International Journal of Disclosure and Governance
https://doi.org/10.1057/s41310-024-00242-7

ORIGINAL ARTICLE

Driving emissions reduction: the power of external sustainability assurance and internal governance committees

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Received: 11 June 2023 / Accepted: 25 March 2024

Abstract
The aim of this study is to investigate the relationship between carbon performance and third-party assurance of sustainability, as well as the moderating role of board committees. Using data from companies listed in the STOXX Europe 600 index from 2006 to 2021, the study finds that there is a positive relationship between a firm's GHG reduction initiatives and external assurance of sustainability. Additionally, the study finds that the presence of sustainability committee and governance committee moderate this relationship, suggesting that companies with dedicated sustainability and governance committees may be better equipped to implement and verify their GHG reduction initiatives. The results are consistent and reliable across various econometric techniques. These findings have important implications for firms pursuing to enhance their eco-friendly practices and for policymakers looking to incentivize and regulate sustainability initiatives.

Keywords GHG reduction initiatives · External assurance of sustainability · Institutional theory · Sustainability committee · Governance committee

Introduction

Climate change and environmental degradation are some of the most significant challenges facing humanity today (Issa and Zaid 2023). Governments, civil society organizations, and corporations have an effective role to play in reducing the negative impacts of these challenges. In recent years, companies have begun to take responsibility for their environmental impact and have implemented various strategies to reduce their carbon footprint. One such strategy is the adoption of third-party assurance of sustainability, whereby firms undergo external audits to verify their sustainability claims. External assurance of sustainability involves the third-party evaluation or validation of corporate social responsibility (CSR) and sustainability performance by an external independent assurance provider (O'Dwyer 2011). This assurance process aims to enhance the credibility and reliability of a company's non-financial disclosures by subjecting them to an external audit or evaluation (Baboukardos et al. 2021). Incorporating third-party validation for sustainability disclosure can provide companies with several benefits, including enhanced reputation (Alon and Vidovic 2015; Birkey et al. 2016), improved stakeholder trust (Krasodomska et al. 2021), and increased access to capital (Martínez-Ferrero and García-Sánchez 2017a).

In recent years, there has been significant improvement in the adoption of external sustainability assurance by companies. According to Filosa et al. (2021), their review of 200 sustainability reports from S&P 500 companies published in 2021 reveals that 53% of the reports included at least some degree of external assurance. This is a substantial increase from the 10% of sustainability reports published by US companies in 2011 that underwent external assurance engagement, as reported by KPMG's 2014 survey of sustainability reporting (GRI 2014). The trend towards increased adoption of external sustainability assurance is promising, as it suggests that companies are recognizing the importance of demonstrating the reliability of their non-financial disclosure to stakeholders. A worldwide trend is observed, indicating an increase in the regulations of sustainability audits worldwide. In December 2022, the European Commission approved the Corporate Sustainability Reporting Directive (CSRD), aiming to modernize and supersede the current Non-Financial Reporting Directive (NFRD), effectively implemented since January 5, 2023. It introduces

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Published online: 17 April 2024

new reporting standards aligned with the EU taxonomy and mandates a heightened level of assurance for non-financial disclosure (European Commission 2023). This marks a notable progress in fostering non-financial disclosure and responsibility within the EU, underscoring the increasing significance of non-financial audits in the contemporary business landscape.

Given the importance of external sustainability assurance, there exists an unexplored research gap concerning the connection between GHG reduction strategies and the embrace of such assurance. The existing literature (e.g., Bui et al. 2021; Fan et al. 2021; Luo et al. 2023) lacks clarity on whether companies demonstrating a stronger commitment to mitigating their carbon footprint are more inclined to adopt independent sustainability assurance. This research intends to bridge this gap by delving into the intricate link between corporate carbon performance and company's inclination to adopt independent sustainability audits. In doing so, the study not only addresses a critical research void but also aligns with the underpinning theoretical framework of institutional theory. Institutional theory provides a lens through which to understand how external pressures, norms, and cultural values influence organizational behaviour and decision-making. By leveraging institutional theory, the study seeks to uncover the underlying mechanisms that drive companies to seek external validation of their sustainability endeavours. This theoretical framework offers a nuanced perspective on the institutional pressures shaping a company's choices regarding sustainability practices. The study, thus, aspires to contribute not only to the empirical understanding of the GHG reduction-assurance relationship but also to the broader theoretical discourse on how institutional forces steer corporate responses to environmental challenges. Through this exploration, the research aims to enrich the theoretical landscape by providing insights into the complex interplay between carbon performance, third-party assurance of sustainability, and the institutional context in which companies operate. Furthermore, this study also examines the moderating role of governance committees within this dynamic. In addition to addressing the empirical gap in understanding the connection between a company's commitment to minimizing its GHG footprint and the adoption of independent sustainability audits, the research introduces the influential dimension of governance committees.

This study, utilizing a sample from non-financial European firms spanning from 2006 to 2021, emphasizes the significance of third-party assurance of sustainability in promoting a company's eco-friendly efforts. The findings suggest that companies that prioritize reducing their carbon footprint impact are more likely to seek independent validation of their pro-environmental efforts. Moreover, the study shows that the presence of a sustainability committee and corporate governance committee can have a moderating effect on this relationship.

This study significantly contributes to the literature on sustainability and corporate governance in multiple ways. Firstly, it is the first study to explore the connection between corporate GHG reduction strategies and the adoption of third-party assurance of sustainability, and the potential moderating effect of internal governance committees. This research fills a critical gap in the existing literature by investigating how firms can effectively communicate their eco-friendly efforts to stakeholders and enhance their legitimacy and social acceptance through external sustainability assurance. Secondly, the study contributes to the theoretical landscape by integrating institutional theory to elucidate the link between carbon performance and the integration of independent sustainability audits, along with exploring the moderating effect of internal governance committees. This theoretical framework deepens the comprehension of how institutional pressures influence a company's choice to pursue external validation for its sustainability efforts, providing additional insights into the organizational responses to environmental challenges. Utilizing this theoretical perspective, the study broadens the intellectual foundations of sustainability and corporate governance scholarship. Thirdly, by analysing the potential moderating effect of internal governance committees, this study provides a better understanding of the mechanisms through which companies can increase the effectiveness of their environmental initiatives. Overall, this study's findings provide valuable insights for managers, regulators, and stakeholders seeking to promote sustainability and effective governance practices in organizations, making it a significant contribution to the field.

This study is structured as follows. After this introduction, it introduces the theoretical literature framework. This is succeeded by the empirical literature review and the formulation of hypotheses in the subsequent section. Following that, the study defines the applied methodological approach, encompassing information about the sample and data collection, variables, and research models. In the results section, the study presents the empirical findings and the conducted robustness checks. Then, the study explains the results in the discussion section. Ultimately, the study concludes the research by acknowledging its limitations and proposing potential future directions in the final section.

Literature review and hypotheses development

Institutional theory is a widely used framework to explain how organizations are influenced by external factors, such as norms, regulations, and cultural values (Hahn et al. 2015; Haque and Ntim 2022). Institutional theory is not only a descriptive framework but also a prescriptive one, in that it offers a roadmap for organizations to gain

legitimacy and maintain their position within their institutional environment (Scott, 2013). This theory suggests that companies that conform to institutional and environmental norms will be seen as more legitimate by external stakeholders, thereby increasing their chances of survival and success (Suchman 1995). According to Delmas & Toffel (2004), firms face various types of pressures from stakeholders, including governments, regulators, customers, competitors, and industry associations. These pressures can be categorized as coercive, normative, and mimetic, which are collectively referred to as institutional isomorphic pressures (Dhanda et al. 2022). Zhu & Sarkis (2007) argue that both normative pressures from the market and coercive pressures from regulatory bodies play a significant role in driving proactive environmental behavior. In addition, mimetic pressures from competitors can also be a strong driver of environmental performance improvement (Marshall et al. 2005).

In the absence of coercive forces or regulations (Tyson and Adams 2019), normative and mimetic pressures can still play a significant role in explaining the link between GHG reduction strategies and the adoption of third-party sustainability assurance. Normative pressures stem from social expectations, values, and norms, which influence firms to conform to the prevailing beliefs and practices of their industry or society. In this case, third-party sustainability assurance can be viewed as a normative practice that signals a firm's commitment to sustainability and corporate social responsibility, aligning with societal expectations and values. Compliance with these norms or standards is usually voluntary. Mimetic pressure is when a firm imitates its competitors' actions on environmental impact reduction and adoption of third-party sustainability assurance to be perceived as socially responsible. This creates a "bandwagon effect", where the adoption of sustainability practices becomes a common practice within the industry. Mimetic pressure and normative pressure are both noncoercive institutional pressures, meaning compliance is voluntary. These pressures are difficult to differentiate, so institutional pressures are often classified as either coercive or noncoercive (Dhanda et al. 2022).

The adoption of third-party sustainability assurance is a way for companies to conform to these noncoercive pressures by demonstrating their commitment to sustainable practices and providing evidence of their environmental impact (Córdova Román et al. 2021). Moreover, the adoption of independent sustainability audits can also lead to an increase in market value and access to capital, as investors are increasingly demanding disclosure of environmental information from companies (Cheng et al. 2015). In this way, the institutional theory provides a theoretical basis for understanding the link between carbon performance and the adoption of third-party sustainability assurance, and the potential benefits that companies can gain from such conjunction.

Due to the lack of strict laws and the voluntary nature of sustainability disclosure, corporations have considerable autonomy in determining the content and scope of their reports, including the extent of their eco-friendly behaviours (Dhaliwal et al. 2011; Zaid and Issa 2023). This might lead to a skewed presentation that highlights the favourable aspects of a company's efforts to minimise GHG footprint while reducing or hiding any adverse effects (Depoers et al. 2016). This incomplete or misleading information may provide stakeholders with an inaccurate perception of a company's environmental impact. Moreover, corporations may adopt either substantive or symbolic actions to enhance their corporate image (Haque and Ntim 2022). According to the substantive approach, entities seek validation by implementing genuine changes in their goals, strategies, structures, and procedures, in line with the prevailing institutional principles and standards. In contrast, symbolic gestures do not enact any concrete changes in the corporation, instead, they employ diverse symbols to present an image in harmony with societal values, intending to shape stakeholders perspectives (de Freitas Netto et al. 2020; Roulet and Touboul 2015; Walker and Wan 2012).

Symbolic actions can be a form of greenwashing if they are used to create the appearance of sustainability without any substantive changes or actions. To mitigate the risks associated with greenwashing and uphold their legitimacy, companies can employ non-financial disclosure practices coupled with independent sustainability assurance (Velte 2021). By offering thorough and transparent environmental disclosure, firms can steer clear of making inaccurate or overstated assertions regarding their environmentally friendly initiatives, thereby fostering trust with stakeholders (Krasodomska et al. 2021). As per the institutional theory, companies strive to align with societal expectations and norms, or mimic the practices of peers within their industry, thereby fostering coherence in industry practices. These efforts are driven by noncoercive forces that influence organizational behaviour. External sustainability assurance further reinforces stakeholders' trust by offering an independent evaluation of corporate environmental behaviours (Issa and Hanaysha 2023a). This evaluation can improve the reliability of their environmental disclosure and signal their dedication to eco-friendly practices, leading to increased stakeholder trust, enhanced corporate reputation, and ultimately contributing to their sustainable prosperity (Reverte 2021). In summary, institutional theory suggests that companies seek legitimacy by adhering to established norms and values. This involves demonstrating authentic sustainability efforts and assurance practices,

with a focus on noncoercive forces shaping organizational behaviour.

Greenhouse gas reduction strategies and external sustainability assurance

Previous research has focused on the relationship between external sustainability assurance and corporate sustainability reporting, but there is limited research on the impact of assurance on a company's greenhouse gas (GHG) reduction strategies, specifically those that may be symbolic in nature. Although external sustainability assurance has been found to enhance the credibility and quality of a company's sustainability reporting, its specific impact on GHG reduction initiatives is not clear.

Recent studies have shown that external assurance of integrated reporting has been associated with higher-quality reporting, especially when provided by a Big 4 firm (Maroun 2019). Moreover, companies with superior sustainability performance are more likely to obtain external assurance of their sustainability disclosure, enhancing their sustainability reputation (Alon and Vidovic 2015). However, Hummel et al. (2019) and Datt et al. (2019) suggest that poor sustainability performers and high carbon emitters tend to request in-depth assurance services to identify areas for improvement in their sustainability-related processes and systems. Moreover, external assurance can help bridge the gap between insiders and outsiders regarding carbon information which in turn can improve transparency and accountability. For example, Fan et al. (2021) suggest that companies with greater asymmetry in emissions-related information have a greater incentive to voluntarily engage an external party for the independent assurance of their carbon performance. Some studies have shown that external sustainability assurance can moderate the negative link between voluntary sustainability disclosures and the cost of capital (Garzón Jiménez and Zorio-Grima 2021; Martínez-Ferrero and García-Sánchez 2017b). Additionally, companies that provide more CSR information are likely to have greater financial accessibility, and the robustness of CSR disclosure, coupled with external assurance, fortifies the correlation between disclosure and financial access (García-Sánchez et al., 2019).

It is worth noting that there is a lack of research examining the link between external sustainability assurance and GHG reduction initiatives, particularly those that may be symbolic in nature. Further research is needed to understand the impact of external sustainability assurance on these initiatives and how they may contribute to a company's overall sustainability performance. In this study, this study argues that there could be a positive link between independent sustainability audits and carbon performance and such a link could be explained by institutional theory.

Institutional theory proposes that companies are under pressure to conform to institutionalized values and norms in order to gain legitimacy and maintain their social standing (Brammer et al. 2012). In the case of sustainability, companies endeavour to emulate industry best practices for favourable outcomes and to align with social values and norms, thereby gaining legitimacy through the adoption of eco-friendly strategies and the reduction of carbon footprint (Gao et al. 2019). By obtaining third-party sustainability assurance, corporations can signal their commitment to adhere to the institutional environment and showcase tangible efforts in reducing their environmental impact (Fan et al. 2021). This can lead to increase their legitimacy and social standing, and contribute to their sustainable growth (Reverte 2021).

Furthermore, external sustainability assurance can provide stakeholders with a third-party assessment of a company's environmental disclosure, thereby enhancing the reliability of their environmental disclosure and reducing the potential for greenwashing (Ruiz-Blanco et al. 2022). This, in turn, can lead to increased stakeholder trust and a stronger reputation, further contributing to a company's institutional legitimacy. Additionally, external assurance can provide valuable feedback and recommendations to companies on how to improve their GHG reduction strategies and achieve their sustainability goals (Hummel et al. 2019). Moreover, external assurance can help companies gain access to finance by improving the integrity of their environmental disclosure, as documented by García-Sánchez et al. (2019). This increased financial access could enable companies to invest in GHG reduction initiatives, such as the development of new technologies or the implementation of sustainable practices.

Overall, by adopting external sustainability assurance, companies can align their practices with institutionalized norms and expectations, gain legitimacy and competitive advantages, and reduce the potential for greenwashing. Therefore, this study proposes the first hypothesis as follows:

H1 There is a positive link between the adoption of third-party sustainability audit and GHG reduction strategies.

Internal board committees

The study argues that board committees, such as the sustainability committee and governance committee can play an important role in moderating the connection between the adoption of independent sustainability assurance and carbon performance.

The sustainability committee is responsible for overseeing the company's sustainability initiatives, including its environmental performance and social responsibility (Martínez-Ferrero and García-Sánchez, 2017b). The committee can work with management to set sustainability goals and

monitor the company's progress in achieving those goals (Peters and Romi 2015). By doing so, the sustainability committee can promote the adoption of external sustainability assurance (Dwekat et al. 2022; García-Sánchez et al., 2022; García-Sánchez et al. 2023; Mardawi et al. 2023), as it can ensure that the assurance process is aligned with the company's sustainability goals and objectives. Similarly, the governance committee is responsible for overseeing the company's governance practices, including risk management and compliance with laws and regulations (Huang et al. 2009). One of its key responsibilities is to ensure that the company's sustainability practices align with its overall strategy and risk appetite (Jones et al. 2015). Hence, the governance committee holds significant potential in encouraging the embrace of external sustainability assurance (Sellami et al. 2019), confirming the alignment of the assurance process with the broader governance structure of the company.

Moreover, both committees can provide oversight and guidance to management on how to improve the company's GHG reduction initiatives based on the recommendations provided by the external assurance provider. They can ensure that the company is taking concrete steps to decrease its carbon footprint and achieve its environmental goals, thereby contributing to the company's green targets.

Overall, the existence of board committees, such as the sustainability committee and governance committee, can play a critical role in moderating the correlation between the adoption of third-party sustainability audits and GHG emissions. They can ensure that the assurance process is aligned with the company's overall governance and sustainability frameworks, and provide oversight and guidance to management on how to improve its GHG reduction initiatives based on the recommendations provided by the external assurance provider. Hence, the study proposes the second hypothesis as follows:

H2 The link between the adoption of third-party sustainability audit and GHG reduction strategies is more pronounced in companies with a sustainability committee.

H3 The link between the adoption of third-party sustainability audit and GHG reduction strategies is more pronounced in companies with a governance committee.

Methods

Sample

The objective of this study is to analyse the correlation between initiatives aimed at reducing emissions and the adoption of external sustainability assurance, and how the effects of board committees moderate this relationship. To achieve this, the study employs a dataset comprising companies included in the STOXX Europe 600 index over the period from 2006 to 2021. The study relies on financial and non-financial data derived from the Refinitiv Eikon database, which is a reliable and credible source of information for research. The sample commences in 2006 due to the availability of data on GHG reduction strategies scores, and it concludes in 2021, which represents the latest year for which data was accessible at the time of data collection. The STOXX Europe 600 index is considered to be a renowned benchmark for European equity markets, as it offers exposure to a broad range of companies with different sizes, industries, and operating in 17 European countries. After removing firms with incomplete or missing data, the final sample size used for analysis comprises 4095 observations.

Measurement

This research explores the relationship between two variables: GHG reduction strategies (GHGS) and third-party assurance of sustainability performance (EXA). GHGS is a metric that assesses a company's effectiveness and dedication to minimizing environmental emissions in its production and operational activities. GHGS score mirrors the company's efforts and achievements, encompassing 28 initiatives and pledges designed to decrease GHG emissions in its manufacturing activities. Such strategies may involve the adoption of green energy technologies, optimization of logistics management, reduction of carbon from transportation, and enhancements in energy optimization, among other strategies. Enhanced GHG reduction level signifies a more pronounced commitment and greater efficacy in diminishing corporate ecological footprint. The score is presented as a percentage, and a higher value indicates more effective measures in reducing GHG emissions. The GHGS score from Refinitiv Eikon has been utilized in prior research studies (Haque and Ntim 2022; Issa 2023; Issa and In'airat, 2023).

On the other hand, EXA assesses the external scrutiny or validation of a company's environmental information conducted by an independent assurance provider. Refinitiv Eikon's team gauges EXA using a binary measure, assigning a value of one for a "reasonable/high" level of assurance and zero for a "limited/moderate" level. This measurement, employed by Refinitiv Eikon's analysts, has been widely utilized in previous empirical studies (Issa and Hanaysha 2023a; Koseoglu et al. 2021; Ruiz-Barbadillo and Martínez-Ferrero, 2020; Ruiz-Barbadillo and Martínez-Ferrero 2022).

In addition to analysing the relationship between GHGS and EXA, the study also investigates how the presence of sustainability committee (SUS_COM) and governance committee (GOV_COM) moderates this relationship.

SUS_COM is a binary variable that takes a value of 1 if the company has a CSR/sustainability committee, and 0 if it does not. Similarly, GOV_COM is a binary variable that takes a value of 1 if the company has a governance committee, and 0 if it does not.

Similar to earlier empirical studies (Bui et al. 2021; Issa and Fang 2019; Issa and Hanaysha 2023a; Liao et al. 2018) the analysis includes several control variables. Board size (B_SIZE) is introduced as a control variable in the study's analysis. A larger board size (B_SIZE) is presumed to facilitate diverse perspectives on corporate strategy, potentially contributing to improved environmental performance (Issa and Hanaysha 2023c; Katmon et al. 2019; Zaid et al. 2020). The measurement of board size involves taking the natural logarithm of the total number of board members (Issa and In'airat 2024). Board expertise (B_EXP) is integrated into the model, recognizing that a broad spectrum of expertise on the board may positively influence decisions related to GHG reduction strategies. Board expertise is quantified as the percentage of board members with either an industry-specific background or a robust financial expertise. Board independence (IND) is considered, given its potential impact on the effectiveness of the decision-making process within the board (Gull et al. 2021a, b; Issa et al. 2024). It is calculated as the ratio of independent directors to the total board members. The model also includes CEO duality (CEOD) because the CEO exercises significant control and influence over the board's decision-making process (Gull et al. 2021a, b). Thus, CEOD is represented as a dummy variable indicating whether the CEO holds both the CEO and chairman positions.

Furthermore, the study incorporates several firm characteristics, namely profitability (ROA), firm size (F_SIZE), and capital expenditure (CAP), as control variables. Profitable firms are posited to possess greater financial resources for environmental projects and regulatory compliance, along with enhanced access to capital for investments in innovative technologies or processes (Danso et al. 2019; Issa and Hanaysha 2023d). Consequently, the return-on-asset ratio (ROA) is computed by dividing net income before extraordinary items by total assets. Firm size (F_SIZE) is considered, recognizing that it can influence environmental performance, with larger companies potentially having more resources for investments in environmental initiatives and being subject to distinct regulations compared to smaller counterparts (Issa 2023). Firm size is controlled for by using the natural logarithm of the firm's total number of employees. Additionally, capital expenditure (CAP) is included, encompassing investments that may involve more energy-efficient technologies and production processes (Issa and Hanaysha 2023b). Hence, the computation involves dividing the capital expenditure by the total assets of the firm. Additionally, industry dummies are incorporated to account for variations among different industries. Table 1 provides clear definitions for all the variables utilized in this study.

Econometric model

This research employs the ordinary least squares (OLS) and fixed effects regression approach to explore the relationship between GHG reduction strategies and the adoption of independent audit for sustainability performance, as well as the impact of board committees on this association.

$$\mathrm{GHGS}_{it} = \beta_0 + \beta_1 \mathrm{EXA}_{it} + \sum_{(i=0)}^{n} \beta_n \mathrm{Control\ variables}_{it} + \varepsilon_{it} \tag{1}$$

$$\mathrm{GHGS}_{it} = \beta_0 + \beta_1 \mathrm{EXA}_{it} * \mathrm{SUS\_COM}_{it} + \sum_{i=0}^{n} \beta_n \mathrm{Control\ variables}_{it} + \varepsilon_{it} \tag{2}$$

$$\mathrm{GHGS}_{it} = \beta_0 + \beta_1 \mathrm{EXA}_{it} * \mathrm{GOV\_COM}_{it} + \sum_{i=0}^{n} \beta_n \mathrm{Control\ variables}_{it} + \varepsilon_{it} \tag{3}$$

The initial equation of this study features GHG reduction strategies (GHGS) as the response variable, and independent audit of sustainability (EXA) as the explanatory variable, with a range of control variables. The second equation examines the moderating impact of the sustainability committee (SUS_COM) on the relationship between GHGS and EXA, with adjustments for all other variables. Similarly, the third equation investigates the influence of governance committee (GOV_COM) as a moderator on the relationship between GHGS and EXA, along with a set of control variables.

Results

Table 2 displays the descriptive analysis for all variables employed in the econometric models. The average value for the dependent variable, GHG reduction strategies (GHGS), is 76.320%, with the lowest recorded value being 0 and the highest value being 99.910%. Additionally, the variability in GHGS is considerable, with a standard deviation of 21.282%. Regarding the focal independent variable, external validation of sustainability performance (EXA), it is observed that, on average, 83.2% of the entities in the dataset engage in third-party audit services to validate their sustainability strategies. This implies a substantial portion of companies place significance on obtaining an impartial assessment or confirmation of their sustainability endeavours. Furthermore, the average proportion of companies with

Table 1 Variables and definitions

Variable	Symbol	Definition
Dependent variable		
Greenhous gas reduction strategy	GHGS	The score represents the firm's efforts and actions, consisting of 28 commitments and initiatives, aimed at decreasing GHG emissions in the operational activities
Independent variable		
External assurance of sustainability	EXA	A binary measure, assigning a value of one for a "reasonable/high" level of assurance and zero for a "limited/moderate" level
Moderating variable		
Sustainability committee	SUS_COM	A dummy variable coded 1 if the firm has a CSR/sustainability committee and 0 otherwise
Governance committee	GOV_COM	A dummy variable coded 1 if the firm has a governance committee and 0 otherwise
Control variables		
Board size	B_SIZE	The natural logarithm of total number of board members
Board expertise	B_EXP	Percentage of board members who have either an industry specific background or a strong financial background
Board independence	INDEP	The proportion of independent directors to the total number of board members
CEO duality	CEOD	A dummy variable that is equal to 1 when the CEO holds the chair position, and 0 otherwise
Profitability	ROA	The ratio of net income divided by total assets
Firm size	F_SIZE	The natural logarithm of the firm's total number of employees
Capital expenditure	CAP	It is computed by dividing the total assets of the firm by its capital expenditure
Industry dummy	INDUSTRY	A dummy variable represents 10 industries

Table 2 Descriptive analysis

Variables	Mean	SD	Min	Max
GHGS	76.320	21.282	0	99.910
EXA	0.832	0.374	0	1
SUS_COM	0.868	0.338	0	1
GOV_COM	0.302	0.459	0	1
B_SIZE	2.416	0.312	1.386	3.258
B_EXP	39.946	20.851	0	100
INDEP	61.796	22.417	0	100
CEOD	0.256	0.436	0	1
ROA	0.062	0.058	−0.33	0.52
F_SIZE	23.683	1.547	19.227	28.927
CAP	0.040	0.032	0	0.321

This table presents the findings of descriptive statistics using the amount of carbon emissions. Please, refer to Table 1 for the measurements of variables

a sustainability committee (SUS_COM) and a governance committee (GOV_COM) stands at 86.8% and 30.2%, respectively. To identify the potential presence of multicollinearity, the study employs variance inflation factors (VIFs) and correlation analysis. The results are presented in Table 3, which shows that multicollinearity is unlikely to have a significant impact on the regressions results.

Table 4 outlines the study's results concerning the association between GHGS and EXA, along with the moderating impacts of the sustainability committee (SUS_COM) and governance committee (GOV_COM). The study employs both OLS and fixed effects regression analyses to examine these relationships. In Model 1, the study examines the relationship between GHGS and EXA, considering all other variables in the analysis. The regression results indicate that there is a significant positive relationship between EXA and GHGS ($\beta = 13.70$, $P < 0.01$). This finding supports Hypothesis 1, which suggests that external assurance of sustainability performance is associated with increased corporate environmental initiatives.

Model 2 introduces SUS_COM as a moderating variable, and the results show that it has a positive moderating effect on the relationship between GHGS and EXA ($\beta = 12.80$, $P < 0.01$). Thus, the study can accept Hypothesis 2, which proposes that sustainability committees have a positive impact on the relationship between GHGS and EXA. Likewise, Model 3 introduces GOV_COM as a moderating variable, and the results show that it has a positive moderating effect on the relationship between GHGS and EXA ($\beta = 4.762$, $P < 0.01$). Thus, the study can accept Hypothesis 3, which proposes that governance committees also positively impact the relationship between GHGS and EXA.

Furthermore, the study performs Fixed Effects regression analyses in Models 4, 5, and 6 to accommodate unobserved time-invariant heterogeneity. The outcomes from these models align with those derived from OLS regression, affirming the robustness of the study's conclusions. Overall, the study's findings align with the tenets of institutional theory, suggesting that companies need to adopt practices that are congruent with the expectations and norms of their institutional environment to achieve legitimacy and social

Table 3 Pairwise correlations

Variables	VIF	1/VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) GHGS			1.000										
(2) EXA	1.215	0.823	0.538***	1.000									
(3) SUS_COM	1.132	0.883	0.559***	0.539***	1.000								
(4) GOV_COM	1.239	0.807	0.242***	0.225***	0.187***	1.000							
(5) B_SIZE	1.678	0.596	0.310***	0.164***	0.180***	0.184***	1.000						
(6) B_EXP	1.061	0.942	−0.110***	−0.120***	−0.041***	0.034***	−0.145***	1.000					
(7) INDEP	1.233	0.811	0.116***	0.153***	0.106***	0.133***	−0.194***	−0.027**	1.000				
(8) CEOD	1.110	0.901	0.129***	0.004	0.037***	0.155***	0.152***	−0.024**	−0.104***	1.000			
(9) ROA	1.202	0.832	−0.066***	−0.050***	−0.066***	−0.093***	−0.165***	0.057***	−0.004	−0.011	1.000		
(10) F_SIZE	1.870	0.535	0.399***	0.284***	0.252***	0.366***	0.528***	−0.061***	0.093***	0.069***	−0.269***	1.000	
(11) CAP	1.047	.955	0.029**	−0.012	0.003	−0.062***	0.013	−0.036***	−0.039***	−0.038***	0.050***	−0.080***	1.000

This table displays the outcomes of the correlation analysis. Please, refer to Table 1 for the measurements of variables. Moreover, the presence of asterisks (*) alongside the estimation results indicates the significance level, with one, two, and three asterisks corresponding to significance levels of 1%, 5%, and 10%, respectively

acceptance. The adoption of third-party assurance practices for environmental disclosure, the presence of a sustainability committee, and the presence of a governance committee can all enhance a company's environmental performance by aligning its practices with the expectations and norms of its stakeholders.

Robustness check

To verify the robustness of the findings, the study undertakes various tests to ensure the validity of the results. First, the study utilizes OLS regressions in Table 5, with the logarithmically transformed amount of carbon emissions as the dependent variable. This approach aims to address the potential concern that certain firms may employ greenwashing strategies to conceal their subpar environmental performance. Greenwashing involves the use of symbolic actions by firms to create an illusion of sustainability without genuinely reducing their carbon emissions (Issa and In'airat, 2023). While the GHG reduction initiatives score is derived from firms' disclosures regarding their strategies and initiatives, there is a possibility that such disclosures may not accurately reflect the true extent of environmental impact mitigation in the company's activities. To mitigate the risk of inaccurate or overstated claims regarding environmental practices, the study incorporates the actual carbon emissions amount as the dependent variable in Table 5. The OLS results in Table 5 reveal a noteworthy pattern—a negative correlation between the amount of carbon emissions and external assurance of sustainability reports. Additionally, the sustainability committee demonstrates a negative moderating effect on this relationship, whereas no such effect is observed for the governance committee. These results imply that firms with external assurance tend to have lower carbon emissions. This supports the notion that the adoption of external assurance is linked to a reduction in carbon emissions, countering the idea that firms may be leveraging assurance to conceal poor environmental performance. Instead, the results imply that external assurance is associated with enhanced environmental practices, contributing to reduced carbon emissions.

Second, the study employs a two-step generalized method of moments (GMM) approach in Table 6. The use of GMM technique in the robustness test provides further evidence to support the validity of the results obtained from the original OLS and Fixed Effects regression models. By addressing the potential issue of reverse causality or simultaneity, the GMM results lend additional credibility to the findings that the adoption of third-party assurance of sustainability performance is positively associated with GHG reduction strategies, and that board committees positively moderate this relationship.

Table 4 OLS and fixed effects results

Variables	OLS (1)	OLS (2)	OLS (3)	Fixed effects (4)	Fixed effects (5)	Fixed effects (6)
EXA	13.70***			12.05***		
	[13.06]			[7.337]		
EXA#SUS_COM		12.80***			10.14***	
		[15.22]			[9.171]	
EXA#GOV_COM			4.762***			7.152***
			[7.766]			[4.230]
B_SIZE	6.317***	6.620***	7.899***	6.405**	6.522**	7.893***
	[5.078]	[5.331]	[6.142]	[2.390]	[2.408]	[2.673]
B_EXP	−0.0779***	−0.0789***	−0.0982***	−0.0529**	−0.0530**	−0.0662***
	[−5.098]	[−5.189]	[−6.225]	[−2.363]	[−2.278]	[−2.726]
IND	0.0710***	0.0711***	0.0791***	0.0580*	0.0626**	0.0921***
	[4.888]	[4.918]	[5.351]	[1.884]	[2.030]	[2.915]
CEOD	5.023***	5.054***	3.646***	−2.034	−2.108	−2.338
	[8.245]	[8.350]	[5.486]	[−1.471]	[−1.479]	[−1.620]
ROA	27.86***	30.73***	29.81***	28.88***	30.88***	32.13***
	[4.647]	[5.146]	[4.717]	[3.466]	[3.689]	[3.723]
F_SIZE	4.975***	4.804***	5.398***	9.444***	9.172***	11.68***
	[18.28]	[17.53]	[18.51]	[6.898]	[6.197]	[7.749]
CAP	−0.507	−0.993	−1.853	−11.81	−11.16	−14.42
	[−0.0487]	[−0.0957]	[−0.167]	[−0.843]	[−0.813]	[−1.001]
Industry	Yes	Yes	Yes	No	No	No
Constant	−84.41***	−78.85***	−90.16***	−175.1***	−167.1***	−225.3***
	[−12.94]	[−11.99]	[−12.69]	[−5.371]	[−4.746]	[−6.224]
Observations	4,095	4,095	4,095	4,095	4,095	4,095
R-squared	0.324	0.330	0.282	0.178	0.179	0.135
F test	90.06	92.18	83.54	20.12	21.98	16.28

This table displays the outcomes of OLS and fixed effects regressions. Please, refer to Table 1 for the measurements of variables. Moreover, the presence of asterisks (*) alongside the estimation results indicates the significance level, with one, two, and three asterisks corresponding to significance levels of 1%, 5%, and 10%, respectively

Third, the study employs propensity score matching (PSM) using Stata's psmatch2 command to address potential selection bias effects. PSM is a statistical technique used to control for selection bias, which can arise when firms self-select into adopting certain practices, such as external sustainability audits. Table 7 outlines the details and results of the initial stage model in the propensity score matching analysis. The results highlight that bigger firms with independent boards, as well as higher capital expenditures, are more prone to adopting external sustainability audits. Conversely, companies with a significant proportion of board members possessing industry-specific or strong financial backgrounds tend to have lower rates of external assurance adoption. More importantly, the study's Table 8 reveals a positive impact of independent audit on firms' commitment to emissions reduction. The treatment group, with independent audit, demonstrates a significantly higher effect compared to the control group, indicating that independent audit may play a role in promoting greenhouse gas reduction initiatives among firms.

Overall, the outcomes of robustness tests substantiate the study's earlier conclusions, indicating the consistency of initial findings. This suggests that the results remain robust when employing alternative measures, different statistical techniques, and accounting for endogeneity and sample selection bias.

Discussion

The investigation into the association between third-party sustainability audit and a company's commitment to GHG reduction initiatives carries profound implications for the realms of corporate governance and environmental sustainability. As the global community intensifies its focus on environmental concerns, understanding the dynamics of how companies approach sustainability efforts and seek external

Table 5 OLS regressions results using the amount of carbon emissions as dependent variable

Variables	OLS (1)	OLS (2)	OLS (3)
EXA	−0.9411*		
	[−1.602]		
EXA#SUS_COM		−0.113*	
		[−1.801]	
EXA#GOV_COM			0.0553
			[1.094]
B_SIZE	0.329***	0.315***	0.325***
	[3.305]	[3.158]	[3.281]
B_EXP	0.00133	0.00142	0.00131
	[1.306]	[1.400]	[1.278]
IND	0.00430***	0.00406***	0.00412***
	[3.894]	[3.671]	[3.713]
CEOD	−0.237***	−0.233***	−0.249***
	[−5.028]	[−4.911]	[−5.124]
ROA	−1.341***	−1.322***	−1.326***
	[−2.658]	[−2.616]	[−2.619]
F_SIZE	1.066***	1.055***	1.057***
	[46.77]	[46.74]	[45.54]
CAP	17.10***	17.08***	17.09***
	[16.94]	[16.89]	[16.91]
Industry	Yes	Yes	Yes
Constant	−18.93***	−18.71***	−18.73***
	[−35.66]	[−35.28]	[−34.41]
Observations	4,095	4,095	4,095
R-squared	0.733	0.733	0.733
F test	574.9	572.5	575.8

This table displays the outcomes of OLS regressions using the amount of carbon emissions. Please, refer to Table 1 for the measurements of variables. Moreover, the presence of asterisks (*) alongside the estimation results indicates the significance level, with one, two, and three asterisks corresponding to significance levels of 1%, 5%, and 10%, respectively

Table 6 GMM results

Variables	(1)	(2)	(3)
L.GHGS	0.509***	0.581***	0.476***
	[6.649]	[8.261]	[2.685]
EXA	12.08*		
	[1.769]		
EXA#SUS_COM		4.314**	
		[2.273]	
EXA#GOV_COM			4.014*
			[1.858]
B_SIZE	5.011*	−2.544	4.067*
	[1.805]	[−0.558]	[1.566]
B_EXP	−0.665**	−0.206*	−0.515**
	[−2.610]	[−1.531]	[−2.194]
IND	0.0534*	0.0618**	0.0718***
	[3.437]	[4.238]	[5.741]
CEOD	−7.141	3.196	−8.624
	[−1.230]	[0.976]	[−1.199]
ROA	12.79	23.20	12.82
	[0.719]	[1.280]	[0.419]
F_SIZE	3.228**	3.643**	2.761
	[2.069]	[2.466]	[1.445]
CAP	−67.89*	−19.01	14.84
	[−1.711]	[−0.475]	[0.273]
Industry	Yes	Yes	Yes
Constant	−55.19	−69.57*	−43.40
	[−1.324]	[−1.849]	[−0.902]
Observations	3,853	3,678	4,015
AR(1)	0.000	0.000	0.000
AR(2)	0.220	0.185	0.298
Hansen	0.212	0.323	0.242

This table displays the outcomes of GMM regressions. Please, refer to Table 1 for the measurements of variables. Moreover, the presence of asterisks (*) alongside the estimation results indicates the significance level, with one, two, and three asterisks corresponding to significance levels of 1%, 5%, and 10%, respectively

validation becomes paramount. The findings of this study shed light on the pivotal role played by external sustainability assurance in driving corporate environmental initiatives. Moreover, the exploration of the moderating influence of sustainability and governance committees provides nuanced insights into the internal factors that shape the adoption of assurance practices. As companies strive to navigate the complex landscape of environmental responsibility, these results contribute to the ongoing discourse on sustainable practices, governance mechanisms, and the strategic adoption of external assurances.

According to institutional theory, firms are influenced by the expectations and norms of their institutional environment, which may include societal norms, regulations, and practices. In the context of this study, the institutional environment encompasses noncoercive pressures, such as the expectations and norms of the community or industry related to corporate environmental and sustainability practices. The results support the argument that companies are influenced by the expectations of their institutional environment. Specifically, companies that adopt independent audit practices for their environmental disclosure may do so to align with societal expectations and norms, or to emulate the practices of peers within their industry, fostering coherence in industry practices. These findings are in harmony with the results obtained by Issa and Hanaysha (2023a), highlighting the affirmative and statistically significant impact of external assurance on a firm's commitment to emissions reduction initiatives.

Table 7 PSM first-stage model: predictor of adopting independent sustainability audit

Variables	Coefficient (*z*-test)
BSIZE	0.586*** (5.710)
BSKILL	−0.007*** (−5.750)
BIND	0.005*** (4.630)
CEOD	−0.082 (−1.410)
ROA	0.272 (0.610)
FSIZE	0.259*** (11.340)
CAP	3.110*** (3.950)
Industry	Yes
Constant	−6.652*** (−13.810)
Observations	4098
Pseudo R^2	0.1265
chi2 (*p*-value)	470.03 (0.000)

This table displays the outcomes of propensity score matching (PSM) first-stage model, presenting the outcomes in relation to the predictor of adopting a third-party sustainability audit. The *z*-statistics are indicated in brackets. Please, refer to Table 1 for the measurements of variables. Moreover, the presence of asterisks (*) alongside the estimation results indicates the significance level, with one, two, and three asterisks corresponding to significance levels of 1%, 5%, and 10%, respectively

Furthermore, the positive moderating effect of sustainability committee on the examined relationship suggests that the presence of a sustainability committee can enhance the company's environmental performance by ensuring that sustainability practices are integrated into the firm's overall strategy and decision-making processes. These findings resonate with previous research, exemplified by the studies of Dwekat et al. (2022), García-Sánchez et al. (2022) and García-Sánchez et al. (2023), highlighting the pivotal role of sustainability committees in fostering the adoption of external sustainability assurance and thereby facilitating the realization of a company's sustainability objectives. Furthermore, the results are in line with institutional theory, indicating that companies need to adopt optimal and acceptable practices to safeguard themselves against threats to their legitimacy. Moreover, the results suggest that the presence of a governance committee can enhance the company's environmental performance by ensuring that the firm's sustainability practices align with the interests of its stakeholders. Furthermore, the presence of a governance committee can increase the transparency and accountability of a firm's sustainability practices, which can enhance stakeholder trust and confidence in the company. This aligns with the research of Sellami et al. (2019), underlining the pivotal role of governance committees in advancing the adoption of third-party sustainability assurance, thereby contributing to the enhancement of the overall firm's governance system.

In conclusion, this study underlines the significance of external sustainability assurance and the nuanced role of governance structures in fostering sustainable practices, contributing to the broader understanding of corporate environmental responsibility. By delving into these intricate relationships, the study makes a substantial contribution to institutional theory, elucidating how firms navigate the expectations and norms of their institutional environment regarding environmental and sustainability practices. This theoretical contribution enhances the insight into the dynamic interplay between external institutional pressures and internal governance mechanisms, shaping corporate sustainability initiatives. The study not only offers practical guidance for companies navigating the evolving landscape of environmental sustainability but also provides valuable insights for decision-makers and policymakers alike.

Table 8 PSM test results

Variable	Sample	Treated	Controls	Difference	Standard error	*t*-stat
GHGS	Unmatched	79.946	58.400	21.546	0.822	26.210
	Average treatment effect for the treated (ATT)	79.946	67.734	12.211	1.902	6.420

This table displays the outcomes of propensity score matching (PSM) test to compare the effects of firms that adopted third-party audit for environmental disclosure with those that did not

Conclusion

The study explores the correlation between GHG mitigation strategies, third-party sustainability assurance, and the moderating influence of board committees, using a sample of non-financial companies from 2006 to 2021. The results support the idea that companies must adopt practices harmonious with stakeholders' expectations to enhance corporate image. Specifically, the study reveals that companies may embrace external assurance practices to align with industry standards and fulfil social norms, showcasing their dedication to environmental sustainability. The presence of a sustainability committee and a governance committee can also enhance a company's environmental performance by ensuring that sustainability practices align with stakeholder interests and increasing transparency and accountability.

Implications

The study's results offer several theoretical and practical implications. First, this study holds significant theoretical implications by pioneering the examination of the interplay between corporate GHG reduction strategies and the adoption of third-party sustainability assurance, with a focus on the moderating role of internal governance committees. By integrating institutional theory, it sheds light on how institutional pressures influence a company's decision to seek external validation for sustainability efforts. The study deepens our understanding of organizational responses to environmental challenges and broadens the intellectual foundations of sustainability and corporate governance scholarship. Additionally, insights into the potential moderating effects of internal governance committees provide practical guidance for stakeholders aiming to enhance sustainability and governance practices in organizations.

Second, the findings underscore the pivotal influence of institutional norms in steering corporate sustainability endeavours. Institutional norms play a crucial role in driving corporate sustainability practices. Companies that want to demonstrate their commitment to environmental sustainability may consider adopting external assurance practices and establishing sustain ability and governance committees to enhance their environmental performance and increase transparency and accountability. This can also help companies to meet the expectations and norms of their institutional environment. Third, the findings of this study may have implications for policymakers and regulators who are interested in promoting corporate sustainability practices. The study suggests that policies and regulations that encourage or mandate external assurance practices and the establishment of sustainability and governance committees may be effective in driving corporate environmental performance. Fourth, investors can use these findings to inform their investment decisions, by taking into account a company's sustainability practices and third-party assurance of environmental reporting. This can also help investors identify companies that are better positioned to address environmental risks and opportunities.

Limitations and future research

The study has a few limitations that are worth noting.

Firstly, this study only looks at companies in the STOXX Europe 600 index, which may not apply to other regions or markets. Therefore, future researchers can extend the scope of the research by conducting cross-regional analyses to explore whether the association between GHG reduction strategies and third-party sustainability assurance holds across different geographical contexts. This would enhance the generalizability of findings and provide a more comprehensive understanding of global trends.

Secondly, while the study focuses on sustainability and governance committees as moderators, other internal and external factors could also play a role. Future research could explore a broader spectrum of variables that might contribute to a more thorough comprehension of the dynamics involved. Future researchers may explore additional internal and external factors that might moderate the connection between GHG reduction strategies and independent sustainability audit. For instance, board diversity, CEO characteristics, social pressure or regulatory environments could be considered as potential moderators.

Thirdly, the study treats independent sustainability audit as a binary variable (reasonable/high or limited/moderate). However, the quality and extent of assurance services might vary significantly within these broad categories. The Refinitiv Eikon's measure of external audit lacks details on the specific scope, affecting the overall effectiveness of sustainability assurance. Prospective academics could investigate the influence of assurance quality and scope on the association between GHG reduction strategies and third-party sustainability audit. A more nuanced analysis of assurance practices, such as distinguishing between different assurance providers and levels of assurance scope, could provide valuable insights.

Declarations

Conflict of interest The author declares that they have no conflict of interest.

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