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Does the presence of an environmental committee strengthen the impact of board gender diversity on corporate environmental disclosure? Evidence from sub-Saharan Africa

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Abstract

This study examines the relationship between board gender diversity, the presence of environmental committees and corporate environmental disclosure (CED). Using 1130 firm-year observations of 113 firms listed across five sub-Saharan Africa (SSA) stock markets from 2010 to 2019, we find that the extent of CED in SSA is low compared with developed countries. However, panel quantile regression analysis reveals that the presence of women directors is positively associated with CED, and the relationship is contingent on the presence of an environmental committee. The study makes three principal contributions: It adds to the limited literature on the relationship between board gender diversity and CED, where virtually all previous studies have been conducted in developed countries; it is the first to examine the direct relationship between environmental committees and CED in the developing world; and, most importantly, it is the first study to examine the possible moderating influence of environmental committees.

KEYWORDS
board gender diversity, corporate environmental disclosure, environmental committees, sub-Saharan Africa

1 | INTRODUCTION

In an age of global warming, depletion of natural resources and other climate concerns, environmental sustainability has been progressively integrated into corporate communication and decision-making processes. One form of corporate communication is corporate environmental disclosure (CED), which we define as the dissemination of information to stakeholders (Hassan & Romilly, 2018) about a firm's environmental strategies, policies and performance. CED has become an essential source of knowledge about the effectiveness of a firm's sustainability strategies (Shahab et al., 2018), containing information about key environmental issues and their impact on companies' performance and survival, including environmental risks and uncertainties, environmental policies and material items of environmental

Abbreviations: ACMTEZ, audit committee size; BZ, board size; CED, corporate environmental disclosure; CSR, corporate social responsibility; DOA, ratio of debt to assets; DWOB, women on boards as a dummy variable; ENV, environment score; ENV_CMTE, environmental committee; ESG, environmental, social and governance; GCC, Gulf Cooperation Council; GDP, gross domestic product; GE, government effectiveness; GMM, generalised method of moment; IND, board independence; IND_ACMTE, audit committee independence; MENA, Middle East and North Africa; MKTCAP, market capitalisation; OLS, ordinary least squares; PQR, panel quantile regression; PS, political stability; SSA, sub-Saharan Africa; TBQ, Tobin's Q; WOB, women on boards.

costs and revenues (Gerged, 2021). Also, CED quality can be seen as a symbolic indicator of transparency, resulting in improved corporate reputation (Deegan & Blomquist, 2006; Haque & Ntim, 2018).

A company's environmental strategy and decisions often consist of significant investments with uncertain and complex outcomes that might influence a wide range of stakeholders differently or, indeed, prompt different reactions from particular types of stakeholders. For example, some stakeholders might pay more attention to financial returns, while others might be more focused on the harmful effect of the corporation's commercial activities on the environment (Liao et al., 2015). A more diverse board of directors would be expected to be more capable of addressing the issues raised by a variety of stakeholders and thus also of providing more comprehensive CED (Singh et al., 2001).

Previous literature indicates that female directors tend to display more orientation toward environmental sustainability than male directors, who may be more concerned about financial performance (Nadeem et al., 2020; Tingbani et al., 2020). Therefore, the presence of women on corporate boards might be expected to facilitate CED. Indeed, most previous studies in developed countries find a positive effect of board gender diversity on CED (Baalouch et al., 2019; Ben-Amar et al., 2017; Hollindale et al., 2019; Liao et al., 2015; Tingbani et al., 2020).

Another board characteristic that might both reflect a willingness to engage in environmental disclosure and further engender it is the existence of an environmental committee. Board committees are set up for specific tasks and usually comprise directors with expertise in a particular area. Given their specific remit, they are likely to influence the board's decisions regarding a particular set of issues. In the case of environmental committees, some prior studies (Liao et al., 2015; Peters & Romi, 2014) have found evidence of a positive effect on CED in developed countries.

Previous literature, however, has shortcomings. First, most studies have focused on studying the impact of board gender diversity on CED in developed countries; Charumathi and Rahman (2019), which examined greenhouse gas emissions in India, is a rare exception. Even if there is evidence of board gender diversity influencing CED in the developed world, cultural factors relating to women in developing countries—especially conservative social attitudes regarding their role and influence—mean that those results cannot be taken for granted. Second, the limited previous research into the direct influence of the presence of an environmental committee on CED appears to have taken place only in developed countries. Again, assuming that such committees are also a feature of practice in developing countries, it would be worth conducting further studies rather than simply presuming that findings from the developed world apply. Third, although there has been some very limited exploration of interaction effects in the area (Liao et al., 2015), to the best of our knowledge no study has explored the potential moderating impact of environmental committees on the association between board gender diversity and CED. It should also be noted that previous studies of the relationship between board gender diversity and CED have used regression approaches, such as ordinary least squares (OLS), that are inefficient in examining the associations at various points in the conditional distribution of the outcome (Koenker & Bassett, 1978).

In this study, we address these shortcomings by using a panel quantile regression (PQR) model to analyse data relating to sub-Saharan Africa (SSA) firms. According to World Bank (2022) data, SSA had an estimated total population of 1.17 billion in 2021, or about 15% of the world's population. Its 48 countries vary greatly on many dimensions (e.g., population, physical size, resources, religion and political system), but SSA is an interesting region for the current study because many of its social attitudes regarding gender are traditional and conservative when compared to 'liberal', developed countries, which have seen significant changes in the role of women in recent years—including in their participation in the boards of listed companies.

As in many parts of the developing world, gender roles in SSA are determined by ethno-religious, socio-cultural and economic factors, which largely influence the distribution of resources and responsibilities between women and men (Akinola, 2018; Azong & Kelso, 2021). In a patriarchal system, men are seen as authorities, and they dominate all aspects of decision-making, both domestically and within business organisations (Adisa et al., 2019; Wadesango et al., 2011). These factors mean that, even when a woman is on the board of an SSA company, she might have limited influence. Sometimes she might even be there, not in her own right, but simply as a member of a family and expected to follow a male lead. Thus, it is not clear that the general finding of a positive relationship between board gender diversity and CED in the developed world is transferable to SSA or similarly conservative developing regions, such as the Middle East and North Africa (MENA) and Southeast Asia.

One of the features on which SSA countries differ from each other, though, is whether they have a developed stock market. Because of their level of economic development and other aspects of their cultural heritage, many do not. However, five were found to have sufficient Bloomberg data to be included in the current study: South Africa, Kenya, Nigeria, Ghana and Zambia. These countries represent roughly 70% of SSA stock market capitalisation and GDP (Acquaah, 2015). In each country, although there have been broad corporate governance reforms (e.g., the King Reports in South Africa), CED and environmental committees are voluntary activities and thus the result of decisions made by individual companies.

The dataset comprises 113 companies across the five SSA countries from 2010 to 2019, resulting in 1130 firm-year observations. Our findings indicate a positive and significant relationship between board gender diversity and CED, and between the presence of an environmental committee and CED, among the sampled SSA companies. Additionally, our results support the proposition that the presence of an environmental committee can positively support the impact of female directors on CED.

Reflecting the previously identified limitations, our study makes three contributions to the current literature. First, we add to the existing literature on the direct relationship between board gender diversity and environmental disclosure. Whereas virtually all prior studies

focus on developed countries, our study is located in the developing world and is the first in the SSA region. Second, we add to the small stock of studies of the direct relationship between the presence of a board committee and CED; ours is the first to examine a developing world context. Third, and most significantly, this is, to the best of our knowledge, the first study anywhere to examine the moderating effect of an environmental committee on the association between board gender diversity and CED.

The remainder of the paper is structured as follows. Section 2 presents the theoretical background, discusses prior empirical literature, and develops the hypotheses. Section 3 explains the research design. Section 4 presents and discusses the empirical findings. Section 5 provides the conclusions. Finally, Section 6 proffers practical implications and suggestions for future research.

2 | THEORETICAL BACKGROUND, LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 | Theoretical background

Several underlying theories have been employed in previous studies of CED, but we employ gender socialisation theory (Liu, 2018) and resource dependence theory (Tingbani et al., 2020), which provide complementary means of exploring how the presence of women directors might affect environmental disclosure.

The primary argument of gender socialisation theory is that women and men tend to act differently because of their divergent interests and qualities, which emanate from their social interactions (Liu, 2018; Nadeem et al., 2020). Women are argued to bring a more participative, communal leadership and democratic style of decision-making (Ben-Amar et al., 2017; Eagly et al., 2003). These qualities may enhance board effectiveness, improve the quality of discussions and result in better communication with stakeholders. It is further noted in gender socialisation theory (Ibrahim et al., 2009) that women directors tend to be more receptive to ethical policies in comparison to their male counterparts. According to Adams and Funk (2012), women in the boardroom tend to demonstrate traits of universalism and benevolence, with less power orientation, by pursuing the welfare of all people and nature (Adams et al., 2011). There is also evidence to indicate that women are more sensitive to environmental and corporate social responsibility issues (Zahid et al., 2020). For example, Boulouta (2013) and Jain and Zaman (2020) found women to be more concerned about the welfare of stakeholders and promoting beneficial environmental activities within an organisation. In their analysis, Bear et al. (2010) discovered a positive relationship between women on boards (WOB) and CSR ratings.

Moreover, there is evidence that board gender diversity enhances the dissemination of environmental or similar information to stakeholders. Frias-Aceituno et al. (2013) found a positive relationship between gender diversity and integrated reporting. Their results are consistent with the proposition that women directors tend to possess attributes, such as heightened concerns for others (Nadeem et al., 2020), which would be expected to promote CED practices.

Building on the seminal research by Pfeffer and Salancik (1978), recent studies (see Cabeza-García et al., 2018; Cordeiro et al., 2020; Tingbani et al., 2020) have highlighted resource dependence theory as a key theoretical lens through which to view board gender diversity. Resource dependence theory suggests that organisations are likely to procure and exchange external resources in their quest for survival, thus creating a dependency between the organisations and their external environment. In this regard, boards may be viewed as a pool of requisite organisational resources, including a diverse range of expertise, capabilities, strategy development, influences and stakeholder engagement (Cordeiro et al., 2020). However, Hillman et al. (2000) argue that these resources can only be maximised when they come from a diverse board of directors that muster their unique skills and knowledge together. From the perspective of diversity, it is suggested that women are more likely to establish networks and links with the external environment, which are essential for business survival, compared to their male counterparts (Cordeiro et al., 2020). Women directors bring a wealth of human and social capital, which harmonise to improve organisations' social outcomes, including environmental disclosure (Mallin & Michelon, 2011). Considering women directors' capacity to maintain engagement with stakeholders (Pucheta-Martínez & Gallego-Álvarez, 2019), it can thus be posited that their presence on boards will enhance the flow of information, thus improving environmental disclosure.

2.2 | Empirical literature review and hypothesis development

2.2.1 | Gender diversity and environmental disclosure

Although CED is mostly voluntary, the vast majority of listed firms in developed economies with strong stakeholder influence now practise some form of environmental disclosure. Given the sensitivity of environmental issues, the question then arises of how much and what to disclose. Scholars have, therefore, attempted to examine factors that may influence firms to engage in environmental disclosure.

Empirical evidence on the role of board gender diversity in influencing CED practices is only beginning to gather momentum, but most of these studies indicate a positive link, and none has found a negative relationship. In only one case (Prado-Lorenzo & Garcia-Sanchez, 2010) was non-significant results obtained. This can be seen in Panel A of Table 1, which lists seven such studies. The overall pattern of findings is consistent with research that has found that board gender diversity positively influences corporate social responsibility and similar forms of disclosure (Cabeza-García et al., 2018; Jizi, 2017).

It is also apparent from Panel A that all but one of the studies (Charumathi & Rahman, 2019) relate to countries in the developed world and that most of them are focused on greenhouse gas emissions.

TABLE 1 Review of related studies

Study	Context	Independent variable	Measure of CED	Model	Findings
Panel A: The impact of board gender diversity on CED					
Liao et al. (2015)	United Kingdom	Percentage of WOB	GHG Emissions Disclosure Index	Probit regressions	Positive
Tingbani et al. (2020)	United Kingdom	Percentage of WOB	GHG Emissions Disclosure Index	Fixed-effects model	Positive
Charumathi and Rahman (2019)	India	Number of WOB	Carbon Emissions Disclosure Index	Multiple linear regression	Positive
Hollindale et al. (2019)	Australia	Number of WOB	GHG Emissions Disclosure Index	Logistic regression	Positive
Ben-Amar et al. (2017)	Canada	Percentage of WOB and binary variable	GHG Emissions Disclosure Index	Instrumental variable probit model	Positive
Prado-Lorenzo and Garcia-Sanchez (2010)	United Kingdom	Percentage of WOB	GHG Emissions Disclosure Index	Multiple linear regression	Non-significant
Baalouch et al. (2019)	France	Percentage of WOB	CED index	Fixed-effects model	Positive
Panel B: The impact of an environmental committee on CED					
Tingbani et al. (2020)	United Kingdom	Environmental committee	GHG disclosure	Fixed-effects model	Non-significant
Liao et al. (2015)	United Kingdom	Environmental committee	GHG disclosure	Probit regression	Positive
Peters and Romi (2014)	United States	Environmental Committee	GHG disclosure	Probit regression	Positive
Rankin et al. (2011)	Australia	Environmental committee	GHG disclosure	2SLS	Non-significant
Panel C: The moderating role of the environmental committee on the board gender diversity–CED link					
No studies					

Abbreviations: CED, corporate environmental disclosure; GHG, greenhouse gases; WOB, women on board of directors.

Based on these results and the earlier theoretical discussion, we hypothesise that:

> **H1.** There is a positive relationship between board gender diversity and CED.

2.2.2 | Environmental committees and environmental disclosure

As the apex decision-making body of an organisation, a large firm's board of directors is charged with many responsibilities. Those demands, and the complexities of an organisation's operating environment, have encouraged the establishment of board sub-committees. The majority of corporate governance codes around the world now require firms to set up standing committees—such as an audit committee, a nominations committee and a compensation or remuneration committee—to facilitate effective oversight and decision-making (Dixon-Fowler et al., 2017; Green & Homroy, 2018; Jiraporn et al., 2009). These committees are relatively small, meet more regularly than the main board, and are assigned specific tasks on which they report to the main board (Kolev et al., 2019).

Other board committees are generally set up at a board's discretion. Increasing calls from stakeholders for organisations to account for the impact of their activities on the environment have resulted in the voluntary establishment of a board committee responsible for collecting and analysing information relating to a firm's environmental practices and impact. Researchers have, therefore, tried to establish a link between environmental committees and environmental disclosure. Panel B of Table 1 shows that a few previous studies have examined the relationship, but only in the developed world. One study in the United Kingdom (Liao et al., 2015) and one study in the United States (Peters & Romi, 2014) found a positive relationship, whereas Tingbani et al. (2020) in the United Kingdom and Rankin et al. (2011) in Australia did not yield significant results. None found a negative relationship. All four studies focused on greenhouse gas disclosures.

Based on these results and the earlier discussion about board committees, we hypothesise that:

> **H2.** There is a positive relationship between the existence of an environmental committee and CED.

2.2.3 | The moderating role of environmental committees

Jain and Jamali (2016) emphasise the importance of a holistic approach when exploring the relationship between corporate

TABLE 2 A summary of operational definitions of research variables

Variables	Operational Definition	Source
Dependent variable		
CED	Corporate environmental disclosure is proxied by the Environmental aspect of Bloomberg's Environmental, Social and Governance (ESG) ratings, which are derived mainly from corporate annual reports, sustainability/CSR reports and corporate websites (Huber & Comstock, 2017). According to Bloomberg (2016), the environmental score (ENV) represents various aspects of environmental performance, including carbon footprint, emissions, energy consumption, water usage, spoilage and production policies by a firm and its supply chain.	Huber and Comstock (2017); Zumente and Lāce (2021); Eliwa et al. (2021)
Independent variables		
WOB	Board gender diversity is proxied by the percentage of women on board. As an alternative measure, we use a dummy variable, taking the value 0 if two or fewer women and one if three or more women.	Bear et al. (2010); Boulouta (2013); Tingbani et al. (2020); Baalouch et al. (2019);
ENV_CMTE	The dummy variable equals one if a board has an environmental committee, 0 otherwise.	Gerged et al. (2022); Tingbani et al. (2020); Liao et al. (2015); Peters and Romi (2014); Rankin et al. (2011)
Firm-level controls		
BZ	Board size, proxied by the number of directors.	Baldini et al. (2018); Crifo and Forget (2015)
IND	Percentage of independent non-executive directors, as a proxy for board independence.	
IND_ACMTE	Percentage of independent non-executive directors on an audit committee as a proxy for its independence.	Ntim (2016); Gerged, Matthews, and Elheddad (2021)
ACMTEZ	Audit committee size, proxied by the number of members.	Hassan et al. (2020); Gerged (2021);
MKTCAP	Natural logarithm of market capitalisation as a proxy for firm size.	Dang et al. (2018)
TBQ	Tobin's Q: the ratio of total assets minus the book value of equity plus the market value of equity to total assets.	Gerged et al. (2021b)
DOA	The ratio of debts to assets as a proxy for leverage.	Fifka (2013); Gerged et al. (2018)
Country-level controls		
GE	Country-level government effectiveness score from the World Governance Index (Kaufmann et al., 2011).	Elamer et al. (2020)
PS	Country-level political stability score from the World Governance Index (Kaufmann et al., 2011).	Gerged et al. (2021a)
GDP	Natural logarithm of gross domestic product per capita.	Elamer et al. (2020); Salem et al. (2020)

governance mechanisms and CED. As such, the different interactions among board structure elements that affect CED, as emphasised in this study, should be considered (Ramon-Llorens et al., 2020).

According to Bravo and Reguera-Alvarado (2019), women directors tend to be more effective in enhancing environmental-related disclosures, given the context within which they deliver their duties. One of these contexts to ensure a specific focus on corporate boards' responsibilities is the development of committees, such as the environmental committee. For example, Pucheta-Martínez et al. (2021) state that the interaction between female directors and audit committee function appears to enhance firms' engagement in social and environmental disclosures in the context of 36 countries worldwide. Thus, it can be suggested that the interaction between the presence of women on a board and an environmental committee will have a tendency to increase a firm's environmental disclosure.

Although there has been some exploration of interaction effects in the area (Liao et al., 2015), to the best of our knowledge, no study has explored the moderating impact of the environmental committee on the WOB–CED nexus (Panel C of Table 1 is empty). In light of this, we, therefore, hypothesise that:

H3. The presence of an environmental committee positively moderates the relationship between board gender diversity and CED.

3 | RESEARCH DESIGN

3.1 | Data and sample considerations

Following prior CSR/sustainability disclosure and corporate governance literature (e.g., Albitar et al., 2020; Baldini et al., 2018;

Gerged, 2021; Gillan et al., 2021; Pham & Tran, 2020), we rely on the Bloomberg dataset to collect data for the study's variables—including the dependent variable used to proxy CED.

As explained earlier, South Africa, Kenya, Nigeria, Ghana and Zambia were selected as the countries for the sample because they have the largest SSA stock markets with sufficient Bloomberg data to conduct comprehensive statistical tests. All the companies listed on them were considered as candidates for the study, but firms were included in the sample only if they had full data on Bloomberg relating to the selected variables for the period 2010–2019. This yielded a sample of 113 firms, with 1130 firm-year observations. The sample comprises 62 South African firms, 33 Nigerian firms, nine Kenyan firms, five Zambian firms and four Ghanaian firms.

3.2 | Measures

Table 2 operationally defines the research variables. In testing our hypotheses, this study divides the measurement of variables into four categories. First, the dependent variable, CED, is measured using the Bloomberg ESG score—specifically, the environmental disclosure score. Bloomberg's ESG ratings are mainly derived from corporate annual reports, sustainability/CSR reports and corporate websites and are based on quantitative and policy-related ESG data (Huber & Comstock, 2017). Specifically, Bloomberg ESG data comprise 120 indicators, including three individual dimensions (i.e., environmental score, social score and governance score) to measure ESG performance. These weights are normalised from zero to 100 and available either as a total ESG score or as single-category scores, namely, environmental, social and governance scores. According to Bloomberg (2016), the environment score (ENV) represents various aspects of environmental performance, including carbon footprint, emissions, energy consumption, water usage, spoilage and production policies by a firm and its supply chain. Although previous research uses ESG data from different sources, such as KLD Research & Analytics, these datasets are binary and are, therefore, less rich in terms of variations than Bloomberg data (Zumente & Lāce, 2021). Arguably, ESG scores are expected to track sustainability disclosure directly, and thus, the environmental dimension of ESG is employed in the current study as a proxy for CED in line with prior literature (Eliwa et al., 2021).

Second, board gender diversity, in the form of WOB, as an independent variable, and the presence of an environmental committee (ENV_CMTE) as a moderator variable, are also measured using the Bloomberg dataset (Gerged et al., 2022). Third, in an attempt to address any omitted variable-related issues (Wooldridge, 2016), this study employs a set of control variables that reflect corporate governance mechanisms and other firm-specific characteristics and country-level features, which were chosen with reference to previous studies (see Baldini et al., 2018; Crifo & Forget, 2015; Fifka, 2013; Gerged et al., 2021a; Hassan et al., 2020; Ntim, 2016). The selected firm-level control variables are board size (BZ), board independence (IND), audit committee size (ACMTEZ), audit committee independence (IND_ACMTE), the firm market value represented by Tobin's *Q* (TBQ), leverage as measured by the ratio of debt to assets (DOA) and firm size as proxied by the logarithm of market capitalisation (MKTCAP) (Dang et al., 2018).[1] The country-level control variables are per capita gross domestic product (GDP) and national governance as proxied by political stability (PS) and government effectiveness (GE) (Elamer et al., 2020; Gerged et al., 2021a; Salem et al., 2020).

3.3 | Model specification

To test our hypotheses, we use PQR modelling (Powell, 2022), which provides a more inclusive understanding of the stated relationships than traditional linear regressions such as OLS and fixed-effects regression models (Cobb-Clark et al., 2016; Gerged, 2021; Gerged, Matthews & Elheddad, 2021). As a check on any potential endogeneity issues, we conduct a two-step generalised method of moment (GMM) regression model, as has been done in studies outside the immediate literature (e.g., Alvarado et al., 2021; Bruna et al., 2021).

Several PQR methods include additive fixed effects, including Canay (2011). However, these models have been criticised for changing the original model (Boumparis et al., 2017) as they are associated with problems in estimating large fixed effects in a quantile model, and there are concerns regarding incidental parameters when the time series (T) is small (Powell, 2022). Powell (2022), therefore, developed a new quantile regression method for panel data that offers consistent point estimates for small T. Compared with many studies in economics, where this model originated, our 10-year T would be considered small. Hence, we selected Powell's PQR over other quantile regressions.

Contrary to traditional least-squares regression models, which estimate the target's conditional *mean* across various values of study variables, a PQR model calculates the conditional *median* of the target (Baum, 2013). Applying a PQR estimation, we intend to provide a richer understanding of the relationship between board gender diversity and CED than prior studies (Baalouch et al., 2019; Ben-Amar et al., 2017; Charumathi & Rahman, 2019; Hollindale et al., 2019; Liao et al., 2015; Prado-Lorenzo & Garcia-Sanchez, 2010; Tingbani et al., 2020)—which were confined to different regular least-squares models, such as fixed-effects and OLS regressions—for two reasons. First, a PQR model is considered to be reasonably robust to outliers compared with traditional least-squares methods. Second, the PQR model is also deemed to be a semiparametric estimator by avoiding assumptions associated with the parametric distribution of the error process (Baum, 2013; Cobb-Clark et al., 2016; Powell, 2022).

The specification of the first model, which is designed without the interaction term to examine the direct impact of board gender diversity and the presence of an environmental committee on CED, is as follows.

$$CED_{it} = \beta_0 + \beta_1 WOB_{it} + \beta_2 ENV\_CMTE_{it} + \beta_3 BZ_{it} + \beta_4 IND_{it} + \beta_5 ACMTEZ_{it} + \beta_6 IND\_ACMTE_{it} + \beta_7 TBQ_{it} + \beta_8 MKTCAP_{it} + \beta_9 DOA_{it} + \beta_{10} GDP_{it} + \beta_{11} PS_t + \beta_{12} GE_t + \varepsilon_{it}. \quad (1)$$

TABLE 3 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CED	1130	15.92	16.65	0	63.64
WOB	1130	17.72	11.92	0	83.31
ENV_CMTE	1130	0.11	0.31	0	1
WOB * ENV_CMTE	1130	0.29	.97	0	8
BZ	1130	7.54	5.83	0	24
IND	1130	42.55	28.05	0	100
IND_ACMTE	1130	64.09	43.90	0	100
ACMTEZ	1130	3.84	1.60	0	9
TBQ	1130	1.76	1.25	0	9.42
DOA	1130	18.45	16.65	0	146.25
MKTCAP	**1123**	10.23	2.08	4.09	20.11
GDP	1130	8.26	0.62	6.86	8.99
PS	1130	29.20	18.44	2.84	68.25
GE	1130	46.43	22.99	10.53	66.51

Note: Research variables are operationally defined in Table 2. Computing the logarithm of MKTCAP has resulted in missing data that led to reducing our sample to 1123 firm-year observations.

The specification of the second model, with an interaction term for the moderating effect analysis, is as follows:

$$CED_{it} = \beta_0 + \beta_1 WOB_{it} + \beta_2 ENV\_CMTE_{it} + \beta_3 WOB * ENV\_CMTE_{it} + \beta_4 BZ_{it} + \beta_5 IND_{it} + \beta_6 ACMTEZ_{it} + \beta_7 IND\_ACMTE_{it} + \beta_8 TBQ_{it} + \beta_9 MKTCAP_{it} + \beta_{10} DOA_{it} + \beta_{11} GDP_{it} + \beta_{12} PS_t + \beta_{13} GE_t + \varepsilon_{it}, \quad (2)$$

where CED is corporate environmental disclosure, WOB is women on board (board gender diversity), ENV_CMTE is the presence of an environmental committee, and the control variables are as previously defined in Table 2.

4 | EMPIRICAL ANALYSIS

4.1 | Descriptive statistics

Table 3 shows a summary of the descriptive statistics of our research variables. The mean value of CED is 15.9%, with a standard variation of 16.6%; it varies from a minimum value of 0 to a maximum value of 63.6%. These results are consistent with prior CED studies in emerging economies (see Eljayash et al., 2012; Gerged et al., 2018, 2021a; Khlif et al., 2015). For instance, Gerged et al. (2018) reveal that the average value of CED in the MENA region—albeit using a different measure—was 13%. Likewise, Gerged et al. (2021a) indicate that CED has scored a mean value of 13.69% in the Gulf Cooperation Council (GCC) region. When the CED figures in Table 3 are compared with developed country settings, the comparatively low incidence of CED in the SSA region is indicated. For example, Matisoff et al. (2013) found a score of 81.8% for CED in a multi-sector study in the United States, while Barbu et al. (2014) recorded a mean value of 64% in the United Kingdom. This suggests that CED is still in its infancy in the SSA region compared with developed economies.

Regarding corporate governance arrangements, Table 3 shows that women make up less than a fifth of board directors (17.7%) on average. This is more than Cordeiro et al. (2020) reported for their US study, where women represented less than a tenth (9.2%) of directors but more aligned with Ben-Amar et al. (2017), who found that women accounted for 16% of directors amongst a sample of Canadian firms. Thus, although women directors comprise only a small proportion of the boards of our sampled firms, they might still be deemed to represent a significant minority when the patriarchal nature of SSA societies is considered.

The mean value of the environmental committee (ENV_CMTE) variable is about 11%, which indicates that just over a tenth of the sampled SSA firms has established a board-related environmental committee. This compares, for example, with Liao et al.'s (2015) finding that 21.6% of FTSE firms had formed a board environmental committee in the United Kingdom. Environmental committees in SSA are thus relatively rare.

Concerning firm-level corporate governance control variables, Table 3 shows that the mean value of the number of directors on boards in our sample is 7.5, with approximately 43% being independent non-executive directors. The average size of audit committees is about four members, with 64% of independent members.

TABLE 4 Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) CED														
(2) WOB	.292**													
(3) BZ	.303**	.275**												
(4) IND	.524**	.368**	.243**											
(5) IND_ACMTE	.506**	.336**	.281**	.625**										
(6) ACMTEZ	.038**	.106**	.253**	−.064**	−.061**									
(7) ENV_CMTE	.350**	.163**	.216**	.296**	.238**	.073**								
(8) WOB * ENV_CMTE	.356**	.281**	.227**	.278**	.221**	.075**	.659**							
(9) TBQ	.048**	.004**	−.043**	.069**	.080**	−.040**	.015**	−.023**						
(10) DOA	.004**	−.017**	.080**	−.005**	−.041**	.092**	.081**	.062**	−.029**					
(11) MKTCAP	.314**	.069**	.274**	.188**	.155**	.260**	.111**	.128**	.251**	−.026**				
(12) GDP	.452**	.103**	.039**	.448**	.506**	−.173**	.116**	.136**	.077**	−.038**	.007**			
(13) PS	.442**	.165**	−.008**	.569**	.601**	−.394**	.173**	.161**	.069**	.002**	−.182**	.622**		
(14) GE	.542**	.229**	.141**	.695**	.760**	−.318**	.188**	.192**	.082**	−.022**	.016**	.788**	.745**	

Note: Research variables are operationally defined in Table 2.

**Significance at the .05 level.

TABLE 5 Panel quantile regression without the interaction term

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Quantiles	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95
Variables	CED	CED	CED	CED	CED	CED	CED	CED	CED	CED
WOB	0.000***	0.125***	0.117***	0.138***	0.104***	0.078***	0.067***	0.068***	0.181***	0.093***
	(0.000)	(0.009)	(0.007)	(0.003)	(0.009)	(0.005)	(0.003)	(0.001)	(0.015)	(0.004)
ENV_CMTE	12.403***	11.368***	10.922***	12.48***	12.349***	12.388***	8.569***	7.573***	8.95***	7.098***
	(0.000)	(0.338)	(0.089)	(0.086)	(0.13)	(0.074)	(0.094)	(0.023)	(0.545)	(0.162)
BZ	0.000***	0.15***	0.237***	0.249***	0.204***	0.249***	0.283***	0.372***	0.399***	0.151***
	(0.000)	(0.009)	(0.003)	(0.006)	(0.011)	(0.013)	(0.004)	(0.002)	(0.06)	(0.007)
IND	0.000***	0.001	0.032***	0.033***	0.014***	0.038***	0.095***	0.133***	0.184***	0.1***
	(0.000)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.009)	(0.003)
IND_ACMTE	0.000***	0.003**	0.013***	0.016***	0.013***	0.008***	0.003**	0.002***	0.054***	0.045***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)	(0.002)
ACMTEZ	0.000**	0.227***	0.615***	0.086***	0.027	0.3***	0.325***	0.413***	0.02	1.618***
	(0.000)	(0.039)	(0.024)	(0.016)	(0.027)	(0.016)	(0.033)	(0.007)	(0.214)	(0.043)
TBQ	0.000*	0.066	−0.087***	−0.38***	−0.353***	−1.142***	−0.958***	−0.994***	−0.531***	−1.562***
	(0.000)	(0.051)	(0.015)	(0.034)	(0.135)	(0.029)	(0.029)	(0.005)	(0.125)	(0.021)
DOA	0.000***	0.01***	−0.01***	0.003**	0.006	0.014***	0.002**	0.008***	0.021**	−0.035***
	(0.000)	(0.002)	(0.001)	(0.002)	(0.005)	(0.002)	(0.001)	(0.001)	(0.009)	(0.004)
MKTCAP	0.000***	0.769***	0.942***	1.085***	1.426***	1.9***	1.813***	1.914***	2.725***	2.98***
	(0.000)	(0.018)	(0.012)	(0.026)	(0.011)	(0.016)	(0.022)	(0.008)	(0.109)	(0.047)
GDP	0.000	0.783*	3.4***	6.718***	6.64***	7.835***	7.658***	7.754***	8.608***	6.062***
	(0.000)	(0.462)	(0.143)	(0.05)	(0.268)	(0.06)	(0.045)	(0.012)	(0.392)	(0.141)
PS	0.000***	0.11***	0.094***	0.076***	0.123***	0.19***	0.167***	0.175***	0.2***	0.194***
	(0.000)	(0.008)	(0.003)	(0.002)	(0.014)	(0.004)	(0.003)	(0.001)	(0.008)	(0.007)
GE	0.000***	−0.015	0.024***	0.029***	0.111***	0.126***	0.12***	0.114***	0.107***	0.244***
	(0.000)	(0.011)	(0.004)	(0.003)	(0.015)	(0.004)	(0.004)	(0.001)	(0.014)	(0.012)
Observations	1123	1123	1123	1123	1123	1123	1123	1123	1123	1123

Note: Research variables are operationally defined in Table 2. Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

4.2 | Correlation matrix

Table 4 reports the correlation matrix for the primary research variables. The coefficients indicate that any residual non-normalities in the distribution of the study's variables seem to be mild and are in line with those shown by previous CED studies (e.g., Cordeiro et al., 2020; Fernandes et al., 2019; Gerged, Albitar, & Al-Haddad, 2021; Gerged et al., 2021a; Giannarakis et al., 2019). Table 4 also shows that the correlation coefficients for CED, WOB, ENV_CMTE and WOB * ENV_CMTE variables are positive and significant, providing initial support for our three hypotheses. In addition, the positive and significant correlation coefficients reveal that large companies and companies with independent boards, large-sized audit committees and independent audit committees are more likely to disclose environmental information. Additionally, the quality of national-level governance, as proxied by PS and GE, is positively correlated with the level of environmental information disclosed by our SSA sample companies.

4.3 | PQR analysis

4.3.1 | Board gender diversity and environmental disclosure

To test the first hypothesis (H1), we investigate the potential influence of board gender diversity (WOB) on CED. Table 5 shows the results of running a PQR regression model of the WOB–CED nexus. Overall, the 10 quantiles of Table 5 indicate that WOB has a positive influence on companies' decision to disseminate environmental information voluntarily, at a 1% level of significance. This means that H1 is accepted.

This result is in line with most of the limited number of studies on the influence of board gender diversity on various forms of CED in the developed world (Baalouch et al., 2019; Ben-Amar et al., 2017; Hollindale et al., 2019; Liao et al., 2015; Tingbani et al., 2020) and a study in India (Charumathi & Rahman, 2019). It is also consistent with Osei et al.'s (2017) finding that, in Ghana (one of our SSA countries),

gender diversity is positively related to corporate social responsibility disclosures.

More generally, our finding is consistent with the broader literature on the impact of board gender diversity on firms' environmental profiles. For example, Atif et al. (2020) found that female directors positively influence sustainability performance and Cabeza-García et al. (2018) argue, in their study of Spanish firms, that corporate engagement in social and environmental disclosures is driven by board gender diversity. This aligns with gender socialisation theory, which suggests that women directors are more responsive to ethical and sustainable policies than their male counterparts (Cumming et al., 2015), affecting corporate decisions and procedures relating to environmental responsibility and accountability (Lara et al., 2017).

This might be because female directors are more like to have non-business backgrounds and sensitise the board towards more environmental practices (Hillman et al., 2002; Hillman et al., 2009). From a resource dependence theory perspective, this is consistent with the idea that women directors are more likely to establish networks and links with the external environment, which are essential for business survival, than their male counterparts (Cordeiro et al., 2020) and that they tend to bring a wealth of human and social capital, which harmonises to improve organisations' social outcomes, such as environmental disclosure (Mallin & Michelon, 2011).

Recall, though, that an important justification for conducting our study in the SSA region was that, even if SSA firms were found to have women directors, it might be the case that traditional, conservative attitudes about the role of women might mean that they have little or no influence (Adisa et al., 2019; Wadesango et al., 2011). However, our findings suggest that women directors do have influence, in line with the implication of gender socialisation theory, that they bring to the board a greater concern about environmental issues and CED.

4.3.2 | Environmental committees and environmental disclosure

The second hypothesis (H2) relates to the possible effect of environmental committees on CED. Table 5 indicates that environmental committees (ENV_CMTE) have a positive association with CED in the 10 quantiles, at a 1% level of significance, leading to acceptance of H2. This finding is consistent with Liao et al. (2015) and Peters and Romi (2014), who found a positive association between the presence of an environmental committee and greenhouse gas disclosures.

With reference to Table 1, our results are thus consistent with all but one of the studies in Panel A (H1) and two of the studies in Panel B (H2). In those three other cases, though, the atypical studies do not directly contradict the other studies and ours, because they report non-significant results rather than a negative relationship. However, it is notable that, in two cases, they are the earliest paper in the respective panel: Prado-Lorenzo and Garcia-Sanchez (2010) in Panel A and Rankin et al. (2011) in Panel B. This might be a coincidence, but it might also reflect the increasing importance of the environmental agenda in recent years or even more sensitive statistical methods implemented by researchers.[2]

4.3.3 | The moderating role of the environmental committee

The third hypothesis (H3) focuses on whether the WOB–CED association is positively moderated by the presence of an environmental committee. Table 6 shows the results of estimating a PQR model to explore the moderating effect of ENV_CMTE on the WOB–CED nexus by including the interaction term WOB * ENV_CMTE. In line with our expectations, WOB * ENV_CMTE is positive, at the 1% level of significance across all the quantiles, thus providing strong support for H3.

To sum up, having found support for our hypotheses that board gender diversity (H1) and the presence of an environmental committee (H2) both have a significantly positive effect on CED, we find that the presence of a board environmental committee also strengthens the relationship between board gender diversity and CED (H3). Thus, all three hypotheses have been accepted.

4.4 | Additional checks

To test the robustness of our findings, we perform two checks—an alternative proxy for board gender diversity and a two-step GMM model to address possible endogeneity concerns.

Liao et al. (2015) suggest that gender diversity has a negligible influence on environmental or similar disclosure unless there is a critical mass of at least three women directors on a board. We therefore employ an alternative proxy, a dummy variable (DWOB) that takes the value 0 if there are two or fewer women directors and 1 if there are three or more women directors. Table 7 gives statistical credibility to our main results reported in Tables 5 and 6. First, DWOB is positively associated with CED at the 1% level of significance in all 10 quantiles. Second, the presence of an environmental committee tends to significantly strengthen this link in all but two of the quantiles.

To address possible endogeneity concerns, we employ a two-step dynamic GMM model (Blundell & Bond, 1998), which has been used to complement PQR in other studies (e.g., Alvarado et al., 2021; Bruna et al., 2021; Gerged et al., 2022). First, we use the Durbin test and Wu–Hausman test to detect the potential incidence of endogeneity problems in individual regressors. Theoretically, the independent variable (i.e., WOB) must not be linked with the error term. In this context, the Durbin and Wu–Hausman tests can decide whether the residuals are associated with the independent variable or not (Ullah et al., 2018). The results of these tests indicate that WOB and

TABLE 6 Panel quantile regression with the interaction term

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Quantiles	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95
Variables	CED	CED	CED	CED	CED	CED	CED	CED	CED	CED
WOB	0.000***	0.104***	0.144***	0.093***	0.125***	0.079***	0.027***	0.069***	0.164***	0.143***
	(0.000)	(0.002)	(0.002)	(0.009)	(0.001)	(0.005)	(0.009)	(0.002)	(0.003)	(0.008)
ENV_CMTE	3.101***	10.367***	8.849***	8.368***	9.048***	7.785***	3.735***	1.79***	18.152***	14.983***
	(0.000)	(0.51)	(0.205)	(0.223)	(0.066)	(0.447)	(0.562)	(0.176)	(0.284)	(0.257)
WOB * ENV_CMTE	3.212***	1.117***	1.605***	1.557***	1.492***	0.985***	1.919***	1.88***	3.17***	3.509***
	(0.000)	(0.268)	(0.102)	(0.06)	(0.018)	(0.109)	(0.131)	(0.065)	(0.079)	(0.105)
BZ	0.000***	0.142***	0.209***	0.239***	0.241***	0.288***	0.265***	0.507***	0.369***	0.219***
	(0.000)	(0.013)	(0.003)	(0.006)	(0.004)	(0.03)	(0.01)	(0.009)	(0.009)	(0.015)
IND	0.000***	0.006*	0.035***	0.054***	0.028***	0.002	0.078***	0.129***	0.171***	0.146***
	(0.000)	(0.003)	(0.002)	(0.005)	(0.001)	(0.005)	(0.003)	(0.001)	(0.006)	(0.003)
IND_ACMTE	0.000***	0.004***	0.008***	−0.008***	0.01***	0.015***	0.023***	0.025***	−0.021***	−0.048***
	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.005)	(0.001)	(0.002)	(0.006)
ACMTEZ	0.000***	0.225***	0.712***	−0.067**	0.001	−0.302***	−0.341***	0.179***	0.289***	1.452***
	(0.000)	(0.018)	(0.022)	(0.029)	(0.017)	(0.048)	(0.055)	(0.021)	(0.046)	(0.032)
TBQ	0.000***	0.055***	−0.313***	−0.327***	−0.729***	−0.541***	−1.083***	−0.723***	−0.999***	−2.222***
	(0.000)	(0.019)	(0.02)	(0.02)	(0.008)	(0.11)	(0.056)	(0.023)	(0.05)	(0.098)
DOA	0.000**	0.002	−0.009***	−0.008***	0.006***	−0.005***	0.024***	0.000	0.034***	−0.029***
	(0.000)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.004)	(0.001)	(0.004)	(0.005)
MKTCAP	0.000***	0.691***	0.771***	1.022***	1.399***	1.46***	1.569***	1.577***	2.28***	2.802***
	(0.000)	(0.014)	(0.02)	(0.009)	(0.01)	(0.112)	(0.053)	(0.027)	(0.024)	(0.032)
GDP	0.000	1.337***	4.004***	5.401***	7.266***	7.17***	4.811***	5.72***	9.349***	8.98***
	(0.000)	(0.072)	(0.088)	(0.151)	(0.055)	(0.203)	(0.165)	(0.084)	(0.207)	(0.092)
PS	0.000***	0.078***	0.103***	0.068***	0.127***	0.122***	0.104***	0.064***	0.235***	0.217***
	(0.000)	(0.004)	(0.004)	(0.004)	(0.003)	(0.021)	(0.018)	(0.007)	(0.007)	(0.007)
GE	0.000***	−0.012***	0.014***	0.081***	0.09***	0.184***	0.186***	0.18***	0.079***	0.142***
	(0.000)	(0.004)	(0.005)	(0.005)	(0.003)	(0.018)	(0.013)	(0.005)	(0.004)	(0.01)
Observations	1123	1123	1123	1123	1123	1123	1123	1123	1123	1123

Note: Research variables are operationally defined in Table 2. Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

TABLE 7 Additional analysis using an alternative board gender diversity measure (DWOB) with the interaction term

Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Quantiles	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95
Variables	CED	CED	CED	CED	CED	CED	CED	CED	CED	CED
DWOB	0.000***	3.989***	3.774***	3.249***	3.681***	3.549***	3.048***	3.079***	2.288***	5.47***
	(0.000)	(0.015)	(0.059)	(0.191)	(0.046)	(0.075)	(0.243)	(0.018)	(0.713)	(0.058)
ENV_CMTE	3.101***	13.12***	12.385***	11.239***	13.054***	11.832***	9.773***	8.263***	14.48***	9.019***
	(0.000)	(0.052)	(0.057)	(0.176)	(0.277)	(0.107)	(0.127)	(0.034)	(0.468)	(0.116)
DWOB * ENV_CMTE	13.178***	0.512***	1.000***	2.527***	0.385	3.428***	0.874**	0.067	7.463***	8.515***
	(0.000)	(0.073)	(0.085)	(0.249)	(0.666)	(0.131)	(0.409)	(0.051)	(1.253)	(0.192)
BZ	0.000***	0.131***	0.223***	0.249***	0.251***	0.314***	0.265***	0.329***	0.365***	0.309***
	(0.000)	(0.003)	(0.003)	(0.006)	(0.009)	(0.005)	(0.003)	(0.002)	(0.063)	(0.016)
IND	0.000***	0.000	0.021***	0.005***	0.015***	0.03***	0.074***	0.106***	0.205***	0.129***
	(0.000)	(0.002)	(0.001)	(0.002)	(0.001)	(0.004)	(0.003)	(0.000)	(0.010)	(0.004)
IND_ACMTE	0.000***	0.006***	0.019***	0.005***	0.011***	0.012***	0.014***	0.011***	0.036***	0.078***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.000)	(0.009)	(0.002)
ACMTEZ	0.000***	0.367***	0.461***	0.010	0.112***	−0.127*	0.202**	0.504***	0.069	1.406***
	(0.000)	(0.017)	(0.016)	(0.025)	(0.028)	(0.065)	(0.087)	(0.004)	(0.309)	(0.053)
TBQ	0.000***	0.033***	−0.049***	−0.249***	−0.573***	0.848***	1.048***	0.951***	−1.429***	−1.534***
	(0.000)	(0.005)	(0.018)	(0.018)	(0.017)	(0.081)	(0.021)	(0.005)	(0.178)	(0.060)
DOA	0.000**	0.002***	0.002*	−0.017***	0.008***	0.028***	0.023***	0.001***	0.002	−0.032***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.000)	(0.003)	(0.006)
MKTCAP	0.000***	0.192***	0.569***	0.932***	1.318***	1.757***	1.907***	1.883***	2.386***	2.842***
	(0.000)	(0.005)	(0.014)	(0.012)	(0.011)	(0.041)	(0.05)	(0.005)	(0.079)	(0.026)
GDP	0.000***	0.991***	3.061***	4.334***	6.733***	6.824***	6.734***	6.882***	9.718***	5.001***
	(0.000)	(0.074)	(0.059)	(0.117)	(0.137)	(0.087)	(0.395)	(0.015)	(0.281)	(0.092)
PS	0.000***	0.046***	0.072***	0.012	0.079***	0.145***	0.194***	0.177***	0.242***	0.187***
	(0.000)	(0.002)	(0.002)	(0.009)	(0.003)	(0.005)	(0.003)	(0.001)	(0.016)	(0.007)
GE	0.000***	0.015***	0.039***	0.162***	0.144***	0.146***	0.157***	0.191***	0.026	0.295***
	(0.000)	(0.003)	(0.003)	(0.009)	(0.005)	(0.006)	(0.008)	(0.001)	(0.032)	(0.005)
Observations	1123	1123	1123	1123	1123	1123	1123	1123	1123	1123

Note: DWOB is a threshold measurement for WOB where a board with more than two women scores 1 and 0 otherwise. Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

ENV_CMTE are endogenous, not exogenous. This means that our primary results shown in Tables 4 and 5 may be biased.

Drawing on prior studies (e.g., Gerged, Albitar, & Al-Haddad, 2021; Gerged, Matthews, & Elheddad, 2021; Moumen et al., 2015; Ullah et al., 2018), we use a two-step dynamic GMM regression model to overcome the endogeneity problems occurring from reverse causality between WOB, ENV_CMTE and CED. We incorporate CED lags to distinguish between '*static*' and 'dynamic' panel data techniques. The two-step GMM models can be specified as follows, with the variables defined as in Table 1:

$$CED_{it} = \alpha_0 + \beta_1 CED_{it-1} + \beta_2 CED_{it-2} + \beta_3 WOB_{it} + \beta_4 ENV\_CMTE_{it} + \sum_{i=1}^{n} \beta_i CONTROLS_{it} + \mu_{it} + \varepsilon_{it}, \quad (3)$$

$$CED_{it} = \alpha_0 + \beta_1 CED_{it-1} + \beta_2 CED_{it-2} + \beta_3 WOB_{it} + \beta_4 ENV\_CMTE_{it} + \beta_5 WOB * ENV\_CMTE_{it} + \sum_{i=1}^{n} \beta_i CONTROLS_{it} + \mu_{it} + \varepsilon_{it}. \quad (4)$$

In Equation (3), CED_{it-1} and CED_{it-2} refer to the 1-year and 2-year lags of CED, respectively. Roodman (2009) states that by incorporating the lags of the dependent variable as explanatory variables, the dynamic GMM method addresses the endogeneity issue by transforming the data internally.

In addition, we use post-estimation tests, including the Hansen test and the Arellano–Bond test, to assess the dynamic GMM model validity and whether the used instruments (i.e., lags of CED in Equations 3 and 4) are properly specified (see Table 8). A crucial

TABLE 8 Robustness check: a two-step system GMM model

	(3)	(4)
	Without interaction term	**With interaction term**
L.CED	0.908***	0.911***
	(0.003)	(0.006)
L2.CED	−0.015***	−0.007
	(0.005)	(0.006)
WOB	0.025*	0.038***
	(0.015)	(0.011)
ENV_CMTE	3.243***	3.798***
	(0.896)	(1.199)
WOB * ENV_CMTE		1.613***
		(0.312)
BZ	0.225***	0.246***
	(0.015)	(0.014)
IND	0.074***	0.077***
	(0.006)	(0.012)
IND_ACMTE	−0.028***	−0.025***
	(0.006)	(0.006)
ACMTEZ	0.713***	0.657***
	(0.132)	(0.088)
MKTCAP	1.969***	1.728***
	(0.178)	(0.189)
TBQ	−1.423***	−1.272***
	(0.289)	(0.268)
DOA	−0.019**	−0.015
	(0.008)	(0.01)
GE	0.305***	0.307***
	(0.02)	(0.018)
PS	0.145***	0.137***
	(0.017)	(0.013)
GDP	−3.248***	−3.042***
	(0.25)	(0.293)
Observations	1015	1015
Arellano–Bond test (*p* value)	.099	.102
Arellano–Bond test (*p* value)	.083	.080
Hansen test of overid	97.89	99.34

Note: Research variables are operationally defined in Table 2. L.CED is a 1-year lagged CED and L2.CED is a 2-year lagged CED. Standard errors are in parentheses.
*$p < .1$. **$p < .05$. ***$p < .01$.

assumption of two-step GMM method validity is that instruments are exogenous (Ullah et al., 2018). Our pre-estimation and post-test results appear to be insignificant, suggesting that our instruments are exogenous and hence valid.

Models (3) and (4) of Table 8 show the results of running the two-step GMM models. The results indicate that WOB significantly influences CED. This relationship is positively moderated by the existence of an environmental committee (ENV_CMTE), which itself is positively associated with CED. Given the consistency with the results of the analysis of our main PQR model, we are confident that our earlier findings are robust to endogeneity concerns.

5 | CONCLUSION

The separate impacts of board gender diversity (WOB) and the existence of a board environmental committee (ENV_CMTE) on CED have previously been studied independently. In this study, we bring the two influences together for the first time by examining the moderating effect of ENV_CMTE on the WOB–CED nexus. We discover, as hypothesised, a positive effect, which is robust to various checks. This is the key contribution of the paper.

However, given that previous studies of the direct WOB–CED relationship have, with the exception of Charumathi and Rahman's (2019) study in India, been focused on developed countries, by focusing on five countries in the SSA region, we also add significantly to the empirical evidence regarding the developing world. This is our second contribution. It is of particular significance for the topic of our research, because it is possible that conservative social attitudes in such countries could mean that, even when women are appointed to a board of directors, they might have little influence. However, at least in the case of CED, this appears not to be the case; board gender diversity makes a difference in SSA. As part of our study, we have also found further evidence of the direct influence of board environmental committees on CED. We thus complement previous studies, which have focused on the developed world. This is our third contribution.

In using PQR analysis, we have also introduced to this stream of research a method that provides a more inclusive understanding of the stated relationships than traditional linear regressions, such as OLS and fixed-effects regression models. We complemented this with a two-step GMM method as a robustness check to ensure that our primary results are not unduly influenced by the possible occurrence of endogeneity issues. It should also be noted that, although not comprehensive, our Bloomberg-based measure of CED is more inclusive than the proxies used in most previous studies, which have tended to be restricted to greenhouse gas emissions.

6 | IMPLICATIONS

In this section, we consider the implications of our research for policy and practice and for future research.

At the beginning of the paper, we pointed out that CED is a response that many companies have been making as stakeholders take climate change increasingly seriously. Even in the absence of mandatory requirements—as is the case in SSA—companies have been

making disclosures, although our findings suggest that the overall level of CED in SSA is still relatively limited.

However, our findings suggest that, just as environmental committees have sometimes been found to have a positive influence on CED in developed countries (see Panel B of Table 1), so they do in SSA—and, by extension, might do so in other developing countries too. It follows that one way to increase CED, without having to go through the sometimes-difficult process of determining or negotiating exactly what form mandated disclosure should take, would be to require listed companies to institute a board environmental committee. Given that only just over a tenth of our SSA sample had such a committee, there is considerable scope for increasing that number, with likely beneficial effects on CED.

However, mandating a board environmental committee would be an unusual step. More common in many developed countries are hard or soft targets designed to increase the proportion of WOB of directors. Our findings are consistent with several developed country studies and one in India that CED is positively influenced by board gender diversity. Therefore, as moves to increase the representation of WOB of directors spread internationally, one consequence of this is likely to be increased CED—even, judging by our evidence from SSA, in regions where women's roles are still subject to some constraints because of the perseverance of traditional patriarchal values. Moreover, our findings suggest that encouraging or mandating both greater board diversity and environmental committees would, together, have a greater impact on CED because of the positive moderating influence of environmental committees on the WOB–CED nexus.

Finally, our results have implications for female directors themselves. If they encourage the board to institute an environmental committee, this is likely both to complement their direct influence on CED and, also, because of the moderation effect, to leverage it.

Nevertheless, we acknowledge that, because our study is the first to examine the moderation effect, further studies will be needed to corroborate it. We have provided evidence from five countries in SSA. It would be common to follow such a study by examining other developing regions, such as MENA or Southeast Asia. However, in this case, there is also a need to conduct studies in developed countries, where previous research into the influence of board gender diversity and environmental committees on CED has taken place without testing for the moderation effect.

Because of its limitations, there are also some other ways to build on the current study. First, our sample is confined to SSA stock markets and listed companies that have sufficient Bloomberg data. Further research in the region—or other developing countries where databases have limited or no coverage—could use hand-collected data.

Second, even in countries where data coverage is good, a different dependent variable could be used. We used Bloomberg's ENV score in this study, and earlier studies have focused on greenhouse gas emissions (see Table 1), so there is scope for measuring CED more broadly by constructing an index from data hand-collected from corporate annual reports and sustainability reports (or equivalent). This would also provide opportunities for more detailed analysis of particular strands within CED (see Gerged et al., 2021b).

Third, given our positive findings for both board gender diversity and the presence of an environmental committee, future studies might examine whether the gender composition of the environmental committee itself is significant. This would require hand-collected data.

Finally, in keeping with our suggestions, which involve studying aspects of the phenomena in greater detail, complementary research within a qualitative tradition (e.g., in-depth interviews) might examine the lived experiences of women directors in relation to environmental issues and, in particular, decisions about CED. Such research would provide valuable insights not only for the CED literature but also for gender socialisation theory.

CONFLICT OF INTEREST

The authors certify that they have no affiliations with or involvement in any organisation or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] Computing the logarithm of MKTCAP has resulted in missing data that led to reducing our sample to 1123 firm-year observations.

[2] Our evidence also shows that the selected control variables significantly influence CED in the SSA region. For example, large-sized boards with a greater percentage of independent directors (IND) are more likely to be associated with CED in all but one quantile (see Table 5). Likewise, in line with prior literature (e.g., Ezhilarasi & Kabra, 2017; Jizi, 2017; Liao et al., 2015; Tauringana & Chithambo, 2015; Trireksani & Djajadikerta, 2016; Wang, 2017), boards with large audit committees (ACMTEZ) that have more independent members (IND_ACMTE) significantly influence CED decisions in most quantiles.

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