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Artículos de investigación

Sustainable Practices and Financial Performance in Latin America: An Analysis of Environmental Scores

Prácticas sostenibles y desempeño financiero en Latinoamérica: un análisis de las calificaciones ambientales

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Abstract: **Purpose:** This study explored the relationship between environmental scores and financial performance in Latin American firms.
Design/Methodology: Using a dataset encompassing 1 708 observations from 372 firms between 2015 and 2020, this study employed panel data analysis to investigate the relationship between environmental scores and Return on Assets (ROA).
Findings: The empirical findings indicate that the current environmental performance in Latin America has a limited impact on firms' financial performance. However, positive results were observed in Brazil, Mexico, and Chile, where environmental practices and financial outcomes have been successfully integrated.
Conclusions: By examining the influence of Environmental, Social, and Governance (ESG) scores, particularly environmental scores, on ROA in Latin American firms, this study contributes to better understanding the complex relationship between sustainability and financial performance in the region. In addition, it underscores both the challenges and opportunities that Latin American firms face in aligning environmental performance with profitability. According to the findings, enhanced strategies and mechanisms should be developed to bridge the gap between environmental and financial outcomes. While Latin America has made progress in establishing consensus on environmental practices, there remains a pressing need to develop robust strategies that effectively integrate sustainability and profitability.
Originality: This study provides valuable insights for policymakers, investors, and firms seeking to navigate the interplay between sustainability and financial success in Latin America.

Keywords: environmental performance, Latin America, financial performance, ESG score, panel data, ROA, **JEL Classification Codes:** 044, F30, O54.

Resumen: **Objetivo:** En este estudio, se investigó la relación entre las calificaciones ambientales y el desempeño financiero de las empresas latinoamericanas.
Diseño/Metodología: Partiendo de un conjunto de datos que abarcó 1 708 observaciones de 372 empresas entre 2015 y 2020, este estudio utilizó datos de

panel para analizar la relación entre las calificaciones ambientales y la rentabilidad de los activos.

Resultados: Según los hallazgos empíricos, el impacto del actual desempeño ambiental en América Latina sobre el desempeño financiero de las empresas de la región es limitado. A pesar de ello, se observaron resultados positivos en Brasil, México y Chile, donde se destaca la exitosa integración de prácticas ambientales y resultados financieros.

Conclusiones: Gracias al análisis del impacto de las calificaciones ambientales, sociales y de gobernanza—en particular las ambientales—sobre la rentabilidad de los activos de las empresas latinoamericanas, este estudio contribuye a una comprensión más profunda de la compleja relación entre la sostenibilidad y el desempeño financiero en la región. Además, destaca los retos y oportunidades que las empresas latinoamericanas enfrentan al momento de alinear su desempeño ambiental con su rentabilidad. De igual forma, pone de manifiesto la necesidad de desarrollar estrategias y mecanismos más efectivos para reducir la brecha entre los resultados en materia ambiental y financiera. A pesar de los avances logrados en América Latina en la consolidación de prácticas ambientales, persiste la apremiante necesidad de crear estrategias sólidas que integren de manera eficiente la sostenibilidad y la rentabilidad.

Originalidad: Este estudio ofrece valiosas orientaciones para los responsables del diseño de políticas, inversionistas y empresas que desean comprender la interacción entre la sostenibilidad y el éxito financiero en América Latina.

Palabras clave: desempeño ambiental, América Latina, desempeño financiero, puntuación ESG, datos de panel, rentabilidad de los activos, **Clasificación JEL:** 044, F30, O54.

Highlights

- The empirical findings showed a positive relationship between the environmental pillar score and financial performance in Brazil, Mexico, and Chile.
- The environmental pillar scores of firms in each country exhibited low variability, making it difficult to assess their effect on ROA.
- The countries showing the strongest relationship between the variables under analysis were those with more developed green bond markets.

Highlights

- Los hallazgos empíricos revelaron una relación positiva entre la calificación del pilar ambiental y el desempeño financiero en Brasil, México y Chile.
- Las calificaciones del pilar ambiental en las empresas de cada país presentaron una baja variabilidad, lo que plantea un reto al momento de evaluar su impacto en la rentabilidad de los activos.
- Los países que demostraron una relación más sólida entre las variables analizadas fueron aquellos donde los mercados de bonos verdes están más desarrollados.

1. INTRODUCTION

During the decade spanning from 2010 to 2019, the world witnessed high levels of climate change, with global temperatures being the warmest ever recorded (United Nations, 2019). Also, the concentrations of carbon dioxide (CO2) and other greenhouse gases in the atmosphere reached new heights, particularly in 2019 (Yang et al., 2020). Given that climate change affects everyone, there has been a shift towards new economic models based on environmental standards (Seyfang, 2010; Chang & Zhu, 2022). For instance, the Paris Agreement, which came into effect in 2015, attempts to counter the threat of climate change by limiting global temperature increases to less than 2°C (Höhne et al., 2017) above pre-industrial levels (Alcamo et al., 2020).

In this regard, core business strategies should incorporate environmental concerns (Johannsdottir & McInerney, 2018), such as pollution, global warming, overpopulation, waste disposal, biodiversity loss, deforestation, ozone layer depletion, and acid rain (Refinitiv, 2022). To gain a better understanding of these issues, corporate management has introduced new aspects, including Environmental, Social, and Governance (ESG) scores, designed to

provide insights into sustainability and business practices (Kumar & Dua, 2021; Zhang, Malik et al., 2022). Additionally, countries have prioritized environmental issues, such as global warming, in their political agendas (United Nations, 2019; Gürlük et al., 2015). From a business perspective, the environmental component (E) evaluates how firms take actions to protect the environment and minimize damage. It encompasses issues related to climate change, natural resource management, pollution, waste disposal, and environmental opportunities (Lee & Suh, 2022). This is supported by Korobeinikova et al. (2021) and Sarfraz et al. (2023), who indicate that environmental performance, along with financial performance, is a key objective in the realm of sustainable development, shaping the modern definition of firms' sustainable development. Therefore, addressing environmental concerns opens doors to capture economic benefits by curbing environmentally damaging practices (Dean & McMullen, 2007).

Furthermore, the growing sustainability mindset has led businesses to follow a positive trend that not only concentrates on economics but also on ESG matters (Neori et al., 2004; Sharma et al., 2021). In this regard, addressing environmental issues contributes to preventing temperature increases while also yielding profits. However, a significant challenge remains: incorporating climate risk from an investment perspective and building investable portfolios (Bender et al., 2019). For example, Cortez et al. (2022) showed that, in recent years, green energy portfolios have performed better than their non-green counterparts. This underscores the essential role of financial performance in business models, where an inclination toward climate-resilient activities significantly impacts capital flows. Considering that preserving environmental resources is one of the best ways to improve corporate financial performance (World Economic Forum, 2018; Nuzula, 2019), Latin American firms have been implementing environmental strategies as the focal point of their operations in recent decades (Alt et al., 2015).

Firms can create shared value in several ways, including reducing raw material costs and minimizing natural resource depletion (Alt et al., 2015). Moreover, logistics is strongly correlated with environmental and financial performance. According to Rintala et al. (2022), combining different logistics orientations can help firms meet stakeholder expectations and transform resources into enhanced environmental and financial performance. Thus, incorporating the sustainability concept into the core business strategies is crucial (Ferrat, 2021; Mejia-Escobar et al., 2020). Ultimately, what matters the most is firms' financial performance with implications in ESG considerations, particularly in the environmental ones (Nollet et al., 2016). All of these aspects have a profound connection with the Sustainable Development Goals (SDGs), particularly Goals 3, 6, 7, 11, 12, and 13. In fact, one of the primary objectives of these goals is to facilitate the establishment of mechanisms aimed at enhancing the capacity for effective climate change-related planning and

management in the least developed countries and small developing nations (United Nations, 2019).

Recent literature in the field has explored how investors are looking for firms capable of developing mitigation, adaptation, and climate risk strategies (Bender et al., 2019; Ren et al., 2022; Wu et al., 2022). In addition, the number of studies into the relationship between environmental and financial performance is growing (Barcellos de Paula et al., 2020; Kumar & Dua, 2021; Tao et al., 2022; Zhang, Wang et al., 2022). Nonetheless, to the best of our knowledge, no elements in the current literature have determined whether there is a relationship between environmental and financial performance, measured by Return on Assets (ROA), in Latin American firms. This paucity of studies stresses the need for research that enhances the understanding of ESG issues and financial performance. Moreover, Latin America plays a pivotal role in the climate and research agenda, and new research might be suitable for firms seeking new SDG strategies. Therefore, to bridge this knowledge gap, this study analyzes the relationship between environmental and financial performance in Latin American firms using a panel data model that includes 1,708 observations pertaining to information about 372 Latin American firms collected from 2015 to 2020.

This study makes two-fold contributions to the field. First, to provide a better understanding of the relationship between financial and environmental performance, it offers an in-depth scientometric analysis that identifies research areas in the field and its evolution. Second, it provides new evidence and insights into the relationship between financial and environmental performance in Latin America, where research in this area is scarce. This highlights the growing importance of environmental issues within the core operations of Latin American firms. Also, the findings might inspire researchers and professionals to broaden their knowledge on sustainable development and criteria involving the environment as the center topic and its parameters. In addition, the findings could spur further studies focused on sustainability matters and financial performance, with an emphasis on Latin America, where research on this topic has not yet been conducted. Such new studies could also lay out roadmaps for improving the understanding of the relationship between ESG scores and firms' performance.

2. THEORETICAL FRAMEWORK

This study conducted a scientometric review of the existing theoretical and empirical literature on the relationship between financial and environmental performance. By employing social network analysis, it was possible to identify specific research trends in the field. To source research papers, the Scopus database was used given its solid reputation (Maditati et al., 2018). Moreover, VOSviewer software version 1.6.18 was used to construct networks based on author citations. This tool has been successfully applied in

several studies to identify the most relevant research trends across various financial domains (Marquez-Cardenas et al., 2022; Mejia-Escobar et al., 2020; Ramirez et al., 2022). The following was the search question employed in this study: ("financial performance" and "environmental performance" or environmental).

Based on the review, two clearly discernible research trends were identified and subjected to analysis. Figure 1 illustrates the interconnections among the most prominent studies into environmental and financial performance (upper part), as well as the trajectories of research in this domain (bottom part).

The first research trend revolves around the singularities of environmental performance and its impact on firms' financial performance. In this context, the effects of a firm's green spending have been found to be consistent and positively associated with carbon emissions and environmental performance. Furthermore, Neori et al. (2004) discovered that an Environmental Management System (EMS) indirectly impacts a firm's design, recycling, and waste management activities. According to their findings, as firms engage in EMS activities, the link between this system and environmental practices strengthens. Likewise, in a study conducted on Chinese firms, Kaakeh and Gokmenoglu (2022) found that, although there is weak evidence that improved environmental performance increases firms' financial performance, the relationship between both becomes positive during economic distress periods, such as the COVID-19 pandemic. This implies that, given their impacts, firms should continue investing in environmentally ethical and sustainable projects during crises. Also, regarding voluntary and mandatory environmental disclosure, Wu et al. (2022) found that, in Chinese firms, there is a positive relationship between these two (voluntary and mandatory environmental disclosure) and financial performance.

In this same vein, Wamba (2022) demonstrated, in a study conducted with European firms, that engaging in environmental protection actions increases stock exchange performance. This result suggests that ecosystem protection by firms leads to a paradigm that can form the basis of a model for responsible governance, whose goal is to create value while respecting environmental issues. Nobanee and Ellili (2017), for their part, found no significant effects of sustainability disclosure on the banking performance of banks in the United Arab Emirates. These studies, therefore, help analyze the actions related to firms' dynamics and firms' positive, negative, or not relevant environmental practices.

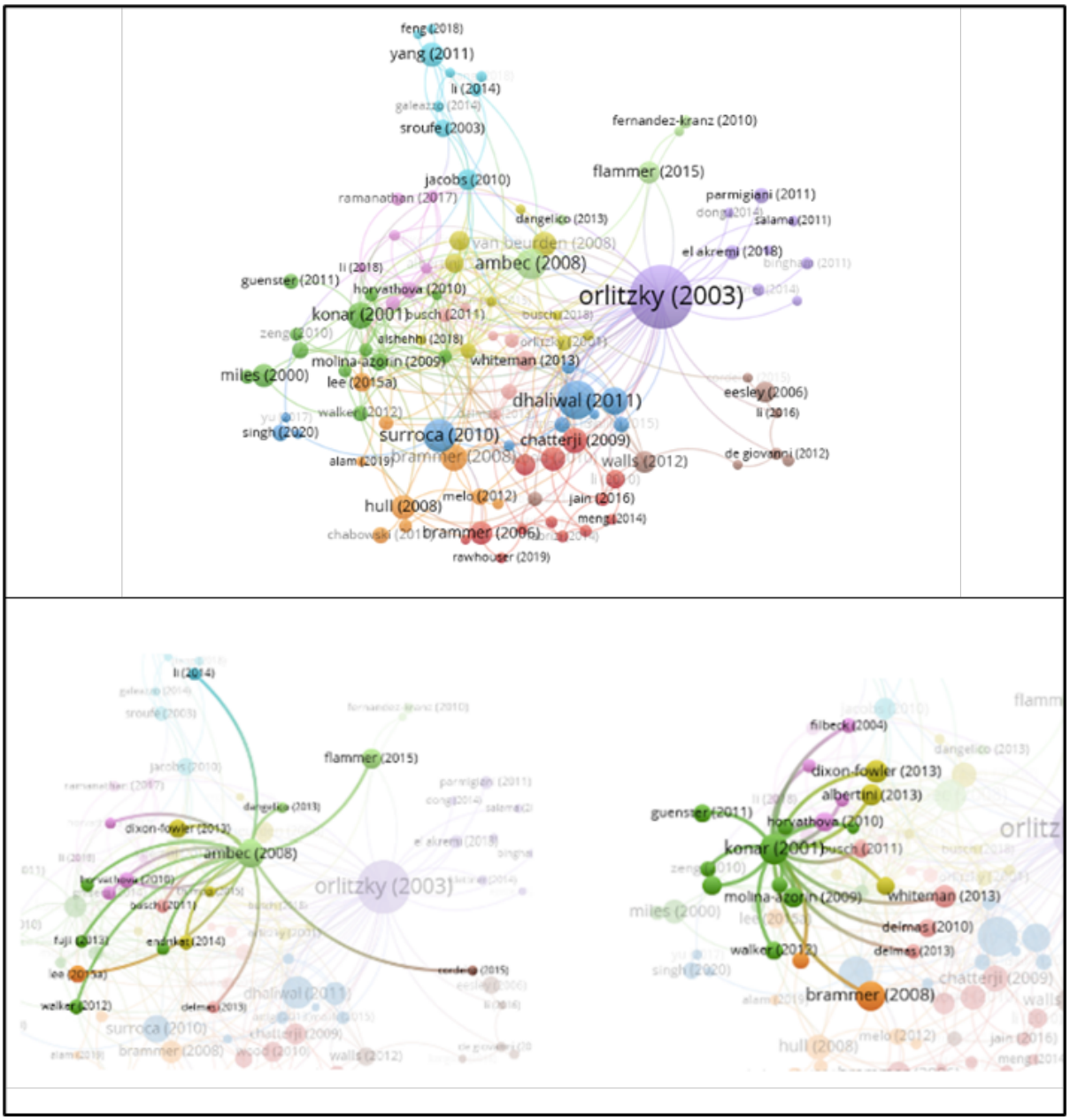

Figure 1

Figure 1. Relationships among the most influential authors

Figura 1. Relación entre los autores más influyentes

Source: Own work using VOSviewer and Scopus.

Based on the key findings in this research trend, Ambec and Lanoie (2008) argued that firms face increasing pressure to become greener. They contended that firms can reduce their impact on the environment without compromising their financial performance and may, in fact, enhance the latter through three avenues: better access to markets, product differentiation, and the incorporation of pollution control technologies. However, the lack of research on this topic has made conclusive results on the relationship between environmental and financial performance, particularly in Latin American firms, remain elusive. Furthermore, improving firms' environmental performance has been linked to better financial performance, and the research shows that the costs associated with pollution reduction can

often be offset by advantages gained elsewhere. Moreover, the findings reveal that larger corporations have a better chance of profiting financially from improved environmental performance than smaller companies with no market stock. Other studies have also examined the effects of environmental performance on market value, aligning with the idea that firms started to seem concerned about environmental issues because they would eventually be rewarded in the marketplace. In this regard, Aragón-Correa et al. (2008) reported that medium-sized firms could embrace environmental policies, leading to a positive impact on their financial performance in most cases. Likewise, Attah-Boakye et al. (2022) showed that the adoption of eco-friendly technologies by multinational technology enterprises contributes to enhanced firm value while also reducing their CO2 footprint.

This first research trend is characterized by firms increasingly requiring quantitative measures to assess their environmental performance in domains such as pollution control, waste management, and natural resource management. In this respect, Yang et al. (2011) argued that environmental performance has a synergetic relationship with reduced waste generation. Nevertheless, improving environmental performance implies additional investments. Also, Li (2014) posited that the environmental crisis has prompted countries to be more concerned about environmental conservation for sustainable improvement. Thus, it has become common practice for firms to obtain the ISO 14001 certification as evidence of their environmental practices, which provides them with positive publicity and is used in selecting suppliers (Chen, 2005).

Furthermore, firms seeking to enhance their environmental performance should focus on improving their environmental processes. This entails developing an environmental strategy, increasing employee awareness of environmental issues, supporting change initiatives, and ensuring staff commitment to environmental goals (Tung et al., 2018). Also, there is evidence indicating that green supply chain management can mitigate the environmental impact of industrial activities without compromising quality, cost-efficiency, reliability, performance, or energy efficiency (Maditati et al., 2018). This, however, requires a shift from end-of-pipe control to a scenario where environmental regulations are met while achieving economic profitability. Most findings in this regard reveal a significant association between internal environmental management, external green supply chain management, eco-design, investment recovery, environmental performance, and positive and negative economic performance.

The second research trend delves into the financial implications of environmental practices and financial performance. Concerning this trend, Uotila et al. (2009) suggest that exploration and exploitation activities have a significant relationship with a firm's financial performance and are essential for firms to get to know the market. In addition, achieving a steady balance between these activities is crucial. Moreover, Fujii et al. (2012) proposed the hypothesis of a positive

effect of environmental performance on the financial performance of Japanese firms. Their research concluded that a firm's environmental practices, particularly in terms of reducing CO2 emissions, were associated with an increase in ROA. However, profitability improvements may not yield short-term results due to energy costs (Carpio & Coviello, 2019). Similarly, Iwata and Okada (2011) conducted a study in which they considered two distinct environmental issues: greenhouse gas emissions and waste management. According to their findings, waste management might not have significant effects on financial performance, whereas a reduction in greenhouse gas emissions was linked to improved financial performance. In this same line, Ramirez et al. (2022) identified an inverse relationship between ESG scores and the cost of capital for Latin American firms, measured by the Weighted Average Cost of Capital (WACC). They also found that only the Governance pillar score showed a negative relationship with the cost of capital. This study emphasized the need for increased attention, both from academic and professional perspectives to ESG scores and financial performance, particularly in Latin America.

From this literature review it is clear that, due to the limited number of studies on the subject, this field represents a multifaceted area of research with diverse professional and academic branches. In addition, it is confirmed that there is a scarcity of studies that explain the relationship between financial and environmental performance in Latin America. Consequently, this study presents an opportunity to investigate whether environmental performance has some effect on financial performance in Latin American firms and thus fill the identified knowledge gap.

Environmental performance in Latin America

Over the last decade, there has been a growing interest in environmental performance in Latin America. Research conducted in most Latin American countries has shed light on how policies significantly impact emissions (Ponce De Leon Barido & Marshall, 2014). Notably, the countries in South America, such as Brazil, Chile, and Argentina, have shown more concern about climate change (Gallego-Álvarez et al., 2018).

According to the Organization for Economic Co-operation and Development (OECD) (2018), Latin America is one of the richest regions in terms of biodiversity, providing an enormous advantage to the countries in the region. However, a major concern arises from deforestation, driven by the use of land for agriculture, mining, and energy production, which puts a severe strain on the ecosystems. As a result, Latin America faces an annual climate change finance deficit of approximately USD 110 billion based on budget capabilities. Although the banking sector receives around USD 7 billion annually in green finance, there are several limitations to closing this gap (Yuan & Gallagher, 2018). Also, strong incentives are offered for implementing environmental strategies in Latin America. This

enhances firms' competitiveness, positioning them favorably in international markets and strengthening their leadership (Rondinelli & Berry, 1997).

Nonetheless, although there is evidence that environmental planning results in improved returns on investments and a better reputation, most Latin American firms struggle to efficiently implement robust environmental policies (Clarkson et al., 2011). In this regard, it is essential to highlight the results of the study conducted by Duque-Grisales et al. (2020). Their findings expose the reality of Latin American firms implementing ISO 14001, which does not affect the way they adopt green innovations. However, they demonstrated that firms do experience increasing levels of financial performance as they allocate more funds to research and development for environmental performance. Additionally, there is proof of a positive relationship between eco-efficiency and financial performance, indicating that a lower CO2 emission-to-sales ratio increases Tobin's q, especially for firms in Brazil and Chile. Colombia, for its part, reports a minor impact, while there is no discernible relationship in Mexico (Rodríguez-García et al., 2022).

The growing interest in environmental and financial performance has led to a broad field of research. Specific theories have been developed from multiple perspectives, including economic, regulatory, organizational, and behavioral approaches (Clarkson et al., 2011). It is clear that environmental performance in Latin America continues to be a central focus of research, but there is no clear consensus on the actual relationship between firms' environmental and financial performance. Thus, while research is still insufficient, it may seem, on the surface, significant. Furthermore, the region has yet to establish a consensus on the environmental effect on firms' financial performance.

3. METHODOLOGY

This study focused on firms headquartered in Latin America, particularly those that provided information on financial and environmental factors to the Eikon Refinitiv Thomson Reuters database for the years 2015 to 2020. Specifically, this data includes the Environmental Pillar Score (EPS), Return on Assets (ROA), total assets, country of headquarters, and the ESG score.

The Eikon Refinitiv Thomson Reuters database has been previously used in relevant research on ESG matters (Marquez-Cardenas et al., 2022; Mejia-Escobar et al., 2020; Ramirez et al., 2022). In this study, the employed dataset comprises panel data with 1 708 observations pertaining to information from 372 firms headquartered in Argentina (57), Brazil (142), Chile (46), Colombia (24), Mexico (60), Panama (3), Peru (34), Puerto Rico (5), and Uruguay (1). These firms operate across different industries, as shown in Table 1.

Table 1

Table 1. Participation of firms in different industries

Industries	(%)	Industries	(%)
Aerospace & Defense	0.27%	Highways & Rail Tracks	1.88%
Agricultural Chemicals	0.27%	Homebuilding	0.88%
Airlines	1.61%	Independent Power Producers	2.42%
Airport Operators & Services	0.81%	Industrial Machinery & Equipment	0.27%
Aluminum	0.27%	Integrated Oil & Gas	0.81%
Apparel & Accessories	0.27%	Integrated Telecommunications Services	2.69%
Apparel & Accessories Retailers	0.81%	Investment Banking & Brokerage Services	0.54%
Appliances, Tools & Housewares	0.27%	Investment Holding Companies	0.54%
Auto, Truck & Motorcycle Parts	1.61%	Investment Management & Fund	0.27%
Banks	10.48%	Iron & Steel	2.69%
Brewers	1.08%	IT Services & Consulting	0.27%
Broadcasting	1.08%	Leisure & Recreation	0.54%
Business Support Services	1.88%	Life & Health Insurance	1.08%
Commercial Printing Services	0.27%	Managed Healthcare	1.08%
Commercial REITs	0.54%	Marine Freight & Logistics	0.27%
Commodity Chemicals	1.08%	Marine Port Services	1.08%
Construction & Engineering	1.61%	Miscellaneous Educational Service	0.81%
Construction Materials	2.15%	Multiline Insurance & Brokers	0.54%
Construction Supplies & Fixtures	0.54%	Natural Gas Utilities	2.15%
Consumer Goods Conglomerates	0.81%	Non-Alcoholic Beverages	1.34%
Consumer Lending	0.54%	Oil & Gas Exploration and Production	1.61%
Corporate Financial Services	0.81%	Oil & Gas Refining and Marketing	2.42%
Department Stores	2.42%	Oil & Gas Transportation Services	0.27%
Discount Stores	0.27%	Online Services	0.27%
Distillers & Wineries	0.54%	Paper Products	1.34%
Diversified Chemicals	0.54%	Passenger Transportation, Ground	0.81%
Diversified Mining	1.08%	Personal Products	0.54%
Drug Retailers	0.27%	Pharmaceuticals	0.81%
Electric Utilities	6.99%	Professional & Business Education	0.54%
Electrical Components	0.27%	Property & Casualty Insurance	0.54%
Financial & Commodity Service	1.61%	Real Estate Rental Development	5.38%
Fishing & Farming	1.88%	Reinsurance	0.27%
Food Processing	5.38%	Restaurants & Bars	0.81%

Food Retail & Distribution	2.42%	Schools, Colleges & Universities	0.54%
Footwear	0.81%	Software	0.54%
Forest & Wood Products	0.54%	Specialty Mining & Metals	1.88%
Gold	0.27%	Tobacco	0.27%
Ground Freight & Logistics	1.08%	Water & Related Utilities	1.34%
Healthcare Facilities & Services	0.81%	Wireless Telecommunications Services	0.62%
Heavy Machinery & Vehicles	0.81%		

Tabla 1. Participación de las empresas en las diferentes industrias
Source: Own work based on the Eikon Refinitiv Thomson Reuters database.

In light of the identified knowledge gap, the following research question was formulated: How is the EPS related to the financial performance of firms in Latin America? Given the lack of consensus in the existing literature regarding a statistically significant inverse effect of the EPS on financial performance, the following null hypothesis (H0) and alternative hypothesis (H1) were proposed to address the research question:

Null hypothesis (H0): The EPS does not significantly affect the ROA of firms in Latin America.

Alternative hypothesis (H1): The EPS does have a significant effect on the ROA of firms in Latin America.

Data and variables

Dependent variable: In this study, the variable of interest was Return on Assets (ROA), which is a financial ratio that indicates how profitable a firm is concerning its total assets (Adams & Ferreira, 2009; Carter et al., 2003). It can be used by managers, analysts, and investors to determine whether a firm uses its assets efficiently to generate profit (Arango-Home et al., 2023). Although other variables could have been chosen, this study is in line with others that have used ROA to evaluate the impact of ESG factors on financial performance, such as those conducted by Marquez-Cardenas et al. (2022), Ramirez et al. (2022), Alareeni and Hamdan (2020), Aouadi and Marsat (2018), and Ortas et al. (2015). The ROA data were sourced from the Eikon Refinitiv Thomson Reuters database, and ROA was calculated as net income divided by total assets.

Independent variable: This study employed the Environmental Pillar Score (EPS), calculated using the Eikon Refinitiv Thomson Reuters database. This score encapsulates several aspects, including emissions, waste management, biodiversity, environmental supply chain, and water and energy resource utilization. These aspects enable market participants to make informed decisions about a low-carbon transition. The EPS is part of a suite of social and governance indicators, which comprise the ESG pillar scores.

Control variables: To identify the variables that can significantly impact ROA, a literature review was conducted (Fama and French, 1995; Marquez-Cardenas et al., 2022; Ramirez et al., 2022). Based on such review, total assets (TA) and the ESG pillar score were selected

as the control variables. Data on these variables were sourced from the Eikon Thomson Reuters database. TA was computed as the sum of total current assets and total non-current assets. The ESG pillar score, for its part, was calculated based on 630 company-level ESG measures, with a subset of 186 deemed the most comparable and relevant per industry, guiding the overall company assessment and scoring process. These measures were grouped into ten categories that reformulate the three pillar scores and the final ESG score, which reflects a firm's ESG performance, commitment, and effectiveness based on publicly reported information. This score is computed as a relative sum of category weights, which can vary across industries for the environmental and social categories. In contrast, the weights for the governance categories remain the same across all industries. The pillar weights are standardized to percentages ranging between 0 and 100 (Refinitiv, 2022).

Moderating variable: The country of headquarters was used in this study as a moderating variable to assess the importance of analyzing the Latin American countries under study individually or the region as a whole (Gallego-Álvarez et al., 2018). This approach is supported by Lee and Suh (2022).

Before analyzing the relationship between the EPS and ROA, it is crucial to examine the current status of the EPS in the countries in the sample. Given the number of firms in each country, the data for 2020 reveals varying mean EPS values for the different countries. Brazil, which is the one with the most firms, boasts a mean EPS of approximately 40.8, while Mexico records 43.3, Argentina 28.8, Chile 42.4, Peru 33.9, Colombia 52.7, Puerto Rico 10.6, Panama 34.2, and Uruguay 73.3, as reported in Table 2. These results suggest that, in Latin American countries, updating EPS results for companies is not a common practice. Interestingly, the country with the highest EPS is Colombia, followed by Mexico. In the case of Colombia, this could mean that the firms reporting their EPS have high scores, which leads to these results. In contrast, in the case of Mexico, which includes a total of 60 firms, the EPS value is significant and indicates that these firms have an actual good EPS. Furthermore, there is a notable difference between the EPS values of firms in Argentina and Mexico, despite both countries having almost the same number of reports made by firms in 2020.

Table 2

Table 2. Summary of EPS results in 2020

Country	Number of firms	Mean EPS	Std. Dev.
Argentina	57	28.80923	22.85525
Brazil	142	40.85563	28.71411
Chile	46	42.48882	28.24260
Colombia	24	52.72974	23.02632
Mexico	60	43.37536	27.13688
Panama	3	34.32742	43.88247
Peru	34	33.95512	24.98384
Puerto Rico	5	10.61919	13.52407
Uruguay	1	73.34465	

Tabla 2. Resumen de la calificación del pilar ambiental en 2020

Source: Own work using R Project.

A robust perspective on the ROA and the EPS across different industries was adopted in this study. To understand the relationship between the EPS and firms' performance in the sample, a core model was tested twice, with one iteration incorporating the ESG score as a control to account for the overall impact. The core model is outlined as follows:

Model 1: ROA ~ EPS + ESG score

Additionally, the following are the models that included *country of headquarters* as a moderating variable and total assets:

Model 2: ROA ~ EPS + ESG score + Country of headquarters

Model 3: ROA ~ EPS + ESG score + Total assets

Model 4: ROA ~ EPS + ESG score + Country of headquarters + Total assets

Model 5: ROA ~ EPS + ESG score + Country of headquarters with robustness

Model 6: ROA ~ EPS + ESG score + Country of headquarters + Total assets with robustness

As observed, Model 5 corresponds to Model 2 with added robustness. Similarly, Model 6 corresponds to Model 4 with added robustness.

Furthermore, the analysis of the mean EPS for the study periods reveals that, in the majority of the countries, the mean EPS is above 30, with a standard deviation greater than 20, as reported in Table 3. This suggests that over the last years, Latin American firms have seen an increase in the number of them reporting their EPS, as well as an improvement in the EPS results. Importantly, these results are not that statistically significant, given the number of firms that were included in the analysis. However, it seems that the firms have managed to maintain their EPS levels, as shown in Figure 2.

Table 3

Table 3. Summary of EPS results by country

Country	Mean EPS	Std. Dev.
Argentina	24.48426	22.172061
Brazil	42.73941	28.246418
Chile	38.39381	28.986128
Colombia	49.95961	22.787308
Mexico	40.66443	27.676959
Panama	30.22822	31.536349
Peru	24.28769	22.471003
Puerto Rico	9.44255	11.219519
Uruguay	58.32705	9.418768

Tabla 3. Resumen de los resultados de la calificación del pilar ambiental por país

Source: Own work using R Project.

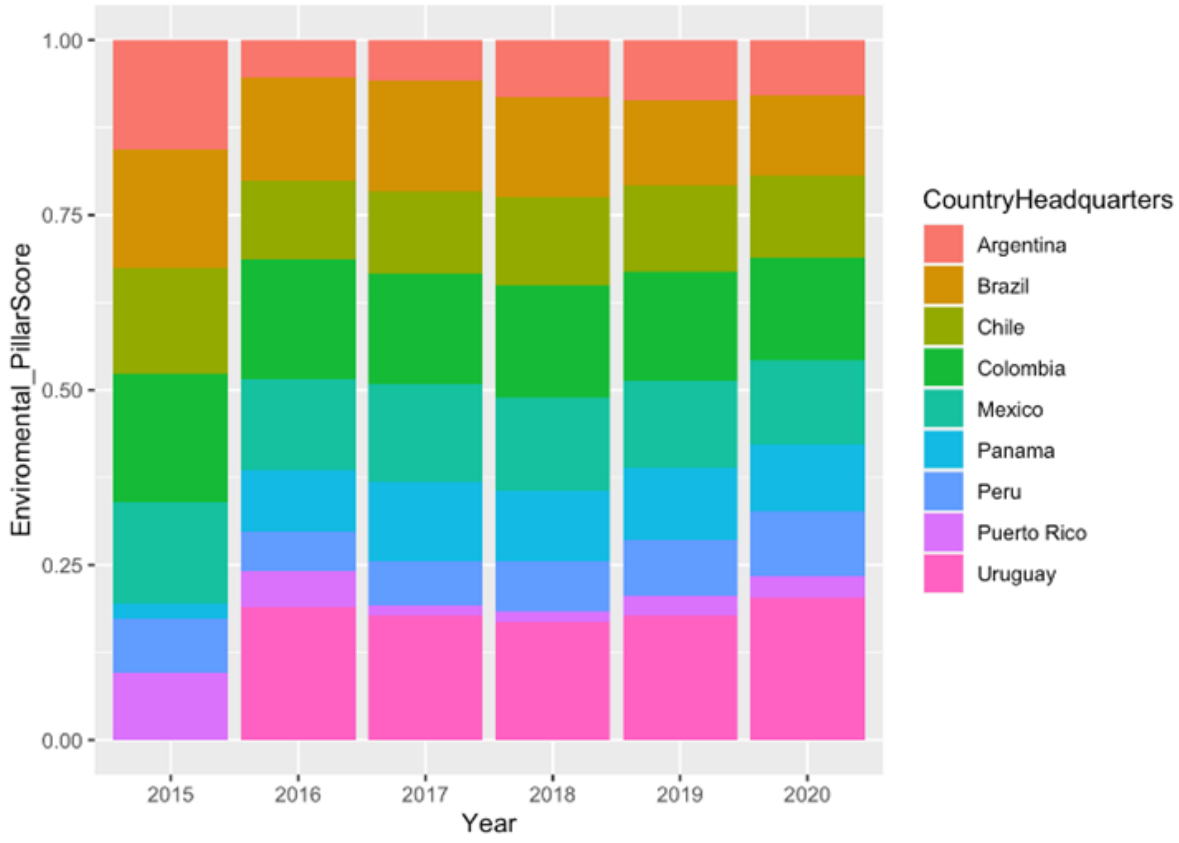

Figure 2

Figure 2. Mean EPS per year in Latin American countries

Figura 2. Media anual de la puntuación del pilar ambiental en los países de América Latina

Source: Own work using R Project.

As can be seen in Figure 3, Brazil, Mexico, Colombia, and Chile exhibit the most stable variations in the EPS from year to year, and they also tend to maintain their ROA, with fewer fluctuations over the years. Notably, Mexican firms yielded the best results when compared to their counterparts in the other countries under study.

This suggests that the EPS may not significantly impact ROA in Latin American firms.

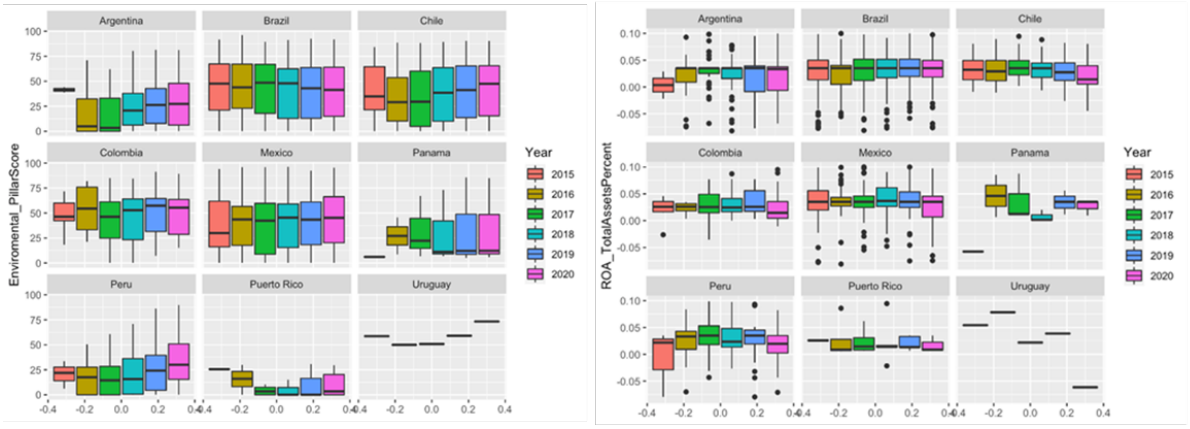

Figure 3

Figure 3. EPS and ROA in each country by year

Figura 3. Puntuación del pilar medioambiental y rendimiento de los activos en cada país por año

Source: Own work using R Project.

As mentioned before, some of Latin American countries have witnessed an increase in their EPS over the past six years while maintaining their ROA. Thus, at last, it was shown that there exists a zero or near-zero correlation between ROA and the other variables under analysis, as reported in Table 4. In other words, there was no linear relationship between ROA and some of the other variables in the study period. Nevertheless, while a positive correlation was observed between the EPS and total assets, the overall correlation behavior between these variables points to the lack of data as the main problem during data analysis. The results indicate that, for the sampled Latin American firms, there seems to be no relationship between the EPS and ROA, despite the absence of a clear association between ROA and the other variables in the countries included in this study. Additionally, there is insufficient evidence to support a positive relationship between ROA and the EPS in the last decades, which highlights the challenges posed by data limitations and the limited classification of the sub-variables and reclassification by industry in each country.

Table 4

Table 4. Matrix of correlations

Variables	ROA	EPS	ESG scores	Total assets
(1) ROA	1			
(2) EPS	0.03 [0.2691]	1		
(3) ESG score	0.01 [0.5452]	0.72*** [0.0000]	1	
(4) Total assets	0.03 [0.1812]	0.12*** [0.0000]	0.13*** [0.0000]	1

p-value in brackets. ***p-value < 0.001, ** p-value < 0.01, * p-value < 0.05 H0: Zero Pearson correlation

Tabla 4. Matriz de correlaciones

Source: Own work using R Project.

p-value in brackets. ***p-value < 0.001, ** p-value < 0.01, * p-value < 0.05 H0: Zero Pearson correlation

4. RESULTS

Although there is evidence of the positive effects on firm performance resulting from improved environmental performance (Farza et al., 2021), a regression analysis was performed in this study to better understand this relationship. Furthermore, it has also been proven that there is a connection between green bond issuances and improvements in firms' ROA and EPS (Mejia-Escobar et al., 2020). Thus, a regression analysis was carried out here to better understand this relationship. In addition, various tests were conducted to select the best model and assess robustness.

As shown in Table 5, the results of the multicollinearity test using the Variance Inflation Factor (VIF) indicate that none of the variables exhibited a VIF value higher than 10. This means there is no problem in employing these variables in the regression models. The resulting VIF values can thus be interpreted as suggesting a moderate correlation between the variables. According to the R documentation, taking the square root of the VIF reveals how big the standard error of the estimated coefficient is when the predictor is independent of the other variables (RDocumentation, 2022).

Table 5

Table 5. Multicollinearity test

Multicollinearity with the EPS - VIF test		
ESG score	Total assets	ROA
1.016617	1.017465	1.001406

Tabla 5. Prueba de multicolinealidad

Source: Own work using R Project.

To test Model 1 and Model 2, a fixed-effects regression (within model) and a multiple linear regression (MLR) were performed to control the unobservable heterogeneity. Notably, multiple regression showed better performance in Model 1, where the *country of headquarters* variable was not included. For its part, fixed-effects regression, with the *year* factor as the fixed effect, showed better results in Model 2, which incorporated the *country of headquarters* variable. As can be seen in Table 6, the p-value was below 0.05, leading to the rejection of H0. In addition, the results demonstrate the superiority of the fixed-effects regression.

Table 6

Table 6. Selection of the best model

Best model	
H0: multiple regression vs. H1: fixed-effects regression F-test for individual effects	
p-value	0.03084

Tabla 6. Selección del mejor modelo

Source: Own work using R Project.

As observed in Table 7, the findings underscore the significance of Brazil, Chile, and Mexico in the analysis, with estimators demonstrating a remarkable degree of consistency, even when incorporating the year as a fixed effect. Focusing on firm performance, regression model 2 remains relevant. However, it is crucial to note that the ESG score did not yield a statistically significant impact on firm performance. This implies that an increase in the ESG score does not unequivocally translate into enhanced effectiveness for Latin American firms or improved overall firm performance. As reported by González-Ruiz et al. (2023) and Mejia-Escobar (2020), Brazil, Chile, and Mexico possess some of the most developed capital markets in the region and offer incentives and have regulations that allow firms to invest in environmental performance. As a result, these countries lead the green bond market in the region (Mejía-Escobar et al., 2021).

Table 7

Table 7. Regression analysis of Model 1 and Model 2

	Model 1 (MLR + ROA)	Model 2 (Fixed effect + ROA)
EPS	4.016e-05 [0.334] (4.159e-05)	7.9554e-06 [0.8529941] (4.2926e-05)
ESG score	-6.514e-07 [0.781] (2.346e-06)	-3.3740e-07 [0.8856222] (2.3452e-06)
Brazil		8.9598e-03*** [0.0007228] (2.6453e-03)
Chile		8.8542e-03** [0.0049085] (3.1435e-03)
Colombia		7.0128e-03 [0.0695792] (3.82621e-03)
Mexico		1.2399e-02*** [3.588e-05] (2.9924e-03)
Panama		9.5205e-04 [0.9137354] (8.7873e-03)
Peru		2.8210e-03 [0.4172865] (3.4770e-03)
Puerto Rico		-2.0589e-04 [0.9768414] (7.0916e-03)
Uruguay		3.5104e-03 [0.81438221] (1.4950e-02)
Observations	1,705	1,708
Residual sum of squares square	0.03311	18.599
R2	0.000761	0.014295
p-value	0.5226	0.006561

Tabla 7. Análisis de regresión del modelo 1 y del modelo 2

Source: Own work using R Project.

***p-value < 0.001, ** p-value < 0.01, * p-value < 0.05

Moreover, the results of regression model 2 suggest that there is no significant relationship between the EPS and firm performance for Latin American firms based on the analyzed data. Nonetheless, there was a slight increase in the ROA of the three countries under study as the years passed by. Importantly, ROA and the EPS in the correlation matrix were lower than those in regression model 2. Furthermore, as mentioned by Farza et al. (2021), there is no clear-cut relationship indicating that the EPS directly increases or decreases ROA in firms. What is important is that banks and insurance companies are now evaluating the environmental performance of their clients and adjusting lending conditions accordingly.

Just as with the Model 1, a test was carried out for the models that incorporated the *total assets* variable. According to the results, which are presented in Table 8, Model 4 was the best performing model.

Table 8

Table 8. Test for the best model

Best model with the *total assets* variable	
H0: multiple regression vs. H1: fixed-effects regression F-test for individual effects	
p-value	0.02761

Tabla 8. Pruebas para el mejor modelo

Source: Own work using R Project.

Table 9 shows that the inclusion of the *total assets* variable did not yield any significant coefficients. However, slight but still statistically significant changes were observed in Brazil, Chile, and Mexico, even though the coefficients seem less negative. This means that the null hypothesis (H0) was supported by Model 4 and not by Model 2, which serves as a reminder that the financial performance of firms is not directly influenced, positively or negatively, by their EPS. Consequently, it becomes evident that there is no moderating variable affecting the relationship between ROA and the EPS for the Latin American firms in the sample.

Table 9

Table 9. Models with the total assets variable

	Model 3 (MLR + ROA)	Model 4 (Fixed effect + ROA)
EPS	4.300e-05 [0.302] (4.162e-05)	1.0763e-05 [0.8020856] (4.2932e-05)
ESG score	-4.619e-07 [0.844] (2.349e-06)	-1.0316e-07 [0.9649576] (2.3478e-06)
Total assets	-1.515e-08 [0.141] (1.029e-08)	-1.7684e-08 [0.0856514] (1.0282e-08)
Brazil		9.1623e-03*** [0.0005492] (2.6464e-03)
Chile		9.1662e-03** [0.0036296] (3.1469e-03)
Colombia		7.1206e-03 [0.0652804] (3.8604e-03)
Mexico		1.2478e-02*** [3.175e-05] (2.9910e-03)
Panama		9.7136e-04 [0.9119421] (8.7822e-03)
Peru		2.8402e-03 [0.4138531] (3.4750e-03)
Puerto Rico		1.3382e-04 [0.9849443] (7.0902e-03)
Uruguay		3.3850e-03 [0.820827] (1.4942e-02)
Observations		1,691
Residual sum of squares square		18.301
R2		0.016016
p-value		0.0040313

Tabla 9. Modelos que incluyen la variable de activos totales

Source: Own work using R Project.

***p-value < 0.001, **p-value < 0.01, *p-value < 0.05

To gain a more accurate insight into the models' performance, heteroskedastic robust standard errors were estimated. This was carried out for the models that showed better performance, namely Model 2 and Model 4, resulting in the creation of Model 5 and

Model 6. However, as indicated in Table 10, no significant differences were observed. This suggests that the null hypothesis (H0) was not rejected for Brazil, Chile, Colombia, and Mexico, with a 90% confidence level. For a clearer overview, Table 11 provides a summary of the best models' performance. Likewise, the robustness test altered the standard deviations with the strongest weighting.

Table 10

Table 10. Model 5 and Model 6

	Model 5 (FE + R + ROA)	**Model 6 (FE + R + ROA)**
EPS	0.0000079554 [0.8955] (0.0000575520)	0.00001076258 [0.8595] (0.0000577236)
ESG score	-0.0000003374 [0.8849] (0.0000022155)	-0.00000010316 [0.9642] (0.00000218892)
Total assets		-0.00000001768 [0.3654] (0.00000001777)
Brazil	0.0089597756* [0.0306] (0.0030011402)	0.00916231881* [0.0327] (0.00312785997)
Chile	0.0088542411* [0.0416] (0.0032515683)	0.00916617788* [0.0377] (0.00326686126)
Colombia	0.0070127911 [0.0695] (0.0030446913)	0.00712061083 [0.0685] (0.00307651023)
Mexico	0.0123991722* [0.0104] (0.0031080913)	0.01247782183* [0.0105] (0.00313345614)
Panama	0.0009520532 [0.9140] (0.0083833061)	0.00097136339 [0.9122] (0.00837380107)
Peru	0.0028209817 [0.3469] (0.0027178157)	0.00284020444 [0.3444] (0.00272092610)
Puerto Rico	-0.0002058921 [0.9309] (0.0022592753)	0.00013381676 [0.9594] (0.00249956029)
Uruguay	0.0035104480 [0.8894] (0.0239983402)	0.00338496515 [0.8938] (0.02410701986)
Residual standard error	0.03292	0.0329
F-statistic (full model) p-value	0.003079	0.001922
F-statistic (proj. model) p-value	0.301	0.3584
Cluster error in parenthesis - [p-value] ***p-value < 0.001, **p-value < 0.01, *p-value < 0.05		

Tabla 10. Modelos 5 y 6

Source: Own work using R Project.

Table 11

Table 11. Summary of the best models' performance

	Model 1 (OLS + ROA)	Model 2 (FE + ROA)	**Model 3 (OLS + ROA + TA)**	Model 4 (FE + ROA + TA)	Model 5 (FE + R + ROA)	Model 6 (FE + R + ROA + TA)
EPS	0.00004	0.00001	0.00004	0.00001	0.00001	0.00001
	(0.00004)	(0.0004)	(0.00004)	(0.0004)	(0.0001)	(0.0001)
ESG score	0.00000	-0.0000	0.00000	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Total assets			0.00000	-0.0000*		-0.0000
			(0.0000)	(0.0000)		(0.0000)
Brazil		0.009***		0.009***	0.009**	0.009**
		(0.003)		(0.003)	(0.003)	(0.003)
Chile		0.009***		0.009***	0.009**	0.009**
		(0.003)		(0.003)	(0.003)	(0.003)
Colombia		0.007*		0.007*	0.007*	0.007*
		(0.004)		(0.004)	(0.003)	(0.003)
Mexico		0.012***		0.012***	0.012**	0.012**
		(0.003)		(0.003)	(0.003)	(0.003)
Panama		0.001		0.001	0.001	0.001
		(0.009)		(0.009)	(0.008)	(0.008)
Peru		0.003		0.003	0.003	0.003
		(0.003)		(0.003)	(0.003)	(0.003)
Puerto Rico		-0.0002		-0.0001	-0.0002	0.0001
		(0.007)		(0.007)	(0.002)	(0.002)
Uruguay		0.004		0.003	0.004	0.003
		(0.015)		(0.015)	(0.024)	(0.024)
Constant	0.029***		0.029***			
	(0.002)		(0.002)			
Observations	1708	1,708	1,708	1,708	1,708	1,708
R2	0.001	0.014	0.002	0.016	0.02	0.022
Adjusted R2	-0.0004	0.006	0.0003	0.007	0.011	0.012

Tabla 11. Resumen del desempeño de los mejores modelos

Source: Own work using R Project.

*p < 0.1, **p < 0.05, ***p < 0.01

The fixed-effects model was compared with Ordinary Least Squares (OLS) models using the Hausman test, as shown in Table 12. When the null hypothesis was not rejected, the model errors were homoscedastic and there was no endogeneity in the explanatory variables. In the case of Model 1 versus Model 2, the null hypothesis was rejected because the p-value obtained ranged between 0.05 and 0.01. These results suggest that one of the models is inconsistent and that there could be endogeneity in the explanatory variables. Conversely, when comparing Model 3 and Model 4, the null hypothesis was not rejected, suggesting that the two estimators may

be considered consistent and efficient under the specified model conditions.

Table 12

Table 12. Hausman test

	Model 1 vs. Model 2	Model 3 vs. Model 4
p-value	0.01087	0.9489
ChiSq	9.0432	0.35713

Tabla 12. Test de Hausman

Source: Own work using R Project.

H0: the errors in the model are homoscedastic and there is no endogeneity in the explanatory variables.

According to the results of the Breusch–Pagan heteroscedasticity test shown in Table 13 (where the null hypothesis suggests homoscedasticity), the p-value of Model 1 and Model 3 was greater than 0.05; therefore, the null hypothesis was not rejected.

Table 13

Table 13. Breusch–Pagan test

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
BP	2.4279	35.087	2.9534	34.654	35.087	34.654
p-value	0.297	0.0001206	0.3989	0.0002826	0.0001206	0.0002826

Table 13. Test de Breusch-Pagan

Source: Own work using R Project.

H0 : var(yi) = var(ei) = σ2, homoscedasticity.

Based on the results of the endogeneity and heteroscedasticity tests presented in Tables 12 and 13, respectively, Model 1 and Model 3—which followed the OLS method—were found to be the most appropriate ones. Model 1 explained 60.25% of the variation in the dependent variable ROA. Model 3, in turn, accounted for 65.75% of the variation and raised the adjusted R-squared value to 64.3%. These results indicate that the ESG score is a statistically significant predictor of the dependent variable ROA.

In summary, the analysis of Model 1 and Model 3 demonstrates that the ESG score emerges as a highly relevant predictor of the dependent variable. Nevertheless, it is worth noting that Model 3 explained a greater proportion of the variation in the dependent variable and presented a higher adjusted R-squared value compared to that of Model 1.

5. DISCUSSION

This paper examined the relationship between ROA and the EPS for firms headquartered in Latin America. Empirical evidence suggests that environmental performance had minimal impact on firms' financial performance for the six years under analysis. In addition, this study found that although Latin American firms and countries have reached an agreement on environmental practices,

their strategies still fall short when it comes to funding projects that prioritize environmental performance with profitable results.

However, positive results were observed in Brazil, Mexico, and Chile, which may be explained by three main factors: First, the EPS of firms in each country exhibited low variability, making it difficult to assess its effect on ROA. Second, the potential for firms to increase profitability by implementing environmental practices, and the positive relationship between environmental and financial performance are not considered when evaluating firms' performance. Third, these countries have superior business development in comparison to other Latin American countries, as evidenced by the results of all the models. Therefore, these three countries are setting a new standard for environmental and financial performance, paving the way for other firms in Latin America. As a result, firms can improve their environmental performance while increasing or maintaining their profitability.

A study conducted by Filbeck and Gorman (2004) found no clear benefits from taking environmental performance measures. Instead, the results showed a negative relationship between firms' financial profitability and environmental performance. In contrast, Delmas et al. (2013) obtained positive results; however, they proved that publicity for firms' environmental performance may not always bring a benefit, as *process* and *outcome* are two distinct dimensions. Finally, Telle (2006), using various regression models of Norwegian plants, confirmed the positive impact that environmental performance exerts on the financial performance of firms. However, as mentioned above, the environmental performance of Latin American firms falls short of that in Europe or East Asia. This situation puts the region at a disadvantage in terms of international competitiveness and investment, considering that the banking sector increasingly demands that firms integrate environmental practices into their core businesses. Similarly, Fujii et al. (2012) found a positive correlation between environmental performance and the financial outcomes of Japanese firms. Their study established that these firms' environmental practices, as measured by the reduction in CO2 emissions, led to an improved ROA.

Although the null hypothesis (H0) was not rejected for most countries, it would be useful to better classify the EPS sub-variables (i.e., emissions, waste, biodiversity, environmental management systems, product innovation, green revenues, use of water resources, energy, sustainable packaging, and environmental supply chain) to identify the leading Latin American firms in terms of environmental practices. Moreover, the evidence shows that the level of the EPS varies between countries, with Brazil leading the way, followed by Mexico and Chile, considering the number of firms in each country.

Contrary to what was expected, the analysis revealed that the region has experienced a slight increase in the EPS. Even though the data demonstrates that the EPS in most countries does not have a positive relationship with firms' ROA, ROA was not found to be affected by the EPS in Latin American firms. This could be attributed

to the fact that the analysis grouped all environmental factors and firms together, without distinguishing between industries or sectors.

This study contributes to a better understanding of the relationship between the environmental and financial performance of Latin American firms. It shows that firms in the region are increasingly adopting environmental practices although, so far, they appear to have no significant impact on profitability. In addition, it is reasonable to consider that the economic benefits from introducing environmental practices may affect Latin American firms' decision making regarding whether they should follow the example of European or East Asian firms.

6. CONCLUSIONS

In general terms, the evidence is consistent with the current status of the EPS in the region, but highlights the need for further monitoring firms' future environmental performance and profitability. In this context, the EPS in Latin America does not have a strong positive correlation with firms' financial performance. Therefore, the control variables included in the model seem insignificant for firms in this region. In addition, the sub-variables composing the EPS were not classified in the database for a thorough analysis of their correlation with ROA. Nonetheless, an important contribution of this study is that it enhanced the understanding of the EPS in a region with enormous resources and economic potential, while also addressing a key matter: In Latin America, environmental regulations are still under development, and firms have not been required to take progressive actions. Consequently, to establish a positive and significant relationship between the EPS and ROA, it is essential to standardize environmental criteria across the region to better interpret the parameters included in the data.

The growth of the green bond market in the region is expected to maximize the impact of environmental performance on financial outcomes. Therefore, similar results to those observed in Brazil, Chile, and Mexico can be anticipated. Despite the valuable contributions of this study, some limitations should be acknowledged. Although efforts have been made to encourage both large and small firms to report their ESG results, it is imperative for more firms to establish disclosure mechanisms as part of their corporate strategy and accountability to stakeholders, especially investors.

Finally, the results of the study reveal a limited data classification, which constitutes a starting point for further research. Thus, to broaden the scope of the present study, data could be grouped by sectors and the EPS sub-variables. Furthermore, future studies should also examine the environmental compensation regulations and practices that Latin American firms need to adopt by country, focusing on how environmental performance can impact a firm's capital structure. It would also be interesting to analyze the relationship among a firm's return on equity, ROA, and the EPS.

This approach could have great impact on small and medium-sized firms, where research on ESG issues is limited.

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Notes

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CONFLICTS OF INTEREST

The authors declare no conflict of financial, professional, or personal interests that may inappropriately influence the results that were obtained or the interpretations that are proposed here.

- AUTHOR CONTRIBUTIONS

In this study, all the authors made a significant contribution, as follows:

Camila Ospina-Patiño: She participated in the design and development of the research. As well as in the analysis and interpretation of the results, writing of the text, and final revision of the manuscript.

Juan David González-Ruiz: He participated in the conception, design, and development of the research. As well as in the analysis and writing of the text and final revision of the manuscript.

Nini Johana Marín-Rodríguez: She participated in the development of the research. As well as in the analysis and final revision of the manuscript.

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