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Board gender diversity, environmental committee and greenhouse gas voluntary disclosures

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Abstract

We explore the impact of gender diversity and environmental committees on greenhouse gas (GHG) voluntary disclosures utilising a sample of 215 firms, which are listed on the London Stock Exchange market. We provide strong evidence for a strong positive association between GHG voluntary disclosures and gender diversity, which constitutes an important input to the ongoing debate about the role of women in the boardroom. The governance mechanism of environmental committees is not found to significantly affect GHG disclosures. This adds to the growing empirical evidence in the literature that questions the effectiveness of the current board structures in serving the wider needs of stakeholders and in addressing the relevant issues on climate change. Overall, our results suggest that by being diverse and open to a mixed-gender governance approach, a firm can better serve the demands of stakeholders and legitimise their green credentials, thus gaining more trust from a broad range of stakeholders other than their shareholders. The noneffectiveness of the environmental committees in enhancing GHG voluntary disclosures demonstrates that firms may not have to directly link the relevant governance mechanism to their disclosure decisions and practices.

KEYWORDS

board diversity, environmental committee, greenhouse gas voluntary disclosure

1 | INTRODUCTION

The composition of the board of directors in an organisation determines its effectiveness in the decision-making process and helps attaining the desired goals [Financial Reporting Council (FRC), 2012; Liao, Luo, & Tang, 2014]. There is a broad consensus in the literature (see, e.g., Carter, D'Souza, Simkins, & Simpson, 2010; Post, Rahman, & Rubow, 2011) that diversity in knowledge and professional skills as a result of a diversity in age, cultural background, education and gender is a crucial element of a board composition. Furthermore, diversity largely contributes to the achievement of the organisational goals and objectives (Bear, Rahman, & Post, 2010; Post et al., 2011). It is also demonstrated (Robinson & Dechant, 1997) that organisations with effective leadership and boards with a high problem-solving ability are often characterised by diversity in the ranks of management. Female directors provide better oversight of managerial actions, which leads to a more reliable financial reporting (Hillman, Shropshire, & Cannella, 2007). That is, a mixed-gender board of directors can enhance the reporting standards through a more effective monitoring. In addition, Gul, Srinidhi, and Ng (2011) suggest that gender diversity leads to an improvement of the governance structure of an organisation by changing the nature and dynamics of board deliberations that make

board members pay greater attention to the consequences of their decisions. Moreover, there is evidence that socially responsible firms are likely to have gender diverse boards compared to their nonsocially responsible counterparts. There is also evidence that women are more sympathetic to socially responsible initiatives than men (Bernardi, Bosco, & Vassill, 2006; Williams, 2003). In this vein, Ciocirlan and Pettersson (2012) conclude when women on board has a positive and significant effect on a company's commitment towards climate change.

Prior literature suggests that the establishment of an environmental committee in an organisation is a clear indication of its intent to engage in environmental and climate change matters (see, e.g., Peters & Romi, 2014; Liao et al., 2014). Amran, Ooi, Nejati, Zulkafli, and Lim (2012) argue that special committees such as the environmental committee is always regarded as an important human capital resource element that cultivates responsible management and rallies the organisation into action. Environmental committees constitute what is known as an environmental governance mechanism in an organisation meant for either ceremonial conformity or substantive intent to reign on relevant matters (Rodrigue, Magnan, & Cho, 2013).

Despite the growing interest around the world by both public and private sectors in enhancing firms' greenhouse gas (GHG) voluntary disclosure,[1] the latter mainly remains at the discretion of board of directors in an organisation. Contrary to the ample research on the impact of corporate governance on voluntary disclosures such as social responsibility (early studies are those of Aguilera, Williams, Conley, & Rupp, 2006; Kolk & Pinkse, 2009; Bear et al., 2010), the role of governance mechanisms on GHG disclosure practices remains largely unexplored (e.g., Galbreath, 2011; Liao et al., 2014; Prado-Lorenzo & Garcia-Sanchez, 2010; Rodrigue et al., 2013). In addition, even though there is a growing evidence that female shareholders champion green issues in their firms, their influence on GHG voluntary reporting at the board level has not yet been thoroughly explored. Along these lines, the effect of board gender on sustainability remains under-researched (Galbreath, 2011; Ricart, Rodriguez, & Sanchez, 2005).

In this paper, we intend to fill the relevant gaps in the literature by investigating how governance characteristics affect the GHG voluntary disclosures. More concretely, we examine the impact of gender diversity in the board of directors and the creation of environmental committees on GHG voluntary disclosures drawn from multiple sources of disclosure. These two corporate governance mechanisms are not explicitly guided by any formal code of practice other than boards' own initiatives to reposition themselves to emerging issues. For example, even though the UK Combined Code (FRC, 2012) contained specific guidance on board independence, board size, audit, remuneration, and nomination committees, there was no explicit provision for the creation of environmental committees. As regards gender diversity, the code signalled the need for organisations to demonstrate their gender diversity without yet imposing any specific requirements on this.

[1]The GHG reporting became mandatory for all LSE-listed companies for reporting years ending on or after September 30, 2013. Earlier initiatives were those of the Australia's National Greenhouse and Energy Reporting (NGER) Act of 2007, the introduction of a GHG emission reporting scheme in Canada, and the Japanese Mandatory GHG accounting and reporting system.

We use a sample of 215 firms, which are listed on the London Stock Exchange (LSE) market in our empirical analysis. We refer to a research index methodology to quantify GHG voluntary disclosures in firms' annual reports, sustainability reports and websites over a 4-year period. We control for all the relevant governance characteristics (board size, proportion of non-executive directors (NEDs), ownership concentration, director ownership, audit committee, board meetings and CEO duality), as well as for some key firm-level characteristics (size, gearing, profitability, liquidity, firm age, financial slack and capital expenditure). We also control for industry-level characteristics such as the participation of our sample firms in the Carbon Disclosure Project (CDP). Our study brings useful insights into the GHG research: unlike previous studies that were cross-sectional and had an exclusive focus on CDP reports (see, e.g., Liao et al., 2014), our study is longitudinal and hinges upon content analysis of annual reports, sustainability reports and firms' websites, which allow us to examine the various trends in GHG voluntary disclosures. The focus on a wide range of disclosure sources enables us to present a comprehensive overview of the relevant trends in the area of research as opposed to other studies whose focus is on one particular source.

Our key findings indicate that board gender diversity is positively and significantly associated with GHG voluntary disclosures whereas environmental committees in an organisation do not significantly affect GHG disclosures. Corporate governance structure such as ownership as well as firm-level characteristics (size, gearing, profitability, financial slack and firm age) exerts a significant impact on GHG disclosures. Overall, our results suggest that by being diverse and open to a mixed-gender governance approach, a firm can better serve the demands of stakeholders and legitimise their green credentials, thus gaining more trust from a broad range of stakeholders (Rupley, Brown, & Marshall, 2012).

The remainder of the paper is organised as follows. Section 2 reviews the literature and develops the relevant research hypotheses. The research design is presented in Section 3. Section 4 discusses the empirical results and the relevant business implications. A set of robustness tests are carried out in Section 5. Section 6 concludes the paper and outlines areas of future research.

2 | LITERATURE REVIEW

2.1 | Theoretical framework

The role of governance mechanisms such as the board gender diversity and environmental committees in GHG disclosures can be regarded from different theoretical viewpoints, which often overlap with each other (Chen & Roberts, 2010; Liao et al., 2014). The key viewpoints hinge upon the stakeholder, resource dependency and legitimacy theories.

Freeman (1984, p. 46) defines a stakeholder as 'any group or individual who can affect or is affected by the achievement of the organisation's objectives'. The stakeholder theory is focused on the stakeholders of a firm and their competing priorities (Freeman, Harrison, & Wicks, 2007; Shahab et al., 2020). A firm creates value by interacting

with stakeholders in a reciprocal dependency network (Freeman et al., 2007). Reciprocity places a moral obligation on firms to strike a balance between the priorities of stakeholders (Huang & Kung, 2010). There is growing evidence that stakeholders are concerned with how firms manage their actions towards environmental issues (Cormier, Gordon, & Magnan, 2004; Henriques & Sadorsky, 1999). Firms gradually engage in environmental governance initiatives in an effort to address these concerns. According to Rodrigue et al. (2013), environmental governance refers to the board's initiatives that go beyond the formal governance mechanisms as dictated by the relevant institutional framework. Such initiatives may involve the set-up of a special committee on environmental issues or the establishment of a diverse boards in terms of gender to ensure that environmental concerns are addressed.

Board diversity and the creation of environment committees can also be viewed through the lenses of the resource dependency theory, which has its origins in the seminal study of Pfeffer and Salancik (1978) that demonstrates how an organisation's behaviour is shaped by the need to procure external resources from the environment. This theory shifts the focus of the relation between ownership and management to the company's links with its environment. That is, under the resource dependence theory, it is assumed that boards serve to link the company to other external organisations in order to address environmental dependencies (Reguera-Alvarado, de Fuentes, & Laffarga, 2017). As Tyrowicz, Terjesen, and Mazurek (2020) mention, the resource dependency theory explores how boards aim to reduce uncertainty by appointing corporate directors who can maximise access to valuable resources required by the firm. In a similar vein, Carter et al. (2010) argue that the resource dependency theory provides a reasonable basis for justifying diversity on a firm's board, which contributes to a more effective decision making. For example, boards can appoint directors who are business experts, support specialists and community influencers (Hillman, Cannella, & Paetzold, 2000). Compared to their male counterparts, female directors are more likely to have advanced degrees and nonbusiness backgrounds and to join multiple boards faster (Hillman, Cannella, & Harris, 2002). Furthermore, female directors can help to link up a firm with important constituents of its environment because they nowadays make up a significant portion of the human capital/workforce. Women are also not considered to be part of an 'old boys' club and hence are viewed to be more independent from men (Brennan & McCafferty, 1997).

Legitimacy theory refers to the view that organisations and societies are engaged in a social contract, where the former are recognised by the latter as being socially responsible (O'Donovan, 2002). An organisation has to demonstrate that it meets the societal standards of legitimacy (Lopes & Rodrigues, 2007). Legitimacy is defined as a perception '… that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions' (Suchman, 1995, p. 574). Companies manage corporate social responsibility (CSR) reporting to gain legitimacy (De Villiers & Van Staden, 2006). Legitimacy theory focuses on how board gender diversity and environmental performance are used by companies to obtain approval on their decisions from the broader society, which is expected to enable companies to be successful and sustainable (Elmagrhi, Ntim, Elamer, & Zhang, 2019; Haque & Ntim, 2018; Torchia, Calabrò, & Huse, 2011). Firms can gain legitimacy and secure access to financial/nonfinancial resources (Shahab, Ntim, Chengang, Ullah, & Fosu, 2018) by adhering to these environmentally friendly rules and regulations.

2.2 | Hypotheses development

2.2.1 | Board gender diversity and GHG voluntary disclosures

There is an increasing interest in women's participation on the boards of firms in the relevant literature. However, the contribution of female directors and board members on companies' decisions remains largely under-researched (Nielsen & Huse, 2010, p. 136). The presence of women in a board of directors can bring a different perspective to the governance and the decision-making process of a company. From a leadership perspective, it is widely acknowledged that directors are often high-skilled individuals who bring to the boardroom their leadership styles. In this respect, boards that consist of more female directors are likely to display leadership styles, which are more closely linked to their gender. Eagly, Johannesen-Schmidt, and Van Engen (2003) identify agentic and communal attributes as being areas where men and women exhibit several differences. Agentic characteristics like being assertive, aggressive, ambitious, daring, competitive, independent and self-confident are mainly associated with men, whereas communal behaviours like being helpful, sensitive, nurturing, kind and sympathetic are primarily linked to women (Nielsen & Huse, 2010). Furthermore, Eagly et al. (2003) show that, when in leadership, women are less hierarchical, more cooperative and collaborative and look for opportunities to uplift and enhance other employers' worth. Jaffee and Hyde (2000) use a sample of 160 independent research papers that show that women are more likely to use more care reasoning (i.e., responding to the needs of others and feeling a responsibility not to hurt other people) than men. In addition, women are found to be more aware of situations requiring ethical judgement than men (Forte, 2004; Smith, Wokutch, Harrington, & Dennis, 2001).

Huse and Solberg (2006) find that women are known to be more committed and diligent in the tasks that are involved with. Other studies (e.g., Campbell & Minguez-Vera, 2008; Carter, Simkins, & Simpson, 2003) show that women's participation in the board of directors is associated with a good financial performance. Regarding the environmental issues, women are found to demonstrate a genuine concern compared to men and are likely to champion initiatives, which reduce a company's environmental risks (Diamantopoulos, Schlegelmilch, Sinkovics, & Bohlen, 2003; Fukukawa, Shafer, & Lee, 2007). De Villiers, Naiker, and Van Staden (2011) provide strong evidence of associations between environmental performance and board characteristics.[2] Bear et al. (2010) and Post et al. (2011) show

[2]The study of De Villiers et al. (2011) focuses on board characteristics like the independence of the board members, the concentration of the directors appointed after the CEO, the board size, how active CEOs are and the expertise of the board members in legal issues. Our study, on the other hand, sheds the light on the board gender diversity.

that when three (or more) women are in the board of directors, the disclosure documents are more closely linked to social and environmental issues. We can therefore form the following hypothesis:

H1. Gender board diversity exerts a positive impact on GHG voluntary disclosures.

2.2.2 | Environmental committees

Prior empirical disclosure literature has investigated the role of governance structures such as audit committees, or social and environmental committees in information disclosure practices (Berthelot & Robert, 2012; Eng & Mak, 2003). The effectiveness of the board of directors does not only depend on the board's composition but also depend on its governance structure. Neu, Warsame, and Pedwell (1998) state that the establishment of an environmental committee is a signal to the stakeholders of the firm's concern about all the relevant issues. In this vein, the study of Rankin et al. (2011, p. 1047) indicates that the presence of such committees demonstrates 'evidence of proactive corporate governance to guide the organisational long-term strategy towards a more carbon-constrained future'. Lorsch and MacIver (1989) argue that the subgroups of directors that form the relevant committees enable them to consider issues of interest more thoroughly than a full board would consider.

Whereas board committees such as audit and remuneration committees has always been a tradition in a board's governance structure, environmental committees are a reasonably new establishment. Michals (2009) notes that firms have been lately turned to designate specialised committees to address the key environmental issues, which are related to their operation and strategic planning. Peters and Romi (2014) suggest that an environmental committee can be equally important to an audit committee in as far as environmental information is concerned.

There is evidence in the literature on the influence of environmental committees on GHG disclosures and climate change. Such specialised committees advocate the disclosures of GHG information to the stakeholders and to the public, championing at the same time in the implementation of long-term strategies on climate change. Cowen, Ferreri, and Parker (1987) conclude that information disclosure is positively associated with the existence of a CSR committee in a firm. Berthelot and Robert (2012) conclude that the Canadian oil and gas companies that have an environmental committee demonstrate a higher level of GHG disclosures. Similarly, Peters and Romi (2014) find that GHG emission accounting disclosures are positively linked to board governance structures, which include environmental committees. In contrast, no relation between the presence of a CSR committee and the related disclosures is documented in Rupley et al. (2012).

H2. The presence of an environmental committee is positively associated with GHG disclosures.

3 | DATA AND METHODOLOGY

3.1 | Sample selection

Our sample consists of 215 firms, which are all traded on the LSE and are listed on the UK FTSE 350 index. We focus on UK FTSE 350 as it covers a wide range of industries and indexes the largest firms that are expected to take the lead in GHG voluntary disclosures and to support gender diversity (Davies, 2014). Brammer and Pavelin (2006) suggest that the use of large firms from several different industries allows a comprehensive review of disclosures and, importantly, a reasonable generalisation of the obtained results. Our sample period extends from 2011 to 2014. This is the period that the majority of the FTSE 350 firms started to disclose their GHG emissions on a voluntary basis in line with Department for Environment, Food, and Rural Affairs's (DEFRA, 2009) guidance.

All the 93 financial services firms (i.e., banks, insurance firms, investment trusts, unit trusts and real estate firms) are excluded from our sample because they are subjected to different disclosure rules and statutory requirements that affect their accounting strategies, disclosure decisions and corporate governance structures (Mangena & Tauringana, 2007). To ensure comparability of our results, we also exclude those firms with unpublished annual reports or missing data mainly as a result of mergers and acquisitions. Finally, we exclude the firms that are not listed on the UK FTSE 350 for the entire period of study, as well as the subsidiary firms whose parent companies are listed the FTSE 350.

3.2 | Dependent variable: Quantifying the GHG voluntary disclosure

To construct our dependent variable, we draw a GHG disclosure list of items. Unlike previous studies (e.g., Prado-Lorenzo, Rodriguez-Dominquez, Gallego-Alvarez, & Garcia-Sanchez, 2009), which base their lists on a single GHG disclosure guidance, we include all the items from several various GHG reporting documents: the Greenhouse Gas Protocol (2004), the Global Reporting Initiative (2006), DEFRA (2009), the Global Framework for Climate Risk Disclosure (2006), and the Climate Disclosure Standard Board (2010). The final index has 60 items in total; 34 items are related to qualitative disclosures, and the remaining 26 items are linked to quantitative disclosures. This checklist is comparatively broader and more comprehensive than previous studies. Prado-Lorenzo et al. (2009) have a checklist of 19 items; Choi, Lee, and Psaros (2013) have 18 items; Freedman and Jaggi (2005) have only five items related to GHG disclosures and global warming.

To quantify the GHG disclosures, we conduct a content analysis, which is widely used in the disclosure literature (see, e.g., Mangena & Tauringana, 2007; Prado-Lorenzo et al., 2009). Literature suggests that the quantification of disclosure can occur on either a weighted or an unweighted basis. However, the two approached are not expected to produce substantially different results (Gray, Kouhy, &

Lavers, 1995). We adopt the unweighted approach as this is more appropriate when no different weights are assigned to any of our user groups (Cooke, 1989). A score of '1' is given to an item disclosed by the firm, and a score of '0' is assigned to a nondisclosed item. However, the firm is not penalised if an item does not apply. The total disclosure index score is then measured for each of our sample firms as the ratio of the total disclosure score divided by the maximum possible disclosure score for the firm. The disclosure index for each firm is then expressed as a percentage.

3.3 | Independent variables

Based on prior literature (De Villiers et al., 2011; De Villiers & Van Staden, 2011; Liao et al., 2014; Peters & Romi, 2014; Post et al., 2011; Rankin et al., 2011), we account for a set of governance variables: board size, CEO duality, audit committee, NEDs, ownership concentration, director ownership and frequency of board meetings. Our selection of these variables is informed by the Combined Code (FRC, 2012), which encourages firms to have boards of sufficient size, dominated by independent NEDs, and with distinctive chairman and chief executive roles. The code also requires from boards to have an audit committee to provide oversight of financial reporting and also a remuneration committee.

Following the literature (Berthelot & Robert, 2012; Brammer & Pavelin, 2006; Freedman & Jaggi, 2005; Prado-Lorenzo et al., 2009; Rankin et al., 2011; Stanny & Ely, 2008), we also control for firm size, profitability and gearing. Size is regarded as a proxy for organisational visibility, which exposes a firm to intense public scrutiny resulting in greater responsiveness towards environmental and GHG issues (Henriques & Sadorsky, 1999). We also incorporate a variable that captures liquidity in our model on the basis that highly liquid companies are expected to have adequate resources that enable them to manage climate change challenges. We also control for financial slack, capital expenditure, firm age and industry effects. Firms with financial slack are expected to channel resources into environmental or climate change initiatives including disclosure (Kock, Santalo, & Diestre, 2012). In line with De Villiers et al. (2011), we also control for the status of a firm's capital equipment in property, plant and equipment because firms with modern equipment are considered to have the capacity to control their emissions better than those with older equipment (De Villiers & Van Staden, 2011).

Regarding the age of a firm, literature (Clarkson, Richardson, & Vasvari, 2008; De Villiers et al., 2011) shows that older firms are deemed as being established well enough to have resources to invest in climate change issues compared to younger firms, which are likely to need to invest their resources in more pressing day-to-day business activities. Along these lines, older firms appear to have the time and knowledge to establish extensive stakeholder networks and research centres that can deal with various issues like the environmental issues. Therefore, stakeholders can benefit from these networks and can help to set the pace for disclosure (Alsaeed, 2006; Kang & Gray, 2011). Finally, prior studies (Kolk, Levy, & Pinkse, 2008; Liao et al., 2014; Peters & Romi, 2014; Stanny & Ely, 2008) provide evidence that participation in CDP incentivises a firm to disclose its GHG emissions. We, hence, introduce participation in CDP as an additional control variable in our model.

3.4 | Empirical model

We employ a fixed-effects modelling technique to capture the possible variation across different firms and also to deal with variation over time (Baltagi, 1995; Inchausti, 1997). Importantly, this technique enables us to take omitted or unobserved variables into account and to control for unobserved heterogeneity among the sample firms. Our theoretical model is as follows:

$$Y_{it} = \alpha_i + x'_{it}\beta + \mu_{it}, \quad (1)$$

where Y_{it} is the GHG-disclosure index; x_{it} are all the key independent and control variables; α_i stands for firm fixed effects; β is a set of vector parameters and μ_{it} is a random variable. i shows the number of firms in our sample and, hence, takes values in the closed interval [1, …, 215]; t equals to 1 for 2011, 2 for 2012, 3 for 2013 and 4 for 2014.

If we account for time fixed effects, Equation 1 is written as follows:

$$Y_{it} = \alpha_i + \gamma_t + x'_{it}\beta + \mu_{it}, \quad (2)$$

where γ_t represents the time fixed effects.

This model gives both the group-specific dummies and time dummies. The final model is, therefore, as follows:

$$\begin{aligned} Y_{it} = {} & \alpha_i + \beta^{fb}.x^{fb}{}_{it} + \beta^{ec}.x^{ec}{}_{it} + \beta^{aud}.x^{aud}{}_{it} + \beta^{ceod}.x^{ceod}{}_{it} + \beta^{ned}.x^{ned}{}_{it} \\ & + \beta^{bm}.x^{bm}{}_{it} + \beta^{bs}.x^{bs}{}_{it} + \beta^{do}.x^{do}{}_{it} + \text{xoos}\,\beta^{ow}.x^{ow}{}_{it} + \beta^{s}.x^{s}{}_{it} + \beta^{gea}. \\ & x^{gea}{}_{it} + \beta^{roa}.x^{roa}{}_{it} + \beta^{liq}.x^{liq}{}_{it} + \beta^{fslack}.x^{fslack}{}_{i} + \beta^{capex}.x^{capex}{}_{it} + \beta^{fage}. \\ & x^{fage}{}_{it} + \beta^{ind}.x^{ind}{}_{it} + \beta^{cdp}.x^{cdp}{}_{it} + \sum^{4}\alpha_t + \mu_{it} \end{aligned} \quad (3)$$

where α_t are intercept variables that change from year to year. They capture the difference between years, assuming the individual sample members are homogeneous. All other variables are defined in Table 1.

4 | EMPIRICAL RESULTS

4.1 | Descriptive statistics

The pooled data (2011–2014) descriptive statistics of both the dependent and independent variables are presented in Table 2. The results indicate that the firms' GHG voluntary disclosure scores ranged from 0% to a maximum of 88.3% but overall, the mean disclosure for the 4 years is 32.45%, an indication that the extent of GHG disclosures by FTSE350 companies is still low. When disaggregated per year (tables

TABLE 1 Variable measurement description

Symbol	Full name	Measurement
Y_{it}	GHG disclosure index	Disclosure score expressed as a ratio of the total possible score, that is, 60
X^{fb}	Board gender diversity	Proportion of female members on the board of directors, that is, number of female directors expressed as % of total board size
X^{ec}	Environmental committee	Presence of an environmental committee coded as 1 if a firm has one, otherwise 0
X^{ceod}	CEO duality	Dummy coded as 1 if a firm's CEO and Board Chair position are occupied by one individual, otherwise 0
x^{ned}	Non-executive directors (NEDs)	Ratio of NEDs on the board
x^{bm}	Board meeting	Number of board meetings held in a year
x^{bs}	Board size	Number of people making up the board of a company
x^{do}	Director or insider ownership	Proportion of shares held by directors
x^{ow}	Ownership concentration	Proportion of ownership by shareholders with 3% or more
x^{s}	Company size	Total assets expressed as natural log
x^{gea}	Gearing	Ratio between total debt and total shareholders' equity
x^{roa}	Profitability	Profit after tax, divided by total assets
x^{liq}	Liquidity	Current assets, divided by current liabilities
x^{fslack}	Financial slack	Measured as cash and cash equivalents divided by total sales
x^{capex}	Capital expenditure	Total capital divided by total sales
x^{fage}	Firm age	Firm age expressed as a natural log of the period the company has been listed on LSE
x^{ind}	Industry	Dummy indicating 1 if in environmentally sensitive industry, otherwise 0
X^{cdp}	Carbon Disclosure Project (CDP)	Dummy indicating 1 if a firm participated in CDP and otherwise 0

Abbreviations: GHG, greenhouse gas; LSE, London Stock Exchange.

not included here), the disclosures display an increasing trend over the period. For example, in 2011, the mean score was 25.2% (with a minimum of 0 and maximum of 78.3%), and this increased to 30.8% and 35.2% in 2012 and 2013, respectively. The increase in GHG voluntary disclosures between 2011 and 2012 has partly been attributed to policy initiatives taken by the UK government to promote measurement and reporting of GHG emissions, in particular, the issuance of DEFRA guidance on GHG reporting (Tauringana & Chithambo, 2015). In the period between 2012 and 2014, the increase is marginal with a mean score of 35.2% in 2012 increasing to 38.5% in 2014.

The results of the independent variables indicate that out of an average of nine directors per board, only one is likely to be a female director, an indication of all male-dominated boards on FTSE350 firms. In line with other prior findings, it would appear not much progress has been made in ensuring that FTSE350 boards are gender diverse. A study by Davies (2014) noted that although there was a slight improvement in a number of female directors on FTSE350 boards, this has slightly gone down over time, especially in 2014. Notwithstanding this, our sample shows an increasing trend in women directors over the period moving from a total of 139 in 2011 to 205 in 2014. Over the 4 years, a total of 78 firms (representing almost 36% of the sample) reported having just one female director on their board, a fact that is often referred to as 'tokenism' (Branson, 2006). Only 55 (25% of the sample) firms reported having two or more female directors. In terms of firm-years board of directors, we have a total of 7,921 directors over the 4 years, and out of this, only 675 were women (representing almost 8.5%). Overall, out of a total of 1,966 directors in 2014, only 205 were female representing 10.4% of the directorship.[3]

On average, nine board meetings are held each year, and 7.9% of the sampled firms had instituted an environmental board committee. The results also show that the companies have low levels of managerial ownership as indicated by a mean of 5.46% and moderate levels of ownership concentration (OWCON) as suggested by the mean of 40.23% over the 4 years. The firms' size (measured by total assets) has a wider range and greater variability over the years. For example, total assets ranged from £40 million to £345,257 million with a mean of £9,594.02 million and standard deviation of £31,638.9 million. On average, the majority of the sampled firms were highly geared (mean of 1.52) over the 4 years. In general, firms are profitable (with a mean ROA of 8.97) and demonstrate a sound liquidity position (liquidity ratio of 1.61 on average). The sample is drawn from nine industries, mostly industrials (28.3%) and consumer services (24.6%). Table 3 shows the correlations between the variables. Most of the independent variables are significantly correlated with the dependent variable (GHG voluntary disclosure). There is no indication of multicollinearity (the highest correlation among independent variables was between the audit committee and board size at −0.51). According to Field (2009), correlation of independent variables of above 0.8 is a

[3]Results are in line with other prior studies. For instance Adams and Ferreira (2009) found that women constituted 8.87% of directorship on their sample of 125,319 directorships (firm-year board positions). Farrell and Hersch (2005) had 8.6% female directorship in a sample of 300 unregulated Fortune 500 firms in the period 1990–1999. Liao et al. (2014) reported that women only accounted for 9.2% of board members on FTSE350 companies in 2011.

TABLE 2 Descriptive statistics—aggregate (2011–2014)

N = 860 firm-year observations						
Variables	**Mean**	**SD**	**Min**	**Max**	**Skewness**	**Kurtosis**
Disclosure	0.3245	0.2236	0	0.8833	0.6606	2.3707
Board gender diversity	0.781	0.8528	0.000	4.000	0.938	3.321
Environmental committee	0.0729	0.2602	0.000	1.000	3.285	11.793
Board size	9.1891	2.6182	4	31	1.4347	8.7902
Non-Exec.	0.6515	0.1118	0.2857	0.9285	−0.2629	2.7461
Board meetings	8.6194	2.6374	2	26	1.061	6.846
CEO duality	0.0231	0.1505	0	1	6.3422	41.2237
Audit committee (no)	3.583	0.912	2	8	0.2594	3.3753
Director Own.	5.4573	13.2501	0	85.37282	2.9868	11.5893
Ownership concentration	40.2311	17.8013	3.55	91.47	0.1689	2.4692
Size	£9,594.02m	31,638.99	£40.0m	£345,257m	7.0611	60.7393
Gearing	1.5219	12.5195	0.0208	246.2383	15.4521	255.2499
Profitability	8.9738	11.5724	−84.6	120.388	1.1108	30.3831
Liquidity	1.6165	1.7014	0.1858	27.2794	7.4616	90.2653
Financial slack	0.7089	6.6875	0	104.2206	11.9557	154.5711
Capital expenditure	0.2089	0.9799	0	17.648	11.1573	155.1897
Firm age	23.6179	20.6193	0	80	0.8559	2.4995

cause of concern; hence, the correlation between board size and audit committee is considered to have less impact on the overall result.

However, according to Myers (1990), a certain degree of multicollinearity can still exist even when none of the correlation coefficients is substantial. Therefore, we also examined the variance inflation factors (VIFs) in our models to further test for multicollinearity. Our mean VIF was 2.19, and this confirms that multicollinearity is not a main concern in our sample.[4]

4.2 | Multivariate results and discussion

4.2.1 | Baseline estimation

Table 4 presents the baseline results on the relationship between board gender diversity, environmental committee and GHG voluntary disclosure. Evidence from column 1 of Table 4 model 1a indicates that board gender diversity has a significant positive impact on the extent of GHG voluntary disclosures. As a result, our hypothesis 1 (H1) in respect of board gender diversity is confirmed. However, contrary to our prediction, the presence of an environmental committee does not have a significant impact on GHG disclosures. This means that our hypothesis 2 (H2) is not supported. In terms of control variables, corporate governance variable (director ownership) and company-specific control variables (size, gearing and financial slack, firm age, CDP participation, industry sectors of basic materials, industrials and consumer services) all have a significant effect on GHG voluntary disclosures. All other control variables have no significant effect on GHG voluntary disclosures. The model explains 41% of the variation in the extent of GHG disclosures.

The confirmation that board gender diversity is significantly associated with the extent of GHG voluntary disclosures is consistent with the notion that women are known to be more concerned with environmental issues than men (Forte, 2004; Post et al., 2011; Smith et al., 2001). Our results are consistent with prior research (e.g., Bear et al., 2010; Liao et al., 2014) but contradict the evidence by Prado-Lorenzo and Garcia-Sanchez (2010) who found that gender diversity had a nonsignificant positive effect in all of their models investigating the role of governance on GHG disclosure. Though the number of female directors is less than 10.0% of the total directors, our results suggest that their presence is not just mere tokenism.[5] Firms with female directors stand to benefit from an extensive linkage with other

[4]Furthermore, we carried out both the Breusch–Pagan/Cook–Weisberg tests for heteroskedasticity and the white's test for homoscedasticity to detect the presence of heteroskedasticity, which if not controlled may render the standard errors and any tests associated with them false. In both cases, the test statistic was highly significant indicating the presence of heterokedasticity. According to Berry and Feldman (1985), heteroskedasticity can be controlled through various means including variable transformation and the use of robust standard errors. In this paper, both options have been used; some variables notably size and board size were transformed logarithmically and again the option of robust was used in Stata 12.

[5]The benefits of having female directors on boards cannot be obtained if female directors are appointed to the board as token (Adams & Ferreira, 2009; Torchia et al., 2011; Liao et al., 2014). Insights from critical mass theory suggests that just having one or two women on board may not be enough to exert significant influence (Konrad, Kramer, & Erkut, 2008; Kramer, Konrad, & Erkut, 2006) because under social or group pressure, minorities are coerced into conforming to the wishes of the majority (Nemeth, 1986). There is also the tendency of treating minorities as tokenism when their numbers are very few, and this may lead to these people being given less ceremonial duties (Brewer & Kramer, 1985). When the number begins to increase to three or more and that these consistently present a common view on an issue, then groups tend to consider their opinions in their decisions.

TABLE 3 The correlation coefficients between all the relevant variables

	Disclosure	Female Board Memb	Environmental Comm	Board size	Non-Exec	Board meetings	CEO duality	Audit committee	Director Own
Disclosure	1. 00								
Female Board Memb	0.3595***	1							
Environmental Comm	0.1272***	0,035	1						
Board size	0.3857***	0.3315***	0.0802**	1					
Non-Exec	0.1635***	0.1529***	0.1551***	0.1091***	1				
Board meetings	0,0229	−0,0516	−0.0588**	0.3315***	0.1232***	1			
CEO duality	−0.0267	−0.0237	−0.0432	0.0033	0.1747	0.030	1		
Audit committee	−0.1706***	−0.1016***	−0.0773***	−0.5186***	0.1144***	0.0321	−0.013	1	
Director Own	−0.2137***	−0.1439***	0.0214	−0.1139***	−0.1216***	−0.1216***	0.019	0.0124	1
Ownership Con	0.2825***	0.3091***	−0.0743***	0.2420***	0.2133***	0,0566	0.0641**	0.019	0.2133***
Firm size	0.2739***	0.1212***	0.0573**	0.3387***	−0.1787***	0.0649**	−0.0035	0.0465	−0.0906***
Gearing	−0.0343	−0.0608**	−0.0217	−0.0387	−0.0289	0.0022	−0.0111	−0.2066***	−0.0289
Profitability	−0.0165	0.0071	0.0453	−0.413	0.0733***	−0.1156***	−0.0003	−0.0079	−0.0389
Liquidity	−0.1134***	−0.1625***	0.01	−0.1383***	0.0539	−0.1326***	−0.0288	0.0463	0.0327
Financial Slack	0.1010***	−0.0855****	0.0383	−0.0592**	−0.1364***	0.0831****	−0.0148	0.0398	0.1116***
Capital expenditure	0.0622**	0.0786****	0.0242	−0.0242	0.0259	−0.0553	−0.0064	−0.0281	0.0837***
Firm age	−0.0587**	0.0258	−0.0094	0.0518	−0.0267	0.1107***	−0.0583**	0.0881****	−0.1759***

TABLE 3 Continued

	Ownership Con	Firms size	Gearing	Profitability	Liquidity	Financial slack	Capital expenditure	Firm age
Disclosure								
Female Board Memb								
Environmental Comm								
Board size								
Non-Exec								
Board meetings								
CEO duality								
Audit committee								
Director Own								
Ownership Con	1							
Firm size	−0.0906****	1						
Gearing	−0.0638**	−0.015	1					
Profitability	0.0411	0.0355	−0.025	1				
Liquidity	0.1768******	−0.0706****	−0.015	−0.021	1			
Financial Slack	−0.0684******	−0.028	−0.0078	0.032	−0.023	1		
Capital expenditure	0.0628**	−0.014	−0.017	0.1972******	0.1972******	−0.0145	1	
Firm age	−0.2823******	0.031	0.1343******	−0.021	−0.0424	0.0061	0.1358******	1

Note. The detailed definitions of the variables can be found in Table 1.
*Significant at the 10%.
**Significant at the 5%.
***Significant at the 1%.

TABLE 4 Baseline estimation

	Model 1a. All		Model 1b. Qualitative		Model 1c. Quantitative	
GHG disclosure (DV)	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**
Board gender diversity	0.3105******	0.0799	0.2488******	0.0831	0.3912******	0.0866
Environmental com.	0.0484	0.0303	0.0541	0.0292	0.0409	0.0339
Board size	0.0053	0.0041	0.0042	0.0042	0.0068	0.0043
Non-executive directors	−0.0667	0.0727	−0.0782	0.0769	−0.0517	0.0765
Board meetings	0.0033	0.0026	0.0026	0.0027	0.0041	0.0028
CEO Duality	−0.0524	0.0532	−0.0324	0.0582	−0.0785	0.0595
Audit committee	−0.0008	0.0004	−0.1014	0.0814	−0.0681	0.0814
Director ownership	−0.002******	0.0005	−0.002******	0.0006	−0.0019******	0.0005
Ownership concent.	−0.0007	0.0004	−0.0009	0.0005	−0.00066	0.0004
Size	0.0540******	0.0066	0.0614******	0.0070	0.0443******	0.0072
Gearing	−0.001******	0.0002	−0.001******	0.0001	−0.0008******	0.0002
Profitability	0.0006	0.0005	0.0008	0.0005	0.0004	0.0005
Liquidity	0.0074	0.0044	0.0079	0.0048	0.0066	0.0042
Financial slack	−0.0012****	0.0006	−0.0012	0.0006	−0.0011****	0.0005
Capital expenditure	0.0075	0.0110	0.0128	0.0110	0.0005	0.0116
Firm age	−0.0138****	0.0068	−0.0197****	0.0072	−0.0058	0.0071
CDP participation	0.0985******	0.0145	0.0955******	0.0149	0.1024******	0.0157
Industrials	0.1169******	0.0284	0.1279******	0.0286	0.1026******	0.0311
Consumer services	0.0828******	0.031	0.0846****	0.0309	0.0804****	0.0334
Oil & gas	0.056	0.0356	0.0558	0.0386	0.057	0.0351
Basic materials	0.0901****	0.0352	0.0725****	0.0357	0.11299******	0.0375
Consumer goods	0.016	0.0307	0.0079	0.0308	0.0267	0.0349
Telecommunications	0.0416	0.0634	−0.0485	0.0483	0.1594	0.0963
Utilities	0.0148	0.0511	0.0203	0.0517	0.0076	0.0528
Technology	0.0145	0.0299	0.0227	0.0309	0.0039	0.0322
Year dummies	Included	Included	Included	Included	Included	Included
N	860		400		460	
R^2	0.41		0.41		0.36	

Note. This table presents fixed-effect regression estimation on the relationship board gender diversity, environmental committee and greenhouse gas voluntary disclosures. Column 1 provides the baseline results on the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures. Column 3 reports the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures using qualitative data. Column 5 presents the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures using quantitative data. Robust standard errors are reported in columns 2, 4, and 6. Detailed definition of all the variables is in Table 1. Time and industry dummies are included in the estimations, but not reported.

Abbreviation: GHG, greenhouse gas.

*Significant at the 10%.

**Significant at the 5%.

***Significant at the 1%.

stakeholders, diverse range of advice and that they are good at acting and communicating their initiatives meant at legitimising their operations (Hillman et al., 2007).

The presence of environmental committee had no significant positive effect on GHG voluntary disclosures. This contradicts our theoretical framework explanation, which suggests more disclosures by firms with such a committee and other prior studies (e.g., Peters & Romi, 2014). However, it is consistent with the findings of Liao et al. (2014) who found that environmental committees of FTSE 350 companies did not have a significant effect on the extent of carbon disclosures. One reason could be that although social and environmental committees are being entrenched within FTSE350 companies, they are yet to find their feet in as far as GHG voluntary disclosures are concerned. Rankin et al. (2011) who also found the presence of environmental committee to be nonsignificant argued that firms might just be creating these portfolios just to gain legitimacy, but in reality, real power and authority to achieve genuine GHG emissions reductions has not been given to them. The other reason

TABLE 5 Board gender diversity, environmental committee and greenhouse gas voluntary disclosures using different sources

	Annual reports		Sustainability reports		Websites reports		Weighted GHG disclosure index	
GHG disclosure (DV)	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE
Board gender diversity	0.4205******	0.088	0.3388******	0.3892******	0.0761	0.0621	0.5612******	0.0916
Environmental com.	0.0584	0.0403	0.0641	0.0509	0.0439	0.0392	0.0509	0.0439
Board size	0.00623	0.0052	0.0053	0.0079	0.0054	0.0053	0.0079	0.0054
Non-executive directors	−0.0777	0.0837	−0.0892	−0.0627	0.0875	0.0879	−0.0627	0.0875
Board meetings	0.0044	0.0037	0.0037	0.0052	0.0039	0.0038	0.0042	0.0039
CEO duality	−0.0634	0.0642	−0.0434	−0.0895	0.0605	0.069992	−0.0875	0.0605
Audit committee	−0.0009	0.0005	−0.1015	−0.0791	0.0924	0.0934	−0.0791	0.0924
Director ownership	−0.003******	0.0006	−0.003******	−0.002******	0.0006	0.0007	−0.002******	0.0006
Ownership concent.	−0.0008	0.0005	−0.001	−0.00077	0.0005	0.0006	−0.00077	0.0005
Size	0.0650******	0.0077	0.0724******	0.0453******	0.0083	0.008	0.0454******	0.0083
Gearing	−0.002******	0.0003	−0.002******	−0.0009******	0.0003	0.0002	−0.0008******	0.0003
Profitability	0.0007	0.0006	0.0009	0.0005	0.0006	0.0006	0.0005	0.006
Liquidity	0.0085	0.0055	0.0080	0.0077	0.0053	0.0059	0.0077	0.0053
Financial slack	−0.0023****	0.0007	−0.0023	−0.0022****	0.0006	0.0007	−0.0022****	0.0006
Capital expenditure	0.0086	0.0121	0.0139	0.0006	0.0126	0.0121	0.0006	0.0127
Firm age	−0.0149****	0.0079	−0.020****	−0.0069	0.0082	0.0083	−0.0069	0.0082
CDP participation	0.0996******	0.0156	0.0966******	0.1035******	0.0168	0.0157	0.1035******	0.0168
Industrials	0.1170******	0.0285	0.1280******	0.1037******	0.0322	0.0297	0.1037******	0.0322
Consumer services	0.0839******	0.042	0.0857****	0.0815****	0.0345	0.0310	0.0815****	0.0345
Oil & gas	0.067	0.0367	0.0569	0.068	0.0362	0.0397	0.068	0.0362
Basic materials	0.0913****	0.0452	0.0835****	0.12399******	0.0485	0.0467	0.11309******	0.0485
Consumer goods	0.027	0.0417	0.0080	0.0307	0.0419	0.0418	0.0377	0.0459
Telecommunications	0.0536	0.0744	−0.0595	0.1604	0.0973	0.0593	0.1604	0.0974
Utilities	0.0258	0.621	0.0313	0.0087	0.0638	0.0627	0.0087	0.0638
Technology	0.0255	0.0309	0.0337	0.0040	0.0432	0.0419	0.0040	0.0432
Year dummies	Included	Included	Included	Included	Included	Included	Included	Included
R^2	0.40		0.39	0.35	0.34		0.55	
N	559		172		129		860	

Note. This table presents fixed-effect regression estimation on the relationship board gender diversity, environmental committee and greenhouse gas voluntary disclosures using different sources. Column 1 provides the results on the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures from annual reports. Column 3 reports the effect of the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures from sustainability reports. Column 5 presents effect of the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures from firms website reports. Column 7 provides the results on the relationship board gender diversity, environmental committee and greenhouse gas voluntary disclosures using weighted GHG disclosure index. Robust standard errors are reported in columns 2 and 4. Detailed definition of all the variables is in Table 1. Time and industry dummies are included in the estimations, but not reported.

Abbreviation: GHG, greenhouse gas.

*Significant at the 10%.

**Significant at the 5%.

***Significant at the 1%.

for nonsignificance of environmental committee in explaining GHG disclosures could be that in practice, such committees do not make final decisions on matters under their jurisdictions; instead, they do recommend, and it is up to the board to adopt it or not. In their mixed method approach, which included interviews, Rodrigue et al. (2013) reported that informants stated that in practice, decisions to implement environmental projects are taken by the board as a whole and not at committee level; hence, this might explain the nonsignificant effect of the presence of the environmental committee on GHG voluntary disclosures. Overall, they concluded that environmental committees are primarily set up to ensure that environmental regulatory issues are complied with but 'are not intended to proactively

TABLE 6 Female prediction model residual on GHG voluntary disclosure

GHG disclosure (DV)	Coefficient	Robust SE
Board gender diver. (residual)	0.3141******	0.0847
Environmental commit.	0.0466	0.0264
Board size	0.0059	0.0037
Non-executive directors	−0.0532	0.0702
Board meetings	0.0026	0.0025
CEO Duality	−0.0476	0.0527
Audit committee	−0.0639	0.0789
Director ownership	−0.0017****	0.0006
Ownership concentrate.	−0.0012****	0.0004
Size	0.0551******	0.0071
Gearing	−0.0011****	0.0005
Profitability	0.0007	0.0005
Liquidity	0.0069	0.0051
Financial slack	−0.0014	0.0009
Capital expenditure	0.0075	0.0119
Firm age	−0.0163****	0.0071
CDP participation	0.1062******	0.0161
Industrials	0.1155******	0.0374
Consumer services	0.0966****	0.0373
Oil & gas	0.047	0.0428
Basic materials	0.0828****	0.0415
Consumer goods	0.032	0.0396
Telecommunications	0.0541	0.0582
Utilities	0.0271	0.0521
Technology	0.0214	0.0426
Year dummies	Included	Included
R^2	0.41	
N	860	

Note. This table reports fixed-effect residual regression estimation on the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures using female director model residual. Robust standard errors are reported in column 2. Detailed definition of all the variables is in Table 1. Time and industry dummies are included in the estimations, but not reported.
Abbreviation: GHG, greenhouse gas.
*Significant at the 10%.
**Significant at the 5%.
***Significant at the 1%.

improve environmental performance'. Others such as Liao et al. (2014) argue that although board environmental committee may decide on disclosure policy, in practice, the decision as to what is actually disclosed could be taken at a lower technical level.

Of the other corporate governance tested here, only director ownership had a significant (negative) relationship with GHG voluntary disclosures meaning more director ownership often leads to less voluntary disclosure. The lack of significance by most of the 'traditional' board characteristics tested here raises questions about the role of board structures in discharging wider environmental responsibilities (Kock et al., 2012; Mallin, Michelon, & Raggi, 2013). The results of the firm-specific control variables also indicate that firm size is positively associated with GHG voluntary disclosures. This is consistent with prior studies on GHG disclosures such as Freedman and Jaggi (2005), Prado-Lorenzo et al. (2009), Rankin et al. (2011) and Berthelot and Robert (2012). The negative coefficient in respect of gearing means that highly geared firms are likely to provide less GHG voluntary disclosures. Although the result contradicts findings of prior studies on GHG disclosures (see Freedman & Jaggi, 2005; Prado-Lorenzo et al., 2009; Rankin et al., 2011), it is consistent with the findings of Brammer and Pavelin (2008). Finally, our results also show that participation in CDP and three industrial sectors (industrials, consumer services and basic materials) is significantly associated with GHG voluntary disclosures.

5 | ADDITIONAL RESULTS AND ROBUSTNESS CHECKS

5.1 | Alternative measures of GHG disclosures—Qualitative versus quantitative disclosures

In order to further examine the sensitivity of our analysis to alternative measure of GHG disclosures, we decompose our dependent variable into qualitative and quantitative GHG disclosures to see if the effect of female board members and the environmental committee is different on each of these compared to overall GHG voluntary disclosures. In environment and climate change disclosures, in particular, prior literature documents evidence of symbolic disclosure or greenwashing or simply legitimation disclosures (Hrasky, 2012). Under greenwashing or what Marquis and Toffel (2012) term 'attention deflection' disclosures, firms disclose by highlighting certain desirable activities or their intention to do something as a way of avoiding scrutiny in their actual practices. Thus, under greenwashing, organisational disclosures are awash with positive environmental attributes or initiatives, whereas negative ones are concealed. Disclosures of this nature are often qualitative rather than quantitative.

Previous evidence suggests that analysis of disclosures in different categories provides comprehensive and richer insights into disclosure quantity and that this help to profile different disclosure strategies employed by firms (Beretta & Bozzolan, 2004). In all models, we expect the direction of the relationship to remain the same. Columns 3 and 5 of Table 4 presents the findings of the relationship between board gender diversity, environmental committee and GHG voluntary disclosures using both qualitative and quantitative data, respectively. Results in the two models, that is, 1b and 1c of Table 4, do not materially differ from the model 1a. Both board gender diversity and environmental committee maintained their original model status. The only notable difference is in respect of financial slack and firm age in that the latter is significant with qualitative disclosures but not quantitative disclosures whereas the former is significant in respect of quantitative but not qualitative disclosures.

5.2 | Alternative measures of GHG disclosures' three main sources of information

In addition, we also run further analysis to compare the sensitivity of our analysis to the three main sources of information used to construct our main GHG disclosure index. The focus of this analysis is to determine which source provides better information to stakeholders. We also, using these three main sources, constructed the weighted average disclosure index as another alternative measure of GHC disclosure. The evidence presented in Table 6 shows a less statistical difference from previous estimations. We find the evidence to be more pronounced from reports presented from company annual reports.

5.3 | Female prediction model residual on GHG voluntary disclosure

We further illustrate the influence of board gender diversity on disclosure decisions by estimating a predictive model for board gender diversity and then examining the unexplained percentage of gender diversity on GHG voluntary disclosure. In this case, we take board gender diversity as a linear combination of both governance and firm characteristics. Adams and Ferreira (2009) argued that the inclusion of women on board is often influenced by the peculiar characteristics of the firm. In their sample, Adams and Ferreira (2009) report that female director participation had varied greatly depending on industrial classification with those firms in consumer goods having more female directors than firms in energy and infrastructure sector. Impliedly that if the same firm characteristics used to explain variation in GHG voluntary disclosure can also help explain variation in gender, then board gender diversity is simply a proxy of those characteristics (Gul et al., 2011). If the unexplained part of board gender diversity explains most of the variation in GHG voluntary disclosures, then causality effects may be argued for.

The model is estimated as follows:

$$fb_{it} = \alpha_i + \beta^{ec}.x^{ec}{}_{it} + \beta^{aud}.x^{aud}{}_{it} + \beta^{ceod}.x^{ceod}{}_{it} + \beta^{ned}.x^{ned}{}_{it} + \beta^{bm}.x^{bm}{}_{it} + \beta^{bs}.x^{bs}{}_{it} + \beta^{do}.x^{do}{}_{it} + \beta^{ow}.x^{ow}{}_{it} + \beta^{s}.x^{s}{}_{it} + \beta^{gea}.x^{gea}{}_{it} + \beta^{roa}.x^{roa}{}_{it} + \beta^{liq}.x^{liq}{}_{it} + \beta^{fslack}.x^{fslack}{}_{i} + \beta^{capex}.x^{capex}{}_{it} + \beta^{fage}.x^{fage}{}_{it} + \beta^{ind}.x^{ind}{}_{it} + \beta^{cdp}.x^{cdp}{}_{it} + \mu_{it}. \quad (4)$$

Using the μ_{it}, which is the unexplained part in the female prediction model, the main model is re-estimated using this residual as follows:

$$Y_{it} = \alpha_i + \beta^{fbresid}.x^{fbresid}{}_{it} + \beta^{ec}.x^{ec}{}_{it} + \beta^{aud}.x^{aud}{}_{it} + \beta^{ceod}.x^{ceod}{}_{it} + \beta^{ned}.x^{ned}{}_{it} + \beta^{bm}.x^{bm}{}_{it} + \beta^{bs}.x^{bs}{}_{it} + \beta^{do}.x^{do}{}_{it} + \beta^{ow}.x^{ow}{}_{it} + \beta^{s}.x^{s}{}_{it} + \beta^{gea}.x^{gea}{}_{it} + \beta^{roa}.x^{roa}{}_{it} + \beta^{liq}.x^{liq}{}_{it} + \beta^{fslack}.x^{fslack}{}_{i} + \beta^{capex}.x^{capex}{}_{it} + \beta^{fage}.x^{fage}{}_{it} + \beta^{ind}.x^{ind}{}_{it} + \beta^{cdp}.x^{cdp}{}_{it} + \sum^{4}\alpha_t + \mu_{it}. \quad (5)$$

Column 1 of Table 5 reports fixed-effect residual regression estimation on the relationship between board gender diversity, environmental committee and GHG voluntary disclosures using female director model residual. The results indicate that the residual is positive and significant with GHG voluntary disclosures and the environmental committee maintaining its nonsignificance. This is consistent with our initial findings presented in column 1 of Table 4.

TABLE 7 Corporate governance legislation, board gender diversity and greenhouse gas voluntary disclosures

Legislation		
GHG disclosure (DV)	**Coefficient**	**Robust SE**
Board gender diversity	0.288******	0.066
Environmental com.	0.041	0.0329
Board size	0.0032	0.0033
Non-executive directors	−0.0812	0.0675
Board meetings	0.0036	0.0038
CEO duality	−0.0424	0.0685
Audit committee	−0.1114	0.0714
Director ownership	−0.001******	0.0006
Ownership concent.	−0.0009	0.0005
Size	0.0714******	0.0082
Gearing	−0.002******	0.0003
Profitability	0.0007	0.0006
Liquidity	0.0099	0.0032
Financial slack	−0.0022	0.0006
Capital expenditure	0.0138	0.0117
Firm age	−0.0290****	0.0061
CDP participation	0.10055******	0.0168
Industrials	0.1378******	0.0411
Consumer services	0.0747****	0.0434
Oil & gas	0.0758	0.0361
Basic materials	0.0825****	0.0415
Consumer goods	0.00811	0.0447
Telecommunications	−0.0495	0.0853
Utilities	0.0303	0.0627
Technology	0.0327	0.042
Prelegislation × Board gender diversity	0.090******	
Year dummies	Included	Included
R^2	0.41	
N	420	

Note. This table presents fixed-effect regression estimation on the impact of the UK corporate governance code on the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures. Column 1 provides the results of the impact of the corporate governance legislation on the relationship between board gender diversity, environmental committee and greenhouse gas voluntary disclosures. Detailed definition of all the variables is in Table 1. Time and industry dummies are included in the estimations, but not reported.

*Significant at the 10%.

**Significant at the 5%.

***Significant at the 1%.

5.4 | Heterogeneity identification using industrial reclassification and corporate governance code

Also, based on our literature review, we noted that the industry variable is categorised differently. For example, Prado-Lorenzo et al. (2009) had 11 categories; Rankin et al. (2011) had four; and Freedman and Jaggi (2005) had five. Our original model had industry variable categorised as per industry classification benchmark, which resulted in nine distinct industries after excluding financial sector industry. We, therefore, reclassified our industry variable into just one dummy variable identifying firms as either environmentally sensitive or not (Thompson, 1998); this resulted in 79 firms being classified as environmentally sensitive. When the model is run again, the results did not materially differ from our models (in that neither the direction nor significance of the explanatory variables changed). Results are not included here but are available on request.

Further, we investigated the effect of corporate governance code on the relationship between board diversity, environmental committee and GHG disclosure. Given the fact that the UK Corporate Governance Code emphasised gender diversity in 2012, our focus has been to determine whether the code could explain the variation of the relationship between board gender diversity, environmental committee and GHG disclosure. In order to achieve this, we constructed a dummy variable 1 2012-2014 and any other period 0. Further, we interacted the corporate governance code variable with gender diversity in order to determine its impact on GHG disclosure. Evidence presented in Table 7 suggests a positive and significant relationship between GHG disclosure and the interactive term for the corporate governance code and board diversity. The evidence suggests that the adoption of the corporate governance code in 2012 had positive influence on the impact of board diversity on the GHG disclosures.

5.5 | Endogeneity concerns

One problem we foresee in our findings is the issue of endogeneity. The literature suggests that socially responsible firms tend to be more gender diverse and suggests that gender diversity drives GHG (i.e., social responsibility), implying that causality might occur in the reverse direction. Also, we envisage that some omitted variables that are correlated with both gender diversity and GHG may bias our estimates towards our baseline results. To address these potential endogeneity issues, we employ the two-stage least square procedure, which has widely been used. Adams and Ferreira (2009) advocate the use of a 2SLS as a technique to deal with simultaneity and other endogeneity problems. The results of the first-stage and second-stage regression results are presented in Table 8. Using a series of valid instruments, results from our 2SLS estimation further provide support for our main hypotheses of a significantly positive association between GHC voluntary disclosures and gender diversity. The result presented in Table 8 implies that our results remain relevant after controlling for endogeneity.

TABLE 8 Board gender diversity, environmental committee and greenhouse gas voluntary disclosures using two stage least square estimation

	First stage estimations	Second stage estimations
	(1)	(2)
	Board gender diversity	GHG disclosure
Predicted value		0.763*** (17.86)
Environmental Com.	−0.0566*** (−5.60)	−0.0311 (−0.82)
Controls	Yes	Yes
Year and industry effects included	Yes	Yes
N	860	860
Adjusted R^2	0.65	0.75

Note. This table presents results of the relationship board gender diversity, environmental committee and greenhouse gas voluntary disclosures using two stage least square estimations. Column 1 reports the first stage estimations on the effect of greenhouse gas voluntary disclosures on board gender diversity. Column 2 presents the second-stage estimations. Detailed definition of all the variables is in Table 1. Year and industry dummies and control variables are included in the estimations, but not reported. Robust standard errors are reported in brackets.
*Significant at the 10%.
**Significant at the 5%.
***Significant at the 1%.

6 | CONCLUSIONS

In this paper, we examine the relationship between two modern governance mechanisms, the board gender diversity and the environmental committees, with GHG voluntary disclosures through the lenses of the stakeholder, resource dependency and legitimacy theoretical frameworks.

Our results document a strong positive relationship between board gender diversity and GHG voluntary disclosures, which is consistent with prior evidence (Ciocirlan & Pettersson, 2012; Liao et al., 2014; Post et al., 2011) and constitutes an important input to the ongoing debate about the role of women in the boardroom. While there is a global momentum on reforming boards of directors to incorporate women, questions have still lingered around the added value of women in a board of directors (Adams & Ferreira, 2009). Our results contribute to this debate by showing that a gender-diverse board can serve a wider and a more diverse range of stakeholders (Carter et al., 2010; Liao et al., 2014) and that women can perform better in dealing with environmental matters than men as they tend to be more sensitive to social issues (Bernardi et al., 2006).

As regards environmental committees, these are found to have no significant influence on GHG voluntary disclosures. This holds also true for several other traditional governance structure variables. These findings add to the growing empirical evidence in the literature that questions the effectiveness of the current board structures in

serving the wider needs of stakeholders and in addressing the relevant issues on climate change. In line with our results, Wang and Hussainey (2013) argue that it is debatable as to whether certain governance characteristics like the establishment of environmental committees as advocated by the UK Corporate Governance Code (FRC, 2012) can effectively improve environmental reporting. Prado-Lorenzo and Garcia-Sanchez (2010) call for a review of the governance codes to ensure that the updated codes include clauses and introduce mechanisms that consider the broader interests of stakeholders (other than shareholders).

The results reported in our paper should be interpreted in the light of the following limitations. First, our focus on the FTSE 350 firms and the exclusion of financial firms from our sample means that results can neither be generalised to the UK firms nor applied to the financial services industry. Second, the archival data we utilise in our empirical analysis do not allow us to capture the dynamics in the stakeholders' views about gender diversity, environment committees and GHG voluntary disclosures. It is, therefore, important for the current research to be complemented by studies that use primary data or mixed methodologies that may reflect the relevant views.

Despite these limitations, our results contribute to the existing literature in the following ways. The finding that board gender diversity exerts a positive effect on the GHG voluntary disclosures suggests that firms should be encouraged to have more women on their boards to improve the relevant disclosure practices. The noneffectiveness of the environmental committees and other corporate governance mechanisms in enhancing the GHG voluntary disclosures shows that firms may not have to directly link the existing mechanisms with their disclosure decisions.

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