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Carbon-Based Environmental Performance and Earnings Management in South African Carbon Emitting Companies

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Abstract: Objectives: This study investigates the association between carbon-related environmental performance and earnings management among firms listed on the Johannesburg Stock Exchange, addressing the growing need to understand whether environmental responsibility improves financial reporting quality or encourages opportunistic behavior. **Prior Work:** Prior research has predominantly focused on composite environmental, social and governance performance, with limited attention to carbon-related environmental performance, especially in developing countries and carbon-intensive firms where evidence remains inconclusive. **Approach:** The study adopts a quantitative panel data approach, analyzing 53 carbon-intensive companies over the period 2015-2024. Fixed effects and system generalized method of moments estimators were employed to address unobserved heterogeneity and potential endogeneity. **Results:** The results report a statistically significant negative relationship between carbon-related environmental performance and earnings management. The findings offer useful insights for investors, regulators and firm managers by demonstrating the role of environmentally responsible practices in strengthening transparent financial reporting and **Value:** This study advances existing literature by isolating carbon-related environmental performance from broader sustainability measures and provide context-specific evidence from a developing country, thereby providing more precise insights into the environmental performance-earnings management relationship.

Keywords: Earnings management; Ethical financial reporting; Financial reporting quality; Environmental performance; JSE carbon-intensive firms

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1. Introduction

Earnings management (EM) continues to attract attention in accounting research due to its implications for financial reporting credibility, reliability, transparency and investor confidence (Ghaleb, Qaderi, Almashaqbeh & Qasem, 2021; Gao & Zhang, 2021; Madwe, Matyana & Oluka, 2024; Primacintya & Kusuma, 2025;). Existing literature has predominantly investigated EM in relation to firm financial performance (FFP) (Zhou, Zhang, Yao & Lok, 2026; Al-Hawtmeh, Alleimoun & Obeidat, 2024; Dos Reis Cardillo, 2025), corporate governance (CG) mechanisms Banerjee, Akhtaruzzaman & Chatterjee, 2026; Hoai, Thu & Anh, 2026), and impression management practices (Liu & Zhao, 2025; Kayed & Meqbel, 2024; Madwe, Khanyile & Ngcubhe, 2024). Increasing environmental accountability has redirected scholarly attention toward the relationship between financial reporting quality (FRQ) and environmental performance (EP) (Palacios-Manzano, Gras-Gil & Santos-Jena, 2021; Bsoul, Almannouuri & Alrabba, 2025). Stakeholder theory posits that companies operate within a network of relationships with investors, regulators, communities and environmental interest groups whose expectations influence corporate behaviour and reporting practices (Awa, Etim & Ogbonda, 2024). As environmental accountability increases, stakeholders demand credible environmental disclosures alongside reliable financial reporting, thereby linking EP with FRQ (Awa et al., 2024). Limited studies have investigated the association between carbon related EP and EM, especially among carbon intensive industries in developing market (Li, 2026; Chouaibi & Zouari, 2022; Chih, Shen & Kang, 2008). Many previous studies focus on composite ESG performance, which often obscures the specific impact of carbon-related EP on financial reporting behaviour (Sun, Chen, Jiao & Fung, 2024; Palas, Gafni, Solomon & Baum, 2025). Given growing emphasis on climate change mitigation and carbon disclosure, investigating carbon-related EP independently provides more precise insights into how environmental responsible practices affect managerial reporting incentives. Therefore, it remains unclear whether firms with stronger carbon related EP engage in less opportunistic reporting due to improved transparency or whether environmental commitment provides reputational cover that facilitate earnings manipulation. This gap is especially evident in developing countries, where regulatory enforcement, stakeholder activism and disclosure regimes differ markedly from developed economies. As companies increasingly disclose carbon related and sustainability information, stakeholders rely on EP metrics to assess firm environmental responsibility and long-term performance (Dobre, Baba, Anton, Zamfirache & Aldea, 2025).

EP represents the extent to which companies alleviate the ecological impact of their operations, comply with environmental regulations and show natural resource utilisation (Alyahya & Agag, 2025). Strong EP is often associated with firm reputation, enhanced stakeholder trust and greater legitimacy, especially in

environmentally sensitive sectors (Matemane, Msomi & Ngundu, 2024). In carbon-intensive industries, environmental indicators have become prominent, as investors, communities and regulators scrutinize firm carbon emissions and environmentally responsible commitments (Siddique, Karim, Haque & Mia, 2026).

Despite the growing emphasis on environmental responsibility, and increased accountability may generate unintended financial reporting incentives. Companies operating in environmentally sensitive sectors often face substantial costs associated with environmental protection investments, GHG emission reduction activities and regulatory compliance (Naseer, Guo & Zhu, 2025). These financial pressures may create incentives for managers to ensure that reported financial performance aligns with stakeholder expectation regarding environmental responsibility. To maintain favourable stakeholder perceptions and demonstrate consistency between EP and financial performance; firms may engage in EM practices (Gerged, Zahoor & Cowton, 2024). In this case, financial reporting becomes a strategic instrument employed to align reported earnings with stakeholder expectations surrounding EP.

Prior studies on association between EP and EM remains mixed. Some researchers indicate that environmentally responsible companies exhibit higher reporting quality and reduced financial reporting opportunistic behaviour (Nguyen, 2022; Xi & Xiao, 2022; Abbas, Zhang, Bilal & Chengang, 2023; Gerged, Albitar & Al-Haddad, 2023; Elrazaz & Aljifri, 2026). Others contend that environmentally responsible initiatives may serve as reputational shields, enabling managers with greater discretion in earnings reporting while sustaining a socially and environmentally responsible image (Elrazaz & Aljifri, 2026). These contradictory results show the need for a clear theoretical explanation of how stakeholder pressures shape the EP-EM nexus.

Against this background, this study explores the relationship between carbon-related EP and EM in carbon-intensive companies listed on the JSE. Grounded on stakeholder theory (ST), the present study provides context-specific evidence on how stakeholder expectations, accountability pressure and reputational concerns influence corporate reporting behaviour. To investigate this association rigorously, this study operationalises EM using accrual-based EM estimated through the Modified Jones Model (1995). EP is measured using greenhouse gas (GHG) emission intensity, thereby measuring JSE carbon-intensive companies' carbon footprint rather than relying on aggregated ESG performance.

This study advances and extends existing literature in three ways. First, study advances sustainability reporting research by focusing specifically on carbon-related EP, moving beyond composite ESG scores that dominate existing literature. Second, the study contributes to the emerging literature on sustainability and financial reporting by examining how carbon-related environmental accountability influence earnings management behaviour. Third, the study provides evidence from carbon-intensive firms in a developing country, a context that remains underexplored despite

increasing global attention to environmental disclosure and climate-related reporting.

2. Theoretical Framework, Literature Review and Hypotheses Development

2.1. Theoretical Framework

This study employs stakeholder theory (ST) to establish the correlation between EM and EP within carbon intensive firms listed on the JSE. ST assumes that companies operate within a network of relationship involving shareholders, customers, employees, communities, regulators and environmental interest group, all of which shape corporate behaviour (Alsaadi, 2025).

According to ST, EP represents companies' responsiveness to environmentally responsible expectations (Mahajan, Lim, Sareen & Kumar, 2023). Strong EP signals commitment to environmentally responsible initiatives, regulatory compliance, which improves stakeholder trust and long-term value creation (Xie, Abbass & Li, 2024). In carbon intensive sectors, stakeholders increasingly demand transparent reporting of emission, resource usage and environmental impact (dos Reis Cardillo & Basso, 2025). Therefore, EP is associated firm reputation and access to critical resources.

However, ST recognizes that heightened environmental accountability can increase performance pressures (Sulemana, Cheng, Agyemang, Odei & Nagriwum, 2025). When stakeholders expect consistent financial success alongside strong EP, firms may experience incentives to ensure that reported earnings align with sustainability performance (Alessa, Akparep, Sulemana & Agyemang, 2024). EM practices may emerge as strategic response to stakeholder scrutiny, especially when environmental investments impose short-term financial losses (Amer, Azimli & Adedokun, 2025).

Under ST, two competing mechanisms may explain the association between EP and EM. First, companies committed to meeting stakeholder expectations may adopt higher FRQ standards, thereby constraining opportunistic earnings manipulation (Alessa et al., 2024). In this view, strong EP represents an ethical orientation and transparent corporate culture that discourages EM. Second, companies may engage in symbolic alignment, using discretionary accrual to present financial performance that support environmentally and socially responsible commitments and maintain stakeholder confidence (Sun & Li, 2025). In this context, EM serves as a reputational management instrument designed to protect stakeholder relationships (Deng, Di Vaio & Ong, 2025).

By grounding the analysis of the relationship between EM and EP in ST, this study conceptualizes EP as both signal of both accountability and a potentially source of reporting pressure.

2.2. Literature Review and Hypotheses Development

Recent researchers have predominantly focused on EP, especially carbon related sub pillar of ESG, to establish their financial consequences, association with CG mechanisms, and disclosure dynamics (Mai, Nguyen & Tran, 2021; Zhang & Liu, 2023; Zhang, Su & Meng, 2024; Al-Mari & Mardini, 2024; Oestreich & Tsiakas, 2024; Kim, Kim & Wee, 2025; Hernandez-Vega, 2025; Ganda & Milondzo, 2018; Madwe, Nzuza & Olarewaju, 2026; Kilic & Kuzey, 2018; Gaidosikova, Valaskova & Durana, 2022; Tessema & Ul-Hassan, 2024). However, empirical evidence on the relationship between EP and EM remains inconclusive. With prior research documenting mixed and sometimes conflicting results. This may suggest that the association between these variables may rely on contextual, regulatory and sector-specific dynamics.

One stream of literature proposes an opportunistic viewpoint. Abdelfattach and Elfeky (2021) contend that strong EP are exposed to increased stakeholder demands and incur significant implementation costs associated with environmentally responsible initiatives. These stakeholders' pressure may strengthen managerial incentives to present favorable firm performance to justify environmental protection investment and sustain reputational standing. Under this perspective, firms may resort to EM practices to align reported financial performance with environmental targets and stakeholder expectations (Abdelfattach & Elfeky, 2021).

Empirical evidence confirming this perspective is provided by Li (2026), who analyzed data from Key pollutant-discharging Chinese firms from 2010-2023 and reports positive relations between that EP and EM. This result shows that improvement in EP score may coincide with greater earnings manipulation. Similar conclusions are made by evidence by Borralho, Hernandez-Linares, Gallardo-Vazquez and Choban de Sousa Paiva (2022), Jian, He, Liu and Sun (2023) and Shi, Liu and Wu (2022), who argue that environmentally responsible initiatives can be used opportunistically to conceal operational shortcomings, divert stakeholder attention from unethical environmental activities, or legitimize questionable reporting practices. In this context, environmentally responsible practices serve as form of reputational licensing, allowing firms to engage in EM practices while maintaining an appearance of compliance and sustainability.

Conversely, a second stream of prior research adopts a disciplinary and legitimacy-based perspective. Elrazaz and Aljifri (2026) examine the relationship between ESG and EM within the Gulf Cooperation Council (GCC) region, revealing a negative

relationship between EP and EM. Similarly, Ehsan et al. [58] analysed the association between corporate social responsibility (CSR) and EM using manufacturing firms in Pakistan, revealing that strong EP is associated with a reduced EM. Furthermore, several studies in existing literature confirm negative association between EP and EM (Gerged et al., 2024; Nguyen, 2022; Xi & Xiao, 2022; Abbas et al., 2023; Adeneye, Fasihi, Kammoun & Albitar, 2024; Racapito, 2024; Soeprajitno, Na'im, Kusuma & Rakhman, 2024). Together, these studies suggest that firms committed to environmentally responsible practices are more likely to prioritize long-term value creation and transparent reporting, thereby reducing incentives to engage in opportunistic accounting behavior.

The disciplinary argument becomes especially compelling in carbon intensive sectors. Companies operating in polluting industries faced heightened regulatory oversight, intense public scrutiny and sustained stakeholder monitoring due to the environmental consequences of their operations (Shi et al., 2022). In such settings, inconsistency between EP and FRQ may trigger significant reputational and legitimacy costs. Therefore, carbon intensive firms with stronger carbon-related EP are likely to protect their credibility by avoiding EM that could compromise stakeholder trust (Song & Ma, 2025). Although the opportunistic point of view acknowledges that EP practices may offer a platform for impression management, the combined effects of regulatory visibility, monitoring intensity, and legitimacy concerns are expected to constrain such behavior in carbon intensive industries. This study advances the disciplinary perspective. It postulates that strong carbon-based EP serves as governance-enhancing mechanisms that mitigate EM. Therefore, the present study formulates the following hypothesis.

H1: Higher carbon-based environmental performance is negatively associated with lower EM in JSE carbon intensive companies.

3. Materials and Methods

3.1. Data Collection and Data Source

This research employs a purposive sampling technique focusing on JSE carbon emitting firm listed in South Africa. The initial population comprised 256 JSE listed firms across all sectors. From this population, a target population of 106 firms was identified by retaining only firms operating in carbon intensive industries, namely basic material, oil and gas, industrial and consumer goods because these sectors are characterized by high energy intensity, significant green gas (GHG) emissions, and greater exposure to environmental regulation and stakeholder scrutiny. This context is appropriate for examining the relationship between these variables. Following [63], this study refined the target population by selecting 50% of the top companies based on market Capitalization within the identified carbon emitting sectors. This

screening process resulted in a final sample of 53 carbon emitting companies listed on the JSE, as illustrated in Table 1. JSE-listed companies with relatively low direct carbon emission, particularly health care, consumer services, telecommunication, financials and technology were excluded to avoid structural heterogeneity and to maintain the environmental materiality necessary for analysis the association between carbon related EP and EM (Madwe & Nzuza, 2026).

Table 1. Sample Selection Process

Sampling stage	Description	Number of companies
Total population	All firms listed on the JSE across sectors	256
Target population	Companies operating in carbon-intensive sectors (basic material, oil & gas, industrials and consumer goods)	106
Market Capitalisation and final sample	Selection of the top 50% of firms based on market Capitalisation within the target population and JSE listed companies included in the study	53

Source: Author's own work

The choice of study period is guided by the availability of companies' annual reports for 10 years spanning from 2015 to 2024. The year 2015 is selected because of the timeline for launching ESG disclosures, and 2024 represents the most recent year for which data was available when the study was conducted, indicating the upper limit of the study period. The study employed a balanced structured econometric approach to explore the association between EP and EM. A correlation matrix was used to assess the preliminary relationship between EP and EM, and to detect potential multicollinearity. FE and RE regression models were estimated to control firm-specific heterogeneity, with the Hausman test applied to determine the most appropriate estimator. To address potential endogeneity, autocorrelation, and heteroskedasticity that FE and RE models may not fully capture, the study further employed the system GMM estimator to provide more robust results (Chawarura, Sibanda & Mamvura, 2025).

3.2. Variable Measurements

In line with prior research (Hassan, Romilly & Khadaroo, 2023), EP is applied as the independent variable and is measured using the GHG emission intensity reduction ratio (GHG). The present study focuses on Scope 1 and Scope 2 emissions (Xie, Qin & Li, 2024). Scope 1 emissions reflect direct GHG emission generated

from firm-controlled operation, while Scope 2 emissions measure indirect emissions associated with purchased electricity, heat, or steam consumption. These two scopes offer a reliable assessment of company's operational carbon management and energy related environmental efficiency within carbon intensive sectors (Liew & Cao, 2024).

Following (Liew & Cao, 2024), the GHG emission is calculated using the year-on-year ratio change in total GHG emission (kilotons). This metric is calculated as the difference between the previous year's total GHG emissions and the current year's total GHG emissions, divided by the previous year's GHG emissions. This metric measures the extent to which a company reduces its carbon emission over time. In consistent with Wang, Liu & Zhang (2022) and Xie et al. (2024), GHG emission data was collected from sustainability reports, ESG reports, annual reports and company websites.

The GHG emission indicator is calculated as

$$GHG_{it} = \frac{GHG_{i,t-1} - GHG_{i,t}}{GHG_{i,t-1}}$$

Where i represents firm and t the year.

Discretionary accrual (DA) is used as a proxy for EM in this study to assess the reporting quality. DA is a non-mandatory expense or asset recorded within the accounting system that has yet to be realized. The DA is calculated as total accrual (TA) minus non-discretionary accruals (NDA). Following [69] model of DA, the following DA model was applied for the study:

$$TA_t = \frac{\alpha_1}{A_{t-1}} + \frac{\alpha_2 \Delta Rev_t}{A_{t-1}} + \frac{\alpha_3 PPE_t}{A_{t-1}} + \frac{\alpha_4 CFO_t}{A_{t-1}} + \frac{\alpha_5 CFO_{t-1}}{A_{t-1}} + \varepsilon_t \text{ ..Equa (1)}$$

Where the NDA component is specified as follows:

$$NDA = \frac{\alpha_1}{A_{t-1}} + \frac{\alpha_2 \Delta Rev_t}{A_{t-1}} + \frac{\alpha_3 PPE_t}{A_{t-1}} + \frac{\alpha_4 CFO_t}{A_{t-1}} + \frac{\alpha_5 CFO_{t-1}}{A_{t-1}} \text{Equa (2)}$$

Where:

TA_t is total accrual calculated as net operating income (NOPI) minus cashflows from operations for each year t ($TA_t = NOPI_t - CFO_t$); NDA is the non-discretionary accruals for each year t; CFO_t (t - 1) is the cash flow from operation for each year t; ΔREV_t is the change in the revenue (from credit sales) for each year t; PPE_t is the Property, Plant and Equipment for each year t; A_{t-1} is the total assets at the end of period; ε_t is the random error, which is used as the estimate for EM (DA). The coefficients: $\alpha_1, \alpha_2, \alpha_3$ are estimates of firm specific parameters.

Control variables that have been included in the model to address any possible endogeneities linked to omitted variables. Prior research find evidence that robust CG mechanisms are associated with improve FRQ and reduced EM practices (Gavana, Gottardo & Moisello, 2023; Lun, Cheong, Hallak & Mihaylow, 2025; Amin, Mollah, Kamal, Zhao & Simsek, 2024; Marquez-Cardenas, Gonzalez-Ruiz & Duque-Crisales, 2022). This study identified board characteristics, namely board independence (B1), board tenure (BT) and board gender diversity (BGD) as the most prominent variable affecting EP (Gavana et al., 2023). BI is measured using the proportion of independent director on firm's board of directors, calculated as the percentage of independent directors among the total number of board members (Lun et al., 2025). BGD is proxied by the percentage of female directors on the board, representing the extent of gender diversity in CG structures (Amin et al., 2024). BT is the average number of years that that board members served on the board, and it reflects an important component of board structure by indicating the balance between accumulated organisation-specific knowledge, advisory effectiveness and governance oversight (Marquez-Cardenas, Gonzalez-Ruiz & Duque-Crisales, 2022).

3.3. Research Model

This study estimates a dynamic panel using system GMM, which is suitable for panel datasets characterized by firm-level heterogeneity, endogenous regressors, and persistence in the dependent variable. EM is modelled as a dynamic process because of current financial reporting behaviour may depend on prior reporting practices. Arellano and Bover (1995) and Blundell and Bond (1998) improved the Difference-GMM by combining the difference and level equations to make a system GMM. System GMM employs lagged levels instruments for first difference and second equation: $Y_{it} = \alpha y_{it-1} + \mu_{it} + \varepsilon_{it}$, especially when variables are persistent. Prior research employed system GMM to explore similar dynamics in EP-EM, refereeing the suitability and reliability of the model specification (Gokhale & Pillai, 2024; Madwe, 2026). The following econometric model specification was used to establish the relationship between EP and EM.

$$EM_{it} = \alpha EM_{it-1} + \beta_1 GHG_{it} + \beta_2 BI_{it} + \beta_3 BGD_{it} + \beta_4 BT_{it} + \mu_{it} + \lambda_{it} + \varepsilon_{it} \dots \text{Equa (1)}$$

Where α indexes the coefficient of lagged dependent variable (EM), $\beta_1 - \beta_4$ capture the effect of EP and control variables on EM respectively, i represents JSE firm and t indexes years. EM_{it} is the level EM in JSE firm i at time t , EM_{it-1} indexes period lag of EM, measuring the dynamic persistence of financial reporting behaviour. GHG_{it} denotes EP, while BI_{it} , BGD_{it} , & BT_{it} represent BI, BGD and BT respectively. μ_{it} denotes unobserved firm-specific effects, λ_{it} measures time-specific effects, and ε_{it} indexes the idiosyncratic error term.

4. Results and Discussion

4.1. Descriptive Statistics

Table 2 reports the summary descriptive statistics for dependent, independent and control variables based on 530 firm-year observations obtained from 53 JSE carbon-intensive firms over period 2015-2024. Table 2 provides a preliminary overview of the variability and central tendencies of the study's variables to understand the data distribution and its influence on EM. The average of EP across the panel is 3.1%, ranging from -12.5% to 50.9%, suggesting that JSE carbon-intensive companies achieved modest reduction in GHG emission and notable variation in EP over the study period. These results are in line with findings of Khan, Serafeim and Yoon (2024), who found that some companies experienced increases in GHG emission intensity, while others achieved significant reduction.

On average the EM level in the sampled firms is 7.2%, with values ranging from -21.5% to 35.4%. This reveals that some sampled companies engage in income-decreasing while others apply income-increasing accrual techniques, indicating the presence of managerial discretion in financial reporting in these companies, consistent with the findings of Elrazaz and Aljifri (2026), Gokhale and Pillai (2024) and Le, Nguyen and Doan (2023). Among the CG mechanisms, in terms of board independence (BI), study shows that on average firms have 62.3% of non-executive directors serving on corporate boards. The results indicate that JSE carbon-intensive firms have most non-executive directors which may improve corporate board's ability to objectively monitor and constraints managers' financial reporting opportunism and encourage transparent and credible financial reporting practices. Table 2 shows that only 28.7% of corporate board members are female serve on JSE carbon-intensive firms' boards, with female representation ranging from 0% to 60%, suggesting that female representation on boards remains relatively low and uneven across the sample. On average BT is 7 years and one month, with years ranging from 1 year and two months to 18 years and five months. This shows some companies have relatively new board members, while others retain long-serving members.

Table 2. Table Captions Should always Be Positioned above the Tables on the Left

Variable	Obs	Mean	Std. dev	Min	Max
EM	530	0.072	0.061	-0.215	0.354
GHG	530	0.031	0.082	-0.124	0.509
BI	530	0.623	0.183	0.250	0.920
BGD	530	0.288	0.143	0.000	0.600
BT	530	7.114	3.862	1.200	18.400

Source: Author's own work

4.2. Correlation Matrix Results

Table 3 presents the correlation matrix among the study variables, offering preliminary insights into the association between EP and EM, and CG mechanisms.

The correlation results indicate that GHG emission reduction, used as a proxy for EP, is negatively and significantly associated with EM ($\beta=-0.162$, $p < 0.01$). This evidence suggests that firms with strong EP tend to exhibit lower levels of EM practices. The implication is that firms committed to reducing their environmental impact may also exhibit more transparent and responsible financial reporting practices, supporting the view that sustainability-oriented firms are less likely to manipulate earnings.

With regards to control variables, BT is negatively and significantly associated with EM ($\beta=-0.119$, $p < 0.05$). This suggests that board with a higher proportion of non-executive directors strengthen oversight and monitoring of managerial activities, thereby discouraging opportunistic financial reporting behaviour. Similarly, BGD shows a negative and significant correlation with EM ($\beta= -0.105$), $p < 0.05$), indicating that greater female representation on board may contribute to improve governance quality and more ethical financial reporting practices.

Conversely, BT exhibits a weak but positive correlation with EM ($\beta=0.076$, $p < 0.10$), suggesting that longer-serving directors may slightly be associated with higher levels of EM. One possible explanation is that extended tenure may lead to familiarity between directors and management, potentially weakening BI and oversight effectiveness.

The correlations among the independent and control variables are generally low to moderate. All correlations matrix among independent (GHG) and control variables (BI, BGD and BT) are below threshold of 0.8 applied to establish multicollinearity. This indicates that each variable measures a unique dimension of EP and CG, thus all variables are kept for subsequent regression analysis.

Table 3. Correlation Matrix Results

Variable	EM	GHG	BI	BGD	BT
EM	1				
GHG	-0.162***	1			
BI	-0.119**	0.083*	1		
BGD	-0.105**	0.041	0.014	1	
BT	0.076*	-0.028	0.037	0.013	1

Source: Author's own work

4.3. Empirical Results and Discussion

Table 4 presents the regression results investigating the correlation between EP and EM, while controlling CG mechanisms. The study begins with traditional panel estimations using FE and RE models. To determine the most appropriate estimator, the Hausman test was performed. The Hausman test results documented in Table 4 ($X^2 = 18.74$, $p = 0.009$), the p-value is below the 5% significance level, leading to rejection of the null hypothesis, suggesting FE more suitable for providing consistent estimates. Therefore, the FE estimator is employed as the suitable static panel estimator and is adopted to offer preliminary assessment of the association between EP and EM.

The FE findings shown in Table 4 reveal that EP, proxied by GHG emission reduction is negatively and statistically significant ($\beta = -0.142$, $p < 0.05$). This result indicates that companies with stronger GHG emission reduction performance are less likely to engage in EM practices. Table 4 shows that, a one-unit improvement in GHG emission reduction is associated with a reduction of 0.142 in EM. The study's findings suggest that companies actively committed to environmentally responsible activities tend to adopt more transparent and credible financial reporting practices. These results are consistent with prior research on sustainability performance and FRQ (Hamed, 2025; Bag, Srivastava, Gupta, Sivarajah & Wilmont, 2024), who documented that companies with stronger environmental performance show lower level of earning manipulation.

Among the CG variables, BI reveals a negative and statistically significant correlation with EM ($\beta = -0.167$, $p < 0.05$). This implies that companies with a higher proportion of independent directors on their boards strengthen monitoring and oversight over management financial reporting decisions, thereby constraining opportunistic reporting behaviour. These results are with Singh (2025), who revealed that stronger board independence enhances FRQ and mitigates EM.

BGD also exhibits a negative and marginally significant relationship with EM ($\beta = -0.049$, $p < 0.10$). Although the relationship is weaker, results suggest that the greater presence of female on boards may improve ethical reporting, enhanced monitoring and corporate board effectiveness. These results are consistent with existing literature (Singh, 2025; Satrio, 2026), who found that the presence of female on board strengthens governance quality and reduces EM practices.

Conversely, BT shows a positive but statistically insignificant association with EM ($\beta = 0.011$, $p > 0.10$), indicating that the length of time directors serve on the board does not influence EM in JSE carbon-intensive companies. While longer BT may improve directors' experience and firm-specific knowledge, it may also reduce board independence due to familiarity with management (Gavana et al., 2023).

Although FE model controls for time-invariant heterogeneity, it may inadequately resolve potential endogeneity concerns. Endogeneity can arise from reverse causality or omitted time-varying factors (Mai, Pham, Van Pho, Phan & Nguyen, 2025). In our case, one problem is that the association between EP and EM may operate in both directions. This means that while improvement in carbon emission reduction (EP) may discourage opportunistic financial reporting, companies that engage in EM could also strategically present environment disclosure to enhance their reputation. This potential feedback effect indicates that EP may be endogenous, where changes in EM may also influence companies' environmentally responsible strategies or reporting behaviour. If such reverse causality exists, traditional panel model such as FE or RE may produce biased and inconsistent estimates. Moreover, EM practices may show persistence overtime, implying that previous year EM practices could shape the current year FRQ. However, including the lagged dependent variable in FE model may introduce the Nickell bias, which occurs from the correlation the lagged dependent variable (EM) and the error term when the time dimension of the panel is small. In this context, the panel comprises of 53 JSE firms ($N=53$) and observed over 10 years ($T=10$), which reflects short panel structure where the dynamic panel bias may be non-negligible (Alalmaee, 2026). To address these potential econometric limitations, the present study used the system GMM model, which is widely regarded as an appropriate approach for analysing dynamic panel data with potential endogeneity (Mai et al., 2025; Alalmaee, 2026; Farzana, Samsudin & Hasan, 2024). The system GMM is more appropriate for the current study because of relatively small time periods and the potential endogeneity of the regressors.

The system GMM results shown in Table 4 support the robustness of the baseline results. EP remains negatively and statistically significant ($\beta = -0.121$, $p < 0.05$), suggesting that companies with stronger environmental responsibility are less likely to engage in opportunistic financial reporting practices. The study's findings support the disciplinary perspective proposed by stakeholder theory, which postulates that companies committed to environmentally responsible activities tend to adopt more transparent financial reporting practices and avoid EM practices (Alsaadi, 2025; Mahajan, Lim, Sareen & Kumar, 2023; Xie, Abbass & Li, 2024). The findings also align with prior research revealing a negative correlation between EP and EM (Gerged et al., 2024; Nguyen, 2022; Xi & Xiao, 2022; Abbas, Zhang, Bilal & Chengang, 2023; Adeneye et al., 2024; Racapito, 2024; Soeprajitno et al., 2024).

However, these results contradict the opportunistic perspective suggested in some earlier studies that companies may strategically use environmental responsible practices to conceal EM practices or maintain reputational legitimacy (Li, 2026; Borralho et al., 2022; Jian et al., 2023; Shi et al., 2022). Within the context of carbon-intensive firms, the study's findings indicate that stronger regulatory scrutiny and

stakeholder monitoring reduce the likelihood that environmental responsibility activities are employed as reputational cover for financial reporting manipulation.

The dynamic specification also exhibits that the lagged dependent variable, EM (L1), is positive and statistically significant ($\beta = 0.263$, $p < 0.05$), suggesting persistence in EM practices over time. This finding means that for every 1% increase in previous year's EM, the current year EM increased by 26.3%, suggesting higher EM practice in the past seems to lead to increase in EM levels in the current year [86].

Among the control variables, BI is negative associated with EM ($\beta = -0.058$, $p < 0.10$), indicating that stronger board oversight may constrain managerial opportunism. BGD shows a positive but statistically insignificant association with EM ($\beta = -0.041$, $p < 0.10$), while BT exhibits a positive but insignificant relationship with EM ($\beta = 0.007$, $p < 0.10$).

The diagnostic tests collectively support the reliability of the system GMM model and the reliability of the empirical results. The Arellano-Bond test for first-order serial correlation AR(1) is significant ($p = 0.019$), while the AR(2) test is insignificant ($p = 0.432$), revealing the absence of second-order serial correlation in the residuals. In addition, the Hansen test ($p = 0.284$) and Sargan test ($p = 0.097$) confirm that the instruments adopted in the model are valid and appropriately specified.

Overall, these results provide strong support for *Hypothesis H1*, confirming that higher carbon-based EP is significantly associated with lower EM among JSE carbon-intensive companies. The findings reinforce the disciplinary role of environmental responsibility in strengthening firm accountability and enhancing FRQ.

Table 4. Hausman Test, FE and System GMM Results

Variables/Tests	Hausman Test	EM (FE)	EM (SGMM)
Model selection test			
Chi-square (X^2)	18.74	-	-
Degree of Freedom	4	-	-
Probability > X^2	0.0009	-	-
Decision	FE preferred	-	-
Regression results			
EM (L1)	-	-	0.263**
GHG	-	-0.142**	-0.121**
BI	-	-0.167**	-0.058*
BGD	-	-0.049*	-0.041

BT		0.011	0.007
Constant	-	0.214**	0.193*
Observations	-	530	530
sigma_u	-	0.037	-
sigma_e	-	0.052	-
Rho	-	0.336	-
AR(1) p-value	-	-	0.019
AR(2) p-value	-	-	0.432
Hansen Test (p-value)	-	-	0.284
Sargan Test (p-value)	-	-	0.097
Notes: *** p < 0.01, ** p < 0.05, * p < 0.10.			

Source: Author's own work

5. Conclusion

This study investigated the relationship between carbon-related EP and EM among 53 JSE carbon-intensive firms over period 2015-2014. Motivated by growing stakeholder expectations regarding corporate environmental accountability and the increasing integration of sustainability metrics into corporate disclosure practices, the study investigated whether environmental responsible initiatives discipline EM practices or s or facilitates opportunistic financial reporting behaviour.

The study employed FE, Hausman test and system GMM to address unobserved heterogeneity, endogeneity, and dynamic panel bias. The Hausman test supports the suitability of the FE model, while system GMM account for potential reversed causality and persistence in EM. The study measured EP using GHG emission intensity ratio, and EM is proxied using DA from the Modified Jones Model. This study successfully shows that consistent findings across all model estimates, reporting that companies with stronger EP engage less in EM practices. This empirical evidence supports the disciplinary perspective of stakeholder, indicating that environmentally responsible activities reinforce transparency and FRQ than allowing managers to engage in EM practices. This study demonstrates that firms' managers are motivated to reduce practices that could undermine stakeholder and financial reporting quality, such as EM manipulation. Notably, the dynamic specification shows persistence of EM, highlighting that prior year EM practice continues to influence the current year EM levels.

The impact of governance is also eminent, BI appears as one of significant CG mechanisms limiting EM practices, supporting its efficacy in improving monitoring and constraining opportunistic financial reporting behaviour.

The robustness of these findings across multiple approaches further reinforces the

reliability of the results.

From a theoretical perspective, the study contributes to the existing literature by offering granular evidence that disaggregated EP indicators apply a meaningful influence on firm financial reporting incentives. By moving beyond aggregate ESG, the study provides a more precise and contextually relevant understanding on the impact of EP on FRQ. The study's results advance stakeholder theory by showing that companies facing heightened environmental scrutiny such as JSE carbon-intensive firms are more likely to align their environmentally responsible initiatives with FRQ, prioritising long-term legitimacy over short-term opportunistic benefits.

Practically, the findings have significant implication, for investor, carbon-related EP emerges as credible and decision-relevant signal of reported earnings quality and reliability. For regulators and standard setters, the study's results highlight the importance of strengthening EP disclosure frameworks and including environmental indicators into financial reporting oversight mechanisms. For firm boards, the empirical evidence underscores the strategic value of integrating environmentally responsible activities within CG structures to reinforce ethical financial reporting.

Despite study's contributions, the present study has several limitations. The on carbon-intensive companies listed on the JSE may limit the generalisability of findings across industries and countries. The reliance on GHG emission as an indicator for EP, while suitable for the sampled firms, does not measure broader environmental dimensions such as resource use efficiency and waste management impact. Furthermore, the adoption of accrual-based EM may not fully represent real earning activities manipulation. Therefore, future studies should extend this analysis across different institutional settings, including multidimensional environmental proxies, and to use integrated indicators of EM. Further investigation of CG mechanisms, such as board environmental expertise, sustainability/ESG committees and board compensation would offer deeper insight into governance-environmental-financial reporting relationships.

This study advances emerging literature on the relationship between EP and EM by highlighting that stronger EP is associated with reduced EM practices in JSE carbon-intensive companies.

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