International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

The Impact of Greenhouse Gas (GHG) Emissions on Firm Financial Performance

Authors:

Mziwendoda Cyprian Madwe (madwem@unizulu.ac.za)
Durban University of Technology, Durban, South Africa

Zwelihle Wiseman Nzuza
Durban University of Technology, Durban, South Africa

Odunayo Magret Olarewaju
Durban University of Technology, Durban, South Africa

Abstract:

The impact of greenhouse gas (GHG) emission reduction on firm financial performance is increasingly contested in prior research and there remains a lack of agreement regarding this relationship. This highlights the unanswered question of whether environmental protection investment pays off. This study investigates the association between greenhouse gas (GHG) emission and firm financial performance of 58 high-polluting companies listed on the Johannesburg Stock Exchange (JSE). The study employed a two-step system generalized method of moment (SGMM) to analyse the relationship between GHG emissions and firm financial performance. Our study reports no statistical association between greenhouse gas (GHG) emission reduction initiatives and firm financial performance of high-polluting companies listed on the Johannesburg Stock Exchange. This paper recommends that firms in high polluting intensify carbon emission reduction initiatives as a long-term investment that can improve competitive advantage and resilience to greenhouse gas emission related risks. We suggest that tax incentives and supportive regulatory mechanisms to offset the short-term financial costs associated with adoption of carbon emission reduction strategies to align firm pollution abatement practices with sustainable development goals.

Keywords:

Environmental Protection Investment, Financial Performance, Greenhouse Gas Emissions, Pollution Abatement Practices, Sustainable Development Goals

Submitted: 2025-10-11. Revised: 2025-10-26. Accepted: 2025-11-05.

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

Introduction

With escalating global temperature due to climate change, there is growing global threat to both human health and firm sustainability (Parums, 2024; Psistaki, Tsantopoulos & Paschalidou, 2024). Greenhouse gas (GHG) released into the atmosphere by companies' operations cause global climate change (Psistaki et al., 2024). Climate change is associated with adverse consequences including increased public health stress, reduced availability and quality of portable water, the spread of infectious diseases, damage to infrastructure, and food insecurity (Ashrafuzzaman, Gomes & Guerra, 2023). The corporate intensity GHG emissions may also expose companies to financial vulnerability through regulatory penalties, operation disruptions, reputational risks and increase adaptation costs, thereby negatively impacting firm financial performance (Abbass, Qasim, Song, Murshed, Mahmood & Younis, 2022).

GHG emissions reduction is an environmental responsibility practice to protect environment and address worst impacts of climate change. One of the goals of United Nations sustainable development goals (SDGs) is to decrease the global carbon dioxide emission to 45% by 2030 and reach net zero by 2050 to control global warming to 1.5℃ above preindustrial levels (Rogelj et al., 2018; United Nations, 2025). Companies are increasingly implementing carbon emission reduction strategies to mitigate GHG emissions. Firms are now aware of their environmental responsibilities towards the planet before considering profit maximization, due to their substantial impact of their operation on the environment (Hamdi, 2023). This awareness has led the firm to focus on GHG emission reduction strategies to address global concern over climate change.

Liu, Zhou, Lu and Hu (2021) assert that implementation of GHG emission reduction strategies significantly influences firm financial performance. However, it is important to take cognisance of initial investment costs associated with the implementation of GHG emissions reduction strategies that may be expensive and may not immediately translate into tangible financial benefits (Le & Nhuyen-Phung, 2024). Given the importance of financial benefits expected from investment in GHG emissions reduction practices, the impact of GHG emissions intensity on firm financial performance remains a subject of interest.

Despite considerable number of studies support financial benefits of adopting GHG emissions reduction strategies, its effects on financial performance of South African high polluting firms listed on the JSE have received little attention (Ganda & Milondzo, 2018). Moreover, the research conducted by Ganda and Milondzo (2018) only focused on one year period (2015) and employed regression models that do not capture unobserved variables. It is also observed from prior research that many studies focus on developed countries, little attention has been paid on developing countries, particularly in South African polluting companies. These limitations can influence the credibility of the results. For instance, a one-year analysis may not adequately represent nature of this relationship over time, and simple econometric

models may not control unobserved variables, leading to overstated or understated relationship between GHG emission reduction strategies and firm performance. This study seeks to investigate the impact of GHG emission intensity on financial performance while addressing limitations observed in prior research. This study contributes to the body of knowledge by addressing shortcomings in prior research by applying a two-step systems GMM to establish the effects of GHG emission intensity on firm financial performance over a period of 9 years (2015-2023). Our study analyses dataset of 522 firm-year observation using annual reports of 58 polluting companies listed on the JSE in South Africa.

Previous studies have produced both negative and positive relationship between GHG emission reduction and firm financial performance (Busch & Lewandowski, 2018; Busch et al., 2020; Trinks, Mulder & Scholtens, 2020; Galama & Scholtens, 2021). Given these contradictory results, the consensus has not reached on whether the implementation of GHG emission reduction investment is profitable. These conflicting results may be attributed to firm characteristic, methodological approaches and employing different financial indicators and time dimensions.

Our study contributes to the literature regarding GHG emission-firm financial performance nexus in the following aspects. First, this study offers empirical insights into the impact of GHG emission on firm financial performance of high polluting companies listed on the JSE. Second, to the best of our knowledge, our study is one of the few investigating this relationship in South African high polluting companies using a three-stage structured MSCI and LSEG ESG scoring methodology to estimate GHG emission performance. The study's results highlight that the firm engaging in GHG emission reduction strategies may not immediately realise financial gains due to upfront costs associated with its implementation. We encourage companies to consider environmental responsible initiatives as a strategic asset that contributes to long-term financial stability, especially if it is not considered as compliance exercise. This paper also encourages policymakers to introduce tax incentives that can offset short term costs of implementing GHG reduction initiatives to encourage its greater acceptance and implementation.

The remainder of this paper is structured as follows: Section 2 presents theoretical framework underpinning the study, the relevant literature on the impact of GHG emission intensity on firm financial performance and proposes hypothesis. Section 3 discusses research methodology. Section 4 provides empirical findings and section 5 concludes the paper.

Theoretical Framework

Stakeholder Theory

Stakeholder theory is based on the idea that firms should consider the interests of stakeholders and shareholders by creating value for all stakeholders (Mahajano, Lim, Sareen & Kumar, 2023). Firms are

required to consider any individual which influences or is influenced by the achievements of firm's objectives and their associated consequences (Awa, Etim & Ogbonda, 2024; Chonco, Madwe & Zungu, 2024). This theory asserts that while firms operate to provide benefits for themselves, they must also provide benefits to stakeholders (Freeman, Dmytriyey & Phillips, 2021; Madwe, Matyana & Oluka, 2024). Communities are also considered stakeholders, and their interests in the company is related to environmental considerations (Seroka-Stolka, 2023). Given the increased expectations and pressures from stakeholders, companies are facing challenges to enhance climate change performance while achieving financial goals (Mardini & Lahyani, 2023).

This theory suggests that by addressing the needs and concerns of these diverse stakeholders, companies can build stronger relationships, reduce conflict, and improve their long-term performance. In environmental, social and governance (ESG) research, stakeholder theory emerges as theoretical bridge, connecting and constructing with other influencing factors, contributing significantly to the academic realm. The relationship between GHG emissions reduction and financial performance can be explained via the adoption of stakeholder theory.

Literature Review and Hypothesis Development

The impact of corporate environmental performance on firm financial performance has been a crucial point of continuous debate during the second half of the 20th century. At the center of this scholarly debate is Porter's hypothesis, which claims that environmental protection investment (EPI) enhances firm financial performance (Poerter, 1991; Porter & Linde, 1995). According to this postulation, environmental pollution reduction costs should be considered as innovative investment in environmental technologies rather than financial burdens (Le & Nguyen-Phung, 2024). Firms embracing EPIs may develop new innovative carbon reduction strategies, enhance company operational efficiency, improve market differentiation, thereby achieving corporate financial performance (Sarfraz, Ozturk, Yoo, Raza & Han, 2023).

EPIs should not be considered as regulatory compliance measures imposed by external pressures. According to Ziegler, Busch, Hoffmann, 2011), firms that adopt and implement environmental pollution abatement practices (EPAP) into their core corporate strategies may curb input consumption, reduce operational expenditures, and maintain competitive advantage over their competitors. EPIs may also lower environmental compliance costs, decrease environmental liabilities and help to reduce capital costs (Pang, 2018; Dechezlepretre, Kozluk, Kruse, Nachtigall & De Serres, 2019). This implies that companies that adopt GHG emission reduction strategies can enhance firm reputation, build stakeholder trust and differential themselves in the market, which ultimately improve corporate profitability (van Emous, Krusinskas & Westerman, 2021).

Prior research supports this relationship between environmental and financial performance (Gallego-Alvarez et al., 2015; Misani & Porgutz, 2015; Worae & Ngwakwe, 2017; Dzomonda & Fatoki, 2020; Siddique et al., 2021; van Emous et al., 2021; Ganda, 2022; Tang, Yue, Ma & Zhang, 2022; Al-Mari & Mardini, 2024; Alyahya & Agrag, 2025). Tang et al. (2022) investigated the relationship between environmental protective practices and firm financial performance (measured by ROA and Tobin's Q) among Chinese manufacturing firms and reported a positive association. In the same vein, Misani and Porgutz (2015) and Al-Mari and Mardini (2024) found that greenhouse gas emission reduction strategies enhance firm financial performance across international firms. Gallego-Alvarez et al. (2015), Siddique et al. (2021), and Li et al. (2017) also explored the relationship between carbon abatement strategies applying diverse econometrics models namely fixed effects, ordinary least squares (OLS) and a two-stage least squares (2SLS) regression. These researchers observed that environmental protection reduction strategies improve firm value through reduced compliance costs, enhance reputational gains, and operational efficiency benefits. Furthermore, Alyahya and Agag (2025) applied the generalized method of moments (GMM) to 2 745 firm-year observations of 305 U.S. firms listed on the Standard and Poor's (S&P) during 2015 to 2023, reporting a positive correlation between environmental performance and financial performance (ROA and TQ),

Hower, some researchers contest this optimistic perspective, suggesting that the short-term financial burden of integrating environmental protection strategies may outweigh expected immediate financial benefits (Delmas, Nain-Birch & Lim, 2016; Ganda & Milondzo, 2018; Busch, Bassen, Lewandowski & Sump, 2020; Liu, Zhu & Sun, 2022; Pullino, Mirella, Barbara & Luigi, 2022; Chou, Yang & Schwarz, 2025). These researchers reported that high upfront costs associated with environmental abatement investment can reduce firm financial performance, especially in capital-intensive industries such as manufacturing, construction and mining that environmental protection practices require significant capital expenditure. These studies argue that while long-term may exist, short-term financial benefits can be challenged by the substantial investment demanded for environmental protection practices. Researchers from developing countries such as China and Indonesia have also found a negative association between greenhouse gas emission reduction and firm financial performance (Zhang et al., 2022; Liu et al., 2022).

Contradictory findings in existing literature shoes that contextual variables, including regulatory stringency, market maturity, and green tax incentives may moderate the EPI- firm financial performance nexus (Markus, Geyer, Rathgeber & Stockl, 2018; Khatib, Ismail, Salameh, Abbas, Bazhair & Sulimany, 2023).

In South African context, there is limited research analysing this relationship (Worae & Ngwakwe, 2017; Dzomonda & Fatoki, 2020; Ganda, 2022; Madwe, Nzuza & Olerawaju, 2025). Worae and Ngwakwe

(2017), Dzomonda and Fatoki (2020) reported Ganda positive association between corporate environmental performance and financial performance among firms listed on JSE. However, these studies observed this relationship in a short-time frame and applied simple regression models (feasible generalised least squares and Granger) that may not adequately measure dynamic long-term effects. In contrary more recent study conducted by Madwe, Nzuza and Olarewaju (2025) in environmental polluting companies listed on the JSE, revealed negative relationship in polluting companies and noted that environmental protection practices negatively influence firm financial performance.

Dai and Wang (2020) examined the impact of firm environmental performance and reported no relationship.

Noteworthy, the limited studies conducted in South Africa, a developing country with high GHG emission intensity highlights the urgent need for extending body of knowledge in context specific that addresses methodological limitation, short study period and ignored financial indicators such as EPS.

Building on this research gap, the authors of this study posit that firms that adopt and implement environmental responsible practices into their core business strategies are more likely to maintain stakeholder confidence, avoid unbearable penalties and fines emanating from environmentally irresponsible behaviour, thereby enhancing firm performance. Observed prior research shows a tendency towards a positive relationship between environmental protection practices and firm financial performance, despite mixed short-term results. It is therefore observed that companies that adopt environmental responsible practices may enhance stakeholder confidence, enhance reputational benefits, and minimise regulatory compliance costs, thereby contributing to firm profitability over time. Therefore, building on Porter Hypothesis and the prior studies analysed, our study proposes the following hypothesis:

Hypothesis H1*: There is a significant positive relationship between GHG emission reduction and firm financial performance (measured by EPS and TQ).*

Methods and Data

This study applied a two-step system GMM to explore the impact of GHG emission reduction on firm financial performance. Following Pulino et al. (2022), this study employed GHG emission reduction ratio to capture GHG emission performance on a year-over-year basis. In consistent with Delmas et al. (2016) our study focuses on scope 1 and scope 2 of GHG emission, since scope 3 is not affected by environmental regulation and not significant cost-driver.

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

Sample Selection and Data Collection

In line with prior research, this present study used data sourced from company's annual reports and sustainability/ESG reports available on the websites of polluting companies listed on the JSE over the period of 2015 to 2023 (Misani & Porgutz, 2015; Dechezlepretre et al., 2019; Khatib et al., 2023; Seytaningsih & Wibowo, 2024). GHG emission data was extracted from companies' sustainability/ESG reports. An initial sample comprises 114 JSE-listed polluting companies, however, only 50% of the top companies in each sector are selected based on market capitalisation, revenues and profits margins. Table 1 shows the final sample comprising 58 pollution companies listed on the JSE over a period of nine years (2015-2023). Table 1 categorises sample into four sectors namely, basic material/mining, industrial, oil & gas production and consumer goods. The sectors were included in the sample due to their significant carbon emissions generated from their operation or production, thereby making GHG emission reduction strategies more applicable in the firm's performance. The study period (2013-2023) is selected to address the sample period limitation observed in prior research, where many researchers focused either before the 2015 Paris Agreement or over short sample period that limit analysis of long-term impact (Dechezlwpretre, Kozlik, Kruse, Machtigall & De Serres, 2019; Al-Mari & Mardini, 2024, Chou et al., 2025; Shmelev & Gilardi, 2025).

Sector	**Number of companies per sector**	**50% of the top companies in the population**	**Companies included in the sample**
Basic Material/Mining	45	50%	23
Consumer Goods	20	50%	10
Industrial	46	50%	23
Oil & Gas Production	3	50%	2
Total	**114**	**50%**	**58**

Table 1: Polluting companies listed on the JSE included in the sample

Variable Measurement

Financial performance as the dependent variable was measured by earnings per share (EPS) and Tobin's Q (TQ). In line with prior research (Ahmad, Mobarek & Roni, 2021; Chen & Guanxia, 2022; Chawarura, Sibanda & Mamvura, 2025; Chau, Anh & Duc, 2025) EPS was employed to reflect changes in profitability and shares. EPS was adopted to capture short-term financial performance and to offer insight into profits attributable to each outstanding shareholder financial returns. TQ is widely applied as

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

one of market-based performance indicators which captures the expected firm performance (Ooi, Goh, Yeap &Loo, 2018). TQ is essential financial indicator to measure investor perceptions and market expectations. TQ is calculated by dividing the market value of the firm by the replacement value of its assets.

In line with prior research, our study includes firm size, age, growth and leverage as the control variables (Chawarura et al., 2025; Hamdi, Guenich & Saada, 2022; Pastor, Stambaugh & Taylor, 2022; Shan, Song & Song, 2024, Bamel, Khatri, Bamel & Kumar, 2025). These variables, their description and formula are shown in Table 2.

Independent Variable: GHG Emission			
Variable	**Description**	**Formula**	**Prior research**
GHG Emission	Measures extent to which the firm reduces its GHG emission overtime (GRI 305 and CDP Climate reporting)	GHG Ratio $\frac{GHG_{t-1} - GHG_t}{GHG_{t-1}}$	Ganda (2022), Gerged, Baddewela and Cowton (2021) and Hasan, Waghule, Al-Koliby, Al-Bukhranu, Al Haifi and Hasan (2024)
	Sectoral normalisation	χ_i,GHG $= \frac{GHG_{i,t} - min_{J\epsilon p\,(s)}\, GHG_{j,t}}{max_{j\epsilon P\,(s)}\; GHG_{j,t} - min_{j\epsilon P}\, GHG_{j,t}}$, χ_i,GHG	(MSCI ESG Research LLC (2024) and LSEG DATA & ANALYSTICS (2024).
	Weight assignment and aggregation	$\varpi_{GHG} = \frac{\varpi_{GHG}}{\varpi_{GHG} + \varpi_{Innov} + \varpi_{Res}}$ $\frac{0.16}{0.16 + 0.03 + 0.16} = 0.4571$	MSCI ESG Research LLC (2024) and LSEG DATA & ANALYSTICS (2024).
	GHG emission score	$GHG_{i,t} = \varpi_{GHG} \cdot \chi_{i_{GHG}}$	MSCI ESG Research LLC (2024) and LSEG DATA & ANALYSTICS (2024).
	Dependent Variable: Financial Performance		
Variable	**Description**	**Formula**	**Prior Research**
EPS	measures shareholder value and firm profitability on a per-share basis	EPS $\frac{Net\ Income - Preference\ Dividends}{Weighted\ Average\ number\ of\ Shares}$	Setyaningsih and Wibowo (2024) and Chawarura et al., (2025)

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

TQ	Measures the firm's market value and reflects the firm's future growth prospects.	TQ $\frac{Market\ Value\ of\ the\ Firm}{Replacement\ cost\ oof\ Assets}$	Wu, Li and Li (2022) and Al-Tarawneh, Tayeh, Iskandrani and Obeidat (2024)
Variable	**Description**	**Formula**	**Prior Research**
Lev	measures extent to which a company is financed by debts relative to equity.	Lev $\frac{Total\ Debt}{Total\ Equity}$	Hamdi et al. (2022)
Firm Size	measures a firm's capacity to engage in ESG initiatives.	FS ln (Number of Employees)	Chawarura et al., (2025 and Pastor et al. (2022)
Growth	measures a firm's reinvestment capacity and expansion potential	Growth $\frac{Equity_t - Equity_{t-1}}{Equity_{t-1}}$	Shan et al., (2024)
Firm Age	measures firm maturity, historical resilience, and firm experience.	FA Current Year – Founding Year	Bamel, Khatri, Bamel & Kumar (2025)
Sectoral normalization: Normalised each company's annual GHG ratio relative to its sectoral peer group through a min-max method; P_s: the set of peer firms in the sector; ϖ_{GHG}: normalised GHG to other environmental protection performance indicators within the same industry (basic material: 0.4571). ϖ_{GHG}, $\varpi_{Innov,\ \varpi_{Res}}$: Environmental protection indicators representing a sector-specific weights.			

Table 2: Variable description and formulas

Model Specification

This study employed a dynamic regression model to test relationship between GHG emissions and firm financial performance. The models were estimated using the following equations.

$$FS_{it} = \delta FS_{it-1} + \beta_1\ GHG_{it} + B_2\ Size_{it} + \beta_3\ Age_{it} + \beta_4\ Lev_{it} + \beta_5\ Growth_{it} + \mu_i + \lambda_i + \varepsilon_{it} \quad (1)$$

Model 1: EPS formula:

$$EPS_{it} = \delta EPS_{it-1} + \beta_1\ GHG_{it} + B_2\ Size_{it} + \beta_3\ Age_{it} + \beta_4\ Lev_{it} + \beta_5\ Growth_{it} + \mu_i + \lambda_i + \varepsilon_{it} \quad (1.1)$$

Model 2: TQ formula

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

$$TQ_{it} = \delta TQ_{it-1} + \beta_1 GHG_{it} + B_2 Size_{it} + \beta_3 Age_{it} + \beta_4 Lev_{it} + \beta_5 Growth_{it} + \mu_i + \lambda_i + \varepsilon_{it} \quad (1.2)$$

Where:

FS_{it-1} = Lagged dependent variable to account for financial inertia, GHG_{it} = GHG score of $Firm_i$ for t, μ_i = Firm-specific effects (unobserved heterogeneity), λ_i=Time-specific effects, ε_{it} = Idiosyncratic error term.

Results

This study employs Stata 18.0 software to perform descriptive statistics on the sample data. Table 3 shows the descriptive statistics results of all variables. The EPS mean value of 5.78 indicated that on average the companies included in the sample are profitable. However, the sample consists of both loss-making and profitable firms (Min=-69.91, max=147.45). The TQ mean of 122, indicates that favourable market valuation of the sample to their assets. The wide range values indicated that the sample is operating under different market conditions. The GHG emissions mean value of 0.031 indicates that on average the sample is making a progress in mitigating GHG emissions in the operations. The wide range also indicated that these firms have differing levels of success in addressing the issue of GHG emissions.

The firm age mean of 56 years, indicates that many firms in the sample are well established with operational maturity. The leverage mean value of 34.89, shows that on average firms in the sample adopt a well-balanced financing structure that combines both debts and equity. The growth mean value of 2.14, suggests that on average the polluting companies listed on the JSE are expanding and strengthening their equity. Firm size with a mean of 10.82, shows that polluting companies consists of comparable scale with different organisational capacity.

Variable	**Obs**	**Mean**	**Std.dev**	**Min**	**Max**
EPS	522	5.780411	13.99408	-69.91	147.45
TQ	522	122.2019	326.9612	-4.398693	4738.099
GHG	522	.030773	.0812517	-.1253568	.5068067
AGE	522	56.21839	51.9175	-699	138
LEV	522	34.89178	255.8497	-21.52504	2429.801
GROWTH	522	2.139053	47.01545	-2.010088	1072.106
SIZE	522	10.82522	0.8437611	9.385805	12.02345

Table 3: Descriptive Statistics of Variables

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

Table 4 indicates that lagged financial performance measured by EPS is positive (0.63), but statistically insufficient, indicating that past financial performance does not influence current year firm financial performance. GHG emission performance with negative coefficient of -3.327, suggest that environmental protection investment may not translate into financial benefits in the short run. Table 4 indicates that firm characteristics (age, leverage, growth and size) do not affect carbon emission performance. This may indicate that earnings per share may only measure short-term performance.

For model 2 (TQ), the study indicates that lagged TQ is positive and statistically significant, suggesting some persistence in market valuation. Leverage ($p<0.01$) and growth ($p<0.01$) indicate investors reward companies that pursue growth strategies and employ well-balanced financing structure. The negative relationship was observed between TQ ($P<0.05$) and firm size. This shows that larger firms are penalised by the market when engaging in GHG emission reduction strategies. This study reports that EPS does not measure the financial impact of environmental protection investments in South African polluters listed on the JSE. On the other hand, firm characteristics such as leverage, growth and firm size influence the firm value measured by TQ. However, both models reported statistical insignificant relationship between GHG emission performance and firm financial performance.

Model 1: EPS		**Model 2: TQ**	
L.EPS	0.263	L.TQ	0.202*
	(0.232)		(0.117)
GHG	-3.277	GHG	-31.981
	(3.905)		(98.412)
Age	0.006	Age	0.051
	(0.008)		(0.112)
Lev	0.0003	Lev	0.285***
	(0.001)		(0.041)
Growth	-0.0001	Growth	0.587***
	(0.002)		(0.088)
Size	-1.075	Size	-40.753***
	(1.179)		(18.873)

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

_Cons	14.951	_Cons	491.031***
	(13.590)		(218,175)
Test Statistics	**Value**	**Test Statistics**	**Value**
AR (1)	-1.21	AR (1)	-1.03
	(0.224)		(0.305)
AR (2)	0.48	AR (2)	0.56
	(0.633)		(0.573)
Hansen Test	$\chi^{2\,(7)}$ =8.78	Hansen Test	$\chi^{2\,(7)}$ =5.36
	(0.269)		(0.616)
***p<0.01, **p<0.05, *p<0.1			

Table 4: GHG emissions and financial performance via a two-step system GMM

This paper employed Hansen test to test for overidentifying restrictions (Hansen, 1982). This test was applied to determine whether the instruments employed in models are valid. The instruments are valid if the p-value is greater than 0.05 (Roodman, 2009). All models in Table 4 passed the Hansen test, with model 1 having a value of 0.269 and model 2 having a p-value of 0.616. Our study concludes that the instruments applied in the two models in the are valid and uncorrelated with the error term.

The Arellano-Bond test shows that both models (EPS & TQ) do not suffer from second-order autocorrelation, as the AR (2) test is insignificant in both models (p>0.05). Although AR (1) test insignificant in EPS and TQ, both models meet the key conditions of the GMM methodology, as the absence of significant second-order autocorrelation ((AR(2)) indicates that the instruments remain valid.

Discussion

The results of our study advance the global discourse on whether environmental protection investment translate into firm financial performance. Although the proposed hypothesis suggests that environmental performance can improve firm performance, the findings from South African polluting companies suggests that this relationship may not be immediate. This study also revealed insignificant relationship between GHG emission and both EPS and Tobin's Q, suggesting that investment in environmental responsible practices may take time to deliver tangible financial gains. The results are in line with prior research, for instance, Hopper and Gunther (2014), Dai & Wang (2020), Junius, Adisurjo and Elvi (2020)

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

and Narula, Purnima, Kumar and Ruhul (2024), reported that firm operating in high carbon sectors often face high up-front transition costs that overshadow short-term benefits. Tobin's Q shows that investors reward companies for operational growth and prudent leverage strategies. This is consistent with Zaine, Zhao & Fu (2022), who reported that the market valuation tends to be more sensitive to growth and capital structure than to ESG performance. The findings underscores that reputation impact may affect market perceptions before operational efficiencies materialise.

Conclusion

This paper investigated whether GHG emission reduction strategies affect firm financial performance among polluting companies listed on the JSE. The findings showed that insignificant association between firms' GHG emission reduction practices and either short-term or long-term firm financial performance measured by EPS and Tobin's Q. These results question the proposition that environmental protection investment in carbon-intensive industries automatically results in financial benefits, within the current South African context.

This study contributes to ESG-firm performance research, focusing on high-emitting firms, a sector that has been ignored from existing literature, and strengthens the evidence base in developing countries. The adoption of a three-stage scoring methodology provides a novel approach for assessing GHG performance in developing countries.

The implications of this study are twofold. Theoretically, our study raises critical questions about the degree to which stakeholder theory holds in market where ESG disclosure expectations are still developing, and where traditional financial measures namely EPS may not measure the longer-term value derived from environmental protection practices. Practically, the findings shows that companies that may require institutional and government support if they are to invest in carbon-control practices without compromising firm value. Introduction and implementation of tax incentives such as accelerated depreciation and tax rebates could help ease the financial burden of transition efforts, while improvements in ESG reporting standards may enable investors to accurately assess the strategic value of emission reduction practices.

Although our study provides insights, some shortcomings offer opportunities for further research. Further studies could include broader datasets, alternative performance measures, and institutional or such as governance culture and leadership support. Comparative research including both developed and emerging countries, and longer observation period, could help explore this relationship over time.

International Journal of Applied Research in Business and Management (ISSN: 2700-8983)
an Open Access journal by Wohllebe & Ross Publishing, Germany.
Volume: 07 Issue: 01 Year: 2026
https://doi.org/10.51137/wrp.ijarbm.345

References

Abbass, K., Qasim, M. Z., Song, H., Murshed, M., Mahmood, H., & Younis, I. A. (2022). Review of the global climate change impacts, adaptation, and sustainable mitigation measures. *Environ. Sci. Pollut. Res, 29*, 42539-42559.

Ahmad, N., Mobarek, A., & Roni, N. N. (2021). Revisiting the impact of ESG on financial performance of FTSE-350 UK firms: Static and dynamics panel data analysis. *Cogen. Busin & Manage.1, 8*.

Alyahya, M., & Agag. G. (2025). How Does Corporate Environmental Performance Contribute to Firm Performance and Customer Satisfaction? A Longitudinal Investigation. *Sustainability 2025, 17 (4*), 1644. https://doi.org/10.3390/su17041644

Al-Mari, J. R., & Mardini, G. H. (2024). Financial performance and carbon emissions disclosure. *J. Busin and Socio-econ. Develop*, 4 (4), 293-307. https://doi.org/10.1108/JBSED-03-2024-0023

Al-Tarawneh, A., Tayeh, M., Iskandrani, M., & Obeidat, M. (2024). The impact of ESG scores on corporate financial performance: A study of non-financial firms listed in the UK. *Asian Econ and Soc. Socie, 14(11*).

Asharafuzzaman, M., Gomes, C., & Guerra, J. (2023). The changing climate is changing safe drinking water, impacting health: A case in the southwestern coastal region of Bangladesh (SWCRB). *Climate 2023, 11(7).* https://doi.org/10.3390/cli11070146

Awa, H. O., Etim, W., & Ogbonda, E. (2024). Stakeholders, stakeholder theory and corporate social responsibility (CSR). *Int J. Corp. Respon*, 9(11). https://doi.org/10.1186/s40991-024-00094-y

Bamel, N., Khatri, K., Bamel, U., & Kumar, S. (2025). ESG disclosure and firm performance in global south economy: Does industry profile and board independence moderate the relationship. *Intern. Rev. Econom & Fin, 100*. https://doi.org/10.1016/j.iref.2025.104093

Busch, T., Bassen, A., Lewandowski, S., & Sump, F. (2020). Corporate carbon and financial performance revisited. Organis & Environ, 35(1), 154-171. https://doi.org/10.1177/1086026620935638

Busch, T.; Lewandowski, S. (2018). Corporate carbon and financial performance: A Meta-analysis. *J. Industr. Ecol, 22(4)*. https://doi.org/10.1111/jiec.12591

Chau, L., Anh, L., & Duc, V. (2025). Valuing ESG: How financial markets respond to corporate sustainability. *Inter. Busin. Rev, 34 (3).* https://doi.org/10.1016/j.ibusrev.2025.102418

Chawarura, W. I., Sibanda, M., & Mamvura, K.(2025). Impact of ESG on the financial performance of Johannesburg Stock Exchange-Listed Companies. *Risks, 13(6),* 144. https://doi.org/10.3390/risks13060114

Chen, Z., & Guanxia, X. (2022). ESG disclosure and financial performance: Moderating role of ESG investors. *Intern. Rev. Financ. Analy, 83*.

Chonco, C. M., Madwe, M. C., & Zungu, A. (2024). Assuring sustainability: Enhancing environmental, social and governance (ESG) Ratings in Top 40 Johannesburg Stock Exchange, International Journal of Applied Research in Business and Management, 5 (2). https://doi.org/10.51137/ijarbm.2024.5.2.22

Chou, C., Yang, K., & Schwarz, G. M. (2025) The paradox of increased carbon emission and firm performance. *Austr. J. Manag, 0(0*). https://doi.org/10.1177/03128962251319714

Dai, L., & Wang, M. (2020). Study on the influence of carbon emission constraints on the performance of thermal power enterprises. *Environ. Sci. Pollut. Res. Int*, 27(24).

Dechezlepretre, A., Kozluk, T., Kruse, T., Nachtigall, D., & De Serres, A. (2019). Do environmental and economic performance go together? A review of micro-level empirical evidence from the past decade or so. *Intern. Rev. Environ and Resour. Econ, 13(1-2). http://dx.doi.org/10.1561/101.00000106*

Delmas, M. A.; Nairn-Birch, N.; Lim, J. (2016). Dynamics of environmental and financial performance: The greenhouse gas emission. *Organ & Environ, 28(4),* 374-393. https://doi.org/10.1177/1086026615620238

Dzomonda, O., & Fatoki, O. (2020). Environmental sustainability commitment and financial performance of firms listed on the Johannesburg Stock Exchange (JSE). *Int. Environ. Res. Public Health, 17(20).* https://doi.org/10.3390/ijerph17207504

Freeman, R. E., Dmytriyev, S. D., & Phillips, R. A. (2021). Stakeholder theory and the resource-based view of the firm. *J. Manag, 47(7),* 1757-1770. https://doi.org/10.1177/0149206321993576

Galama, J. T., & Scholtens, B. (2021). A meta-analysis of the relationship between companies' greenhouse gas emissions and financial performance. *Environ. Res. Lett, 16(4*). https://doi.org/10.1088/1748-9326/abdf08

Gallego-Alvarez, I., Segura, L., & Martinez-Ferrero, J. (2015). Carbon emission reduction: The impact of financial and operational performance of international companies. *J. Clean. Prod*.

Ganda, F. (2022). Carbon performance, company financial performance, financial value, and transmission channel: An analysis of South African listed companies. *Environ. Sci and Pollut. Res, 29(19*). https://doi.org/10.1007/s11356-021-18467-2

Ganda, F., & Milondzo, K. S. (2018). The impact of carbon emission on corporate financial performance: Evidence from the South African firms. *Sustainability 2018, 10(7*), 2398. https://doi.org/10.3390/su10072398

Gerged, A. M., Beddewela, E., &Cowton, C. J. (2021). Does corporate environmental disclosure enhance firm value? Evidence from MENA emerging markets. *Busin. Strateg and the Environ, 31(3),* 1141-1163.

Hamdan. (2023). A. Carbon dioxide emission and the economic growth: Competitiveness and economic development view, Competitiveness Review: *An Intern. Bus. J, 34 (4*), 761-785. https://doi.org/10.1108/cr-04-2023-0087 (7)

Hamdi, K., Guenich, H., & Saada, M. (2022). Does corporate governance performance promote ESG: Evidence from US firms. *Coge, Busin & Manag, 9(1).* https://doi.org/10.1080/23311975.2022.2154053

Hasan, S. A., Waghule, S. N., Al-Koliby, I. S., Al-Bukhrani., Al Haifi, M., & Hasan, M. B. (2024). Innovating for sustainability: The role of environmental management accounting in driving environmental performance. *Discov. Sustain, 5.* https://doi.org/10.1007/s43621-024-00389-x

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometi: J. Econometi. Soceity, 50.*

Hoppe, H., & Guenther, E. (2014). Merging limited perspectives, a synopsis of measurement approaches and theories of the relationship between corporate environmental and financial performance. *J. Industr Ecol, 18(5).*

Junius, D., Adisurjo, Y.A., Rijanto, A., & Elvi, A. Y. (2020). The impact of ESG performance and market value. *J. Aplik. Akunt, 5.*

Khatib, S. F. A., Ismail, I. H. M., Salameh, N., Abbas, A.F., Bazhair, A. H., Sulimany, H. G. (2023). Carbon emission and firm performance: the moderating role of management environmental training. *Sustainability 2023, 15(13).* https://doi.org/10.3390/su151310485

Kraus, S.; Rehman, S. U.; Garcia, F. J. S. Corporate social responsibility and environmental performance: the mediating role of environmental strategy and green innovation. *Technol. Forecast. Soc. Chang. 2020, 160*. https://doi.org/10.1016/j.techfore.2020.120262 (28)

Le, H., & Nguyen-Phung, H. (2024). Assessing the impact of environmental performance on corporate financial performance: A firm-level study of GHG emission in Africa, *Sustain. Prod and Consum, 47*, 644 654.https://doi.org/10.1016/j.spc.2024.04.024

Li, S., Ngniatedema, T., & Chen, F. (2017). Understanding the impact of green initiatives and green performance on financial performance in the US. *Business Strategy and the Environment, 26(6).* https://doi.org/10.1002/bse.1948

Liu, M., Zhou, C., Lu, F., & Hu, X.(2021). Impact of the implementation of carbon emission trading on corporate financial performance: evidence from listed companies in China. *PLOS ONE, 16*. https://doi.org/10.1371/journal.pone.0253460

Liu, Z., Zhu, J., & Sun, J. (2022). Research on the correlation between environmental performance and financial performance in China's heavy pollution industries based on Raga-PP model. *Pol. J. Environ. Stud, 31(4).* https://doi.org/10.15244/pjoes/146558

LSEG DATA & ANALYSTICS (2024). Environmental. Social and governance scores from LSEG 2024. https://www.lseg.com/content/dam/data-analytics/en_us/documents/methodology/lseg-esg-scores-methodology.pdf (Accessed on 1 June 2025)

Madwe, M., Nzuza, Z., & Olarewaju, O. (2025). How does corporate environmental responsibility (CER) contribute to corporate financial performance (CFP)? *Intern. J. Appl. Res in Busin & Manag, 6(2).* https://doi.org/10.51137/wrp.ijarbm.2025.mmhd.45870

Madwe, M.C., Matyana, M., & Oluka, A. (2024). The impact of corporate governance mechanisms on impression managementin Top 40 JSE-listed companies. International Journal of Applied Research in Business and Management, 5(2). https://doi.org/10.51137/wrp.ijarbm.2024.mmti.45614

Mahajani, R., Lim, W. M., Sareen, M., & Kumar, S. (2023). Stakeholder theory. *J. Busin. Res, 166*. https://doi.org/10.1016/j.jbusres.2023.114104

Mardini, G. H., & Lahyani, F. E. (2023). The relevance of carbon performance and board characteristics on carbon disclosure. *Stud. Econ and Fina*, 41(3). https://doi.org/10.1108/sef-02-2023-0056

Markus, H., Geyer-Klingeberg, J., Rathgeber, A., & Stockl, S. (2018). Economic development matters: A meta-regression analysis on the relationship between environmental management and financial performance. *J. Industr. Ecol, 22(4).*

Misani, N., & Porgutz, S. (2015). Unravelling the effects of environmental outcomes and processes on financial performance: A non-linear approach. Ecolog. *Econom, 109(C).* https://ideas.repec.org/a/eee/ecolec/v109y2015icp150-160.html

MSCI ESG Research LLC. (2024). MSCI ESG Ratings methodology 2024. MSCI Inc. https://www.msci.com/esg-and-climate-methodologies (Accessed 5 September 2025).

Narula, R., Purnima, R., Kumar, S.& Rahul, M. (2024). ESG scores and firm performance-evidence from emerging markets. *Inter. Rev. Econ & Fina. 2024, 89.*

Ooi, S. K., Goh, S.., Yeap, J. A. L., & Loo, K, S. (2018). Linking corporate climate change and financial performance: Evidence from Malaysia. *Glob. Busin and Manag. Res, 10(1).*

Pang, Y. (2018). Profitable pollution abatement? A worker productivity perspective. Resour. Energy Econ, 52. https://doi.org/10.1016/j.reseneeco.2017.12.003

Parums, D. V. (2024). A review of the increasing global impact of climate change on human health and approaches to medical preparedness. *Med. Sci Monit, 11.* https://doi.org/10.12659/MSM.945763

Pastor, L., Stambaugh, R. F., & Taylor, L. A. (2022). Dissecting green returns. NBER Working Ppaer No. 28940. *J. Financ. Econom, 146*.

Porter, M. E. (1991). Towards a dynamic theory of strategy. *Strateg. Manag. J, 12 (S2),* 95-117. https://doi.org/10.1002/smj.4250121008

Porter, M. E., & Linde, C. V. D. (1995). Toward a new conception of environmental-competitiveness relationship. *J. Econ. Perspect, 9(4),* 97-118. https://doi.org/10.1257/jep.9.4.97

Psistaki, K., Tsantopoulos, G., & Paschalidou, A. (2024). Overview of the forests in climate change mitigation. *Sustainability 2024, 16(14),* 6089. https://doi.org/10.3390/su16146089

Pulino, S. C., Mirella, C., Barbara, S. M., & Luigi, N.(2022). Does ESG disclosure influence firm performance? *Sustainability 2022, 14.*

Rogelj, J., Popp, A., Calvin, K. V., Luderer, G., Emmerlig, J., Gernaat, D., Fujimori, S., Strefler, J., Hasegawa, T., Marangoni, G., et al. (2018). Scenarios towards limiting global mean temperature increase below 1.5 C. *Nat. Clim. Change, 8.* 325-332.

Roodman, D. (2009). How to do Xtabond2: An introduction to difference and system GMM in Stata. *The Sta. J, 9*.

Sarfraz, M., Ozturk, I., Yoo, S., Raza, M. A., & Han, H. (2023). Toward a new understanding of environmental and financial performance through corporate social responsibility, green responsibility, green innovation, and sustainable development. *Humanit. Soc. Sci. Commun, 10(1).* https://doi.org/10.1057/s41599-023-01799-4

Seroka-Stolka, O. (2023). Enhancing environmental sustainability: Stakeholder pressure and corporate Co2 -related performance: An examination of the mediating and moderating effects of corporate decarbonisation strategies. *Sustainability 2023, 15(19*), 14257. https://doi.org/10.3390/su151914257

Setyaningsih, W., & Wibowo, R. S. (2024). Does earnings per share contributes to the effect of ESG score on share price of mining sector companies? *Adv. Account. Innov (AAI). 2024, 1 91.* https://doi.org/10.69725/aai.v1i1.90

Shan, X., Song, Y., &Song, P. (2024). How ESG performance impacts corporate financial performance? A DuPoint analysis approach. *Intern. J. Clim. Chan. Strateg and Manag. 2024*. https://doi.org/10.1108/IJCCSM 07-2024-0125

Shmelev, S. E., & Gilardi, E. (2025). Corporate environmental, social, and governance performance: The impacts on financial returns, business model innovation, and social transformation. *Sustainability 2025, 17(3),* 1286. https://doi.org/10.3390/su17031286

Siddique, M. A., Akhtaruzzaman, M., Rashid, A., & Hammami, A. (2021). Carbon disclosure, carbon performance and financial performance: International evidence. *Intern. Rev of Financ. Analy, 75.* https://doi.org/10.1016/j.irfa.2021.101734

Tang, Y., Yue, S., Ma, W., & Zhang, L. (2022). How doe environmental protection expenditure and green technology innovation affect synergistically the financial performance of heavy polluting enterprises? Evidence from China. *Environ. Sci. Control Ser***.** https://doi.org/10.1007/s11356-022-21908-1

Trinks, A., Mulder, M., & Scholtens, B. (2020). An efficiency perspective on carbon emission and financial performance. *Ecolog. Econ, 175. https://doi.org/10.1016/j.ecolecon.2020.106632*

United Nations. (2025). Ahead of Climate Action Summit, UN Secretariat Adopts Plan to Slash Own Emission by almost half by 2030. (Accessed 10 August 2025)

Van Emous, R., Krusinskas, R., & Westerman, W. (2021). Carbon emission reduction and corporate financial performance: The Influence of country-level characteristics. *Energies, 14*, 6029. https://doi.org/10.3390/en14196029

Worae, T. A., & Ngwakwe, C. C. (2017). Environmental responsibility and financial performance nexus in South Africa: Panel Grander causality analysis. *Environ. Econ. 2017, 8.*

Wu, S., Li, X., & Li, Z. (2022). The impact of ESG performance on firm value: The moderating role of ownership structure. *Sustainability 2022, 14(21),* 14507. https://doi.org/10.3390/su142114507

Zaiane, S., & Dorra, E. (2022). Corporate responsibility and firm financial performance: The moderating effects of size and industry sensitivity. *J. Manag and Govern, 27*.

Zhang, Y., Zhao, X., & Fu, B. (2022). Impact of energy saving on financial performance of industrial enterprises in China: An empirical analysis based on propensity score matching. *J. Environ. Mang, 317*.

Ziegler, A., Busch, T., & Hoffmann, V. H. (2011). Disclosed corporate responses to climate change and stock performance: An international empirical analysis. *Energ. Econ*, *33(6),* 1283-1294. https://doi.org/10.1016/j.eneco.2011.03.007