential to disrupt business operations, reduce shareholder value and increase costs related to legal disputes or legitimacy concerns (Luo & Tang, 2014). Conversely, emission reductions serve as a strong indicator of overall corporate efficiency. GHG emission data also helps managers assess and disclose the impact of emissions on a company's overall performance. This is because reducing environmental impact directly improves corporate outcomes (Boiral et al., 2012).

Hoffmann and Busch (2008) propose a comprehensive approach to assessing emissions, outlining constructs such as intensity, exposure, dependency, and carbon risk, which are key in evaluating a company's carbon footprint. Busch and Lewandowski (2018) suggest analyzing these dimensions through GHG emissions categorized under scopes 1, 2 and 3, as established by the Kyoto Protocol (UNFCCC, 1997). Scope 1 covers direct emissions under the organization's control, Scope 2 covers indirect emissions related to electricity, heating, or cooling, and Scope 3 covers indirect emissions across the supply chain. In summary, carbon performance encompasses both the quantitative GHG emissions affecting climate change and the measures and processes implemented to reduce these emissions, reflecting the outcomes of management activities focused on GHG mitigation (Hoffmann & Busch, 2008).

2.3 Empirical Studies and Hypothesis Develop,ment

In the past, sustainability was the subject of considerable debate regarding the ability of ecosystems to adapt to changes. Today, sustainability is essential for addressing emerging issues (Rajesh, 2020). Environmental challenges have raised awareness about sustainability issues worldwide, prompting a shift in traditional investments — from those focused solely on profit maximization to those supporting sustainability initiatives (Baratta et al., 2023).

Cong et al. (2022) argue that there has been a paradigm shift in understanding the relationship between economic development and pollution. In the past, the prevailing assumption was that economic progress would inevitably result in high levels of pollution. However, according to the authors, the growing demands for sustainable development are challenging this perspective, driving a green transition in business practices.

Today, the discussion on sustainability goes beyond simple environmental preservation practices, embracing the Triple Bottom Line, which requires companies to consciously integrate the environmental, economic and social dimensions into their sustainable development strategies (Borsatto et al., 2020). The current scenario fosters a perspective in which economic success is no longer perceived as incompatible with environmental sustainability and social well-being (Klaus et al., 2023). According to the authors, investors and companies are focusing more closely on issues that extend beyond financial aspects, considering environmental, social, and governance factors and promoting initiatives to improve their standards across each of these pillars.

The ESG principles were conceived in 2004; since then, countries worldwide have continued to advance the coordinated development of environmental, social, and governance aspects in alignment with these principles (Li et al., 2021). This concept, which gained significant prominence during the COVID-19 pandemic, underscores the growing importance of coordinated ESG initiatives. The health crisis increased awareness of ESG metrics significantly, highlighting the importance of understanding and managing non-financial risks, such as environmental and social risks (Turzo et al., 2022). According to the authors, ESG disclosure represents a corporate response to public demand for reducing pollution levels and achieving the sustainable development goals outlined in the UN 2030 Agenda.

Li et al. (2021) argue that ESG has emerged as an international benchmark for companies to incorporate sustainable development practices, solidifying its role as a central framework in corporate management and investment decisions. However, the authors emphasize that the ESG evaluation system, predominantly based on data from platforms like Thomson Reuters, relies on subjective analyses and metrics, thereby requiring greater standardization. The systematic review of the literature on ESG scores conducted by Clément et al. (2023) emphasizes the importance of caution when using these indicators, as they encompass topics such as sustainability, corporate social responsibility, disclosure, finance, and the analysis of ESG ratings that represent the trade-off between financial risk and return as well as business sustainability. The authors highlight this diversity of interpretations and suggest moderation when evaluating and applying ESG ratings in different contexts.

According to Cornell and Damodaran (2020), ESG practices have been promoted as beneficial for society, companies, and investors. However, the authors argue that their actual impact is often overestimated. While consultants, bankers, and investment managers encourage the adoption of the concept, evidence regarding its financial benefits remains ambiguous and inconsistent,

and the objective is limited to the investor's perspective (Young-Ferris & Roberts, 2021).

Bhagat e Hubbard (2022) suggests that the primary beneficiaries of the growing adoption of ESG practices are, in fact, consultants and experts in the field. The author argues that the positive impacts of ESG practices on companies and investors remain uncertain, and that there is insufficient evidence to assert that ESG alone makes companies significantly more socially responsible. In this context, Bhagat e Hubbard (2022) advocates for a more in-depth debate on public policies related to ESG, particularly in the context of climate change. According to the author, it is essential to establish a clear and effective regulatory framework that enables companies to reconcile shareholder wealth maximization with the adoption of sustainable practices.

Although the literature presents mixed results regarding the relationship between environmental and financial performance in organizations (Kluza et al., 2021), ESG reports can facilitate effective management monitoring, improve decision-making by managers, and lead to more efficient management of corporate low-carbon investments (Dhanda et al., 2022). At the same time, a company's risk rating, which derives from its performance in ESG criteria, plays an important role as a source of legitimacy (Qian et al., 2013).

Baratta et al. (2023) see ESG as one of the most innovative and widely adopted approaches to sustainability. Its three pillars—Environmental (E), Social (S), and Governance (G)—represent the core dimensions of sustainability and corporate responsibility, garnering significant attention from policymakers, governments, academics, and the general public, particularly following the adoption of the SDGs (Alkaraan et al., 2022). Furthermore, ESG aspects are essential for investors to evaluate business conduct and ensure corporate sustainability (Husted & Sousa-Filho, 2017; Wasiuzzaman et al., 2022).

Although Wang et al. (2023) identified a negative short-term relationship between ESG and GHG emissions, ESG-based investments stand out as important catalysts for reducing GHG emissions (Luo & Tang, 2022). This relationship is further supported by Albitar et al. (2023) and Cong et al. (2022), whose findings demonstrated that corporate ESG investments significantly reduced GHG emissions. Therefore, based on the assumptions presented, this study proposes the following hypothesis:

H1: The higher a firm's ESG performance, the higher its GHG emissions score.

It is important to note that ESG performance will be evaluated both holistically and disaggregated into its three pillars (environmental, social and governance).

3 METHODOLOGY

3.1 Sample and Research Variables

The sample for this research includes non-financial companies listed on the stock exchanges of Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The sample was selected after excluding missing values for GHG emissions scores, which were obtained from the Thomson Reuters database. The final sample is based on the availability and reliability of data associated with GHG emission scores and ESG criteria, comprising 249 companies. The period analyzed in this study spans from 2015, the year when the UN established the SDGs and countries committed to targets for GHG emission reduction (Minardi, 2023), to 2022.

We used Thomson Reuters' carbon emissions scores as the dependent variable. These emission scores serve as the measure of a company's commitment to and effectiveness in reducing its carbon emissions. A higher score indicates a greater effort by the company to reduce its emissions. Consequently, a higher score indicates better environmental performance by the company. The use of this method to estimate emissions performance has gained increasing popularity in recent literature (Tanthanongsakkun et al., 2023).

The explanatory variables are the overall ESG scores and their three pillars (environmental, social and governance). The ESG scores are estimated based on the ESG performance of the companies in the sample. These scores can be used to evaluate corporate investment behavior and its contribution to promoting sustainable economic development and social responsibilities (Cong et al., 2022).

The control variables used in this study were firm-level variables, as identified in the literature. They are Firm Size (natural logarithm of total assets), Leverage (total debt/total assets), Return on Assets (net income/total assets), and Tobin's Q (sum of market value and total debt/total assets). Moreira et al. (2023) demonstrated that ESG initiatives in the Brazilian capital markets are associated with measures such as profitability, indebtedness, and market value. Outliers were handled through winsorizing, applying a 2.5% limit only to the control variables.

Table 1 presents the research variables along with their corresponding reference authors.

Table 1
Presentation of research variables

Variable	Acronym	Measure	Expected Sign	References
Dependent Variable				
CO2 Emissions Score	EMS	Score measuring a company's commitment to and effectiveness in reducing emissions in operational and production processes.		Tanthanongsakkun et al. (2023)
Explanatory Variables				
ESG Score	ESG	Overall score of the company based on information assessed across the environmental, social and corporate governance pillars.	+	Albitar et al. (2023) Cong et al. (2022) Luo and Tang (2022) Shu and Tan (2023)
Environment Pillar Score	ENV	Company score based on information assessed in the environmental pillar.	+	Cong et al. (2022)
Social Pillar Score	SOC	Company score based on information assessed in the social pillar.	+	Cong et al. (2022)
Governance Pillar Score	GOV	Company score based on information assessed in the corporate governance pillar.	+	Cong et al. (2022)
Control Variables				
Firm Size	FSIZ	Natural logarithm of Total Assets	+/-	Albitar et al. (2023) Luo and Tang (2022) Shu and Tan (2023)
Leverage	LEV	Ratio of Gross Debt to Total Assets	+/-	Albitar et al. (2023) Luo and Tang (2022) Shu and Tan (2023)
Return on Assets	ROA	Ratio of Net Income to Total Assets	+/-	Albitar et al. (2023) Luo and Tang (2022) Shu and Tan (2023)
Tobin's Q	TBNQ	Sum of Market Value and Total Debt divided by Total Assets	+/-	Luo and Tang (2022) Shu and Tan (2023)

Source: *Prepared by the authors.*

3.2 Econometric Model

Following the approach of Bernardo et al. (2018), this study employed three-level hierarchical regressions, accounting for repeated measures since the data is structured in a nested format across countries, and the GHG emission scores vary over time for each company. As indicated by Elango and Wieland (2015), a multilevel regression model is the most suitable for this type of analysis because it ensures more precise and robust results. Furthermore, this method allows for the observation of dependent variation among companies at each level, helping to mitigate endogeneity issues.

The model was developed using the maximum likelihood (ML) estimation technique excluding predictors, seeking to determine the proportion of variation among companies and countries. The first level represents the linear function for the mean emissions score (EMS) Y_{ikt} over time (t) for each company (i) in each country (k), as outlined in Equation (1):

$$Y_{ikt} = \beta_{0ik} + e_{ikt} \sim \text{ND}(0, \sigma_e{}^2) \quad (1)$$

where β_{0ik} determines the mean emissions score (EMS) over time (t years) for company i in country k, and e_{ikt} is the random error term, representing the variation of the company over time, including the variation of omitted factors, assuming a normal distribution with a mean of zero and variance σ^2.

At the second level, the study considered the mean emissions score (EMS)β_{0ik} over the entire period for each company i and each country k, as estimated by Equation (2):

$$\beta_{0ik} = \beta_{00k} + \mu_{ik} \sim \text{ND}(0, \sigma_e{}^2) \quad (2)$$

At this level, we examine the mean emissions score (EMS) over the period for all companies in country k, represented by the expression β_{00k} in Equation (2), along with the random error term μ_{ik}, which also follows a normal distribution with a mean of zero and variance σ^2. In this model, each coefficient from Equation (1) is treated as a dependent variable.

The third level is a linear function for the mean emissions performance (EMS) for all firms during the analysis period in each country β_{00k}, as described in Equation (3):

$$\beta_{00k} = \beta_{000} + e_{ik} \sim \text{ND}(0, \sigma_e{}^2) \quad (3)$$

where β_{000} represents the emissions score (EMS) assumed during the period for all companies across all countries, plus the random effect e_{ik} of company i and country k.

Equation (4) summarizes the three levels, where Y_{ikt} is the total emissions score (EMS) composed of the overall mean β_{000} plus the random effects of country e_{ik}, the random effect μ_{ik} of company i within country k, and the random error over time e_{ikt}.

$$Y_{ikt} = \beta_{000} + \varepsilon_{ik} + \mu_{ik} + e_{ikt} \quad (4)$$

After estimating the models at each level, we investigated the relationship between emissions score (EMS) and ESG performance (ESG) in the equation (Model 1), including the control variables, as outlined in the research hypothesis:

$$EMS_{ikt} = \beta_{000} + \varepsilon_{ik} + \mu_{ik} + \beta_1 ESG_{ikt} + \beta_2 CONT_{ikt} + e_{ikt} \quad \textbf{Model 1}$$

where EMS_{ikt} is the sum of the overall average emissions performance; ε_{ik} is the random effect of country k, and μ_{ik} is the random effect of company i in country k. ESG_{ikt} represents the dependent variable of Model 1; $CONT_{ikt}$ is the set of control variables, and e_{ikt} is the random error term that represents the variation in the emissions score (EMS) of company i in country k over time (t).

Next, we focused on the three ESG pillars: Environmental (ENV), Social (SOC) and Governance (GOV). Each pillar was analyzed individually through models 2, 3, and 4 (respectively) in order to identify specific relationships between emissions score (EMS) and each of the ESG pillars.

$$EMS_{ikt} = \beta_{000} + \varepsilon_{ik} + \mu_{ik} + \beta_1 ENV_{ikt} + \beta_2 CONT_{ikt} + e_{tik} \quad \textbf{Model 2}$$

$$EMS_{ikt} = \beta_{000} + \varepsilon_{ik} + \mu_{ik} + \beta_1 SOC_{ikt} + \beta_2 CONT_{ikt} + e_{tik} \quad \textbf{Model 3}$$

$$EMS_{ikt} = \beta_{000} + \varepsilon_{ik} + \mu_{ik} + \beta_1 GOV_{ikt} + \beta_2 CONT_{ikt} + e_{tik} \quad \textbf{Model 4}$$

To ensure the reliability of the regression results, we conducted a comprehensive set of tests to check for multicollinearity, heteroscedasticity and autocorrelation. The VIF (Variance Inflation Factor) test indicated VIF values between 1.16 and 1.31, confirming the absence of multicollinearity.

4 RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 2 presents the descriptive statistics of the variables selected for each country (Argentina, Brazil, Chile, Colombia, Mexico, and Peru), including the means and standard deviations for the overall sample.

The descriptive analysis of the data reveals significant differences between countries regarding variables related to sustainability and the financial performance of companies. Regarding the GHG emission score (EMS_S), Chile and Colombia lead with the highest means, 58.4 and 57.03, respectively, suggesting better performance of these countries in terms of emissions scores. In contrast, Argentina and Peru present considerably lower averages, with 43.4 and 45.6. The variability, represented by the standard deviation of the full sample (32.0), indicates significant dispersion in the GHG emission results among companies in the countries analyzed.

When analyzing the overall ESG score (ESG_S), Brazil (49.8) and Colombia (50.6) present the highest means, reflecting strong performance by companies in those countries in terms of environmental, social, and governance responsibility. In contrast, Argentina has the lowest ESG score (31.7), suggesting weaker performance in these criteria. The standard deviation in Colombia (7.3) is significantly lower than in other countries, indicating less variability in the ESG scores among Colombian companies.

Regarding the environmental pillar (ENV_S), Brazil (44.4) and Chile (42.2) also stand out with the highest scores, demonstrating greater concern for environmental practices. Argentina (24.4) and Peru (24.1) again have the lowest scores, suggesting less emphasis on the environmental aspect. The high standard deviation in Brazil (28.8) and Chile (29.3) indicates considerable variation in environmental performance among companies in these countries.

When looking at the social pillar (SOC_S), Colombia stands out with the highest mean (54.6), followed by Brazil (52.2), indicating that companies in these countries show strong performance on social issues. In contrast, Argentina has the lowest score (26.6), indicating lower performance. However, the variability is considerable across all countries, as evidenced by the high standard deviations.

Turning to the governance pillar (GOV_S), Colombia stands out with a mean score of 78.7, far above the other countries, suggesting a stronger focus on corporate governance practices. Argentina, Brazil, and Chile have similar mean scores, around 50, indicating a more balanced approach to governance practices among companies in these countries. Colombia's standard deviation (9.6) is the lowest, reflecting more uniform governance practices among its companies.

In terms of firm size (FSIZ), Mexico leads with a mean of 13.9, suggesting that Mexican companies are, on average, larger than those in other countries. Argentina has the smallest companies, with a mean of 11.8. Leverage (LEV) is higher in Mexico (0.3), indicating a more intense use of debt by companies, while Argentina (0.1) shows the lowest mean leverage.

Tobin's Q (TBNQ), which reflects the market valuation of companies relative to their book value, is highest in Chile (0.8), suggesting that Chilean companies are more highly valued. Argentina and Colombia have the lowest ratios, indicating a lower relative market value. The ROA (Return on Assets) means were very close to zero in all countries, reflecting a low or neutral profitability performance for most of the companies analyzed.

In summary, Colombia stands out in terms of governance and social responsibility, while Brazil and Chile perform strongly in environmental aspects. Argentina consistently shows lower performance in sustainability and financial indicators, indicating greater challenges compared to the other countries analyzed. Mexico, on the other hand, leads in terms of firm size and leverage use. These regional differences underscore the importance of considering country-specific factors when assessing company performance.

4.2 Results of Null or Empty Models

Table 3 presents the results of the null model regressions, which, based on the random intercepts, consider the mean of the variables EMS, ESG, ENV (Environmental Score), SOC (Social Score), and GOV (Governance Score).

The analysis of the null models indicates that company performance in GHG emissions (EMS) and ESG scores is predominantly influenced by company-specific characteristics, with over 77% of the variation explained at

Table 2
Descriptive Statistics of the Research Variables

Varable	Observations	Argentina		Brazil		Chile		Colombia		Mexico		Peru		Overall sample	
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
EMS_S	1,417	43.4	32.0	46.0	32.7	58.4	29.0	57.03	28.7	51.3	33.0	45.6	30.8	49.2	32.0
ESG_S	529	31.7	19.9	49.8	19.3	47.0	25.9	50.6	7.3	43.3	23.1	34.9	21.8	42.8	22.5
ENV_S	529	24.4	20.1	44.4	28.8	42.2	29.3	31.3	9.1	36.4	27.2	24.1	20.6	35.7	27.1
SOC_S	529	26.6	24.9	52.2	21.7	48.9	28.9	54.6	16.7	45.5	26.4	35.6	27.9	43.6	26.8
GOV_S	529	49.5	24.6	52.1	22.1	49.5	24.8	78.7	9.6	47.4	23.8	50.2	25.0	50.5	23.9
FSIZ	1,837	11.8	2.4	13.1	2.0	13.1	2.6	12.1	1.9	13.9	1.4	12.6	2.1	13.0	2.1
LEV	1,837	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.1	0.3	0.3	0.2	0.7	0.2	0.3
TBNQ	1,668	0.2	0.3	0.5	0.8	0.8	1.4	0.3	0.2	0.5	0.9	0.6	1.3	0.5	1.0
ROA	1,817	0.0	0.3	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.2

Note: *EMS = GHG Emission Score; ESG = Overall ESG Score; ENV = Environmental Pillar Score; SOC = Social Pillar Score; GOV = Governance Pillar Score; FSIZ = Firm Size; LEV = Leverage; TBNQ = Tobin's Q; ROA = Return on Assets.*
Source: *Prepared by the authors.*

Table 3
Performance in Emissions, ESG, and the Environmental, Social and Governance Pillars – Null Model

	EMS	ESG	ENV	SOC	GOV
Observations	1417	529	529	529	529
Fixed Effects	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	**47.05*** **	**41.20*** **	**33.58*** **	**42.06*** **	**48.98*** **
Estimators (variance) Random effects parameters					
Country	**21.87**	**30.31**	**62.23**	**74.24**	**1.95**
Company	**239.41**	**82.15**	**110.42**	**160.28**	**120.87**
Time	**3.78**	**2.27**	**2.84**	**2.71**	**0.91**
Total	265.06	114.73	175.49	237.23	123.73
Intraclass Correlation Coefficient (ICC)					
Level 3 (Country)	**2.08%**	**5.93%**	**8.38%**	**9.82%**	**3.39%**
Level 2 (Company)	**77.20%**	**83.92%**	**85.12%**	**78.79%**	**78.98%**
Level 1 (Time)	**20.72%**	**10.15%**	**6.50%**	**11.39%**	**17.63%**
Total	100.00%	100.00%	100.00%	100%	100%
Wald	**345.52*** **	**127.37*** **	**148.04*** **	**93.53*** **	**14.13*** **
LR Test (Chi-Square)	**1,335.85*** **	**110.11*** **	**125.75*** **	**83.71*** **	**13.83*** **

Note: *EMS = GHG Emission Score; ESG = Overall ESG Score; ENV = Environmental Score; SOC = Social Score; GOV = Governance Score; LR = Likelihood Ratio.*
*** indicate 1% significance.*
Source: *Prepared by the authors.*

the company level. For EMS, 77.2% of the variation is due to companies, 2.08% to the country, and 20.72% to time. For the ESG score, 83.92% is attributed to companies and 5.93% to the country. The environmental pillar (ENV) shows 85.12% of the variation at the company level, while the social pillar (SOC) shows 78.79% at the company level and 9.82% at the country level. In turn, 78.98% of the variation in the governance pillar (GOV) is explained by internal practices, with time accounting for 17.63%.

These results demonstrate a predominance of company-specific characteristics in sustainability performance and emissions control, with national and temporal variations playing smaller roles.

4.3 Regression Results

Table 4 presents the results of the regressions for the four models in which EMS is the dependent variable, displaying the influence of the overall ESG score (Model 1), as well as the individual scores attributed to the Environmental (Model 2), Social (Model 3) and Governance (Model 4) pillars, on the GHG emissions performance of Latin American companies.

In Model 1, the ESG score (coefficient = 0.2767, $p < 0.01$) showed a positive and highly significant relationship with emission performance. This suggests that companies with better ESG practices achieve better results in their GHG emissions performance. For each 1-unit increase in the ESG score, emission performance improved by about 0.28 units, indicating that a more comprehensive corporate sustainability strategy is associated with better emission control. On the other hand, the leverage variable (LEV) had a significant negative coefficient (-28.6442, $p < 0.05$), indicating that more indebted companies perform worse in terms of emissions. This may be due to financial difficulties that hinder investment in emission reduction initiatives. The variables Firm Size (FSIZ), Tobin's Q (TBNQ) and ROA were not statistically significant in this model.

Model 2 focused on environmental performance (ENV), which also presented a positive and highly significant coefficient (0.2925, $p < 0.01$). This indicates that companies with better environmental practices tend to better control their GHG emissions. This result is expected, as the environmental pillar is directly related to mitigating environmental impacts, including emissions reduction. The negative effect of leverage (coefficient = -26.3939, $p < 0.05$) persisted, confirming that more indebted companies perform worse in terms of emissions. The remaining variables continued to have no statistical significance.

In Model 3, the social score (SOC) had a negative and significant coefficient (-0.1040, $p < 0.1$), suggesting that better performance in the social pillar may be slightly associated with poorer emissions performance. This negative relationship could indicate that, even though companies excelling in social performance focus on

Table 4
Regression Results of the Research Models

Variables	EMS			
	Model 1	**Model 2**	**Model 3**	**Model 4**
ESG	0.2767***			
	(0.0783)			
ENV		0.2925***		
		(0.0661)		
SOC			-0.1040*	
			(0.0593)	
GOV				0.0592
				(0.0697)
FSIZ	0.7381	0.1334	2.4700	2.3939
	(1.8520)	(1.8625)	(1.9496)	(1.8100)
LEV	-28.6442**	-26.3939**	-13.4979	-29.2015**
	(12.2819)	(12.2343)	(11.7176)	(12.4710)
TBNQ	0.1276	-0.0934	1.9230	1.7102
	(2.8792)	(2.8638)	(2.7197)	(2.8777)
ROA	-7.9410	-8.4432	-8.2550	-6.2529
	(13.1637)	(13.0349)	(11.0903)	(13.3780)
Const.	32.8131	42.4338	-1.055***	16.7953
	(26.1057)	(26.4517)	(1762.9)	(26.0426)
Observations	425	425	425	425
Country	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Wald	18.92***	25.99***	5.08***	7.24***
LR	300.24***	302.16***	346.32***	293.19***

Note: *EMS = GHG Emission Score; ESG = Overall ESG Score; ENV = Environmental Pillar Score; SOC = Social Pillar Score; GOV = Governance Pillar Score; FSIZ = Firm Size; LEV = Leverage; TBNQ = Tobin's Q; ROA = Return on Assets; LR = Likelihood Ratio. * p < 0.10, ** p < 0.05 and *** p < 0.01.*
Source: *Prepared by the authors.*

aspects such as diversity, human rights and community impacts, these initiatives do not necessarily translate into improved emissions control. Financial variables such as firm size, leverage, Tobin's Q, and ROA remained statistically insignificant in this model.

Finally, in Model 4, the governance score (GOV) was not significant, indicating that governance practices alone do not have a clear impact on emissions performance. Leverage continues to show a negative and significant coefficient (-29.2015, $p < 0.05$), once again suggesting that more indebted companies face greater challenges in controlling their GHG emissions. The other financial variables remained statistically insignificant.

In summary, the results demonstrate that overall ESG and environmental performance have a positive and significant relationship with emissions performance, highlighting that companies more engaged in sustainable practices achieve better results in controlling their GHG emissions. This finding is in line with previous studies (Albitar et al., 2023; Cong et al., 2022; Dhanda et al., 2022; Husted & Sousa-Filho, 2017; Luo & Tang, 2022; Wasiuzzaman et al., 2022) and suggests that ESG practices are associated with a positive impact on emissions performance, supporting the initial research hypothesis. On the other hand, as noted by Luo and Tang (2022), leverage stands out negatively in nearly all models, indicating that more indebted companies tend to perform worse in terms of emissions management. Social performance showed a negative relationship with emissions, while governance was not statistically relevant.

5 CONCLUSION

This study provided a multi-country analysis of the relationship between ESG scores and GHG emission performance, revealing significant findings that enhance the understanding of the interdependence between sustainable practices, corporate responsibility, and environmental performance. **H1** was robustly confirmed by the findings.

The strong research outcome is attributed to the effectiveness of the multilevel econometric model employed. The careful selection of this model proved essential for analyzing the complex relationships present in the collected data. The multilevel model enabled the incorporation of multiple variation levels, considering the particularities and heterogeneities inherent in the data, which resulted in more precise and generalizable estimates, thereby enhancing the robustness of the results. This provided greater reliability and validity to the research findings.

Previous studies, such as Albitar et al. (2023), Cong et al. (2022) and Luo and Tang (2022), have demonstrated the growing importance of integrating ESG practices to achieve more positive environmental outcomes. Organizations that integrate ESG principles into their operations consistently demonstrate greater environmental awareness and, consequently, achieve higher scores in GHG emissions performance. The findings of this study also align with the conclusions of Dhanda et al. (2022), Husted and Sousa-Filho (2017), and Wasiuzzaman et al. (2022), whose research outlined the relationship between corporate governance strategies and the effectiveness of environmental management practices.

Ultimately, our findings not only confirm the established hypothesis but also align consistently with previous studies, advancing the understanding of the strategic importance of effectively integrating ESG practices to achieve better environmental outcomes. These findings underscore the urgent need for companies to adopt holistic approaches to addressing climate challenges, considering not only the financial impact but also social and environmental aspects to ensure lasting sustainability and promote effective carbon mitigation as critical components of corporate strategies.

By demonstrating this positive relationship, this study provides insights that can inform public policies and corporate strategies. These findings are relevant not only to the academic community but also to policymakers, regulators, and business leaders seeking to face urgent challenges related to climate change and promote sustainable practices.

Companies adopting sustainable practices have the potential to create positive impacts on employment and on local communities, generating significant social and economic results for their regions. In addition, firms situated in areas with higher ESG scores and better carbon performance may gain a competitive advantage, attracting environmentally conscious investors and consumers.

A limitation of this study was the lack of data on GHG emissions and ESG performance in Latin American countries, which suggests potential delays in adopting sustainable practices in the region. Another limitation was the exclusion of industry-level effects. We recommended that future research address these gaps by incorporating a more specific sector-level analysis and investigating the determinants of the absence of countries in analyses of GHG emissions and ESG for a more comprehensive understanding of sustainable practices in the region.

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