ISSN: 1648-6897 / eISSN: 1822-4199

VILNIUS TECH
Vilnius Gediminas Technical University

JOURNAL of ENVIRONMENTAL ENGINEERING & LANDSCAPE MANAGEMENT

2026
Volume 34
Issue 4
Pages 383–405
https://doi.org/10.3846/jeelm.2026.28563

INTEGRATING SUSTAINABILITY: ENVIRONMENTAL AND FINANCIAL PERFORMANCE IN BRICS ENERGY AND HEAVY INDUSTRY

Shahid ALI[1], Aamir AZEEM[2], Muhammad AKRAM NASEEM[3], Dong WANG[1]✉, Syed TAUSEEF HASSAN[1]

[1]*School of Economics and Management, Hezhou University, 542899 Hezhou, China*
[2]*Department of Management Science, Virtual University of Pakistan, 54000 Lahore, Pakistan*
[3]*Lahore Business School, The University of Lahore, 54000 Lahore, Pakistan*

Highlights:

- environmental performance enhances financial performance;
- firm market reputation and competitive advantage has partial mediating factor;
- voluntary environmental regulation positive while thin capitalization negatively moderates the relationship.

Article History:

- received 5 June 2025
- accepted 6 January 2026

Abstract. This study provides a clear and compelling analysis of how Environmental Performance (EP) drives Financial Performance (FP) in BRICS countries. It shows that strong EP reduces environmental risks, enhances value, and improves firms' financial outcomes. Focusing on firm-level data, the study examines the EP-FP link with market reputation and competitive advantage as mediators, and thin capitalization and voluntary environmental regulation adoption as moderators. Using the Generalized Method of Moments and bootstrapping on 295 BRICS firms (2015–2022), the results confirm that EP positively influences both accounting- and market-based FP, with a stronger and slightly delayed effect on accounting measures. The study also finds that market reputation and competitive advantage partially mediate this relationship. Moreover, voluntary environmental regulation strengthens the EP-FP link, while thin capitalization weakens it. We found that firms with roust environmental initiatives have potential competitive strength that foster stronger reputations thus secure positive financial gains. The insights of this research underscore the significance of adopting forward-looking, sustainability-focused strategies that rise above narrow, short-term profit objectives. The findings offer valuable guidance for managers, companies, and policymakers seeking to improve environmental and financial outcomes.

Keywords: environmental performance, mediator, market reputation, competitive advantage, moderator, voluntary environmental regulation adoption, thin capitalization, BRICS, GMM.

✉Corresponding author. E-mail: *m13870015586@163.com*

1. Introduction

Researchers in environmental management remain deeply interested in how an organization's Environmental Performance (EP) affects its Financial Performance (FP). Moreover, over the past three decades, EP and the environmental associated costs for subsiding negative environmental externalities have received keen interest from policymakers, scholars, and management. Following the 1970s scholarly engagement, researchers in pioneering literature emphasized that EP negatively affects FP under neoclassical production theory and the trade-off hypothesis. However, after 1990, environmental concern leaned toward the revisionist approach under the organizational social impact hypothesis that tends to constructive relationships and endorses positive environmental externalities for firms through innovation for securing sustainable development.

The literature presents varied findings regarding EP-FP relationships. Traditional shareholders consider environmental costs redundant and unproductive to impact profitably negatively or marginal benefits to shareholders (Ayayi & Wijesiri, 2022; Haibo & Manu, 2022). However, many scholars under the environmental and social impact hypothesis oblige a positive nexus that enhances a firm's competitiveness and sustainability (Wagner et al., 2002). However, few endorse the curved relationship and threshold presence (Ben Lahouel et al., 2022; Trumpp & Guenther, 2017). Different scholars provided the reasons for inconclusive empirical evidence. Despite the prevalence of direct relationships in the existing literature, López-Gamero et al. (2009) described the approach as a "black box". Similarly, Saeidi et al. (2015) insisted that a direct

Copyright © 2026 The Author(s). Published by Vilnius Gediminas Technical University

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (*http://creativecommons.org/licenses/by/4.0/*), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

relationship is spurious. On statistical grounds, hypothesis testing without endogeneity treatment provides misleading results (Zheng & He, 2022). Scholarly engagement reveals that the EP-FP direct relationship cannot provide a comprehensive view, so missing moderating mediating factors are crucial for holistic understanding (Aigbedo, 2021; Wedari et al., 2023). Besides this, Bassetti et al. (2021) argued that dynamic and complex environmental practices require future scrutiny for definite proof. Therefore, incorporating all these arguments may provide an exhaustive view of the relationship. Researchers have rigorously tested this concept in developed regions, but few studies have examined it in the BRICS region.

BRICS adopted global agreements and SDGs to promote sustainability and mitigate climate risks, particularly those arising from industrial carbon emissions. BRICS is a signatory to key global environmental agreements[1], such as the Paris Agreement, CBD, UNFCCC, Basel, and Stockholm Conventions, which establish a framework for protecting the environmental bottom line. In addition, Sustainable Development Goal (SDG) 12 highlights the significance of responsible production and consumption by reducing waste via recycling programs and reporting sustainability efforts. Similarly, SDG 13 encourages and enforces urgent climate action to build resilience and protect the ecosystem for a sustainable future. The BRICS region, known for its dense population and rapid industrialization, confronts substantial climate-related vulnerabilities and negative externalities due to low environmental stringency and usage of renewable energy sources. This minor reliance contributes to 44% of global CO_2 emissions (Nassani et al., 2017), whereas energy and heavy industry account for 76% of the emissions (Zakharov et al., 2022). Environmental initiatives remain largely voluntary in BRICS nations; however, having faith in environmental agreements demonstrates a commitment to addressing environmental challenges. Furthermore, ecological sustainability is the top priority for BRICS, evidenced by initiatives such as green bonds, affordable green financing, and tax rebates (Udeagha & Ngepah, 2023).

The primary objective of this paper is to find the relationship between EP and FP in the energy and industrial sectors of the BRICS region in a panel setting. Our analysis reveals that the impact of EP is positive and statistically significant with FP from accounting and market perspective measures. However, the relationship gets stronger from the accounting perspective and with the lag effect. Similarly, we find that pollution negatively impacts FP. The secondary objective is to find the indirect or mediating effect of the firm's market reputation and competitive advantage between EP and FP and found these mediate the relationship partially. In addition, we tested the Voluntary Environmental Regulation Adoption (VERA) and Thin Capitalization (TC) of the firms as moderating contingencies between EP and FP. The VERA positively moderates the relationship and seconds the Porter win-win hypothesis for stakeholders, while TC negatively moderates the relationship and supports agency cost issues. The study finds that an effective environmental management environment can boost reputation, reduce costs, and make capital more affordable. As a result, pursuing environmental protection goals can lead to improved FP, both directly and indirectly (Tucker & Melewar, 2005). Our findings are aligned with the revisionist preposition endorsed by NRBV, Porter hypothesis, and stakeholders' approach of EP and FP simultaneous mutual positive gains, and they contradict the traditional view consisting of shareholders and trade-off perspective. We find that firms' leading role toward environmental initiatives is a positive factor that brings a firm competitive advantage, brand reputation, and sustainable development. Moreover, we find that the positive nexus between EP and FP is crucial for environmental sustainability efforts in the energy and heavy industry sectors.

In this paper, we added different contributions on theoretical and empirical grounds in existing literature. On theoretical grounds, we used two mediators (firm market reputation; firm competitive advantage) and two moderators (Voluntary Environmental Regulation Adoption and thin capitalization) of firms, which provide a panoramic view of the EP and FP relationship in a multi-theoretical context. On empirical grounds, scholars consider GMM an efficient method in case of heterogeneity, simultaneity, and endogeneity (Ullah et al., 2021). A firm's strong financial position facilitates the adoption of environmental strategies and technologies, leading to endogeneity issues, which GMM tackles through the inclusion of lag instruments (Blundell & Bond, 2023). Additionally, we incorporated a diverse sample from polluting industries across multiple countries within the BRICS region, which are under-researched and susceptible to climate vulnerabilities. Besides this, we test non-linearly exhaustively, and robustness is achieved by extensive empirical testing via different proxies and methodologies. We also provided fresh evidence from recent data and endorsed NRBV and Porter's win-win hypothesis for a holistic picture of environmental initiatives and sustainable FP. To our knowledge, it is the first comprehensive understanding of the nexus between EP and FP in a BRICS multi-country sample. Finally, our findings provide insight into practitioners, policymakers, and management for environmentally friendly initiatives, strategies, and actions in the energy and industrial sectors.

2. Literature review

2.1. Theoretical stance of EP and FP

Traditional shareholder views see a trade-off between EP and financial returns, whereas resource- and strategy-based perspectives view environmental initiatives as drivers of competitive advantage and long-term value. Friedman

[1] BRICS region is a signatory of the Paris Agreement for reducing CO_2 emissions, the United Nations Framework Convention on Climate Change UNFCCC is international cooperation to combat climate change, the Convention on Biological Diversity (CBD) conserves biological diversity, the Basel Agreement focuses on minimizing the generation of hazardous wastes, while the Stockholm treaty is to restrict organic pollutants.

(2017) prioritized shareholder wealth maximization under the neoclassical economic approach by ignoring the business social responsibility inducing environmental welfare. He considered the costs that stem from firm environmental initiatives to be redundant and deviate a firm from its prime profitability objective, thus endorsing the negative relationship between EP and FR under the traditional approach of the trade-off hypothesis. However, Barney (1991) deviated and provided a thought in Resource-Based View (RBV), which recommended the bundling of resources and capabilities for a sustainable competitive advantage. He emphasized dynamic capability based on environmental initiatives as environmental conditions change rapidly and create opportunities or threats to the business, and seizing such opportunities is the source of sustainable competitive advantages. Similarly, Hart and Dowell (2011) expanded on this idea and emphasized that competitive advantage is deeply tied to its connection with the natural environment due to the scarcity of resources and significant environmental impact. Similarly, Porter and Linde advocated that a well-designed environment regulation is a win-win scenario for stakeholders (Porter & Van Der Linde, 1995). In the recent century, Wagner et al. (2002) extended the notion and provided the revisionist view that assumed environmental compliance costs as future investments. The literature shows a consensus that RBV, NRBV, Porter's win-win proposition, and revisionist view accommodate the social impact hypothesis while the shareholder view obliges the trade-off hypothesis.

2.2. Environmental performance and financial performance

Firms' environmental initiatives can influence both EP and FP, yet empirical evidence on the relationship remains mixed that reflects the benefits and costs of adoption of sustainable practices. Firms may adopt various environmental initiatives to improve their EP, such as reducing wastage, adopting eco-friendly technologies, and committing resources to green products (Hart & Ahuja, 1996). Factors such as size, industrial sensitivity, and process efficiency can influence a firm's FP, depending on their environmental strategies and commitment. Empirical research has yielded mixed results regarding the EP-FP relationship (Tucker & Melewar, 2005). Nonetheless, a meta-analysis suggests a generally positive correlation between the two (Dixon-Fowler et al., 2013). Similarly, another meta-study containing empirical studies encompassing 101,775 observations found that strong carbon performance is a catalyst for FP (Busch & Lewandowski, 2018). Their findings also indicate a broad consensus among studies that high carbon emissions reflect poor EP, often stemming from inadequate environmental management (Busch & Lewandowski, 2018). On the other hand, clean technologies adoption reduces carbon emissions and can enhance EP, but it might negatively impact FP due to associated financial costs. Recent literature shows, in a multi-country sample, that the EP of a firm contributes positively to economic and financial gains (Bendig et al., 2023; Gupta & Deb, 2023), whereas few endorsed the inverted (Ben Lahouel et al., 2022), including negative and positive nexus at a time.

Prior studies on the EP-FP nexus shows mixed results due to inconsistent measurement of EP and FP, omitted mediating and moderating factors, weak causal identification, and contextual variation across countries and industries. Many focused only on the direct EP-FP link, ignoring how or under what conditions EP enhances FP. Moreover, limited attention to endogeneity, lag effects, and reporting quality further produced inconclusive evidence. Prior mixed findings stem from inconsistent measurement, omitted mediators/moderators, endogeneity, sample heterogeneity, timing issues, and disclosure bias. Your study counters these weaknesses by harmonizing EP/FP metrics, modelling reputation and competitive advantage as mediators, including VERA and thin capitalization as moderators, applying GMM and lag analyses for causal clarity, bootstrapping mediation, focusing on BRICS energy/heavy industries, and testing for disclosure/earnings-management distortions thereby producing a more internally valid, contextually grounded, and policy-relevant assessment of the EP and FP nexus.

EP creates economic value through reputation and operating efficiency and RBV emphasizes efficiency gains from distinctive environmental capabilities, while NRBV highlights reputation as a strategic intangible asset and firm relationship with natural environment. Thus, drawing theoretical insights from RBV and NRBV and their associated arguments, we anticipate that strong EP serves as a competitive advantage, positively influencing FP.

H1: *EP of firms is positively associated with FP.*

2.3. Moderating role of voluntary environmental regulation adoption between EP and FP

Environmental regulations can be a cost or a catalyst for future financial gain, and well-designed voluntary approaches may drive innovation, provide competitive advantage, and create sustainable value. The neoclassical or traditional approach assumes environmental compliance is costly and results in market losses, while the Porter hypothesis suggests that a well-crafted environmental regulation can catalyze firms' innovation efforts, thereby mitigating or fully offsetting compliance expenses and granting them an early adoption advantage (Porter & Van Der Linde, 1995). This hypothesis acknowledges that "the appropriate environmental regulatory design can drive innovation and improve the competitiveness of enterprises "grounded in a win-win scenario for stakeholders. Building upon this notion, Wagner et al. (2002) put forth a revisionist perspective, viewing environmental costs as investments in the future. Arimura et al. (2019) characterize firms' voluntary adoption of regulations as a commitment to environmental protection activities, noting a global increase driven

by the significant flexibility it affords, acting as a catalyst for innovation. Similarly, Banerjee and Gupta (2019) advocates those voluntary environmental regulations may spur innovation, yet despite its manifold benefits, scholarly engagement in this area remains limited. A recent study of Dai et al. (2025b) explores that technological innovation and digitalization are other ways reduction of carbon emission and can create a competitive advantage. Wang and Lin (2022) further delineated ER into command-based, market-based, and voluntary approaches. However, BRICS countries encourage firms to adopt voluntary steps for environmental regulation adoption due to the shortage of funds and limited stakeholder pressure.

Firms' voluntary adoption of environmental initiatives and certifications plays a critical role in shaping stakeholder perceptions and may strengthen the link between EP and FP. The adoption of a green approach by firms reflects a commitment to the philosophy of stakeholders who advocate for a continuous supply of resources aimed at enhancing firm EP. In today's landscape, firms are increasingly focused on mitigating information asymmetry regarding their environmental initiatives, recognizing that stakeholders prioritize engagement in environmentally responsible practices. As a result, the link between EP and FP may depend on a firm's environmental activism and its voluntary attitude toward environmental regulation like ISO or EMAS. However, the existing literature offers mixed findings on this relationship, indicating that moderating factors could play a significant role (Zhang et al., 2020). Hence, we posit a hypothesis: when firms undertake voluntary environmental measures, stakeholders perceive such actions as indicative of a sustainable approach. As a result, stakeholders are more inclined to invest in these firms due to their preemptive environmental philosophy, which improves the market value of the business. Given this hypothesis, we underscore the significance of firms' voluntary adoption of environmental regulations as the moderator variables in the EP-FP relationship. So, the adoption entails obtaining official certifications such as ISO 14001 (International Organization for Standardization, 2015) or EMAS certification, which serve as tangible markers of a firm's commitment to environmental stewardship and can potentially enhance the link of EP-FP.

H2: *Firms' VERA positively moderates the relationship between EP and FP performance.*

2.4. Moderating role of thin capitalization between EP and FP

The relationship between capital structure and FP has been widely debated, with conflicting evidence on whether debt positively, negatively, or indirectly influences FP. The pioneer theory of CS irrelevance by Lane (2009) advocated no impact of debt on FP, but in 1970, scholarly engagement favored agency theory, which endorsed the negative relationship. However, scholars supported a positive connection between debt and FP and supported the trade-off theory of capital structure. Environmental infinitives need huge investments, which is why Manrique and Martí-Ballester (2017) endorsed debt levels as an influencing factor for such decisions. Normally, debt has been empirically tested in a direct relationship with FP. However, Ramli et al. (2019) supported the direct connection between Indonesian and Malaysian companies, where debt only mediates in Malaysian companies. The literature finds conflicting conclusions between debt and FP; Bae et al. (2019) supported negative and Arfazil et al. (2022) favored positive connection. Arfazil et al. (2022) empirically tested EP, FP, and debt within the institutional ownership framework and found a positive connection among all variables. A firm that has a higher degree of debt in its CS than equity is considered a thin-capitalized firm. As per the Austrian definition, more than 60% of debt is considered a thin-capitalized firm.

A firm's financial structure (equity and debt composition) plays a critical role in shaping its financial autonomy, risk exposure, and capacity to implement environmental initiatives. The flexibility of CS depends upon the FP of a firm, and good FP can increase effective decision-making regarding the long-term objective of a firm. Similarly, high-equity-backed firms enjoy more financial decision autonomy. On the contrary, thin-capitalized firms have to pay higher financial costs that may create bankruptcy, especially in the economic recession phase of the economy or crisis time like COVID. Furthermore, investors and lenders prefer high-equity firms as high equity shows higher owner stakes (Esposito et al., 2021), and they avoid thin-capitalized firms. High-equity-backed firms are considered financially autonomous, while thin-capitalized firms are considered compromised from the financial decision-making perspective. Hart (1995) revealed that autonomy in financial decision-making is crucial for adopting environmental initiatives like pollution mitigation, product stewardship, and sustainable development goals of the firm. Nishitani et al. (2017) provided unique empirical evidence regarding pollution mitigation and found that firms' CO_2 emissions contribute profitably through low production costs rather than higher sales. Similarly, Fernández-Cuesta et al. (2019) endorsed better EP via pollution reduction as a strategy for attaining affordable long-term loans. In a nutshell, thin-capitalized firms have a higher probability of bankruptcy, restricted financial autonomy, high financial burden, low reputation among shareholders, and costly financing. Conversely, high-equity-backed firms enjoy more financial autonomy, better reputation, and low financial cost. These factors may impact the FP of thin-capitalized firms and high-equity-backed firms differently, and the magnitude of debt in the CS may be a possible reason. Furthermore, the mixed findings regarding the relationship between debt and FP create a chance for moderating contingency. Furthermore, Zhang et al. (2020) endorsed that the omitted factors moderating the impact of the relationship between EP and FP can provide a consensus of a unanimous relationship. Therefore, we hypothesize.

H3: *Firms' TC negatively moderates the relationship between EP and FP.*

2.5. Mediating role of competitive advantage between EP and FP

A firm's ability to compete successfully is called firm competitiveness (Porter & Van Der Linde, 1995), while the literature associated other terms as superior performance than benchmark and above industry return. However, the latest approach focusses sustainability reporting as competitive advantage (Hassanein & Elmaghrabi, 2025).

Barney (1991) claims that resources are rare and valuable and, coupled with unique capabilities, provide the foundation of competitive advantage. A firm's competitive advantage is deeply rooted in RBV, which advocates for firm adaptability or resources with ordinary or dynamic capability for superior FP. RBV emphasizes the bundling of resources and the capability for strategies excellence for sustainable FP, especially in cut-throat competition and in a rapidly changing environment. Chikán et al. (2022) found that a firm's competitive advantage from dynamic capabilities (strategic aspect) is dominant, but ordinary capability (operational aspect), which is the basic building block of a firm, is under-researched. NRBV advocates product stewardship, pollution prevention, and sustainable development to secure a competitive advantage by considering a firm's relationship with the natural environment. These strategies provide a competitive advantage by reducing costs and integrating shareholders. Similarly, RBV asserts that effective environmental management directly drives higher productivity and cost-effectiveness, establishing a distinct competitive advantage for businesses (Barney, 1991). As a result, companies can expand confidently due to robust stakeholder support. Employees recognize the sustainability of the business model, customers willingly pay premium prices for green products, lending institutions offer capital at lower interest rates, and investors pursue opportunities even with lower returns. These dynamics not only reduce costs but also significantly enhance sales and create substantial opportunities for economies of scale, ultimately solidifying a firm's competitive edge in the marketplace.

The literature supports that better EP provides cost savings in terms of wastage, litigation costs, operational efficiency, new efficient technology (Dai et al., 2025a), and even premium prices. These factors improve the FP of firms and even provide financial resilience. So, product cost reduction is a new competitive advantage for the firms (Rezende et al., 2019). Furthermore, Feng et al. (2018) supported the notion that higher EP increases profitability, but research on EP-FP nexus is dominant in the direct relationship. Only a few studies used some mediating channels between EP and FP (Aigbedo, 2021). On theoretical grounds, the Resource-Based View endorses that EP reduces explicit and implicit costs and provides a sound foundation for financial gains that could be a sustainable competitive advantage. Furthermore, the view claims that resource bundling in a unique way provides a competitive advantage that can be translated into financial gain. Additionally, NRBV claims that the firm's close connection to the natural environment is the genuine root of competitive advantage. Therefore, it is expected that the cost-competitive advantage resulting from better FP may enhance FP. Benameur et al. (2024) provide a comprehensive overview of sustainability reporting scholarship and highlight several structural and thematic gaps that require further investigation. Building on these gaps, exploring mediating factors offers a strong theoretical contribution, particularly within the BRICS context. However, Abdelbaky et al. (2025) examined the role of innovation as a mediating factor in the relationship between ESG performance and firm finical outcomes. The preceding discussion highlights the critical gap in understanding competitive advantage concerning the relationship between environmental and financial performance, especially when viewed through the lens of cost reduction. Consequently, we propose the following hypothesis:

H4: *FCA mediates the effect of EP and FP.*

2.6. Mediating role of firm market reputation between EP and FP

A firm's reputation, shaped by environmental initiatives and ESG practices, plays a pivotal role in influencing investor perceptions and corporate image. The favorable public perception of a firm is its reputation, assessed in various ways in the research literature. Indicators such as stock prices, dividends, market share, and employee turnover can yield short-term effects, while the firm's capitalization, indicative of its marketability and investor trust, has long-term implications. Baah et al. (2021) asserted a correlation between firms' environmental initiatives, reputation, and FP. Similarly, Martínez and Rodríguez del Bosque (2014) contends that firms' environmental efforts contribute to a positive corporate image and reputation, with EP serving as a good strategy and tool for fostering favorable impressions among investors and lenders. These assertions are grounded in the comprehensive theoretical framework of RBV, which posits that environmental initiatives reinforce the dynamic capability of a firm, which enhances reputation (Aslam et al., 2021). Moreover, environmental initiatives shape investors' preferences and open pathways for future opportunities (Rehman et al., 2020). ESG actions also enhance stock liquidity, offering greater benefits to investors (Hassanein & Elsayed, 2025), while governance mechanisms such as sustainability committees strengthen ESG transparency, which can ultimately translate into financial gains (Tahat & Hassanein, 2024). Conversely, Tucker and Melewar (2005) found that a firm's reputation serves as an asset and a catalyst for corporate image and customer loyalty (De Leaniz & Del Bosque Rodríguez, 2016), leading to reduced equity costs (Mardiana, 2021) and consequently economically incentivizing firms that enhance FP.

In our literature review, we encountered only a few studies that used firm reputation as a mediating factor, but these are country-specific and ignore the wider net of the multi-country sample (Cantele & Zardini, 2018; Rehman

et al., 2020). From the social impact perspective, Rehman et al. (2020) explored how firm reputation acts as a mediator in the relationship between CSR, firm performance, and CSR-related risks. It is noteworthy that (Rehman et al., 2020) examined CSR more broadly, encompassing EP among its components. In contrast, our study aims to delve into the specific mediating role of a firm's market reputation between EP and FP rather than the broader concept of CSR and FP. However, within the literature on EP, the predominant focus has been on the direct relationship between EP and FP Miroshnychenko et al. (2022), with limited exploration into the mediating roles of various factors (Aigbedo, 2021). We propose a hypothesis that EP indirectly influences firm FP through the pathway of firm reputation. We argue that a firm reputation serves as a magnet for investors and customers, facilitates access to low-cost debt and equity financing, fosters a positive perception among stakeholders, unlocks new market opportunities, and expands market share, thereby exerting a favorable impact on FP. The signaling theory describes reputation as a positive mediating agent between EP and FP. This view suggests that environmental initiatives act as a positive signal among stakeholders of society and uplift the firm's reputation. Resultantly, the organization's reputation can lead to higher sales and lower financing costs that positively impact the FP. A strong reputation enhances trust and investor confidence, which in turn strengthens the financial outcomes of the organization. Similarly, the Resource-Based View suggests that a strong reputation built on environmental initiatives is a valuable, inimitable resource that drives financial gains. These theoretical views suggest that EP has a positive impact on reputation that eventually translates into financial gains.

H5: *FMR mediates the relationship between EP and FP.*

3. Data and methodology

3.1. Data and sample

The data were gathered from BRICS countries for the study and consisted of energy and heavy industry sectors. Energy and heavy industries are prioritized by BRICS nations not simply because they emit more, but because they drive growth, create jobs, and power industrial progress. These sectors are the engines of national development, offering vast potential for innovation, cleaner technologies, and sustainable transformation The data includes firms from different countries of BRICS. We obtained data of 295 companies from 2015 to 2022 from the Asset4 Eikon database, data stream, and WDI. Additionally, we screened those data and winsorized the data to remove outliers at 1%. The sample contains 239 from the industrial sector 81% and 56 from the energy sector making 19%. Figure 1 demonstrates the multi-country sample bifurcation of BRICS from a country perspective as Brazil (70), Russia (22), India (33), China (154), and South Africa (16). Our sample includes various sectors and economies, resulting in differences in resource availability, impact severity, and cultural factors. Therefore, we applied several macro controlling factors in addition to the firm's controlling factors. The sample includes the energy and heavy industry sectors, which significantly impact the environment due to their high fuel and energy consumption, which affects firm EP. Zakharov et al. (2022) report that based on 2021 data, energy and heavy industries are the main polluting sectors, contributing 76% of global CO_2 emissions, totaling 37.2 Gt.

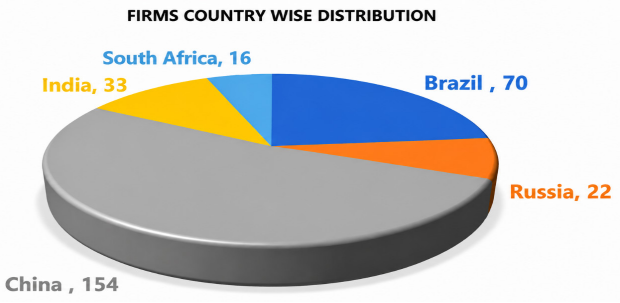


Figure 1. BRICS bifurcation

3.2. Model and methodology

We choose an explanatory research methodology and a deductive argument-building approach under positive philosophy, which makes the quantitative method the most suitable approach. To carry out the mediation analysis, Preacher and Hayes (2008) method is applied, as it is more appropriate than others due to the bootstrapping approach. The Generalized Method of Moments (GMM) is applied for testing direct and moderating relationships owing to diverse benefits and statistical soundness.

The literature states that unobserved factors are the root cause of endogeneity because unobserved productivity, environmental initiatives, and marginal benefits are correlated (Abban & Hasan, 2021). As FP rises, organizations can invest more in effective environmental strategies and eco-friendly technologies, potentially introducing endogeneity. In such cases, GMM may be more appropriate. Additionally, FP is likely to show a lagged relationship, which dynamic system GMM can address effectively. Furthermore, few studies found reverse causality between EP and FP (Abban & Hasan, 2021). Zheng and He (2022) identified three reasons that may create an endogeneity issue: (1) unobserved heterogeneity, (2) simultaneity, and (3) dynamism. Unobserved heterogeneity refers to the dependent variable depending on some omitted variables that correlate with the independent variable. In this study, we used Lagged differences of Y as internal instruments whereas average variable age, leverage, and size as external instruments as per the approach of Zheng and He (2022). Simultaneity refers to X variable impacting Y, and resultantly, Y impacts X. Similarly, Dynamism refers to a dynamic relation of Y with its lag of Y variable affected by previous value [for details of GMM suitability in EP-FP nexus, please read (Zheng & He, 2022). Ordinary Least Squares (OLS) can lead to misleading findings and biased

estimations, reducing the likelihood of achieving the BLUE property. In contrast, the Generalized Method of Moments (GMM) effectively addresses challenges like heterogeneity and endogeneity, making it a superior choice for accurate analysis (Table 1) (Ullah et al., 2021).

This study applied xtabond2 in Stata for dynamic GMM estimation within a linearity setting and is suitable for large N (entities) and small T (time). It is flexible, robust, and efficient for estimating dynamic panel models with potential endogeneity, making it a standard choice for EP-FP studies. Furthermore, we applied the Windmeijer (2005) correction, which adjusts the two-step standard errors to make them robust and unbiased, especially in small samples, and efficiently deals with downward-biased standard errors. We added the robust option in the Stata command for GMM estimation to obtain standard errors for each equation or model of analysis. Moreover, we addressed heteroskedasticity and clustered at the firm level by adding year, country, and industry dummies in all dynamic GMM estimations.

Recent academic discussions have shown that there is a non-linear relationship between EP-FP, as endorsed by studies conducted by Trumpp and Guenther (2017), Chen et al. (2016), and Ben Lahouel et al. (2022). These studies object to the linear association between EP and FP. Hence, we critically evaluated the linearity assumption even at the model level. Table A1 reveals that quadratic and level-term have the same relationship, indicating a linear association. We also conducted an LR check test, and non-significant values in Table A2 support the suitability of a linear dynamic GMM application. Moreover, the graphical representation shows a positive linear trend between EPSC and MTBV and a negative linear trend between LCO2S1 and MTBV.

4. Results and discussion

Table 2 presents a descriptive analysis of data that comprises 2196 firm-year observations of the BRICS region. To address the issue of outliers and extreme values that may potentially impact the average relationship, we winsorized the data at 1%, which had significant variation and outliers while winsorizing at 1% minimizes the impact of rare outliers while preserving valid extremes, ensuring data integrity and statistical power. We have used the measures of FP, FMR, FCA, LEVG, INFL, and LRT while applying log transformation on LCO2S1 and LTA. However, EPSC and GDP_G are taken in raw format as the data for these vari-

Table 1. Variables description and operationalization

Variable	Operationalization	Researchers
Environmental Performance (EP)	Environmental Pillar Score (EPSC) is the proxy of Environmental Performance in this study. EPSC is measured by environmental pillar score based on 62 questions, which is derived from emission reduction, resource reduction, and product innovation. Higher score means more EP, and it ranges from 0 to 100. For detail of EPSC read the following document[2] LCO2S1 is firm direct carbon emission in metric tons and converted in log format. It is an alternative proxy and applied for robustness purposes as well.	Benkraiem et al. (2023)
Financial Performance (FP)	Market perspective: Tobin q is measured by MTBV (Market Value Equity/Book Value Equity). Accounting perspective: ROA (Net Income/Total income), ROE (Net Income/ Shareholder Equity), ROCE (EBIT/Shareholder Equity + Total Bebt), BVPS [(Shareholder Equity–Preferred Stock)/Outstanding Common Shares].	Hasan et al. (2022)
Firm Market Reputation (FMR)	Excess Capitalization = Firm Market Value-Firm Book Value; the higher value indicates more firm market reputation.	Arora et al. (2021)
Firm Competitive Advantage (FCA)	Costs of Goods Sold/Sales, A lower value indicates better profitability, gross profit margin, and competitiveness.	Lu et al. (2021)
Thin Capitalization (TC)	Dummy variable assigned 1 if firm long-term debt >60%; otherwise, zero.	Long et al. (2023)
Voluntary Environmental Regulation Adoption (VERA)	Dummy variable assigned 1 if firm adopted ISO14001 or EMAS certification; otherwise, zero.	Johnstone and Hallberg (2020)
Firm Age (FA)	Years (number of year incorporation).	Zheng and He (2022)
Firm Size (LTA)	Log of Total Assets.	Long et al. (2023)
Leverage (LEVG)	Debt to Equity Ratio.	Nguyen et al. (2021)
GDP Growth (GDP_G)	GDP growth is measured by PPP (%) method.	Ayayi and Wijesiri (2022)
Inflation (INFL)	Annual % measured by GDP deflator method.	Ayayi and Wijesiri (2022)
Lending rate (LRT)	Annual % for short-term and medium-term loans.	

[2] https://onlinelibrary.wiley.com/doi/full/10.1002/csr.2326

ables are normally distributed, and TC and VERA are in dummy format.

Table 2. Descriptive statistics complete sample

Variable	Obs	Mean	Std. Dev.	Min	Max
MTBV	2196	2.636	2.584	−0.76	13.81
ROA	2196	5.237	5.759	−15.13	23.91
ROE	2196	8.963	16.249	−80.56	54.77
EPSC	2196	38.524	25.738	0	97.38
LCO2S1	788	11.97	3.284	3.755	21.788
FMR	2196	2.213	3.707	−2.6	13
FCA	2196	69.692	20.347	55.8	108.91
FA	2196	27.948	17.963	0	110
LTA	2196	15.307	1.585	8.679	19.925
LEVG	2196	36.902	26.104	0	145.35
GDP_G	2196	4.374	3.37	−9.5	9.05
INFL	2196	3.049	2.553	−1.282	11.384
LRT	2196	7.58	8.728	2.802	46.917
VERA	2196	0.429	0.495	0	1
TC	2196	0.302	0.459	0	1

The average value of MTBV is 2.636, while the lowest value is 0.76 and the highest is 13.81 (Delta Electronics, China). Similarly, the EPSC average value is 38.524, while the highest is 97.38 (Longi Green Energy, China). In-depth descriptive analysis shows that, on average, companies with ISO certification show 0.98 more MTBV than those with no certification. It is noted that companies with more than 60% debt in capital structure show an average 0.16-point low EPSC. Similarly, the average value pollution of VERA firms (ISO-certified) firms is lower than that of counterpart firms. It means ISO certification is a catalyst while TC is a hurdle in securing better EP scores. Table 2 shows that the direct CO_2 emission data are not available for all the firms for all years, but EPSC data are the maximum available. That is why EPSC is our main variable of interest, while pollution variables are used for robustness. Similarly, other proxies of FP for accounting purposes are ROA, ROE, ROCE, and BVPS winsorized and used for the robustness of H1 testing. The average value of FMR measured by excess capitalization is USD 2.21 million, while the lowest value is 0.26 million and the highest is USD 13.00 million. One average leverage ratio is 36.902%, while the highest is 145.35%, with huge variation in the sample (26.104). The average value of competitive advantage measured by the cost of goods sold by its sales is USD 69.92 million, while the lowest value is 55.8 million, and the highest ratio is 108.91.

From the control variable perspective, descriptive analysis shows that the oldest company in our analysis is Reunert Limited from South Africa, which is more than 110 years old. The average size of companies is 15.307 years with low dispersion (1.585), while the biggest company is Gazprom Pao, which has a log of total assets as 19.925 (USD 450,000,000). On average, the leverage ratio is 36.902%, while the highest is 145.35%, with huge variation in the sample (26.104). The average value of GDP_G is 4.37, while the highest is 9.05 in China and the lowest is −9.5 in South Africa. The average inflation rate is 3.049, the lowest found in China (−1.282), while the highest was 11.384 in Russia. Low lending rates show the ease of doing business with low external costs, while high lending rates show difficulty in getting affordable financing. The lowest lending rate is 2.8 in China, while the highest is 46.9 in Brazil.

We find EPSC, GDP_G, FMR, and VERA positively related to FP (MTBV). FMR reveals a high correlation of 0.442*. The results show that EPSC has a positive association with MTBV, and its coefficient is 0.051*, thus supporting H1, though the relationship is weak. Similarly, VERA shows a positive significant connection with MTBV (0.091*), which endorses that the firms that have adopted ISO or EMAS certification voluntarily can increase their FP. It is logical that excess capitalization is rooted in capitalization as a firm's capitalization increases, resulting in positive excess, thus endorsing firm reputation increase FP. However, in the matrix, the highest correlation is found between LTA and LCO2S1 as 0.516*. It is justified that as firm size increases, its direct CO_2 emission rises due to the huge use of energy, resources, and production. We find that FA, LTA, FCA, LEVG, TC, and INFL are negatively related to FP (MTBV). We find the negative relationship between the firm's costs and MTBV as −0.111*, which reveals that cost reduction is a competitive advantage to the firms. Table 2 shows that the FP measured by EPSC is positive, and LCO2S1 measured direct pollution, which is negatively related to FP measured by Tobin q, thus endorsing the H1. All variables are significantly related to FP except INFL. As Table 3 shows, all correlation coefficients are below 0.6, indicating a low likelihood of multicollinearity. We also applied a sophisticated test for testing multicollinearity after performing regression, and the results show that the VIF of each variable is less than 3, which indicates no issue of multi in the data (Table A3).

Table 4 reveals the result of the mediation of FMR between EP and FP. Here, EP was measured by EPSC, FP was measured through MTBV, and FCA was quantified through the cost of goods to sales ratio. The following equation is used as:

$$MTBV_{i,t} = \alpha 0 + c \times EPSC_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon; \quad (1)$$

$$MTBV_{i,t} = \alpha 0 + c' \times EPSC_{i,t} + b \times FCA_{i,t} + \Sigma di \times Control_{i,t} + \varepsilon; (2)$$

$$FCA_{i,t} = \alpha 0 + a \times EPSC_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon. \quad (3)$$

We find that EPSC has a positive relation with MTBV as the coefficient shows 0.012*** while the explanatory power of the model is 14.7%. It reveals that EP is statistically significant with FP. Furthermore, EPSC and are positively related to MTBV at 0.011** and −0.008**, respectively. The negative sign of FCA is justified as higher direct or indirect costs reduce the competitiveness of a firm. It can be interpreted that the reduction in cost is a competitive advantage. The result of Table 4 shows EP and FCA positively contribute to FP, and the explanatory power of the model

Table 3. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) MTBV	1.000													
(2) ROA	0.299*	1.000												
(3) ROE	0.169*	0.818*	1.000											
(4) EPSC	0.051*	0.039	0.002	1.000										
(5) LCO2S1	−0.308*	−0.080*	−0.061	−0.089*	1.000									
(6) FMR	0.442*	0.212*	0.190*	0.063*	−0.020	1.000								
(7) FCA	−0.111*	−0.386*	−0.285*	0.032	−0.006	−0.054*	1.000							
(8) FA	−0.099*	−0.050*	−0.057*	−0.240*	−0.007	−0.087*	0.166*	1.000						
(9) LTA	−0.345*	−0.174*	−0.021	−0.312*	0.516*	0.122*	0.054*	−0.033	1.000					
(10) LEVG	−0.152*	−0.375*	−0.279*	−0.091*	0.147*	−0.010	0.125*	−0.021	0.288*	1.000				
(11) GDP_G	0.161*	0.089*	0.118*	0.161*	0.039	0.148*	−0.015	−0.218*	0.026	−0.084*	1.000			
(12) INFL	−0.034	0.123*	0.094*	−0.128*	0.072*	0.023	−0.170*	0.155*	0.021	0.043*	−0.001	1.000		
(13) VERA	0.091*	−0.031	−0.038	−0.434*	0.022	0.044*	0.020	0.266*	0.208*	0.056*	−0.238*	0.081*	1.000	
(14) TC	−0.079*	−0.264*	−0.190*	−0.035	0.119*	−0.012	0.112*	−0.005	0.238*	0.772*	−0.041*	0.036	−0.003	1.000

Note: * $p < 0.1$.

Table 4. Mediation results of FCA

	FCA Model		
	MTBV	MTBV	FCA
EPSC	0.012 *** (0.002)	0.011 ** (0.002)	−0.065 *** (0.014)
FA	−0.014 *** (0.003)	0.012 *** (0.002)	0.269 *** (0.011)
LTA	−0.568 *** (0.178)	0.566 *** (0.029)	0.321 * (0.163)
LEVG	−0.006 * (0.031)	0.004 * (0.002)	0.028 ** (0.178)
GDP_G	0.129 ** (0.043)	0.131 ** (0.041)	0.107 (0.284)
INFL	−0.037 (0.021)	−0.047 * (0.021)	−1.263 *** (0.283)
LRT	0.021 ** (0.11)	1.017 * (0.007)	−0.246 *** (0.049)
FCA		−0.008 ** (0.002)	
_cons	Yes	Yes	Yes
Obs.	2176	2176	2176
R-square	0.147	0.151	0.151
Sobel			0.000 ***
Aroian			0.000 ***
Goodman			0.000 ***
TME			0.053
IDE			0.045
TDE			1.045
Bootstrapping–IE			0.005 ***
Bootstrapping–DE			0.011 ***
Bootstrapping–TE			0.012 ***

Notes: TME (Total Mediated Effects); IDE (Indirect to Direct Effect); TDE (Total to Direct Effect); Bootstrapping-IE (Indirect Effect); Bootstrapping-DE (Direct Effect); Bootstrapping-TE (Total Effect). ( ) shows standard errors while *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

moves from 14.7 to 15.1%. It increases the authenticity of the model and inclusion variable (mediator). In the third step of mediation analysis (Eq. (2)), we find that EPSC has a statistically negative connection with FCA (−0.065***), which reveals that higher EP reduces costs. Additionally, we added control variables in the regression at two stages; firm-level control variables are FA, LTA, and LEVG, while macro-level control variables are GDP_G, INFL, and LRT in all equations. Furthermore, as coefficients a, b, and c are all significant, they provide the justification of the mediation hypothesis derived from Eqs. (1)–(3) and confirm that FAC mediates the link between EP-FP.

We find EPSC remains statistically significant in all equations. So, the mediating variable FCA positively impacts MTBV ($\beta = -0.008$, $p < 0.05$). Goodman, Aroian, and Sobel test validate the concreteness of the mediator variable as the significance of all these tests advocates that FCA is the valid mediator between EPSC and MTBV. The results indicate that the 5.3% effect of EP on FP is because of indirect effects, while the ratio of direct to indirect is 4.5. Bootstrapping results reveal that total effect, indirect, and direct effect are significant with minor standard error correction. The findings strongly support H4, showing that enhanced EP yields a cost-effective FCA by optimizing resource utilization and minimizing environmental compliance costs. Thus, by adopting effective environmental management strategies, organizations can achieve improved EP, which will ultimately enhance FP, either directly or indirectly. Moreover, this study robustly validates the mediating role of firm competitive advantage, affirming that our mediation hypothesis holds true.

Table 5 reveals the result of the mediation of FMR between EP and FP. Here, EP was measured by EPSC, FP was measured through MTBV, and FMR was quantified through excess market capitalization. The following equation was used as:

$$MTBV_{i,t} = \alpha 0 + c \times EPSC_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon; \quad (4)$$

$$MTBV_{i,t} = \alpha 0 + c' \times EPSC_{i,t} + b \times FMR_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon; \quad (5)$$

$$FMR_{i,t} = \alpha 0 + a \times EPSC_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon. \quad (6)$$

We find that EPSC has a positive relation with MTBV as the coefficient shows 0.011*** while the explanatory power of the model is 14.7%. It reveals that EP is statistically significant to FP. Furthermore, EPSC and FMR are positively related to MTBV at 0.007** and 0.331***, respectively. This result shows EPSC and FMR positively contribute to FP, and the explanatory power of the model moves from 14.7 to 38.1%, increasing the authenticity of the model and inclusion variable (mediator). In the third step of mediation analysis (Eq. (5)), we find that EPSC has a statistically positive connection with FMR (0.012**), which indicates that EP enhances FMR. Additionally, we added control variables in the regression at two stages: 1) firm-level control variables are FA, LTA, and LEVG, while 2) macro-level control variables are GDP_G, INFL, and LRT in all equations. Furthermore, Eqs. (4)–(6) together verify that the mediation hypothesis coefficients a, b, and c are all significant, indicating that FMR mediates the relationship between EP and FP.

Table 5. Mediation results of FMR

	FMR Model		
	MTBV	MTBV	FMR
EPSC	0.011 *** (0.002)	0.007 ** (0.001)	0.012 ** (0.005)
FA	−0.014 *** (0.003)	−0.009 *** (0.001)	−0.0151 *** (0.004)
LTA	−0.568 *** (0.029)	0.637 *** (0.031)	0.212 (0.124)
LEVG	−0.005 * (0.002)	−0.002 (0.002)	0.008 *** (0.002)
GDP_G	0.128 ** (0.043)	0.575 ** (0.017)	0.213 ** (0.089)
INFL	- 0.031 (0.018)	−0.009 (0.145)	−0.661 (0.041)
LRT	0.018 ** (0.007)	0.002 (0.005)	0.481 ** (0.014)
FMR		0.331 *** (0.027)	
_cons	Yes	Yes	Yes
Obs.	2176	2176	2176
R-square	0.147	0.381	0.154
Sobel			0.002 ***
Aroian			0.002 ***
Goodman			0.002 ***
TME			0.369
IDE			0.584
TDE			1.584
Boot-strapping-IE			0.004 ***
Boot-strapping-DE			0.007 ***
Boot-strapping-TE			0.11 ***

Notes: TME (Total Mediated Effects); IDE (Indirect to Direct Effect); TDE (Total to Direct Effect); Bootstrapping-IE (Indirect Effect); Bootstrapping-DE (Direct Effect); Bootstrapping-TE (Total Effect); ( ) are standard errors; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

We find EPSC remains statistically significant in all equations. So, the mediating variable FMR positively impacts MTBV ($\beta = 0.331$, $p < 0.01$). Goodman, Aroian, and Sobel test validate the concreteness of the mediator variable as the significance of all these tests advocates that FMR is the valid mediator between EP and FP. The results indicate that 36.9 % of the effect of EP on FP is because of indirect effects, while the ratio of direct to indirect is 58.4. Bootstrapping results reveal that total effect, indirect, and direct effect are significant with minor standard error correction. Our results support the mediation hypothesis about Firm Reputation (FMR), which is supported by RBV, which suggests that FMR is an intangible asset and can be considered a dynamic capability. Additionally, Ayayi and Wijesiri (2022) supported the idea that environmental policies can impact investor preferences, while Rehman et al. (2020) suggested that adopting a good environmental approach can lead to future economic gains for a firm (Ayayi, & Wijesiri, 2022).

We used two-step GMM system regression to tackle endogeneity and reverse causality (Aslam et al., 2021). The significance of AR (1) and the insignificance of AR (2) confirm the appropriateness of system GMM. Similarly, the instruments < groups reveal model authenticity. Furthermore, the p value of the Hensen test > 5% justifies all models in Table 6 as being statistically valid. Furthermore, we added country, industry, and year dummies to all GMM estimations. The result from Columns (1) to (5) shows that FP is positively impacted by its previous values as L.MTBV is statistically significant, so dynamic GMM is justified (0.725***, 0.467***, 0.709***, 0.386***, 0.361r ***). These results show that the previous year's FP is positively related to the recent year's FP and justifies the application of dynamic GMM. In Column (1), EPSC positively impacts MTBV ($\beta = 0.013$***), which provides the foundation for accepting H1 that reveals EP contributes to FP positively. Similarly, in Column (2), we added LCO2S1 in the previous model and found it is statistically significant with MTBV ($\beta = -0.079$**).

One of the key issues arises when we use FMR proxy of market reputation (excess capitalization) as a mediating factor between EPSC and MTBV. In this paper, we adopt excess capitalization which is calculated as market value minus book value (Arora et al., 2021). On the other hand, the proxy of FP is measured as market value divided by book value. It is evident that both measures incorporate market value and book value, so they share an inherent relationship despite their different calculation methods. This overlap may lead to a mechanical correlation that could artificially inflate the mediation results. To address this issue, we conducted a robustness check by substituting ROA as the measure of financial performance instead of MTBV. Our main findings are based on FP measured by

MTBV, while ROA is used solely for robustness purposes. The equations for the robustness mediation are presented as follows:

$$ROA_{i,t} = \alpha 0 + c \times EPSC_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon; \quad (4.1)$$

$$ROA_{i,t} = \alpha 0 + c' \times EPSC_{i,t} + b \times FMR_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon; \quad (5.1)$$

$$FMR_{i,t} = \alpha 0 + a \times EPSC_{i,t} + \Sigma d_i \times Control_{i,t} + \varepsilon. \quad (6.1)$$

Table A4 (Appendix) reveals EPSC remains statistically significant in all robust Eqs. (4.1)–(5.1). So, the mediating variable FMR positively impacts ROA ($\beta = 0.117$, $p < 0.01$). Goodman, Aroian, and Sobel test validate the mediation path and advocates that FMR is the valid mediator between EP and FP (when measured by ROA also). The results indicate that 21.3 % of the effect of EP on FP is because of indirect effects, while the ratio of direct to indirect is 36.1. Bootstrapping results reveal that total effect, indirect, and direct effect are significant with minor standard error correction. Our results support the mediation hypothesis about firm reputation (FMR), which is supported by RBV.

Table 6. Main model results in dynamic GMM

	(1)	(2)	(3)	(4)	(5)
	MTBV	MTBV	MTBV	MTBV	MTBV
L.MTBV	0.725** (0.029)	0.467** (0.081)	0.709** (0.034)	0.386** (0.086)	0.361** (0.093)
EPSC	0.013** (0.004)	0.098 (0.016)	0.014** (0.004)	0.017** (0.008)	0.019** (0.008)
LCO2S1		−0.079** (0.014)			
FA	−0.003 (0.003)	−0.009* (0.004)	0.003 (0.005)	−0.006 (0.004)	0.001 (0.011)
LTA	−0.108* (0.055)	−0.558** (0.267)	−0.116* (0.059)	−0.358** (0.129)	−0.361** (0.143)
LEVG	−0.018** (0.006)	−0.181 (0.012)	−0.019** (0.006)	−0.019* (0.016)	−0.022 (0.018)
GDP_G	0.086 (0.033)	0.175** (0.067)	0.065* (0.037)	0.087* (0.055)	0.064 (0.063)
INFL	−0.031* (0.041)	−0.195* (0.107)	−0.059* (0.041)	−0.078 (0.076)	−0.132* (0.89)
LRT	0.028 (0.019)	0.096** (0.039)	0.006 (0.021)	0.038 (0.038)	0.011 (0.046)
FCA			−0.032* (0.21)		−0.046* (0.031)
FMR				0.001** (0.000)	0.001** (0.00)
F-TEST	320.50	45.82**	234.05	104.43**	75.85**
Observation	1967	730	1966	1966	1967
Intercept	YES	YES	YES	YES	YES
Year, industry, country Dummy	YES	YES	YES	YES	YES
Instruments	45	31	45	31	47
AR1	0.00	0.00	0.00	0.00	0.00
AR2	0.31	0.12	0.34	0.21	0.22
Hensen Test	0.07	0.51	0.11	0.08	0.095
Groups	295	176	295	295	295

Notes: ( ) shows standard errors from Windmeijer approach while ** $p <$ 0.05, * $p < 0.1$. We added Year, Industry, Country in each model.

The negative relation is required as a reduction in CO_2 is considered better EP, thus endorsing the H1. Reduction in CO_2 emissions can significantly enhance FP. Thus, we affirm our hypothesis that EP directly impacts FP and conclude that inadequate EP hinders FP. This finding reinforces NRBV, which asserts that effective pollution prevention not only boosts FP but also highlights that a firm's competitiveness is closely tied to its relationship with the natural environment. So, H1 is supported in all models with varying relationship intensity (Table 6, $\beta = 0.014$***, $\beta = 0.017$**, $\beta = 0.019$**). Additionally, we added FCA and FMR in the previous models in Columns (3–5) to test their direct relationship with MTBV. We find that FCA in Columns (3) and (5) is statically significant with FP ($\beta = -0.032$*, $\beta = -0.046$*). The negative sign can be interpreted as that the reduction in costs improve MTBV (FP). Similarly, FMR has a statistically significant relationship with MTBV ($\beta = 0.001$***, $\beta = 0.001$***), which shows that firm reputation increases FP.

In the context of the controlling factors at the firm level, we find FA, LTA, and LEVG are negatively related to FP measured by MTBV, where only firm FA has an insignificant relationship. In simple words, firm age, size, and debt negatively impact FP. On the macro level, GDP_G and LRT are positively associated, while INFL is negatively related to MTBV. However, we find that the controlling factors do not demonstrate statistical significance in all models, but their nature or relationship is theoretically justified except for the lending rate.

Table 7 tests the relationship between EP and FP. However, FP has been measured from the accounting perspective. We used the four proxies of FP from the accounting domain, i.e., Return on Assets (ROA), Return on Equity (ROE), Return on Capital Employed (ROCE), and Book Value per Share (BVPS). The results show that dynamic system GMM is the most appropriate technique, and its post estimations are valid (1) instrument < groups, (2) AR (2) is insignificant, (3) the Hensen test is insignificant, and (4) F test is significant.

The result from Columns (1)–(4) shows that each accounting proxy of FP is positively impacted by its previous values as L. MTBV is statistically significant, so dynamic GMM is justified (0.544***, 0.467***, 0.293***, 1.048***, 0.483***). In Column (1) to Column (4), EPSC positively impacts each proxy of accounting FP (βROA = 0.039**; βROE = 0.075*; βBVPS = 0.028***; βROCE = 0.024*), which provides the foundation for accepting H1 that reveals EP contribute to FP positively. Though the magnitude of the relation varies across the choice of the accounting proxy, we find a consensus of H1 acceptance at a 10% significance level. The highest coefficient was found in ROE (0.075*), while the lowest coefficient was observed in ROCE (0.024*).

In the context of the controlling factors, the result deviates from Table 6. Firm FA, LTA, and LEVG all have negatively and statistically significant relationships

with FP measured from accounting perspectives. Firm age is negative across the model (−0.020**, −0.051*, −0.021***, −0.025**); firm size is negatively related to FP (βLTA = −0.258**, −0.461***, −0.189**, −0.307**); firm debt reduces FP (βLEVG = −0.038***, −0.464**, −0.004**, −0.061**). Similar behavior is revealed by macro controlling factors, where GDP_G, INFL, and LRT have a statistically significant relationship to FP. From the macro perspective, GDP growth has a more profound impact on FP than inflation and lending rate. However, we found an anomaly in the lending rate that positively impacts FP, which needed future scrutiny.

In the context of post estimation of GMM, the AR (1) test reveals first-order serial correlation, and a p-value < 0.05 means AR (1) exists and dynamic GMM is appropriate. GMM endorses that the AR (2) test must yield a p-value greater than 0.05, which supports the absence of second-order serial correlation and validates the dynamic specification. The Hansen test of overidentifying restrictions tests the overall validity of the instruments, that is, whether they are jointly exogenous. The null hypothesis (H_0) assumes instruments are valid. Therefore, a p-value of the Hansen test > 0.05 indicates that the instruments are valid and uncorrelated with the error term. In System GMM, the number of instruments should be less than the number of cross-sectional groups to ensure reliable and valid estimates. All the tables show that groups are more than instruments, so System GMM is valid in this case. Oure results show that AR 2serial correlation at order two is absent, instruments are appropriate and do not introduce bias into the estimation.

Table 7. Robustness of FP from accounting proxies in dynamic GMM

	(1)	(2)	(3)	(4)
	ROA	ROE	BVPS	ROCE
L.ROA/ ROE/BVPS/ WROCE	0.544 *** (0.045)	0.293 *** (0.014)	1.048 *** (0.012)	0.483 *** (0.036)
EPSC	0.039 *** (0.011)	0.075 * (0.041)	0.028 *** (0.006)	0.024 * (0.015)
FA	−0.020 *** (0.008)	−0.051 * (0.030)	−0.021 *** (0.004)	−0.025 *** (0.010)
LTA	−0.258 *** (0.109)	−0.461 *** (0.506)	−0.189 *** (0.072)	−0.307 *** (0.147)
LEVG	−0.038 *** (0.006)	−0.464 *** (0.076)	−0.004 *** (0.001)	−0.061 *** (0.009)
GDP_G	0.125 *** (0.061)	0.959 *** (0.362)	0.167 *** (0.045)	0.129 * (0.077)
INFL	0.174 *** (0.071)	−0.594 (0.467)	0.078 *** (0.029)	0.447 *** (0.104)
LRT	0.049 *** (0.022)	0.0754 (0.236)	0.017 *** (0.008)	0.035 (0.026)
F-TEST	189.08 ***	62.68 ***	234.05	230.06 ***
Observation	1965	1912	1960	1940
Intercept	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Industry and Country Dummy	YES	YES	YES	YES
Instruments	38	45	31	47
AR1	0.00	0.01	0.02	0.00
AR2	0.83	0.42	0.88	0.65
Hensen Test	0.06	0.13	0.28	0.22
Groups	295	293	295	295

Notes: ( ) shows standard errors from Windmeijer approach while ** p < 0.05, * p < 0.1. We added Year, Industry, Country in each model.

This study assumes the thin capitalization or excessive debt as a moderating variable between EP and FP. To test this hypothesis, we added a dummy variable of TC in Columns (1), (2), and (3) of Table 7. We find the MTBV lag is positively related, which means previous FP influences current FP (0.596***, 0.561***, 0.268**). The relationship of TC is negative and significant with MTBV that firms having high debt in the capital structure perform financially lower than counterparts, though its magnitude is diverse (−0.777*, −0.894**, −0.804**). In Column (2), we added an interaction term of TC and EPSC, which shows the negative impact of TC (−0.864**) and the interaction term (−0.139***) on MTBV. The interaction term reveals that if a firm has a higher debt proportion in capital structure, its EP may decrease by 0.864% at each score of EPSC. Similarly, in Column (3), all variables are identical except for the addition of two mediator variables in the model for the robustness of the moderating hypothesis. The interaction term is also significant in Column (3) with a coefficient of −0.055*. The result of interaction terms endorses hypothesis H3 that thin capitalization has a negative moderating impact on FP, as measured by Tobin q. Out results endorse the agency theory that favors the negative relationship between debt and FP of firms because of agency problems or conflicts between principals and agents.

The result of firm-level control demonstrates that firm FA, LTA, and LEVG are negatively and statistically related to FP. Similarly, INFL is negative while GDP_G and LRT are positively related to FP but have a statistically insignificant relationship with FP with exceptions. The post estimations of Table 8 are valid for the application

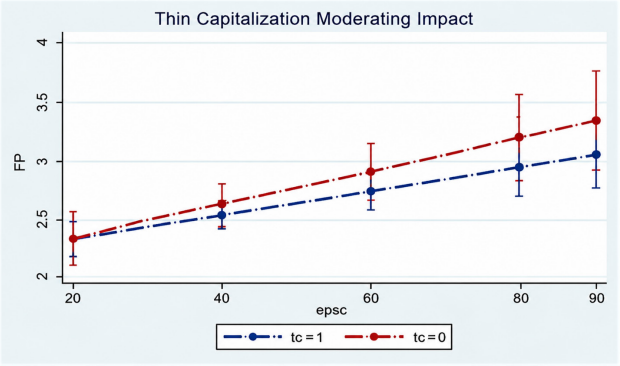


Figure 2. TC moderation impact

of GMM in the study (1) instrument < groups, (2) AR (2) is insignificant so no serial correlation at order 2, (3) the Hensen test is insignificant, so instruments are appropriate and do not create bias into the estimation, and (4) F test is significant.

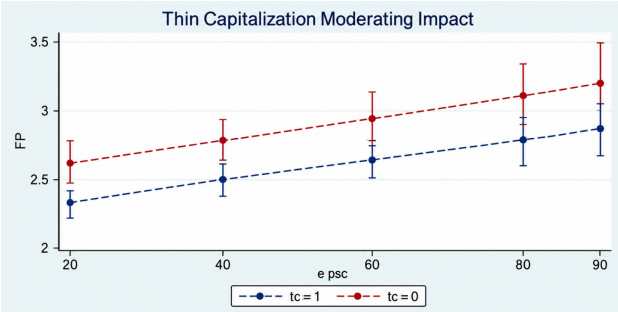


Figure 3. TC moderation impact (WM)

Table 8. Moderation of TC

	(1)	(2)	(3)
	MTBV	MTBV	MTBV
L.MTBV	0.596*** (0.065)	0.561*** (0.086)	0.268*** (0.075)
EPSC	0.015** (0.006)	0.085*** (0.017)	0.041** (0.018)
FA	−0.004 (0.004)	−0.017*** (0.006)	0.003 (0.008)
LTA	−0.053* (0.101)	−0.354** (0.169)	−0.116* (0.059)
LEVG	−0.017 (0.017)	−0.096** (0.041)	−0.026 (0.019)
GDP_G	0.110*** (0.031)	0.171*** (0.042)	0.071* (0.044)
INFL	−0.029 (0.021)	−0.047 (0.044)	−0.122* (0.071)
LRT	0.038** (0.015)	0.054** (0.022)	−0.003 (0.011)
TC	−0.777* (0.998)	−0.864*** (0.51)	−0.804** (0.648)
TCM		−0.139*** (0.41)	−0.071** (0.41)
FCA			−0.055* (0.030)
FMR			0.331*** (0.071)
F–TEST	94.70***	50.64***	73.07***
Observation	1967	1967	1966
Intercept	YES	YES	YES
Year, Industry, Country Dummy	YES	YES	YES
Instruments	34	32	41
AR1	0.01	0.00	0.02
AR2	0.24	0.14	0.17
Hensen Test	0.06	0.19	0.31

Notes: ( ) shows standard errors while *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. We added Year, Industry, Country in each model.

Derivative graphs show that TC firms' relationship is not the same as the slopes are different, so the moderating role is justified. The result of derivative mapping demonstrated by Figure 2 shows that TC firms are low at every EPSC worth the presence of mediating factors in the model. Figure 3 is derivative mapping in the presence of mediating factors and clearly shows the different slopes of TC firms and high-equity-based firms.

This study assumes the voluntary adoption of ISO as a moderating variable between EP and FP. To test this hypothesis, we added a dummy variable of ISO certification in Columns (1)–(3) of Table 8. We find the lag of MTBV is positively related, which means previous FP influences current FP. The relationship of VERA adoption is positive and highly significant with MTBV, which shows that firms with voluntary environmental certification outperform their counterparts in FP with diverse impacts (1.621***, 1.896**, 1.591*). The interaction term in Column (2) shows the positive impact of VERA (1.89688) and interaction term (0.02*) on MTBV. The interaction term reveals that if a firm secured environmental certification, its EP may be increased by 0.02% with an additional score of EP. Similarly, in Column (3), all variables are identical except for the addition of two mediator variables in the model for the robustness of the moderating hypothesis. The interaction term is also significant with a coefficient of 0.051**, as Column (3) reveals. The result of the interaction terms endorses hypothesis H2 that voluntary environmental certification has a moderating impact on FP, as measured by Tobin q. Our results endorse the Porter hypothesis and NRBV, which establish that environmental initiatives are a boost for sustainable FP.

The result of firm-level control demonstrates that firm FA, LTA, and LEVG are negatively and statistically related to FP. Similarly, inflation is negative, while GDP_G and LRT are positively related to FP in almost all models. The post estimations in Table 9 are valid for the application of GMM in the study (1) instrument < groups, (2) AR (2) is insignificant, (3) the Hensen test is insignificant which means instrument did not increase bias into the estimation, and (4) F test is significant means model is valid.

Derivative graphs show that VERA firms' relationship is not the same as the slops are different, so the moderating role is justified. The result of derivative mapping demonstrates in Figure 4 that TC firms have low at every EPSC worth the presence of mediating factors in the model. Figure 5 is derivative mapping in the presence of mediating factors and clearly shows the different slopes of VERA firms and high-equity-based firms. These results reveal that firms that secured environmental certifications like ISO or EMAS outperform their counterpart firms financially.

Table 9. Moderation of VERA between EP and FP by dynamic GMM

	(1)	(2)	(3)
	MTBV	MTBV	MTBV
L.MTBV	0.431 *** (0.029)	0.372 ** (0.056)	0.243 ** (0.122)
EPSC	0.017 ** (0.008)	0.023 ** (0.012)	0.002 (0.015)
FA	−0.017 *** (0.004)	−0.011 ** (0.005)	0.008 (0.014)
LTA	−0.441 *** (0.072)	−0.279 ** (0.151)	−0.476 *** (0.169)
LEVG	−0.001 (0.001)	−0.018 (0.014)	−0.021 * (0.011)
GDP_G	0.226 *** (0.038)	0.161 *** (0.055)	0.049 (0.061)
INFL	−0.021 (0.028)	−0.147 * (0.028)	−0.226 ** (0.115)
LRT	0.024 ** (0.011)	0.027 * (0.015)	0.011 (0.023)
VERA	1.621 *** (0.591)	1.896 ** (0.959)	1.591 * (0.693)
ISOM		0.027 * (0.016)	0.051 ** (0.023)
FCA			−0.081 * (0.041)
FMR			0.001 *** (0.001)
F	134.35 ***	146.74 ***	45.62
Observation	1953	1953	1953
Intercept	YES	YES	YES
Year, Industry, Country Dummy	YES	YES	YES
Instruments	60	30	32
AR1	0.01	0.00	0.00
AR2	0.07	0.14	0.13
Hensen Test	0.12	0.19	0.39

Notes: ( ) shows standard errors while *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. We added Year, Industry, Country in each model.

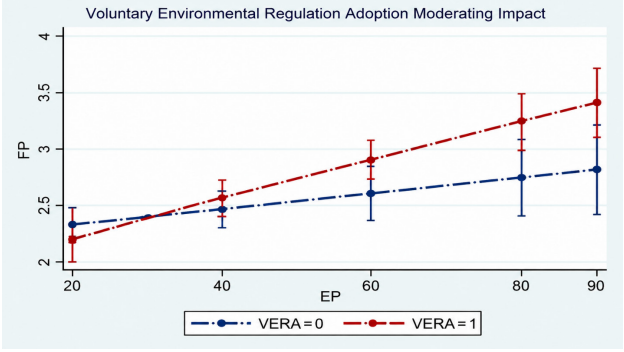


Figure 4. VERA moderating impact

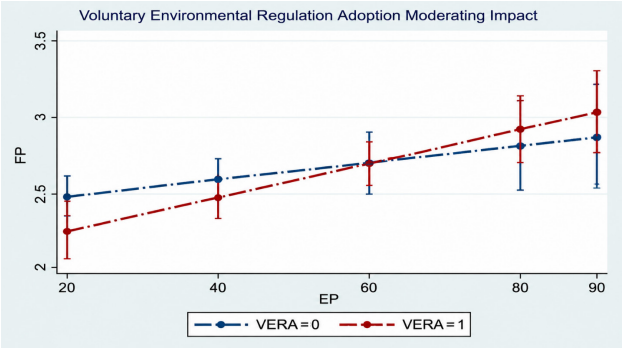


Figure 5. VERA moderating impact (WM)

4.1. Discussion

Social pressure is mounting on firms to become environment-friendly (Orlitzky et al., 2017), and resultantly, firms are formulating strategies to reduce their harmful impact on the natural environment (Danso et al., 2020) and incorporating different environmental initiatives (Dai et al., 2025a) for their sustainability and ecosystem welfare by keeping their financial objectives intact (Marsat et al., 2021; Benameur et al., 2025). Firms' environmental initiatives for environmental management are now a strategic consideration, and the energy and industrial sectors are no exception. In developing countries of the BRICS, energy and industrial sector firms are vital to the economy. Traditionally, their performance is accessed by financial and social bottom lines, but the recent pressure and expectations of stakeholders have shifted the firm's horizon toward better Environmental Performance (FP) for sustainable Financial Performance (FP). Consequently, these firms adopted different environmental initiatives, strategies, and models for environmentally sustainable models for meeting the UN's Sustainable Development Goals (SDGs).

Under the NRBV, firms gain a competitive edge by developing sustainable capabilities such as pollution prevention, product stewardship, and clean technology innovation. However, in BRICS nations, these advantages are often undermined by lax regulation and limited institutional pressure, making sustainability a choice rather than a necessity. Porter's Hypothesis argues that well-designed environmental regulations can stimulate innovation and competitiveness. Yet, in BRICS economies, weak policy enforcement and reliance on voluntary compliance reduce this pressure to innovate. In essence, while both theories align with BRICS' developmental goals, their effectiveness depends on strengthening regulatory frameworks and institutional accountability to turn voluntary action into systemic progress.

The first study objective quantifies the relationship between EP and FP in a multi-country sample of the BRICS region by devising H1. A few studies endorse the non-linear relationship between EP and FP. Consequently, we critically evaluated the linearity assumption and found that linear GMM modeling is suitable for BRICS data (Tables A1 –A2 and Figures A1–A3). We find a positive connection

between EP and FP from the accounting and market perspective. The accounting perspective of FP has a slightly strong relationship, as revealed by the coefficients. This result is also endorsed by a meta-analysis regarding the corporate social and financial perspective (Orlitzky et al., 2017). The results provide a foundation for accepting H1 through alternative measures of EP and FP and the presence of mediating factors of competitive advantage and firm market reputation. EP measured by environmental pillar score is the variable of interest and is positively related to FP from the market perspective (MTBV) and accounting perspective (ROA, ROE, ROCE, BVPS). From the pollution context, H1 has also confirmed the environmental positive economic benefits. The relationship of EP with FP is stronger when FP is measured from an accounting perspective than the market perspective. The following studies are aligned with our findings on H1 (Bendig et al., 2023; Gupta & Deb, 2023; Haibo & Manu, 2022) while contradicting the following studies (Ben Lahouel et al., 2022; El Khoury et al., 2023). Our findings on H1 are supported by the following theories that focus on the positive and sustainability that arise from an organization's social impact (NRBV, Legitimacy, and stakeholders' theories).

Our results show that EP boosts FP with stronger and more immediate effects on accounting measures. The lag in market-based performance reflects the time needed for reputation and investor recognition to translate into economic gains in BRICS because markets underreact to environmental information in this region. EP bring efficiency and reduce costs, which is reflected more immediately in accounting-based measures like ROA or ROE. The lag effect indicates that the benefits of environmental initiatives may take time to materialize in market-based performance, as reputation building and investor recognition gradually translate into stock market gains. This pattern aligns with prior studies showing that tangible operational gains appear sooner than market valuation effects, supporting the robustness of our results.

The second objective assumes the moderating role of the voluntary environmental approach of an organization between EP and FP by devising H2. As the BRICS region is developing instead of mandatory, countries encourage firms for voluntary environmental initiatives. The results show that voluntary regulated firms have more FP than counterpart firms. Our results endorse the H2 regression and correlation perspectives. We find that VERA firms have higher FP than counterpart firms, and ISO or EMAS adoption strengthens the relationship between EP and FP (Figures 4–5 and Table 9) and finds robustness in the presence of the mediating factors. H2 acceptance is endorsed by (Arocena et al., 2021; Johnstone & Hallberg, 2020) and contradicts (Neves et al., 2024; J. X. Wang & Zhao, 2020). Positive moderating results support the Porter win-win hypothesis, which reveals that environmental regulations and compliance costs are partially or wholly offset in the long run, providing them a first-mover advantage (Porter & Van Der Linde, 1995). H3 reveals that thin capitalization (high debt) is a moderating factor where high debt weakens the EP-FP relationship. The findings show that TC and its interaction term are negatively related to FP, and the significance persists despite the mediating factors in the model. Table 8 and Figures 2–3 endorse H3. These results are endorsed by the following studies (Bae et al., 2019; Boshnak, 2023) and opposed by (Arfazil et al., 2022). The negative connection of TC (high leverage) is consistent with the crux of agency theory, which suggests that the management or managers use the opaque environment due to TC for personal benefits rather than shareholders' benefits.

The literature reveals many reasons for conflicting results; however, one school of thought considers too much focus on direct relationships without mediating or moderating contingency as the cause of inconsistent results between EP and FP (Aigbedo, 2021; Miroshnychenko et al., 2022). Furthermore, López-Gamero et al. (2009) considered that without a mediating factor, the relationship is a black-box approach. Therefore, we devised H4, which assumes the mediating role of FCA between EP and FP. Table 3 demonstrates that FCA serves as a statistically significant mediator between EP and FP, as assumed by our conceptual framework, indicating a partially mediated relationship. Additionally, the findings support the notion that EP directly influences FP while also indirectly bolstering FP by enhancing cost-competitive advantage through cost reduction. Therefore, the favorable influence of EP on FP stems from gaining a competitive edge through cost reduction, and these outcomes remain consistent across various statistical methodologies. In the literature, H4 has been endorsed by various countries or domain-specific studies for its social impact (Chen et al., 2016) rather than environmental impact. For example, a study reveals that FCA is a mediator between FP and environmental protection (López-Gamero et al., 2009). However, in the context of CSR and FP, Saeidi et al. (2015) validated CA as a mediator on the data of Iranian firms. Additionally, Cantele and Zardini (2018) endorsed that CA is a mediator in Italian organizations. The mediating role of CA aligns with the core principles of RBV, which emphasize operational capabilities and cost minimization as crucial for gaining a competitive edge in a global market. CA's emphasis on cost reduction enhances FP and contributes to the firm's long-term sustainability. Additionally, this outcome supports contingency theory, which underscores the importance of mediating contingencies in the direct relationship between two variables.

Scholarly involvement indicates that relying solely on the EP-FP direct relationship is insufficient for a thorough perspective, emphasizing the importance of considering mediating factors to achieve a holistic understanding (Aigbedo, 2021; Wedari et al., 2023; Elmaghrabi et al., 2025). Table 5 demonstrates that firm reputation is a statistically significant mediator between EP and FP, indicating partial mediation in the relationship. The findings support the notion that EP directly influences FP and indirectly boosts FP through firms' market reputation. Therefore, the favorable impact of EP on FP can be attributed to the firm's market

reputation, with results consistent across methodologies. Scholarly stances indicate that a few studies incorporated firm reputation as a mediating factor but in a specific country perspective instead of a multi-country sample. The mediating role of firm reputation is confirmed by Baah et al. (2021), Cantele and Zardini (2018), Saeidi et al. (2015) in the sample firms of Iran, Italy, Ghana, and Vietnam, respectively. Thus, these studies endorse H5 in a broader sense. However, in the multi-country context, the mediating role of firm reputation is tested between CSR and FP. Although EP has characteristics of CSR but not the same, we found a research gap between EP and FP. The literature has a consensus that environmental initiatives are the root cause of good EP. That is why Madsen and Ulhøi (2001) revealed that firms induct environmental initiatives to cater to stakeholders' expectations while Baah et al. (2021) obliged that low CO_2 emission through improved EP is the source of firm reputation. Additionally, Martínez and Rodríguez del Bosque (2014) empirically found that environmental initiatives create and nurture firms' good image among regulators, lenders, and investors. RBV pleads those environmental initiatives can improve a firm's reputation, influence investors' perceptions and preferences, and push a firm for future profitability (Rehman et al., 2020). H5 can also be endorsed by NRBV, which prefers a positive connection between EP and FP through good environmental strategies for financial resilience and sustainability.

We find that EP contributes to economic value creation through two primary mechanisms: the first is reputation standing among competitors, and the second is operating efficiency. Therefore, from the perspective of the RBV, firms that develop distinctive environmental capabilities such as pollution prevention, resource efficiency, and eco-innovation gain valuable, rare, and inimitable resources that enhance competitiveness. These capabilities improve operating efficiency in multiple ways, such as waste reduction, optimal resource usage, and lower production costs, which ultimately increase FP. Similarly, from the NRBV perspective, reputation is a vital intangible asset that fosters environmental responsibility and signals long-term sustainability and legitimacy to stakeholders. This reputation serves as an intangible strategic asset that enhances firm value and market positioning.

Nevertheless, the magnitude of these payoffs depends on institutional conditions and financial constraints. Specifically, voluntary environmental standards and institutional pressures shape the effectiveness of environmental initiatives, while balance-sheet constraints, such as thin capitalization, impede a firm's ability to convert environmental strengths into financial outcomes.

5. Conclusions

The primary aim of this study is to explore the relationship between EP and FP at the firm level across a multi-country sample within the BRICS region. Additionally, the study seeks to examine the mediating effects of a firm's Market Reputation (FMR) and Competitive Advantage (FCA). Additionally, the moderating role of firms' thin capitalization (TC) and Voluntary Environmental Regulation Adoption (VERA) is empirically tested to explore the main research question comprehensively. The sample data consist of 295 firms from 2015 to 2022 from the databases of Eikon ASSET4, DataStream, and WDI. The analysis technique is system GMM due to the issue of endogeneity and reverse causality. For mediation testing, we used the Preacher and Hayes (2008) method. We also performed robustness of finding by different models and different proxies of FP. We find that EP positively contributes to FP from an accounting and market perspective and is aligned with the following studies (Aigbedo, 2021; Nguyen et al., 2021), but its relationship is weak. However, from an accounting perspective, the relationship is a bit stronger than the market perspective. We find EP also positively linked with FP measured by ROA, ROE, ROCE, BVPS, and Tobin q.

We found that the firms' VERA measured by ISO adoption positively moderates the relationship, while TC measured by high gearing has a negative moderating impact on FP. The findings of the moderating equation postulate that ISO adoption directly impacts the FP, which supports the hypothesis that the firms having voluntary ISO adoption have a moderating impact on FP and financially outperform the counterpart firms. This finding shows that the firm association with the natural environment leads to sustainable FP by reducing wastage, efficient process, low litigation, and credibility among stakeholders. On the contrary, we find the direct negative impact of TC on FP as well as the negative moderating impact. The finding is justified that the geared firms have more costs, market pressure, and the chance of bankruptcy. The main objective is aligned with the NRBV, which endorsed sustainable development of the organization depending upon the linkage with the natural environment. Similarly, the hypothesis of VERA is endorsed by Porter's win-win hypothesis that reveals environmental initiatives, despite their associated costs, offer firms a distinct competitive edge.

Similarly, the meditation hypothesis is aligned with the contingency theory, which endorses that the optimal course of action is contingent on external or internal situations. We find that a firm's reputation is measured by its excess capitalization, which has a direct positive link with EP and an indirect mediating channel between EP and FP. We found that environmental initiatives create and nurture firms' good image among regulators, lenders, and investors. Additionally, A firm's reputation influences investors' perceptions and preferences that push a firm for future profitability. Furthermore, firm cost-competitive advantage also has a direct and indirect mediating impact on FP. Therefore, the favorable influence of EP on FP stems from gaining a competitive edge through cost reduction. Furthermore, firm reputation and competitive advantage partially mediate the relationship between EP and FP. Mediating hypotheses are endorsed by RBV, which assumes a firm dynamic strategy provides a competitive advantage

to the organizations and obliges a positive connection between EP and FP through good environmental strategies for financial resilience and sustainability.

In a nutshell, EP creates economic value through reputation and operating efficiency while its payoffs are shaped by institutional pressures and financial constraints. RBV emphasizes efficiency gains from distinctive environmental capabilities, while NRBV highlights reputation as a strategic intangible asset and firm relationship with natural environment.

6. Limitations and future research

This study, like any other research, has some limitations. The study used a proxy of the environmental pillar score, known as EP, based on a weighted score of 62 questions that are not available to all firms in the selected sectors. Additionally, only two sectors, energy and industrial, were used, which have a significant impact on the natural environment. However, future studies may consider all other polluting sectors as well. Data limitations were also present, as the sample size consisted of only 295 firms from the selected sectors, which is less than 7% of the population of the BRICS region. The coverage for direct CO_2 (LCO2S1) in BRICS regions is limited that is why it is only for used for robustness purpose. We acknowledge the possibility of survivorship bias; however, the sample of 295 firms was determined purely by data availability and reporting consistency across 2015–2022. Firms with missing or unreliable data were excluded to ensure data accuracy, not selective sampling. The use of panel data and GMM estimation further minimizes potential attrition effects. Hence, while coverage is below 7% of the population, the sample represents reliable and transparent firms, maintaining the study's validity and robustness.

The study also focused exclusively on public companies of BRICS, but future research may consider family firms or SMEs as well. Moreover, the study used only one mediator and two moderators, but future studies may adopt other moderating or mediating contingencies like green innovation, culture and stakeholder trust. As the environmental philosophy of any nation or country shapes management decisions, future research should consider it as a moderating or mediating effect. Furthermore, Hofstede's cultural dimensions can provide a framework for addressing cultural differences that may impact organizational behavior shape sustainability practices and philosophy (Hassanein et al. 2024), practices, and economic philosophy. Therefore, these should be included in future environmental and economic performance frameworks. Future research could broaden the scope beyond BRICS countries to include other emerging economies and explore additional mediating mechanisms such as green innovation or stakeholder trust to deepen the understanding of sustainability dynamics across diverse contexts.

Future research could explore the non-linear effects of EP on FP to identify thresholds where sustainability yields diminishing or accelerating returns. Incorporating governance-related moderators such as board diversity (Tahat & Hassanein, 2024), ownership structure (or ESG oversight can reveal how internal mechanisms influence the EP and FP link. Additionally, cross-country comparative studies within and beyond BRICS can provide deeper insights into how institutional and regulatory differences shape this relationship.

This study has practical implications for management, stakeholders, and authorities. Management can gain insight into how stakeholders perceive the company's EP as a competitive advantage and a source of sustainable firm performance. By adopting environmental initiatives for long-term objectives, the management can achieve a low WACC and enhance its market reputation. Second, the voluntary adoption of environmental initiatives such as ISO is a win–win situation for stakeholders and acts as a catalyst for sustainable firm performance. Similarly, the management can avoid thin capitalization, which can reduce the risk of bankruptcy, agency problems, downgrades, and compromised financial resilience while bringing financial autonomy. Investors and lending institutions can also gain the acumen that high EP is more sustainable, and investment in such companies can be cash cows in the future. Lastly, the authorities can learn that a firm's sustainable performance is linked to its association with the natural environment, as described by NRBV. The authorities may devise policies to reduce environmental hazards and subsidize firms with better EP.

7. Recommendations

BRICS regulators could incentivize ISO 14001 (International Organization for Standardization, 2015) or EMAS adoption by offering tax credits, green financing access, or preferential treatment in public procurement for certified firms, thereby encouraging environmental compliance and sustainable practices. Additionally, regulators could discourage thin capitalization by tightening interest deductibility rules, introducing minimum equity ratios, or linking corporate tax incentives to responsible financial structures. These measures would promote both environmental accountability and financial stability across BRICS economies.

The findings show that VERA strengthens the EP-FP relationship by encouraging firms to invest in cleaner technologies and improve reputation. Policymakers should support and incentivize voluntary environmental initiatives through tax benefits, recognition programs, and reporting frameworks. Regulators can further enhance this link by gradually integrating voluntary standards into formal policy, ensuring broader adoption and sustained environmental and financial gains.

8. Contributions

This research fills key theoretical gaps by clarifying mechanisms, boundary conditions, and applying stronger meth-

odology. Prior studies often report mixed findings because of reliance on direct relationship. This study is novel in integrating market reputation and competitive advantage as mediators that explain how environ EP translates into FP. These mediators capture both external recognition (reputation) and internal capability (competitive advantage), offering a dual mechanism that extends the NRBV and signaling theory within the BRICS context. The inclusion of VERA and thin capitalization as moderators further adds originality by contextualizing the EP-FP relationship under weak enforcement and financial constraints. VERA reflects firms' proactive sustainability behavior, while thin capitalization highlights financial vulnerability that limits the benefits of environmental initiatives. Together, these factors provide a comprehensive and context-specific contribution to sustainability and strategic management literature.

We also addressed some practical gaps in the BRICS region, as firms in emerging economies lack clear, evidence-based guidance on which environmental strategies truly create value and enhance financial outcomes. Policymakers and managers also face gaps in understanding the effectiveness of voluntary regulations and how financial structure risks such as thin capitalization can weaken the benefits of environmental initiatives.

8.1. Theoretical contributions

This study advances the theoretical understanding of the EP-FP nexus by integrating mediating mechanisms (competitive advantage and market reputation) and moderating factors (Voluntary environmental regulation adoption and thin capitalization). It extends the NRBV and Porter's Hypothesis by demonstrating how sustainability-driven capabilities can enhance firm performance even in emerging economies with weak regulatory enforcement. The model provides a holistic framework linking environmental initiatives with firm-level strategic and financial outcomes, thereby enriching sustainability and strategic management literature.

8.2. Empirical contributions

Using a panel dataset of 295 BRICS firms (2015–2022), the study empirically validates the positive relationship between EP and FP from both accounting and market perspectives, highlighting a lagged effect of EP on FP. The application of GMM addresses endogeneity issues, while bootstrapping confirms the mediating roles of market reputation and competitive advantage. The findings reveal that VERA strengthens the EP-FP relationship, whereas thin capitalization weakens it, providing novel evidence from the BRICS context.

8.3. Policy contributions

The study underscores the need for stronger environmental governance in BRICS countries to ensure that voluntary environmental actions evolve into enforceable standards. Policymakers can leverage these insights to design incentive-based regulations that encourage firms to integrate sustainability into core business strategies. The results emphasize the importance of promoting clean technology, product stewardship, and pollution prevention in energy and heavy industry sectors. By linking environmental responsibility with financial gains, the study provides actionable guidance for regulators, managers, and investors to support sustainable industrial transformation

Author contributions

Conceptualization, S.A. and A.A.; methodology, S.T.H. and D.F.; software, A.A. D.F.; validation, M.A.N., A.A., and S.A.; formal analysis, S.T.H.; investigation, A.A.; resources, S.T.H.; data curation, A.A. D.F.; writing – original draft preparation, S.A. and A.A.; writing – review and editing, S.A.; visualization, S.T.H.; supervision, M.A.N.; project administration, S.A. and D.F. All authors have read and agreed to the published version of the manuscript.

Disclosure statement

The authors have no relevant financial or non-financial interests to disclose

Availability of data and materials

This study is based on secondary data. All the data is available on the online data stream' such as Asset4 Eikon database, data stream, and World Development Indicators (WDI).

References

Abban, A. R., & Hasan, M. Z. (2021). The causality direction between environmental performance and financial performance in Australian mining companies – A panel data analysis. *Resources Policy*, *70*, Article 101894. https://doi.org/10.1016/j.resourpol.2020.101894

Abdelbaky, A., Liu, T., Mingyang, X., Shahzad, M. F., & Hassanein, A. (2025). Real earnings management and ESG performance in China: The mediating role of corporate innovations. *International Journal of Finance & Economics*, *30*(4), 3476–3499. https://doi.org/10.1002/ijfe.3074

Aigbedo, H. (2021). An empirical analysis of the effect of financial performance on environmental performance of companies in global supply chains. *Journal of Cleaner Production*, *278*, Article 121741. https://doi.org/10.1016/j.jclepro.2020.121741

Arfazil, M., Saputra, M., & Indayani. (2022). The effects of environmental performance, financial leverage, and institutional ownership on firm value: A study on manufacturing firms in Indonesia. *Journal of Contemporary Accounting*, *3*(3), 162–168. https://doi.org/10.20885/jca.vol3.iss3.art5

Arimura, T. H., Kaneko, S., Managi, S., Shinkuma, T., Yamamoto, M., & Yoshida, Y. (2019). Political economy of voluntary approaches: A lesson from environmental policies in Japan. *Economic Analysis and Policy*, *64*, 41–53. https://doi.org/10.1016/j.eap.2019.07.003

Arocena, P., Orcos, R., & Zouaghi, F. (2021). The impact of ISO 14001 on firm environmental and economic performance: The moderating role of size and environmental awareness. *Business Strategy and the Environment*, *30*(2), 955–967. https://doi.org/10.1002/bse.2663

Arora, N., Saggar, R., & Singh, B. (2021). Nexus between risk disclosure and corporate reputation: A longitudinal approach. *Journal of Strategy and Management*, *14*(4), 529–544. https://doi.org/10.1108/JSMA-06-2020-0162

Aslam, S., Elmagrhi, M. H., Rehman, R. U., & Ntim, C. G. (2021). Environmental management practices and financial performance using data envelopment analysis in Japan: The mediating role of environmental performance. *Business Strategy and the Environment*, *30*(4), 1655–1673. https://doi.org/10.1002/bse.2700

Ayayi, A. G., & Wijesiri, M. (2022). Is there a trade-off between environmental performance and financial sustainability in microfinance institutions? Evidence from South and Southeast Asia. *Business Strategy and the Environment*, *31*(4), 1552–1565. https://doi.org/10.1002/bse.2969

Baah, C., Opoku-Agyeman, D., Acquah, I. S. K., Agyabeng-Mensah, Y., Afum, E., Faibil, D., & Abdoulaye, F. A. M. (2021). Examining the correlations between stakeholder pressures, green production practices, firm reputation, environmental and financial performance: Evidence from manufacturing SMEs. *Sustainable Production and Consumption*, *27*, 100–114. https://doi.org/10.1016/j.spc.2020.10.015

Bae, K.-H., El Ghoul, S., Guedhami, O., Kwok, C. C. Y., & Zheng, Y. (2019). Does corporate social responsibility reduce the costs of high leverage? Evidence from capital structure and product market interactions. *Journal of Banking and Finance*, *100*, 135–150. https://doi.org/10.1016/j.jbankfin.2018.11.007

Banerjee, R., & Gupta, K. (2019). The effect of environmentally sustainable practices on firm R&D: International evidence. *Economic Modelling*, *78*, 262–274. https://doi.org/10.1016/j.econmod.2018.09.024

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Bassetti, T., Blasi, S., & Sedita, S. R. (2021). The management of sustainable development: A longitudinal analysis of the effects of environmental performance on economic performance. *Business Strategy and the Environment*, *30*(1), 21–37. https://doi.org/10.1002/bse.2607

Ben Lahouel, B., Ben Zaied, Y., Managi, S., & Taleb, L. (2022). Rethinking about U: The relevance of regime-switching model in the relationship between environmental corporate social responsibility and financial performance. *Journal of Business Research*, *140*, 498–519. https://doi.org/10.1016/j.jbusres.2021.11.019

Benameur, K. B., Mostafa, M. M., Hassanein, A., Shariff, M. Z., & Al-Shattarat, W. (2024). Sustainability reporting scholarly research: A bibliometric review and a future research agenda. *Management Review Quarterly*, *74*, 823–866. https://doi.org/10.1007/s11301-023-00319-7

Benameur, K., Hassanein, A., Mostafa, M. M., Elmaghrabi, M., & Tharwat, H. (2025). A decade of sustainable finance scholarly research: Performance analysis, science mapping and future pathways. *Journal of Financial Reporting and Accounting*. https://doi.org/10.1108/JFRA-10-2024-0722

Bendig, D., Wagner, A., & Lau, K. (2023). Does it pay to be science-based green? The impact of science-based emission-reduction targets on corporate financial performance. *Journal of Industrial Ecology*, *27*(1), 125–140. https://doi.org/10.1111/jiec.13341

Benkraiem, R., Dubocage, E., Lelong, Y., & Shuwaikh, F. (2023). The effects of environmental performance and green innovation on corporate venture capital. *Ecological Economics*, *210*, Article 107860. https://doi.org/10.1016/j.ecolecon.2023.107860

Blundell, R., & Bond, S. (2023). Reprint of: Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *234*, 38–55. https://doi.org/10.1016/j.jeconom.2023.03.001

Boshnak, H. (2023). The impact of capital structure on firm performance: Evidence from Saudi-listed firms. *International Journal of Disclosure and Governance*, *20*, 15–26. https://doi.org/10.1057/s41310-022-00154-4

Busch, T., & Lewandowski, S. (2018). Corporate carbon and financial performance a meta-analysis. *Journal of Industrial Ecology*, *22*(4), 745–759. https://doi.org/10.1111/jiec.12591

Cantele, S., & Zardini, A. (2018). Is sustainability a competitive advantage for small businesses? An empirical analysis of possible mediators in the sustainability–financial performance relationship. *Journal of Cleaner Production*, *182*, 166–176. https://doi.org/10.1016/j.jclepro.2018.02.016

Chen, P. H., Ong, C. F., & Hsu, S. C. (2016). Understanding the relationships between environmental management practices and financial performances of multinational construction firms. *Journal of Cleaner Production*, *139*, 750–760. https://doi.org/10.1016/j.jclepro.2016.08.109

Chikán, A., Czakó, E., Kiss-Dobronyi, B., & Losonci, D. (2022). Firm competitiveness: A general model and a manufacturing application. *International Journal of Production Economics*, *243*, Article 108316. https://doi.org/10.1016/j.ijpe.2021.108316

Dai, J., Mehmood, U., & Nassani, A. A. (2025a). Empowering sustainability through energy efficiency, green innovations, and the sharing economy: Insights from G7 economies. *Energy*, *318*, Article 134768. https://doi.org/10.1016/j.energy.2025.134768

Dai, J., Zhou, B., & Meng, W. (2025b). The impact of digitization on environmental sustainability: New insights from G20 nations. *Journal of Environmental Management*, *394*, Article 127225. https://doi.org/10.1016/j.jenvman.2025.127225

Danso, A., Adomako, S., Lartey, T., Amankwah-Amoah, J., & Owusu-Yirenkyi, D. (2020). Stakeholder integration, environmental sustainability orientation and financial performance. *Journal of Business Research*, *119*, 652–662. https://doi.org/10.1016/j.jbusres.2019.02.038

De Leaniz, P. M. G., & Del Bosque Rodríguez, I. R. (2016). Corporate image and reputation as drivers of customer loyalty. *Corporate Reputation Review*, *19*, 166–178. https://doi.org/10.1057/crr.2016.2

Dixon-Fowler, H. R., Slater, D. J., Johnson, J. L., Ellstrand, A. E., & Romi, A. M. (2013). Beyond "does it pay to be green?" A meta-analysis of moderators of the CEP-CFP relationship. *Journal of Business Ethics*, *112*, 353–366. https://doi.org/10.1007/s10551-012-1268-8

El Khoury, R., Nasrallah, N., & Alareeni, B. (2023). ESG and financial performance of banks in the MENAT region: Concavity–convexity patterns. *Journal of Sustainable Finance and Investment*, *13*(1), 406–430. https://doi.org/10.1080/20430795.2021.1929807

Esposito, P., Dicorato, S. L., & Doronzo, E. (2021). The effect of ownership on sustainable development and environmental policy in urban waste management: An explicatory empirical analysis of Italian municipal corporations. *Business Strategy and the Environment*, *30*(2), 1067–1079. https://doi.org/10.1002/bse.2671

Feng, M., Yu, W., Wang, X., Wong, C. Y., Xu, M., & Xiao, Z. (2018). Green supply chain management and financial performance:

The mediating roles of operational and environmental performance. *Business Strategy and the Environment*, *27*(7), 811–824. https://doi.org/10.1002/bse.2033

Elmaghrabi, M., Hassanein, A., & Diab, A. (2025). How do firm-level and country-level sustainability governance shape corporate sustainability? Insights from environmentally-sensitive industries. *Social Responsibility Journal*, *21*(5), 1086–1110. https://doi.org/10.1108/SRJ-02-2024-0088

Fernández-Cuesta, C., Castro, P., Tascón, M. T., & Castaño, F. J. (2019). The effect of environmental performance on financial debt. European evidence. *Journal of Cleaner Production*, *207*, 379–390. https://doi.org/10.1016/j.jclepro.2018.09.239

Friedman, M. (2017). The social responsibility of business is to increase its profits. In W. C. Zimmerli, M. Holzinger, & K. Richter (Eds.), *Corporate ethics and corporate governance* (pp. 173–178). Springer. https://doi.org/10.1007/978-3-540-70818-6_14

Gupta, R. D., & Deb, S. G. (2023). Interlinkage between corporate social, environmental performance and financial performance: Firm-mediators in a multi-country context. *Finance Research Letters*, *52*, Article 103386. https://doi.org/10.1016/j.frl.2022.103386

Haibo, C., & Manu, E. K. (2022). The impact of banks' financial performance on environmental performance in Africa. *Environmental Science and Pollution Research*, *29*, 49214–49233. https://doi.org/10.1007/s11356-022-19401-w

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, *20*(4), 986–1014. https://doi.org/10.2307/258963

Hart, S. L., & Ahuja, G. (1996). Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. *Business Strategy and the Environment*, *5*(1), 30–37. https://doi.org/10.1002/(sici)1099-0836(199603)5:1<30::aid-bse38>3.0.co;2-q

Hart, S. L., & Dowell, G. (2011). Invited editorial: A natural-resource-based view of the firm: Fifteen years after. *Journal of Management*, *37*(5), 1464–1479. https://doi.org/10.1177/0149206310390219

Hasan, R., Miah, M. D., & Hassan, M. K. (2022). The nexus between environmental and financial performance: Evidence from gulf cooperative council banks. *Business Strategy and the Environment*, *31*(7), 2882–2907. https://doi.org/10.1002/bse.3053

Hassanein, A., & Elmaghrabi, M. (2025). How does market competition affect the reporting of sustainability practices? Insights from the UK and Germany. *International Journal of Productivity and Performance Management*, *74*(4), 1452–1474. https://doi.org/10.1108/IJPPM-07-2023-0369

Hassanein, A., & Elsayed, N. (2025). Reporting ESG initiatives and gender diversity in Germany: Implications for stock liquidity. *International Journal of Finance & Economics*, *31*(2), 2824–2844. https://doi.org/10.1002/ijfe.70009

Hassanein, A., Bani-Mustafa, A., & Nimer, K. (2024). A country's culture and reporting of sustainability practices in energy industries: Does a corporate sustainability committee matter?. *Humanities and Social Sciences Communications*, *11*, Article 1140. https://doi.org/10.1057/s41599-024-03536-x

International Organization for Standardization (ISO). (2015). *Environmental management systems — Requirements with guidance for use* (ISO Standard No. 14001:2015). https://www.iso.org/standard/60857.html

Johnstone, L., & Hallberg, P. (2020). ISO 14001 adoption and environmental performance in small to medium sized enterprises. *Journal of Environmental Management*, *266*, Article 110592. https://doi.org/10.1016/j.jenvman.2020.110592

Lane, D. (2009). The cost of capital, corporation finance and the theory of investment: A refinement. *Applied Economics Letters*, *16*(10), 1017–1019. https://doi.org/10.1080/17446540802345448

Long, W., Luo, L., Sun, H., & Zhong, Q. (2023). Does going abroad lead to going green? Firm outward foreign direct investment and domestic environmental performance. *Business Strategy and the Environment*, *32*(1), 484–498. https://doi.org/10.1002/bse.3156

López-Gamero, M. D., Molina-Azorín, J. F., & Claver-Cortés, E. (2009). The whole relationship between environmental variables and firm performance: Competitive advantage and firm resources as mediator variables. *Journal of Environmental Management*, *90*(10), 3110–3121. https://doi.org/10.1016/j.jenvman.2009.05.007

Lu, Y., Li, G., Luo, Z., Anwar, M., & Zhang, Y. (2021). Does intellectual capital spur sustainable competitive advantage and sustainable growth?: A study of Chinese and Pakistani firms. *SAGE Open*, *11*(1). https://doi.org/10.1177/2158244021996702

Madsen, H., & Ulhøi, J. P. (2001). Integrating environmental and stakeholder management. *Business Strategy and the Environment*, *10*(2), 77–88. https://doi.org/10.1002/bse.279

Manrique, S., & Martí-Ballester, C.-P. (2017). Analyzing the effect of corporate environmental performance on corporate financial performance in developed and developing countries. *Sustainability*, *9*(11), Article 1957. https://doi.org/10.3390/su9111957

Mardiana, A. (2021). The impact of corporate reputation on the cost of equity as mediated by earnings quality. *Atestasi*: *Jurnal Ilmiah Akuntansi*, *4*(2), 217–229. https://doi.org/10.57178/atestasi.v4i2.268

Marsat, S., Pijourlet, G., & Ullah, M. (2021). Is there a trade-off between environmental performance and financial resilience? International evidence from the subprime crisis. *Accounting and Finance*, *61*(3), 4061–4084. https://doi.org/10.1111/acfi.12726

Martínez, P., & Rodríguez del Bosque, I. (2014). Sustainability dimensions: A source to enhance corporate reputation. *Corporate Reputation Review*, *17*, 239–253. https://doi.org/10.1057/crr.2014.13

Miroshnychenko, I., De Massis, A., Barontini, R., & Testa, F. (2022). Family firms and environmental performance: A meta-analytic review. *Family Business Review*, *35*(1), 68–90. https://doi.org/10.1177/08944865211064409

Nassani, A. A., Aldakhil, A. M., Qazi Abro, M. M., & Zaman, K. (2017). Environmental Kuznets curve among BRICS countries: Spot lightening finance, transport, energy and growth factors. *Journal of Cleaner Production*, *154*, 474–487. https://doi.org/10.1016/j.jclepro.2017.04.025

Neves, M. E. D., Reis, S., Reis, P., & Dias, A. G. (2024). Impact of ISO 14001 and ISO 9001 adoption on corporate performance: Evidence on a bank-based system. *International Journal of Productivity and Performance Management*, *73*(5), 1641–1667. https://doi.org/10.1108/IJPPM-08-2022-0398

Nguyen, T. H. H., Elmagrhi, M. H., Ntim, C. G., & Wu, Y. (2021). Environmental performance, sustainability, governance and financial performance: Evidence from heavily polluting industries in China. *Business Strategy and the Environment*, *30*(5), 2313–2331. https://doi.org/10.1002/bse.2748

Nishitani, K., Jannah, N., Kaneko, S., & Hardinsyah. (2017). Does corporate environmental performance enhance financial performance? An empirical study of Indonesian firms. *Environmental Development*, *23*, 10–21. https://doi.org/10.1016/j.envdev.2017.06.003

Orlitzky, M., Louche, C., Gond, J. P., & Chapple, W. (2017). Unpacking the drivers of corporate social performance: A multilevel, multistakeholder, and multimethod analysis. *Journal of Business Ethics*, *144*, 21–40. https://doi.org/10.1007/s10551-015-2822-y

Porter, M. E., & Van Der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, *9*(4), 97–118. https://doi.org/10.1257/jep.9.4.97

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879–891. https://doi.org/10.3758/BRM.40.3.879

Ramli, N. A., Latan, H., & Solovida, G. T. (2019). Determinants of capital structure and firm financial performance – A PLS-SEM approach: Evidence from Malaysia and Indonesia. *Quarterly Review of Economics and Finance*, *71*, 148–160. https://doi.org/10.1016/j.qref.2018.07.001

Rehman, Z. ur, Khan, A., & Rahman, A. (2020). Corporate social responsibility's influence on firm risk and firm performance: The mediating role of firm reputation. *Corporate Social Responsibility and Environmental Management*, *27*(6), 2991–3005. https://doi.org/10.1002/csr.2018

Rezende, L. de A., Bansi, A. C., Alves, M. F. R., & Galina, S. V. R. (2019). Take your time: Examining when green innovation affects financial performance in multinationals. *Journal of Cleaner Production*, *233*, 993–1003. https://doi.org/10.1016/j.jclepro.2019.06.135

Saeidi, S. P., Sofian, S., Saeidi, P., Saeidi, S. P., & Saaeidi, S. A. (2015). How does corporate social responsibility contribute to firm financial performance? The mediating role of competitive advantage, reputation, and customer satisfaction. *Journal of Business Research*, *68*(2), 341–350. https://doi.org/10.1016/j.jbusres.2014.06.024

Tahat, Y. A., & Hassanein, A. (2024). Exploring the synergy of corporate gender diversity, sustainability committee, and reporting ESG practices: An international evidence. *Journal of Environmental Management*, *371*, Article 123093. https://doi.org/10.1016/j.jenvman.2024.123093

Trumpp, C., & Guenther, T. (2017). Too little or too much? Exploring U-shaped relationships between corporate environmental performance and corporate financial performance. *Business Strategy and the Environment*, *26*(1), 49–68. https://doi.org/10.1002/bse.1900

Tucker, L., & Melewar, T. C. (2005). Corporate reputation and crisis management: The threat and manageability of anti-corporatism. *Corporate Reputation Review*, *7*, 377–387. https://doi.org/10.1057/palgrave.crr.1540233

Udeagha, M. C., & Ngepah, N. (2023). The drivers of environmental sustainability in BRICS economies: Do green finance and fintech matter? *World Development Sustainability*, *3*, Article 100096. https://doi.org/10.1016/j.wds.2023.100096

Ullah, S., Zaefarian, G., & Ullah, F. (2021). How to use instrumental variables in addressing endogeneity? A step-by-step procedure for non-specialists. *Industrial Marketing Management*, *96*, A1–A6. https://doi.org/10.1016/j.indmarman.2020.03.006

Wagner, M., Van Phu, N., Azomahou, T., & Wehrmeyer, W. (2002). The relationship between the environmental and economic performance of firms: An empirical analysis of the European paper industry. *Corporate Social Responsibility and Environmental Management*, *9*(3), 133–146. https://doi.org/10.1002/csr.22

Wang, C., & Lin, Y. (2022). Does bargaining power mitigate the relationship between environmental regulation and firm performance? Evidence from China. *Journal of Cleaner Production*, *331*, Article 129859. https://doi.org/10.1016/j.jclepro.2021.129859

Wang, J.-X., & Zhao, M.-Z. (2020). Economic impacts of ISO 14001 certification in China and the moderating role of firm size and age. *Journal of Cleaner Production*, *274*, Article 123059. https://doi.org/10.1016/j.jclepro.2020.123059

Wedari, L. K., Moradi-Motlagh, A., & Jubb, C. (2023). The moderating effect of innovation on the relationship between environmental and financial performance: Evidence from high emitters in Australia. *Business Strategy and the Environment*, *32*(1), 654–672. https://doi.org/10.1002/bse.3167

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, *126*(1), 25–51. https://doi.org/10.1016/j.jeconom.2004.02.005

Zakharov, S. V., Lushpey, V. P., Abbasova, L. R., & Zhongkai, S. (2022). Analysis of the impact of the energy industry on the environment. *IOP Conference Series*: *Earth and Environmental Science*, *1070*, Article 012044. https://doi.org/10.1088/1755-1315/1070/1/012044

Zhang, Y., Wei, J., Zhu, Y., & George-Ufot, G. (2020). Untangling the relationship between corporate environmental performance and corporate financial performance: The double-edged moderating effects of environmental uncertainty. *Journal of Cleaner Production*, *263*, Article 121584. https://doi.org/10.1016/j.jclepro.2020.121584

Zheng, H., & He, Y. (2022). How do the China pollution discharge fee policy and the environmental protection tax law affect firm performance during the transitional period? *Environmental Science and Pollution Research*, *29*, 44541–44557. https://doi.org/10.1007/s11356-022-19050-z

APPENDIX

Table A1. Quadratic terms

	(1)	(2)	(3)	(4)
	OLS MTBV	FE MTBV	RE MTBV	GMM MTBV
L.MTBV				0.483*** (0.036)
EPSC	0.006 (0.005)	0.014** (0.006)	0.011** (0.006)	0.011 (0.015)
EPSC * EPSC (Quadratic Term EP)	0.001 (0.000)	0.001 (0.000)	0.001 (0.000)	0.001 (0.000)
FMR	0.329*** (0.111)	0.265*** (0.101)	–0.287** (0.011)	0.379*** (0.059)
FCA	–0.006*** (0.002)	-0.003 (0.003)	-0.001 (0.001)	–0.004 (0.017)
TC /LEVG	0.011*** (0.022)	0.002 (0.002)	–0.004 (0.002)	0.008 (0.013)
VERA	0.108 (0.097)	0.006 (0.094)	0.012* (0.09)	–
Firm control added	YES	YES	YES	YES
Macro control added	YES	YES	YES	YES
Observation	2159	2159	2159	1966
Intercept	YES	YES	YES	YES
Model significant	YES	YES	YES	YES
Instruments	–	–	–	42

End of Table A1

Notes: ( ) shows Standard errors while *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2. Linearity tests

	Overall model Test	EPSC-FP (MTBV) Test	LCO2S1-FP (MTBV) Test
F-states	(9,767)	(9, 2184)	(9, 777)
Calculated Value	1.25	0.94	1.72
Probability	0.26	0.49	0.09

Note: Non-significant probability indicates linearity between variable or model.

Table A3. Variance inflation factor

	VIF	1/VIF
LEVG	2.549	.392
TC	2.493	.401
LTA	2.038	.491
LCO2S1	1.74	.575
EPSC	1.274	.785
FA	1.187	.843
FCA	1.173	.853
INFL	1.165	.859
GDP_G	1.139	.878
VERA	1.125	.889
FMR	1.076	.93
Mean VIF	1.542	.

Table A4. Mediation results of ROA (For robustness of EPSE-FMR-ROA)

	ROA Model		
	ROA	ROA	FMR
EPSC	0.013 ** (0.001)	0.008 ** (0.001)	0.015 ** (0.004)
FA	−0.008 *** (0.002)	−0.007 *** (0.001)	0.007 *** (0.002)
LTA	−0.568 *** (0.018)	0.542 *** (0.041)	0.313 (0.221)
LEVG	−0.003 * (0.001)	−0.002 (0.002)	0.007 *** (0.002)
GDP_G	0.112 ** (0.046)	0.5413 ** (0.027)	0.199 ** (0.079)
INFL	−0.042 (0.024)	−0.008 (0.124)	−0.451 (0.41)
LRT	0.011 ** (0.005)	0.002 (0.005)	0.342 ** (0.015)
FMR		0.117*** (0.008)	
_cons	Yes	Yes	Yes
Obs.	2176	2176	2176
R-square	0.179	0.231	0.164
Sobel			0.002 ***
Aroian			0.002 ***
Goodman			0.001 ***
TME			0.213
IDE			0.361
TDE			1.242
Bootstrapping-IE			0.003 ***
Bootstrapping-DE			0.005**
Bootstrapping-TE			0.11 ***

Notes: TME (Total Mediated Effects); IDE (Indirect to Direct Effect); TDE (Total to Direct Effect); Bootstrapping-IE (Indirect Effect); Bootstrapping-DE (Direct Effect); Bootstrapping-TE (Total Effect); ( ) are standard errors; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

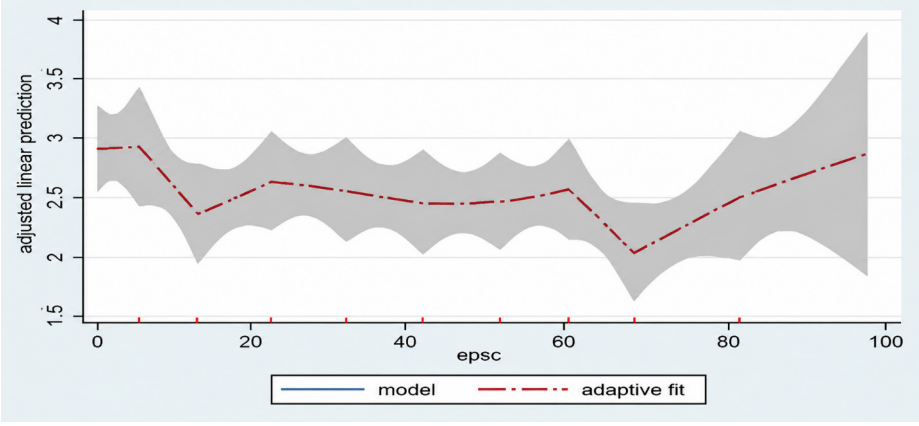


Figure A1. Linear Graphs EPSC-MTBV

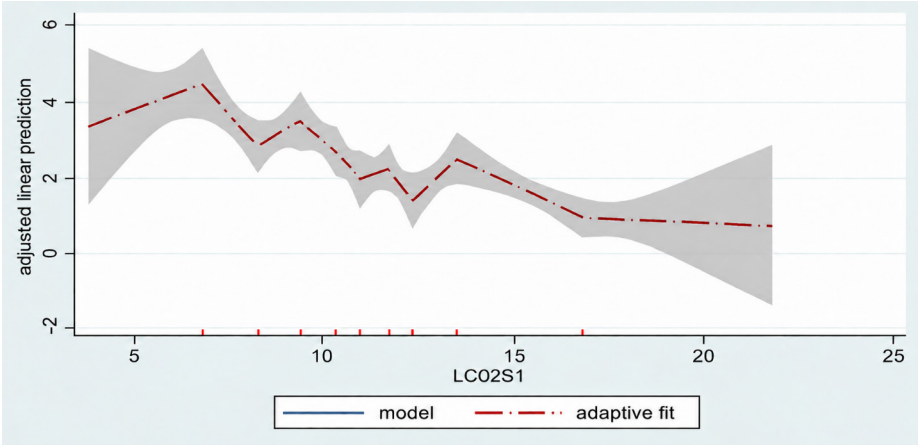


Figure A2. Linear Graphs LCO2S1- MTBV

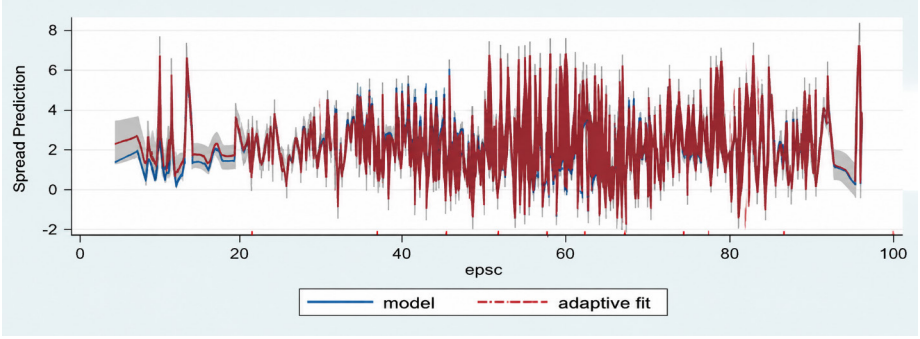


Figure A3. Linear Graphs overall model