Board gender diversity, ESG controversies and circular economy disclosure. An analysis on European listed companies

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Abstract

Purpose – *This paper aims to explore how board gender diversity impacts on circular economy (CE) disclosure by a sample of European listed companies. In addition, the paper investigates the moderating role of environmental, social and governance (ESG) controversies in previous relationship.*

Design/methodology/approach – *The study conducted a regression analysis on a sample of 485 companies and 3,761 firm-year observations of European listed companies operating in 19 countries between 2004 and 2021.*

Findings – *The results reveal that the presence of female directors on the board favors the release of higher levels of CE disclosures. Moreover, female directors operating in companies characterized by higher levels of ESG controversies tend to release higher CE disclosures.*

Research limitations/implications – *First, the paper does not investigate the qualitative dimension of disclosures. Moreover, the research does not examine other elements of differentiation within the boards, such as cultural or religious diversities.*

Practical implications – *The analysis shows that diversity has an impact on the dissemination of CE information. This should lead companies and policymakers to orient their actions toward both greater diversity in board composition and the higher CE disclosure in fostering sustainable development.*

Originality/value – *This paper offers novel contributions to existing literature suggesting an objective way to measure CE-related disclosure and investigating the moderating role of ESG controversies in the relationship between gender diversity and CE disclosure.*

Keywords *Female directors, Circular economy, Environmental reporting, ESG controversies, European companies*

Paper type *Research paper*

1. Introduction

In recent years, companies are increasingly requesting to disclose environmental information in response to new regulations (i.e. Directive 2014/95/EU which was recently replaced by the Corporate Sustainability Reporting Directive – CSRD 2022/2464/EU) and stakeholder pressures (Roberts *et al.*, 2022; Sinclair-Desgagne and Gozlan, 2003). Environmental reporting is considered a useful tool for addressing environmental issues (Dagiliene *et al.*, 2020; Zivin and Neidell, 2009), such as climate change, global warming, droughts and deforestation (Yokessa and Marette, 2019; Renstrom *et al.*, 2019; Alrazi *et al.*, 2015). The circular economy (CE) seeks to overcome previous environmental issues by favoring the efficient use of resources through the transition from their traditional linear transformation in production and consumption to a circular transformation (Ellen MacArthur Foundation – EMF, 2012). The circular transformation of resources can be achieved through actions aimed at reducing, reusing, recycling and recovering, better known as the four CE dimensions (Kirchherr *et al.*, 2017). The European Commission (EC), identifying the

importance of shifting toward a more CE approach, issued the CE Action Plan in 2015 aiming at reducing waste and reusing resources more efficiently. In a similar vein, the EC recognized the relevance of providing comparable environmental disclosure, requiring companies to perform this disclosure according to specific sustainability standards (Chapter 6a Sustainability Reporting Standards of CSRD) and asked the European Financial Reporting Advisory Group (EFRAG) to prepare a set of sustainability standards. EFRAG issued the first draft of these standards in July 2023, and among the sustainability standards issued, there is a standard specifically devoted to CE-related disclosure (ESRS E5 "Resource use and circular economy").

Although the CE paradigm is relevant in promoting sustainable development, CE-related disclosure is a poorly investigated topic (Opferkuch *et al.*, 2021; Dagiliene *et al.*, 2020), as is the identification of the determinants of such disclosures (Vitolla *et al.*, 2023; Kuo and Chang, 2021). Although there are different studies investigating the relationship between board composition and environmental disclosure, there are no research on the effects of board of directors on the CE-related disclosure. This paper seeks to fill the existing research gap by investigating the influence of board gender diversity (BGD) on CE-related disclosure, using both the agency and the stakeholder theories.

According to these theoretical frameworks, the presence of women sitting on the board results as a useful control mechanism in reducing the information asymmetries. Women directors, enhancing board effectiveness (Jizi, 2017), increase the disclosure quality (Khemakhem *et al.*, 2022; Ayman *et al.*, 2019). Moreover, female directors are more stakeholder-oriented than male members (Injeni *et al.*, 2022), as they pay more attention to the information released to external parties. In addition, they are more oriented toward sustainability themes, mainly because of their characteristics, such as being supportive, respectful, kind and empathetic (Katmon *et al.*, 2019). Both the agency and the stakeholder theories support a positive relationship between BGD and CE-related disclosure. In line with these theoretical argumentations, most previous studies found a positive association between these variables (e.g. Injeni *et al.*, 2022; Baalouch *et al.*, 2019; Elmagrhi *et al.*, 2019). However, there are also studies showing a nonsignificant relationship (Gallego-Álvarez and Pucheta-Martínez, 2020; Garanina and Aray, 2021; Hussain *et al.*, 2018), revealing the need to further investigate the moderating role of other variables. This paper specifically focuses on the moderating role of environmental, social and governance (ESG) controversies in the relationship between BGD and CE-related disclosure. The moderating role of ESG controversies in the relationship between BGD and CE-related disclosure is not present in the literature. To date, few studies have investigated the influence of ESG controversies on environmental disclosure (e.g. Schiemann and Tietmeyer, 2022). Most studies conducted on ESG controversies have analyzed their influence on company financial performance (e.g. Brinette *et al.*, 2023; Shakil *et al.*, 2021).

Companies sometimes do not assign priority to sustainability topics and involve themselves in ESG controversies, consisting of bad news on environmental and/or social scandals or lawsuits (Aouadi and Marsat, 2018). Companies presenting high levels of ESG disputes tend to release more disclosures to mitigate the negative effects of ESG controversies (Schiemann and Tietmeyer, 2022), obtaining legitimation for their actions and achieving stakeholders' trust (Shakil *et al.*, 2021). In this context, female directors, paying more attention to sustainability issues than male members (Arayssi *et al.*, 2020) and seriously considering ESG controversies (Shakil *et al.*, 2021), should favor higher levels of CE-related disclosure.

The results of the research reveal that the presence of female directors on the board favors the release of higher levels of CE-related disclosures. Moreover, in companies characterized by higher levels of ESG controversies, female directors tend to release higher CE-related disclosures.

This paper contributes to the literature by investigating CE-related disclosure using data collected from the Refinitiv database, suggesting an objective way to measure this phenomenon that could be used by scholars in future research. Almost all previous studies on CE-related disclosure developed a disclosure index based on the CE dimensions (i.e. Dagiliene *et al.*, 2020) and/or some standards that contained suggestions on CE, such as the GRI 306 on waste-related impacts (i.e. Roberts *et al.*, 2022). However, as stated by Opferkuch *et al.* (2021), there are only a few standards containing suggestions on CE-related disclosures, meaning that it is very difficult for scholars to develop a disclosure index that captures all the CE aspects disclosed by companies. Moreover, most of the previous studies explored the CE-related information provided by companies using data from 2016 or even more recently (i.e. Opferkuch *et al.*, 2021; Dagiliene *et al.*, 2020). This paper adds to previous research by investigating the CE-related disclosure released in the period 2004–2021, that is, both before and after the issue of regulation on CE. Moreover, the presented results show the companies' CE disclosure behavior in a context of voluntary CE disclosure, that is before the implementation of CSRD. The paper contributes to the research on the determinants of disclosure by investigating the influence of BGD on CE-related disclosure and the moderating role played by ESG controversies. To date, in fact, only the research of Kuo and Chang (2021) investigated the determinants of CE-related disclosure by focusing on the effect of firm-specific variables on CE-related disclosure.

To achieve the pursued objectives, the paper is structured as follows. The next section describes the background of the study. Section 3 illustrates the theoretical frameworks and Section 4 reviews the previous studies that are addressed as useful to develop the proposed hypotheses. Section 5 illustrates the methodology, while Section 6 reports the results of the study. Section 7 discusses the results and concludes the paper by also illustrating the limitations and future research.

2. Background

The paper focuses on the European context. The choice of this setting was guided by various factors. Firstly, the increasing EU attention toward sustainability and, specifically, CE issues. In fact, the CE's ability to achieve the sustainable development goals (Schroeder *et al.*, 2019; Ghisellini *et al.*, 2016; Rashid *et al.*, 2013) brought the EU in issuing several related regulations (see Table 1).

The EC introduced the CE concept in 2014 by issuing the communication "Towards a Circular Economy: A Zero Waste Programme for Europe". In 2015, the EC issued the EU Action Plan aimed at fostering the transition toward CE, by reducing waste and boosting a more efficient use of the resources. The first CE Action Plan marked the beginning of the

Table 1 Regulations, frameworks and standards on CE

EU regulations on CE	*Frameworks and standards on CE*
2014. Toward a circular economy: a zero waste programme for Europe	2017. Eco-Management and Audit Scheme (EMAS)
2015. CE action plan	2017. British Standards Institute (BSI) BS 8001
2019. European Green Deal	2018. Underwriters Laboratories (UL) 3600
2019. Report on the implementation of the Circular Economy Action Plan	2020. Global Reporting Initiative (GRI) 306
2020. A New Circular Economy Action Plan for a Cleaner and More Competitive Europe	2020. World Economic Forum (WEF) "Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation"
2020. European Taxonomy Regulation 2020 / 852	2022. European Sustainability Reporting Standard (ESRS) E5 "Resource Use and Circular Economy"
2022. Corporate Sustainability Reporting Directive 2464/2022	

Source(s): Developed by authors

EU's formal strategy on the CE, outlining a roadmap for integrating CE principles across the European value chain and stimulating regulatory and industrial changes. In 2019, the EC issued the European Green Deal, which is considered as a key pillar to reduce carbon emissions and promote sustainable growth. In the same year, the EC illustrated the main achievements and potential challenges in fostering the transition toward CE by issuing the "Report on the implementation of the Circular Economy Action Plan". Based on the analysis conducted in this report, in 2020 the EC published "A New Circular Economy Action Plan for a Cleaner and More Competitive Europe", which indicates new measures to be started by March 2022. The transition to CE has also been included in the European Taxonomy Regulation 2020 / 852 as one of the six key environmental targets to pursue sustainable finance.

In addition to fostering the transition toward CE, the EU also recognized the relevance for companies to release CE-related disclosure to external stakeholders. A first attempt to introduce the need to release environmental information was conducted with the issuing of Directive 2003/51/EC, followed by Directive 2014/95/EU. Previous directives required companies to provide environmental information, although they did not report detailed suggestions on the CE information to disclose. The explicit requirement to release CE disclosure was contained in the CSRD, according to which companies must release CE information in their sustainability reports starting from fiscal year 2024. In disclosing CE information, companies must refer to the European sustainability standards, in particular to the ESRS E5.

Therefore, before the implementation of CSRD, companies released CE disclosure in a voluntary manner. Moreover, before the issuing of the ESRS E5, there were no frameworks or standards specifically dedicated to CE disclosure (GRI, 2019). Except for the GRI and WEF, the five documents issued on the CE, illustrated in Table 1, were largely focused on the activities for introducing the CE principles within a company's processes, indicating only indirectly the CE disclosure to release.

The decision to voluntarily release CE disclosure is influenced, among other factors, by the composition of the board of directors (Elmghaamez *et al.*, 2024). This aspect represents the second reason that guided the choice of the European setting. More specifically, this paper focuses on the board gender diversity, that is a topic of great interest for scholars, policymakers and government, due to the frequent underrepresentation of women within the board. To improve the boards heterogeneity, different EU countries introduced reforms aiming at enhancing, on a mandatory or voluntary manner, the percentage of female directors sitting on the board. Due to these reforms, the number of women sitting on the board has gradually risen, mainly in countries that introduced mandatory requirements (Nguyen *et al.*, 2020). Therefore, the European context represents and interesting setting in which investigates the influence of board gender diversity on CE disclosure.

3. Theoretical literature review

The release of CE-related disclosure allows companies to satisfy stakeholders' needs and increase their legitimacy (Lepore *et al.*, 2022; Stewart and Niero, 2018; Lock and Seele, 2016; de Colle *et al.*, 2014). In addition, the provision of CE-related disclosure favors investors' understanding of both companies' operations and their level of risk, making their investment decisions more effective (Kuo and Chang, 2021).

The decision to release CE disclosure or, more generally, environmental disclosure, as well as the analysis of its determinants, has been widely investigated with references to agency, stakeholder, legitimacy or institutional theories. This paper referred to both agency theory (Jensen and Meckling, 1976) and stakeholder theory (Freeman, 1984) to explain the relation between BGD and CE-related disclosure (Bannò *et al.*, 2023; Nicolò *et al.*, 2022),

considering the provision of information a way to reduce the conflicts between the company's management and stakeholders.

According to the agency theory, the agency problems arise when there is a divergence of interests between the principal and the agent, that operates on the principal's behalf. To reduce the agent's discretion, the principal can define specific control mechanisms (named agency costs), which influence the behaviours of the agent. In this context, the presence of women sitting on the board is considered a useful control mechanism in reducing the information asymmetries between the agent and the principal. According to the previous literature, a larger presence of women, enhancing board effectiveness (Jizi, 2017), brings to higher levels of disclosure quality (Khemakhem *et al.*, 2022; Ayman *et al.*, 2019).

According to the stakeholder theory, the success of a company depends on its capability to fulfill all stakeholders' needs (Alatawi *et al.*, 2023; Alipour *et al.*, 2019). Each company, in fact, has numerous counterparts, apart from its shareholders, that can both influence and be affected by the company's actions in different ways. In this context, a strong and more diversified board structure promotes the reduction of the information asymmetries between the company and all its stakeholders, favoring a better dialog with stakeholders by monitoring the corporate reporting processes (Michelon and Parbonetti, 2012). With specific concern to BGD, the literature suggests that the presence of women on the board favors the release of higher levels of environmental disclosure, as women are more stakeholder-oriented (Injeni *et al.*, 2022) and present greater attention to sustainability questions (Hussain *et al.*, 2018; Matsa and Miller, 2013).

4. Empirical literature review and hypotheses development

To date, few studies have been conducted on CE-related disclosures released by companies. Almost all the studies mainly performed a content analysis of the sustainability report (i.e. Opferkuch *et al.*, 2021; Camilleri, 2015) or the integrated report (i.e. Barnabè and Nazir, 2021) and developed a disclosure index to collect data on CE-related disclosure releases. These disclosure indices were based on the CE dimensions (i.e. Dagiliene *et al.*, 2020) or the few disclosure standards that contained some suggestions on CE-related information (i.e. Tiscini *et al.*, 2022; Roberts *et al.*, 2022). The results revealed that companies released little information (Roberts *et al.*, 2022; Kuo and Chang, 2021) and, when provided, the CE content is superficial, inconsistent (Opferkuch *et al.*, 2021) and largely disclosed in a qualitative form (Dagiliene *et al.*, 2020; Stewart and Niero, 2018). The information released mainly concerns the "reduce" dimension, describing the results and activities carried out to achieve both energy savings and waste reduction (Opferkuch *et al.*, 2021; Kuo and Chang, 2021; Dagiliene *et al.*, 2020). The main conclusion of almost all previous research is that the low level of CE-related disclosure is the consequence of the absence of rules and standards specifically devoted to this topic (Roberts *et al.*, 2022; Opferkuch *et al.*, 2021; GRI, 2019) and, therefore, that a more consistent approach to CE-related disclosure is necessary (Opferkuch *et al.*, 2021). More likely, this target could be achieved in the coming years, thanks to the adoption of both CSRD and disclosure standards specifically dedicated to CE issues, such as the ESRS E5.

4.1 Board gender diversity and circular economy disclosure

With respect to the relation between BGD and CE disclosure, to date no studies have investigated this association. Most previous studies have analyzed the association between BGD and the wider concept of environmental disclosure (Lepore and Pisano, 2023), mainly revealing that the presence of female directors on the board increases the level of disclosed information (Buallay and Alhalwachi, 2022; Effah *et al.*, 2022; García-Sánchez *et al.*, 2022; Injeni *et al.*, 2022).

According to the agency theory, female directors enhance board effectiveness (Jizi, 2017), by better monitoring the management activities and increasing the commitment toward sustainability issues, and, therefore, improve disclosure quality (Khemakhem *et al.*, 2022; Ayman *et al.*, 2019). According to stakeholder theory, the presence of women directors promotes the release of higher levels of environmental disclosure, as women are more stakeholder-oriented (Injeni *et al.*, 2022) and present greater attention to sustainability questions (Hussain *et al.*, 2018; Matsa and Miller, 2013). This greater commitment toward sustainability issues could be due to some female characteristics, such as being supportive, respectful, kind and empathetic (Katmon *et al.*, 2019; Kend, 2015).

In line with theoretical arguments, most studies have hypothesized and found a positive relationship between BGD and environmental disclosure (e.g. Injeni *et al.*, 2022; Baalouch *et al.*, 2019; Elmagrhi *et al.*, 2019; Fuente *et al.*, 2017; Tamimi and Sebastianelli, 2017; Javaid Lone *et al.*, 2016; Liao *et al.*, 2015; Garcia-Sanchez *et al.*, 2014; Ntim and Soobaroyen, 2013; Rao and Tilt, 2016). However, there are also studies that found a non-significant association between BGD and environmental disclosure (Gallego-Álvarez and Pucheta-Martínez, 2020; Garanina and Aray, 2021; Hussain *et al.*, 2018).

Based on the theoretical argumentations, we hypothesize the following:

H1. There is a positive association between BGD- and CE-related disclosures.

4.2 The influence of environmental, social and governance controversies

ESG controversies consist of bad news on environmental and/or social scandals or lawsuits (Aouadi and Marsat, 2018) that could damage the reputation of a company (Shakil *et al.*, 2021). The occurrence of ESG controversies puts the company under stakeholder scrutiny, as ESG controversies enhance uncertainty about the company's prospects and strategies (Schiemann and Tietmeyer, 2022). As a result, the manifestation of ESG controversies can negatively influence stakeholders' opinions and damage companies' legitimacy (Brinette *et al.*, 2023).

The literature suggests that companies characterized by high levels of ESG controversies tend to release more information to mitigate uncertainty due to ESG controversies (Schiemann and Tietmeyer, 2022). In fact, disclosure is considered an instrument to identify and assess the impact of ESG controversies (Amel-Zadeh and Serafeim, 2018). In this sense, companies tend to increase ESG disclosure to protect themselves from negative stakeholder reactions that could appear after the manifestation of an ESG controversy (Hummel and Rötzel, 2019). Releasing more information, companies can legitimate their activities and achieve stakeholder trust (Shakil *et al.*, 2021; Patten and Shin, 2019), especially in the presence of ESG controversies (Brinette *et al.*, 2023). In line with these considerations, the study of Schiemann and Tietmeyer (2022) empirically shows that the existence of high environmental controversies enhances the ESG disclosure released because of the increased pressure from external stakeholders. Therefore, companies presenting high levels of ESG controversies should also report greater CE-related disclosures.

With respect to the relation with CE-related disclosure, women directors could increase the level of information in the presence of higher levels of ESG controversies to contain reputational damage. Female directors pay more attention to sustainability issues than male members (Arayssi *et al.*, 2020) and seriously consider ESG controversies (Shakil *et al.*, 2021). Thanks to their female characteristics, women lead companies to adopt lower levels of harmful and illegal practices (Passas *et al.*, 2022) and, in the occurrence of ESG controversies, tend to limit their negative effects. Therefore, stakeholders value in a positive way the presence of women on the board in the occurrence of ESG controversies because female directors can limit the negative effects of ESG controversies (Brinette *et al.*, 2023).

On this basis, the study hypothesizes the following:

H2. ESG controversies positively moderate the relationship between BGD and CE-related disclosure.

5. Research design

5.1 Sample selection and data source

The study is based on a population of 574 European listed companies (8,748 firm-year observations). Specifically, on the Refinitiv database we selected all the listed companies whose both headquarters and businesses are located in a European member state, which prepared a sustainability report in the period 2004–2021, and that presented a market capitalization equal or higher than 500 million. Due to their characteristics, financial and insurance companies were not included in the sample.

We decided to start the analysis in 2004 to investigate what happened before the introduction of some form of regulation on CE (the CE Action Plan was issued in, 2015). The year 2004 was selected as the starting year as it was the first year after the issuing of Directive 2003/51/EC, with which the EU legislature introduced a first requirement for companies to report environmental information in their management commentary and analysis. The last year analyzed is 2021, as is the year with the most recent available data when the study was conducted. We eliminated 89 companies due to the unavailability of data on Refinitiv. The final unbalanced sample was composed of 485 companies (3,761 firm-year observations) belonging to 18 industries and 19 different countries.

Data on CE-related disclosure, board characteristics and accounting and financial data were collected from the Refinitiv Eikon database.

Table 2 shows the sample selection process (Panel A) and its composition by Country (Panel B) and industry (Panel C).

5.2 Dependent, independent, moderating and control variables

Table 3 shows all the variables included in the analysis, illustrating how they have been measured, the source of data for each one and previous studies that used the same variable.

The dependent variable, CE-related disclosure (*CEDisc*), was measured as an unweighted sum of 12 environmental items collected by the Refinitiv Eikon database that measure a company's level of environmental disclosure on CE topics. Refinitiv measured each item by assigning a score of 1 when the company discloses the specific environmental information and 0 otherwise (Gallego-Alvarez *et al.*, 2017; Du *et al.*, 2010; Kolk and Pinkse, 2010; Chen and Bouvain, 2009).

The 12 environmental items considered to define the value of *CEDisc* belong to three different categories: 6 items for emissions, 4 for innovation and 2 for resource use (see Table 4). The emission category describes the company's commitment to and success in reducing environmental emissions in production processes. The innovation category describes companies' willingness to reduce costs and environmental obligations by envisioning new economic prospects through environmentally sound technologies and circular practices. Finally, the resource use category describes companies' attitudes toward adopting the 4R paradigm by avoiding resource waste and improving supply chain management.

The independent variable, i.e. BGD (*BoGenDiv*) was measured as the percentage of women on the board.

To analyze the moderating effect of ESG controversies (*ESGContr*) on the relationship between BGD and CE-related disclosure, we included in our regression model an interaction term obtained by multiplying *BoGenDiv* with *ESGContr*.

Table 2 The sample

Panel A. Sample selection process

	N. of firms
Listed companies:	574
- Having the country of headquarters in one of 27 European countries	
- Having the country of Exchange in one of 27 European countries	
- Preparing a sustainability report in the period 2004–2021	
- Having a market capitalization equal or higher than 500 million	
Companies with no accounting and financial data	(89)
Final sample	*485*

Panel B. sample by country

	Country of Headquarter	No. of firms	No. of obs	% of obs
1	Austria	17	121	3.22
2	Belgium	16	106	2.82
3	Czech Republic	1	17	0.45
4	Denmark	18	131	3.48
5	Finland	22	196	5.21
6	France	73	611	16.25
7	Germany	85	624	16.59
8	Greece	11	96	2.55
9	Hungary	4	48	1.28
10	Ireland	2	8	0.21
11	Italy	54	367	9.76
12	Luxembourg	9	55	1.46
13	Netherlands	23	238	6.33
14	Poland	8	72	1.91
15	Portugal	8	70	1.86
16	Romania	5	17	0.45
17	Slovenia	2	9	0.24
18	Spain	36	358	9.52
19	Sweden	91	617	16.41
	Tot.	*485*	*3,761*	*100.00*

Panel C. sample by industry

	Sector	No. of firms	No. of obs	% of Obs
1	Accommodation and Food Services	7	54	1.44
2	Admin. and Supp., Waste Manag. and Remed. Services	11	86	2.29
3	Agriculture, Forestry, Fishing and Hunting	1	6	0.16
4	Arts, Entertainment, and Recreation	5	29	0.77
5	Construction	24	184	4.89
6	Educational Services	1	5	0.13
7	Finance and Insurance	55	417	11.09
8	Health Care and Social Assistance	31	213	5.66
9	Information	191	1643	43.69
10	Manufacturing	3	27	0.72
11	Mining, Quarrying, Oil and Gas Extraction	2	13	0.35
12	Other Services (except Public Administration)	29	175	4.65
13	Professional, Scientific, and Technical Services	37	185	4.92
14	Real Estate, Rental and Leasing	20	155	4.12
15	Retail Trade	16	165	4.39
16	Transportation and Warehousing	16	73	4.39
17	Utilities	28	281	7.47
18	Wholesale Trade	8	50	1.33
	Tot.	*485*	*3,761*	*100.00*

Source(s): Developed by author

The moderating variable *ESGContr* was measured using the ESG Controversy Category Score computed by Refinitiv Eikon based on 23 ESG controversy topics. This score measures the company's exposure to ESG controversies, and the negative events exhibited in the media. The score ranges from 0 to 100. Companies with no controversies obtain a score of 100. Considering that we focused on the level of exposure to ESG controversies, we computed the moderating variable using the reverse version, that is, 100 minus ESG controversies, so that higher values consistently reflect higher ESG controversies. This inversion enhances interpretability and theoretical consistency, as it aligns the direction of the variable with the expectation that higher ESG controversies acts as a moderating factor in the relationship between BGD- and CE-related disclosures.

Finally, to avoid biased results and resolve endogeneity issues related to omitted variables, we included the following control variables:

- Profit (*Profit*): return on total assets;
- Leverage (*Lev*): long-term debt divided by total assets;
- Firm Size (*FirmSize*): natural logarithm of total assets;
- Board Tenure (*BoTen*): average number of years each board member has been on the board;
- Board Meetings (*BoMeet*): number of board meetings during the year;

Table 3 Description of variables and measurement

Variable	*Description*	*Measurement*	*Source*	*Previous studies*
Dependent variable				
CEDisc	CE-related disclosure	*Unweighted sum of 12 environmental items disclosed by companies, assigning value 1 when the company does present information on that environmental aspect and 0 otherwise*	*Eikon*	Gallego-Alvarez *et al.*, 2017; Du *et al.*, 2010; Kolk and Pinkse, 2010; Chen and Bouvain, 2009
Independent variable				
BoGenDiv	*Board gender diversity*	*Percentage of female on the board*	*Eikon*	Pozzoli *et al.*, 2023; Lepore and Pisano, 2023; Raimo *et al.*, 2022; Vitolla *et al.*, 2023; Liao *et al.*, 2015
Moderating variable				
ESGContr	*ESG controversies*	*100 minus the ESG Controversy Score, that is calculated based on 23 ESG controversy topics*	*Eikon*	D'Amore *et al.*, 2024; Passas *et al.*, 2022; Schiemann and Tietmeyer, 2022
Interaction term				
BoGenDiv ESGContr*	*Interaction term*	*Two ways interaction term obtained by multiplying the BoGenDiv and ESGContr*	*Eikon*	
Control variables				
Profit	*Profit*	*Return on Assets*	*Eikon*	Pozzoli *et al.*, 2023; Raimo *et al.*, 2022; Ayman *et al.*, 2019
Lev	*Leverage*	*Long-term debt divided by total assets*	*Eikon*	Pozzoli *et al.*, 2023; Lepore and Pisano, 2023; Chan *et al.*, 2013
FirmSize	*Firm size*	*Natural logarithm of total assets*	*Eikon*	Lepore and Pisano, 2023; Vitolla *et al.*, 2023; Michelon and Parbonetti, 2012
BoTen	*Board tenure*	*Average number of years each board member has been on the board*	*Eikon*	Katmon *et al.*, 2019; Shiah-Hou, 2021
BoMeet	*Board meetings*	*Number of board meetings during the year*	*Eikon*	D'Amore *et al.*, 2024; Lepore and Pisano, 2023
BoSize	*Board size*	*Total number of board members at the end of the fiscal year*	*Eikon*	Khan, 2021; Nicolò *et al.*, 2022; Raimo *et al.*, 2022; Aladwey, 2021; Vairavan and Zhang, 2020; Assenga *et al.*, 2018
BoInd	*Board independence*	*Percentage of independent directors on the board*	*Eikon*	Lepore *et al.*, 2022; Garcia-Sanchez *et al.*, 2014; Vitolla *et al.*, 2023; Assenga *et al.*, 2018; Michelon and Parbonetti, 2012

Source(s): Developed by authors

- Board Size (*BoSize*): total number of board members at the end of the fiscal year; and
- Board Independence (*BoInd*): Percentage of independent directors on the board.

We used one lag period for all the explanatory variables in regression to avoid endogeneity problems.

5.3 Regression analysis

To test the above hypotheses, we developed the following fixed-effect linear regression models for panel data (time-fixed effects) to control heterogeneity problems:

$$CEDisc = \alpha + \beta_1 BoGenDiv + \beta_2 ESGContr + \beta_3 Profit + \beta_4 Lev + \beta_5 FirmSize + \beta_6 BoTen + \beta_7 BoMeet + \beta_8 BoSize + \beta_9 BoInd + year + \varepsilon \quad (1)$$

$$CEDisc = \alpha + \beta_1 BoGenDiv + \beta_2 ESGContr + \beta_3 BoGenDiv{*}ESGContr + \beta_4 Profit + \beta_5 Lev + \beta_6 FirmSize + \beta_7 BoTen + \beta_8 BoMeet + \beta_9 BoSize + \beta_{10} BoInd + year + \varepsilon \quad (2)$$

Table 4 Description of environmental disclosure items

CE-related disclosure		
Emissions category *Title* *Description*	*Innovation category* *Title* *Description*	*Resource use category* *Title* *Description*
VOC or particulate matter emissions reduction Does the company report on initiatives to reduce, substitute or phase out volatile organic compounds (VOC) or particulate matter less than ten microns in diameter (PM10)?	*Eco-Design products* Does the company report on specific products which are designed for reuse, recycling or the reduction of environmental impacts?	*Environmental materials sourcing* Does the company claim to use environmental criteria (e.g. life cycle assessment) to source or eliminate materials?
NOx and SOx emissions reduction Does the company report on initiatives to reduce, reuse, recycle, substitute or phase out SOx (sulfur oxides) or NOx (nitrogen oxides) emissions?	*Take-back and recycling initiatives* Does the company report about take-back procedures and recycling programs to reduce the potential risks of products entering the environment?	*Toxic chemicals reduction* Does the company report on initiatives to reduce, reuse, substitute or phase out toxic chemicals or substances?
VOC emissions reduction Does the company report on initiatives to reduce, substitute or phase out volatile organic compounds (VOC)?	*Product impact minimization* Does the company report about take-back procedures and recycling programmes to reduce the potential risks of products entering the environment or does the company report about product features or services that will promote responsible and environmentally preferable use?	
Particulate matter emissions reduction Does the company report on initiatives to reduce, substitute or phase out particulate matter less than 10 microns in diameter (PM10)?	*GRI sustainability certifications* GRI standards represent guidelines for creating sustainable performance reports. They consist of a modular and interdependent structure to best create reports in the economic, social and environmental areas	
Waste reduction initiatives Does the company report on initiatives to recycle, reduce, reuse, substitute, treat or phase out total waste?		
E-waste reduction Does the company report on initiatives to recycle, reduce, reuse, substitute, treat or phase out e-waste?		

Source(s): Developed by authors

6. Empirical results and discussion

6.1 Descriptive statistics

Table 5 shows the descriptive statistics of all the variables included in the analysis.

On average, the companies in the sample issued almost 11 out of 12 environmental items related to CE issues. Differently from previous studies that conducted a content analysis on sustainability reports (Opferkuch *et al.*, 2021; Roberts *et al.*, 2022; Kuo and Chang, 2021; Dagiliene *et al.*, 2020; Stewart and Niero, 2018), this finding shows high levels of attentions toward CE issues, revealing the relevance to study the CE disclosure using different methods.

The percentage of women sitting on the board is 29.12%, highlighting a limited presence of female directors. The results also reveal that the independent variable varies considerably among the sampled companies, ranging from 0% to 75%.

The ESG controversies are on average equal to 9.83, showing that companies present low levels of exposure to ESG controversies and negative events exhibited in the media. However, this moderating variable varies considerably among the sample companies, ranging from 0 to 99.32.

Table 5 Descriptive statistics

Variables	*No. obs*	*Mean*	*Sd*	*Min*	*Max*
CEDisc	3,761	10.97527	0.8691981	2	12
BoGenDiv	3,761	29.12345	14.61531	0	75
ESGContr	3,761	9.830374	23.20216	0	99.32433
BoGenDiv×*ESGContr*	3,761	272.8161	730.4898	0	5948.617
Profit	3,761	0.0469432	0.06708	−0.5353444	0.5572245
Lev	3,761	22.56063	1.848947	0	28.42058
FirmSize	3,761	0.2068527	0.1421267	0	0.8245783
BoTen	3,761	6.13407	3.229729	0	23.16667
BoMeet	3,761	9.403084	6.783995	0	92
BoSize	3,761	11.35974	4.448352	0	34
BoInd	3,761	52.15801	27.3296	0	100

Note(s): Dependent variable. *CEDisc*: Unweighted sum of 12 environmental items disclosed by companies, assigning value 1 when the company does present information on that environmental aspect and 0 otherwise; Independent variable. *BoGenDiv*: Percentage of female on the board; Moderating variable. *ESGContr*: 100 minus the ESG Controversy Score, that is calculated based on 23 ESG controversy topics; Interaction term. *BoGenDiv* * *ESGContr*: Two ways interaction term obtained by multiplying the BoGenDiv and ESGContr; Control variables. *Profit*: Return on assets; *Lev*: Long-term debt divided by total assets; *FirmSize*: Natural logarithm of total assets; *BoTen*: Average number of years each board member has been on the board; *BoMeet*: Number of board meetings during the year; *BoSize*: Total number of board members at the end of the fiscal year; *BoInd*: Percentage of independent directors on the board
Source(s): Developed by authors

Passing to the control variables, the sampled companies present an average ROA of 4%, a mean leverage of 22.56 and an average value of the natural logarithm of total assets of 0.20.

The number of years each board member has been on the board is on average equal to 6.13. The average number of board meetings during the year is equal to 9.40, including a limited number of companies that registered 0 as the minimum value, revealing an absence of yearly meetings. The total number of board members at the end of the fiscal year is on average equal to 11.35. On average, 52.15% of board members are independent directors. This control variable varies from 0% to 100%, revealing that there are both companies with no independent directors and companies with all independent board members.

Before performing the regression analysis, we analyzed the correlations between variables (Table 6). *BoGenDiv* is positively correlated with *CEDisc*. In addition, almost all the control variables are correlated with *CEDisc*. More specifically, *Profit*, *Lev*, *BoTen*, *BoSize* and *BoInd* are correlated with *CEDisc*.

6.2 Regression results

Table 7 shows the results of the regression analyses conducted using Stata Software. More specifically, the table reports the findings for the tests of H_1 and H_2. Model 1 shows the findings for the test of the direct effect of BGD and CE-related disclosure. Model 2, instead, shows the findings for the test of the moderating influence of ESG controversies on the relationship between BGD and CE-related disclosure.

We used a panel data fixed effect with a time effects model that provides findings more robust than other models (Eibinger *et al.*, 2024), such as pooled ordinary least squares or random effects models.

The results reported in Model 2 confirm H_1, showing a positive and significant relationship between *BoGenDiv* and *CEDisc*. More specifically, the coefficient of *BoGenDiv* is positive and statistically significant at better than the 1% level for explaining variations in *CEDisc* ($\beta = 0.0036863$, $p < 0.01$). This result is consistent with the theoretical argumentations of the agency and stakeholder theories, as well as with the findings of most previous studies

Table 6 Correlation matrix

	CEDisc	BoGenDiv	ESGContr	BoGenDiv × ESGContr	Profit	Lev	FirmSize	BoTen	BoMeet	BoSize	BoInd
CEDisc	1,000										
BoGenDiv	0.0695***	1,000									
ESGContr	0.0173	−0.0398**	1,000								
BoGenDiv × ESGContr	0.0188	0.1543***	0.8777***	1,000							
Profit	0.0574***	0.0521***	−0.0867***	−0.0610***	1,000						
Lev	−0.1142***	−0.1156***	0.3811***	0.3224***	−0.2355***	1,000					
FirmSize	−0.0125	0.0650***	−0.0257	−0.0137	−0.1847***	−0.0401**	1,000				
BoTen	0.0423***	0.0156	−0.0093	−0.0093	0.0798***	−0.0087	−0.1184***	1,000			
BoMeet	0.0016	0.0231	0.0020	0.0049	−0.0848***	0.0512**	0.0603***	−0.1295***	1,000		
BoSize	−0.0893***	−0.1783***	0.2984***	0.2242***	−0.1459***	0.5590***	−0.0222	−0.0053	−0.0535***	1,000	
BoInd	0.0900***	0.1788***	−0.0276**	0.0221	0.0107	−0.0497***	0.0565***	−0.0131	0.1819***	−0.2956***	1,000

Note(s): *Dependent variable. CEDisc*: Unweighted sum of 12 environmental items disclosed by companies, assigning value 1 when the company does present information on that environmental aspect and 0 otherwise; *Independent variable. BoGenDiv*: Percentage of female on the board; *Moderating variable. ESGContr*: 100 minus the ESG Controversy Score, that is calculated based on 23 ESG controversy topics; *Interaction term. BoGenDiv * ESGContr*: Two ways interaction term obtained by multiplying the BoGenDiv and ESGContr; *Control variables. Profit*: Return on assets; *Lev*: Long-term debt divided by total assets; *FirmSize*: Natural logarithm of total assets; *BoTen*: Average number of years each board member has been on the board; *BoMeet*: Number of board meetings during the year; *BoSize*: Total number of board members at the end of the fiscal year; *BoInd*: Percentage of independent directors on the board. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Source(s): Developed by authors

Table 7 Regression results (dependent variable: *CEDisc*)

Variables	*Circular economy disclosure* Model (1) Direct effect	Model (2) Interaction effect
BoGenDiv	0.0048129 *** (0.0009627)	0.0036863 *** (0.0010389)
ESGContr	−0.0007388 (0.0005663)	−0.0034952 *** (0.0011157)
BoGenDiv × ESGContr		0.0000965 ** (0.0000337)
Profit	−0.9914934 *** (0.236681)	−0.987996 *** (0.2364232)
Lev	0.0888998 (0.0184834)	0.0885104 *** (0.0184635)
FirmSize	0.0303672 (0.1129386)	0.0198483 (0.1128738)
BoTen	0.0380269 *** (0.0071799)	0.0395477 *** (0.0071916)
BoMeet	0.0018116 (0.0024718)	0.0018628 (0.0024691)
BoSize	−0.0026251 (0.0062877)	−0.0034293 (0.0062871)
BoInd	0.0011901 (0.0006732)	0.0009805 (0.0006765)
Year	YES	YES
Constant	8.594448 *** (0.4103221)	8.649073 *** (0.4103124)
Sigma_u	0.71101916	0.71083371
Sigma_e	0.59241627	0.59176306
Rho	0.59024533	0.59065274

Note(s): *Dependent variable. CEDisc*: Unweighted sum of 12 environmental items disclosed by companies, assigning value 1 when the company does present information on that environmental aspect and 0 otherwise; *Independent variable. BoGenDiv*: Percentage of female on the board; *Moderating variable. ESGContr*: 100 minus the ESG Controversy Score, that is calculated based on 23 ESG controversy topics; *Interaction term. BoGenDiv * ESGContr*: Two ways interaction term obtained by multiplying the BoGenDiv and ESGContr; *Control variables. Profit*: Return on Assets; *Lev*: Long-term debt divided by total assets; *FirmSize*: Natural logarithm of total assets; *BoTen*: Average number of years each board member has been on the board; *BoMeet*: Number of board meetings during the year; *BoSize*: Total number of board members at the end of the fiscal year; *BoInd*: Percentage of independent directors on the board. 485 companies (3,761 firm-year observations). Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors in parentheses
Source(s): Developed by authors

that investigated the relationship between BGD and the wider concept of environmental disclosure, highlighting that female directors within the board enhance the board effectiveness, by better controlling the management activities and favoring the commitment toward sustainability issues, and increase the level of environmental disclosure released by companies to external parties (e.g. Injeni *et al.*, 2022; Baalouch *et al.*, 2019; Fuente *et al.*, 2017; Tamimi and Sebastianelli, 2017; Javaid Lone *et al.*, 2016; Liao *et al.*, 2015; Garcia-Sanchez *et al.*, 2014; Ntim and Soobaroyen, 2013; Rao and Tilt, 2016).

The results reported in Model 2 confirm *H1* and are in line with the results reported in Model 1.

The results reported in Model 2 also confirm *H2*, showing that ESG controversies positively moderate the association between BGD and *CEDisc*. According to *H2*, the coefficient of *BoGenDiv* ESGContr* is positive and statistically significant at less than the 5% level for explaining variations in *CEDisc* ($\beta = 0.0000965$, $p < 0.05$), meaning that in the occurrence of ESG controversies, female directors tend to increase the CE-related disclosure released. This result confirms the theoretical argumentation, according to which women directors pay great attention to ESG controversies (Shakil *et al.*, 2021), and tend to reveal more information in occurrence of higher levels of ESG controversies to contain negative effects.

The study's findings overall highlight the need for EU policymakers and governments to pay attention to both the transition toward CE principles by companies and the composition of their board of directors, pursuing reforms that jointly consider these aspects.

With respect to the control variables, the coefficient of *Lev* is positive and statistically significant in both models, meaning that companies with higher levels of leverage should disclose more CE information to meet the data requirements of their debtholders (Pozzoli *et al.*, 2023; Chan *et al.*, 2013).

In addition, the coefficient of *BoTen* is positive and statistically significant in both models, meaning that the average number of years each board member has been on the board positively influences the level of CE-related disclosure released. Finally, the coefficient of *Profit* is negative and statistically significant in both models, meaning that companies with higher levels of profitability tend to disclose less CE information to external parties. The coefficients of the other control variables are not statistically significant.

In addition, in the Table 7, we reported the values of *Sigma_u*, *Sigma_e* and *Rho* to provide useful information for understanding data properties and model behaviour (Stock and Watson, 2005).

Sigma_u is equal to 0.59, represents a measure of variance due to temporal fixed effects. *Sigma*_e is equal to 0.71, represents the variance of idiosyncratic errors (e_{it}) which capture the variability of observations that is explained neither by time effects nor by the explanatory variables included in the model. Finally, *rho* represents the proportion of the total variance explained by time fixed effects.

The rho value is 0.59 close to 1, so time effects explain much of the variance in the data.

6.3 Robustness and additional analysis

To demonstrate the robustness of our findings to alternative estimations, we constructed the ordinary least squares regression model, as well as random and fixed effects regression models without time dummies, to test both the direct effects and the interaction effects. The results are substantially similar to those ones obtained with the fixed effects with time effects model, confirming the validity of the findings in the present analysis and demonstrating their robustness. We also estimated the fixed effects with time effects model using no lagged explanatory variables and obtained similar results to those achieved with the main models.

7. Summary and conclusion

The findings of this paper show that the presence of female directors on the board is associated with higher levels of CE-related disclosure. For their characteristics, such as being supportive, respectful, kind and empathetic (Katmon *et al.*, 2019), women pay more attention to sustainability matters (Hussain *et al.*, 2018; Matsa and Miller, 2013), bringing companies to release higher levels of CE-related disclosure. Therefore, although the percentage of female directors within the board is limited in the sampled companies, their presence positively influences the level of CE-related disclosure. This result is consistent with previous studies revealing a positive relationship between BGD and the wider concept of environmental information (e.g. Injeni *et al.*, 2022; Baalouch *et al.*, 2019; Fuente *et al.*, 2017; Tamimi and Sebastianelli, 2017; Javaid Lone *et al.*, 2016; Liao *et al.*, 2015; Garcia-Sanchez *et al.*, 2014; Rao and Tilt, 2016). Considering stakeholder theory, the results of the paper show that female directors are more stakeholder oriented (Injeni *et al.*, 2022), leading companies to provide higher CE-related disclosure to satisfy external stakeholders' information needs. In addition, considering agency theory, the findings of the paper show that more diversified boards, in terms of gender diversity, favor better dialog with stakeholders, decreasing information asymmetries with the company.

The results of the paper also show that ESG controversies positively moderate the association between BGD and CE-related disclosure. This finding confirms the hypothesis developed, which stated that, in the occurrence of ESG controversies, female directors tend to enhance the level of CE-related disclosure to contain reputational damage. In line with our expectations, the results reveal that, when companies are exposed to higher ESG controversies, female directors favor the release of higher levels of CE-related disclosures. This means that the occurrence of ESG controversies enhances the effectiveness of BGD in stimulating higher levels of disclosures.

The results have important practical implications for regulators and companies. It has been emphasized that gender diversity has an important impact on the level of CE-related disclosure as well. This should lead regulators, and policymakers as well, to orient their acts toward mandatory diversity in the composition of the boards. Diversity can contribute to considering different perspectives, and female directors seem to enhance the level of disclosure in sensitive themes, such as CE, that can be particularly appreciated by stakeholders, supporting the creation of value in the medium and long term. Similar motivations should lead companies to increase their number of female directors on their boards, as this paper highlights that sensitivity to critical issues can be increased when the board is diversified. Therefore, the findings of the study highlight the necessity, for both companies and policymakers, to pay attention to both the disclosure on CE issues and the corporate governance in fostering sustainable development.

There are implications for academia as well. The positive relation between BGD and CE-related disclosure highlight the need to further investigate the association between corporate governance and sustainability disclosure, especially in the light of the effects of the implementation of CSRD and ESRSs. The mandatory adoption of ESRSs in the future could stress the changes produced in this context, as other research could distinguish the level of information in relation to the applied technical standards. Moreover, the use of data collected from Refinitiv to measure CE-related disclosure suggests an objective way for evaluating the information released, which could serve as a useful tool for scholars in future research.

The research presents some limitations as well. The applied model takes into consideration the level of disclosure, without providing an evaluation of the quality of the disclosure. Future research could add a qualitative analysis to the quantitative analysis. In addition, the Refinitiv database addresses only the output related to the presence of CE-related disclosures, without taking into consideration the effort produced to achieve that information; this level of information should also require a qualitative investigation. In this context, a related limitation is due to the fact that Refinitiv cannot identify if a company did not report a CEDisc because the information is not material or because this company did not appropriately address the CE issue. Another limitation is related to the adopted sample. It would be interesting to separately examine countries where there is no legislation and the decision on the composition of the board is free from the adoption of *ad hoc* requirements. Finally, in the future is interesting to examine the different type of diversity not only gender diversity. It would be interesting to examine interactions with diversity to find new evidence in other fields.

References

Aladwey, L.M.A. (2021), "The effect of equity ownership structure on non-conditional conservatism: an empirical study based on listed companies in Egypt", *Journal of Financial Reporting and Accounting*, Vol. 19 No. 5, pp. 742-771, doi: 10.1108/JFRA-04-2020-0104.

Alatawi, I.A., Ntim, C.G., Zras, A. and Elmagrhi, M.H. (2023), "CSR, financial and non-financial performance in the tourism sector: a systematic literature review and future research agenda", *International Review of Financial Analysis*, Vol. 89, p. 102734, doi: 10.1016/j.irfa.2023.102734.

Alipour, M., Ghanbari, M., Jamshidinavid, B. and Taherabadi, A. (2019), "Does board independence moderate the relationship between environmental disclosure quality and performance? Evidence from static and dynamic panel data", *Corporate Governance: The International Journal of Business in Society*, Vol. 19 No. 3, pp. 580-610, doi: 10.1108/CG-06-2018-0196.

Alrazi, B., De Villiers, C. and Van Staden, C.J. (2015), "A comprehensive literature review on, and the construction of a framework for, environmental legitimacy, accountability and proactivity", *Journal of Cleaner Production*, Vol. 102, pp. 44-57, doi: 10.1016/j.jclepro.2015.05.022.

Amel-Zadeh, A. and Serafeim, G. (2018), "Why and how investors use ESG information: evidence from a global survey", *Financial Analysts Journal*, Vol. 74 No. 3, pp. 87-103, doi: 10.2469/faj.v74.n3.2.

Arayssi, M., Jizi, M. and Tabaja, H.H. (2020), "The impact of board composition on the level of ESG disclosures in GCC countries", *Sustainability Accounting, Management and Policy Journal*, Vol. 11 No. 1, pp. 137-161, doi: 10.1108/SAMPJ-05-2018-0136.

Assenga, M.P., Aly, D. and Hussainey, K. (2018), "The impact of board characteristics on the financial performance of Tanzanian firms", *Corporate Governance: The International Journal of Business in Society*, Vol. 18 No. 6, pp. 1089-1106, doi: 10.1108/CG-09-2016-0174.

Ayman, A., El-Helaly, M. and Shehata, N. (2019), "Board diversity and earnings news dissemination on twitter in the UK", *Journal of Management and Governance*, Vol. 23 No. 3, pp. 715-734, doi: 10.1007/s10997-018-9441-9.

Aouadi, A. and Marsat, S. (2018), "Do ESG controversies matter for firm value? Evidence from international data", *Journal of Business Ethics*, Vol. 151 No. 4, pp. 1027-1047, doi: 10.1007/s10551-016-3213-8.

Baalouch, F., Ayadi, S.D. and Hussainey, K. (2019), "A study of the determinants of environmental disclosure quality: evidence from French listed companies", *Journal of Management and Governance*, Vol. 23 No. 4, pp. 939-971, doi: 10.1007/s10997-019-09474-0.

Bannò, M., Filippi, E. and Trento, S. (2023), "Women in top echelon positions and their effects on sustainability: a review, synthesis and future research agenda", *Journal of Management and Governance*, Vol. 27 No. 1, pp. 181-251, doi: 10.1007/s10997-021-09604-7.

Barnabè, F. and Nazir, S. (2021), "Investigating the interplays between integrated reporting practices and circular economy disclosure", *International Journal of Productivity and Performance Management*, Vol. 70 No. 8, pp. 2001-2031, doi: 10.1108/IJPPM-03-2020-0128.

Brinette, S., Sonmez, F.D. and Tournus, P.S. (2023), "ESG controversies and firm value: moderating role of board gender diversity and board independence", *IEEE Transactions on Engineering Management*, Vol. 71, doi: 10.1109/TEM.2023.3236667.

Buallay, A. and Alhalwachi, L. (2022), "Board gender diversity and environmental disclosure: evidence from the banking sector", *Journal of Chinese Economic and Foreign Trade Studies, (Ahead-of-Print)*, Vol. 15 No. 3, doi: 10.1108/JCEFTS-08-2021-0046.

Camilleri, M.A. (2015), "Environmental, social and governance disclosures in Europe", *Sustainability Accounting, Management and Policy Journal*, Vol. 6 No. 2, pp. 224-242, doi: 10.1108/SAMPJ-10-2014-0065.

Chan, K.H., Lin, K.Z. and Tang, F. (2013), "Tax effects of book-tax conformity, financial reporting incentives, and firm size", *Journal of International Accounting Research*, Vol. 12 No. 2, pp. 1-25, doi: 10.2308/jiar-50404.

Chen, S. and Bouvain, P. (2009), "Is corporate responsibility converging? A comparison of corporate responsibility reporting in the USA, UK, Australia, and Germany", *Journal of Business Ethics*, Vol. 87 No. S1, pp. 299-317, doi: 10.1007/s10551-008-9794-0.

Dagiliene, L., Frendzel, M., Sutiene, K. and Wnuk-Pel, T. (2020), "Wise managers think about circular economy, wiser report and analyze it. Research of environmental reporting practices in EU manufacturing companies", *Journal of Cleaner Production*, Vol. 274, p. 121968, doi: 10.1016/j.jclepro.2020.121968.

D'Amore, G., Testa, M. and Lepore, L. (2024), "Do ESG controversies boost the effectiveness of independent directors in stimulating environmental disclosure?", *Environment, Development and Sustainability*, pp. 1-39, doi: 10.1007/s10668-024-05628-9.

De Colle, S., Henriques, A. and Sarasvathy, S. (2014), "The paradox of corporate social responsibility standards", *Journal of Business Ethics*, Vol. 125 No. 2, pp. 177-191, doi: 10.1007/s10551-013-1912-y.

Du, S., Bhattacharya, C.B. and Sen, S. (2010), "Maximizing business returns to corporate social responsibility (CSR): the role of CSR communication", *International Journal of Management Reviews*, Vol. 12 No. 1, pp. 8-19, doi: 10.1111/j.1468-2370.2009.00276.x.

Effah, N.A.A., Kyei, B.T., Kyeremeh, G. and Ekor, N.W.K. (2022), "Boardroom characteristics and forward-looking information disclosure: evidence from Ghana", *Corporate Governance: The International Journal of Business in Society*, Vol. 22 No. 7, pp. 1444-1461, doi: 10.1108/CG-09-2021-0321.

Eibinger, T., Deixelberger, B. and Manner, H. (2024), "Panel data in environmental economics: Econometric issues and applications to IPAT models", *Journal of Environmental Economics and Management*, Vol. 125, p. 102941, doi: 10.1016/j.jeem.2024.102941.

Elmghaamez, I.K., Nwachukwu, J. and Ntim, C.G. (2024), "ESG disclosure and financial performance of multinational enterprises: the moderating effect of board standing committees", *International Journal of Finance & Economics*, Vol. 29 No. 3, pp. 3593-3638, doi: 10.1002/ijfe.2846.

Elmagrhi, M.H., Ntim, C.G., Elamer, A.A. and Zhang, Q. (2019), "A study of environmental policies and regulations, governance structures, and environmental performance: the role of female directors", *Business Strategy and the Environment*, Vol. 28 No. 1, pp. 206-220, doi: 10.1002/bse.2250.

EMF (2012), "Toward the circular economy vol. 1: economic and business rationale for an accelerated transition", *Ellen Macarthur Foundation*, Vol. 1, pp. 1-98, available at: www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-_Economy-vol.1.pdf.

Freeman, E. (1984), *Strategic Management: A Stakeholder Approach*, Pitman Press, Boston.

Fuente, J.A., García-Sanchez, I.M. and Loza, M.B. (2017), "The role of the board of directors in the adoption of GRI guidelines for the disclosure of CSR information", *Journal of Cleaner Production*, Vol. 141, pp. 737-750, doi: 10.1016/j.jclepro.2016.09.155.

Gallego-Alvarez, I., Ortas, E., Vicente-Villardón, J.L. and Alvarez Etxeberria, I. (2017), "Institutional constraints, stakeholder pressure and corporate environmental reporting policies", *Business Strategy and the Environment*, Vol. 26 No. 6, pp. 807-825, doi: 10.1002/bse.1952.

Gallego-Álvarez, I. and Pucheta-Martínez, M.C. (2020), "Environmental strategy in the global bank-ing industry within the varieties of capitalism approach: the moderating role of gender diversity and board members with specific skills", *Business Strategy and the Environment*, Vol. 29 No. 2, pp. 347-360, doi: 10.1002/bse.2368.

Garanina, T. and Aray, Y. (2021), "Enhancing CSR disclosure through foreign ownership, foreign board members, and cross-listing: does it work in Russian context?", *Emerging Markets Review*, Vol. 46, p. 100754, doi: 10.1016/j.ememar.2020.100754.

Garcia-Sanchez, I.M., Cuadrado-Ballesteros, B. and Sepulveda, C. (2014), "Does media pressure moderate CSR disclosures by external directors?", *Management Decision*, Vol. 52 No. 6, doi: 10.1108/MD-09-2013-0446.

García-Sánchez, I.M., Hussain, N., Khan, S.A. and Martínez-Ferrero, J. (2022), "Assurance of corporate social responsibility reports: examining the role of internal and external corporate governance mechanisms", *Corporate Social Responsibility and Environmental Management*, Vol. 29 No. 1, pp. 89-106, doi: 10.1002/csr.2186.

Ghisellini, P., Cialani, C. and Ulgiati, S. (2016), "A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems", *Journal of Cleaner Production*, Vol. 114, pp. 11-32, doi: 10.1016/j.jclepro.2015.09.007.

GRI (2019), "Business Reporting on the SDG. An Analysis of the goals and targets".

Hussain, N., Rigoni, U. and Orij, R.P. (2018), "Corporate governance and sustainability performance: analysis of triple bottom line performance", *Journal of Business Ethics*, Vol. 149 No. 2, pp. 411-432, doi: 10.1007/s10551-016-3099-5.

Injeni, G., Mangena, M., Mathuva, D. and Mudida, R. (2022), "Agency and institutional-related factors and the heterogeneity of sustainability and integrated report information disclosures in Kenya", *Journal of Financial Reporting and Accounting*, Vol. 20 No. 5, pp. 809-840, doi: 10.1108/JFRA-10-2020-0305.

Javaid Lone, E., Ali, A. and Khan, I. (2016), "Corporate governance and corporate social responsibility disclosure: evidence from Pakistan", *Corporate Governance: The International Journal of Business in Society*, Vol. 16 No. 5, pp. 785-797, doi: 10.1108/CG-05-2016-0100.

Jensen, M.C. and Meckling, W.H. (1976), "Theory of the firm: managerial behavior, agency costs and ownership structure", *Journal of Financial Economics*, Vol. 3 No. 4, pp. 305-360, doi: 10.1016/0304-405X(76)90026-X.

Jizi, M. (2017), "The influence of board composition on sustainable development disclosure", *Business Strategy and the Environment*, Vol. 26 No. 5, pp. 640-655, doi: 10.1002/bse.1943.

Katmon, N., Mohamad, Z.Z., Norwani, N.M. and Farooque, O.A. (2019), "Comprehensive board diversity and quality of corporate social responsibility disclosure: evidence from an emerging market", *Journal of Business Ethics*, Vol. 157 No. 2, pp. 447-481, doi: 10.1007/s10551-017-3672-6.

Kend, M. (2015), "Governance, firm-level characteristics and their impact on the client's voluntary sustainability disclosures and assurance decisions", *Sustainability Accounting, Management and Policy Journal*, Vol. 6 No. 1, pp. 54-78, doi: 10.1108/SAMPJ-12-2013-0061.

Khan, A. (2021), "Ownership structure, board characteristics and dividend policy: evidence from Turkey", *Corporate Governance: The International Journal of Business in Society*, Vol. 22 No. 2, pp. 340-363, doi: 10.1108/CG-04-2021-0129.

Khemakhem, H., Arroyo, P. and Montecinos, J. (2022), "Gender diversity on board committees and ESG disclosure: evidence from Canada", *Journal of Management and Governance*, Vol. 27 No. 4, pp. 1-26, doi: 10.1007/s10997-022-09658-1.

Kirchherr, J., Reike, D. and Hekkert, M. (2017), "Conceptualizing the circular economy: an analysis of 114 definitions", *Resources, Conservation and Recycling*, Vol. 127, pp. 221-232, doi: 10.1016/j.resconrec.2017.09.005.

Kolk, A. and Pinkse, J. (2010), "The integration of corporate governance in corporate social responsibility disclosures", *Corporate Social Responsibility and Environmental Management*, Vol. 17 No. 1, pp. 15-26, doi: 10.1002/csr.196.

Kuo, L. and Chang, B.G. (2021), "The affecting factors of circular economy information and its impact on corporate economic sustainability-Evidence from China", *Sustainable Production and Consumption*, Vol. 27, pp. 986-997, doi: 10.1016/j.spc.2021.02.014.

Lepore, L. and Pisano, S. (2023), *Environmental Disclosure: Critical Issues and New Trends*, Taylor & Francis, doi: 10.4324/9781003245933.

Lepore, L., Landriani, L., Pisano, S., D'Amore, G. and Pozzoli, S. (2022), "Corporate governance in the digital age: the role of social media and board independence in CSR disclosure. Evidence from Italian listed companies", *Journal of Management and Governance*, Vol. 27 No. 3, pp. 1-37, doi: 10.1007/s10997-021-09617-2.

Liao, L., Luo, L. and Tang, Q. (2015), "Gender diversity, board independence, environmental committee and greenhouse gas disclosure", *The British Accounting Review*, Vol. 47 No. 4, pp. 409-424, doi: 10.1016/j.bar.2014.01.002.

Lock, I. and Seele, P. (2016), "The credibility of CSR (corporate social responsibility) reports in Europe. Evidence from a quantitative content analysis in 11 countries", *Journal of Cleaner Production*, Vol. 122, pp. 186-200, doi: 10.1016/j.bar.2014.01.002.

Matsa, D.A. and Miller, A.R. (2013), "A female style in corporate leadership? Evidence from quotas", *American Economic Journal: Applied Economics*, Vol. 5 No. 3, pp. 136-169, doi: http://dx.doi.org/10.1257/app.5.3.136.

Michelon, G. and Parbonetti, A. (2012), "The effect of corporate governance on sustainability disclosure", *Journal of Management & Governance*, Vol. 16 No. 3, pp. 477-509, doi: 10.1007/s10997-010-9160-3.

Nicolò, G., Aversano, N., Sannino, G. and Polcini, P.T. (2022), "Online sustainability disclosure practices in the university context. The role of the board of directors", *Corporate Governance: The International Journal of Business in Society*, doi: 10.1108/CG-05-2022-0224.

Nguyen, T.H.H., Ntim, C.G. and Malagila, J.K. (2020), "Women on corporate boards and corporate financial and non-financial performance: a systematic literature review and future research agenda", *International Review of Financial Analysis*, Vol. 71,p. 101554, doi: 10.1016/j.irfa.2020.101554.

Ntim, C.G. and Soobaroyen, T. (2013), "Corporate governance and performance in socially responsible corporations: new empirical insights from a neo-institutional framework", *Corporate Governance: An International Review*, Vol. 21 No. 5, pp. 468-494, doi: 10.1111/corg.12026.

Opferkuch, K., Caeiro, S., Salomone, R. and Ramos, T.B. (2021), "Circular economy in corporate sustainability reporting: a review of organisational approaches", *Business Strategy and the Environment*, Vol. 30 No. 8, pp. 4015-4036, doi: 10.1002/bse.2854.

Passas, I., Ragazou, K., Zafeiriou, E., Garefalakis, A. and Zopounidis, C. (2022), "ESG controversies: a quantitative and qualitative analysis for the sociopolitical determinants in EU firms", *Sustainability*, Vol. 14 No. 19, p. 12879, doi: 10.3390/su141912879.

Patten, D.M. and Shin, H. (2019), "Sustainability accounting, management and policy journal's contributions to corporate social responsibility disclosure research: a review and assessment", *Sustainability Accounting, Management and Policy Journal*, Vol. 10 No. 1, pp. 26-40, doi: 10.1108/SAMPJ-01-2018-0017.

Pozzoli, M., Nastari, R., Pisano, S. and Venuti, M. (2023), "How circular economy disclosure responds to institutional determinants empirical evidences in non-financial European firms", *Sustainability*, Vol. 15 No. 22, p. 16069, doi: 10.3390/su152216069.

Raimo, N., de Nuccio, E. and Vitolla, F. (2022), "Corporate governance and environmental disclosure through integrated reporting", *Measuring Business Excellence*, Vol. 26 No. 4, pp. 451-470, doi: 10.1108/MBE-05-2021-0066.

Rao, K. and Tilt, C. (2016), "Board diversity and CSR reporting: an Australian study", *Meditari Accountancy Research*, Vol. 24 No. 2, pp. 182-210, doi: 10.1108/MEDAR-08-2015-0052.

Rashid, A., Asif, F.M., Krajnik, P. and Nicolescu, C.M. (2013), "Resource conservative manufacturing: an essential change in business and technology paradigm for sustainable manufacturing", *Journal of Cleaner Production*, Vol. 57, pp. 166-177, doi: 10.1016/j.jclepro.2013.06.012.

Renstrom, T., Spatarom, L. and Marsiliani, L. (2019), "Optimal taxation, environment quality, socially responsible firms and investors", *International Review of Environmental and Resource Economics*, Vol. 13 Nos 3/4, pp. 339-373, doi: 10.1561/101.00000112.

Roberts, L., Georgiou, N. and Hassan, A.M. (2022), "Investigating biodiversity and circular economy disclosure practices: insights from global firms", *Corporate Social Responsibility and Environmental Management*, Vol. 30 No. 3, doi: 10.1002/csr.2402.

Hummel, K. and Rötzel, P. (2019), "Mandating the sustainability disclosure in annual reports—evidence from the United Kingdom", *Schmalenbach Business Review*, Vol. 71 No. 2, pp. 205-247, doi: 10.1007/s41464-019-00069-8.

Schiemann, F. and Tietmeyer, R. (2022), "ESG controversies, ESG disclosure and analyst forecast accuracy", *International Review of Financial Analysis*, Vol. 84, p. 102373, doi: 10.1016/j.irfa.2022.102373.

Schroeder, P., Anggraeni, K. and Weber, U. (2019), "The relevance of circular economy practices to the sustainable development goals", *Journal of Industrial Ecology*, Vol. 23 No. 1, pp. 77-95, doi: 10.1111/jiec.12732.

Shakil, M.H., Tasnia, M. and Mostafiz, M.I. (2021), "Board gender diversity and environmental, social and governance performance of US banks: moderating role of environmental, social and corporate governance controversies", *International Journal of Bank Marketing*, Vol. 39 No. 4, pp. 661-677, doi: 10.1016/j.resourpol.2021.102144.

Shiah-Hou, S.R. (2021), "Powerful CEOs and earnings quality", *Managerial Finance*, Vol. 47 No. 12, pp. 1714-1735, doi: 10.1108/MF-07-2020-0363.

Sinclair-Desgagne, B. and Gozlan, E. (2003), "A theory of environmental risk disclosure", *Journal of Environmental Economics and Management*, Vol. 45 No. 2, pp. 377-393, doi: 10.1016/S0095-0696(02)00056-6.

Stewart, R. and Niero, M. (2018), "Circular economy in corporate sustainability strategies: a review of corporate sustainability reports in the fast-moving consumer goods sector", *Business Strategy and the Environment*, Vol. 27 No. 7, pp. 1005-1022, doi: 10.1002/bse.2048.

Stock, J.H. and Watson, M.W. (2005), *Introduzione All'econometria*, Pearson Italia Spa.

Tamimi, N. and Sebastianelli, R. (2017), "Transparency among S&P 500 companies: an analysis of ESG disclosure scores", *Management Decision*, Vol. 55 No. 8, pp. 1660-1680, doi: 10.1108/MD-01-2017-0018.

Tiscini, R., Martiniello, L. and Lombardi, R. (2022), "Circular economy and environmental disclosure in sustainability reports: empirical evidence in cosmetic companies", *Business Strategy and the Environment*, Vol. 31 No. 3, pp. 892-907, doi: 10.1002/bse.2924.

Vairavan, A. and Zhang, G.P. (2020), "Does a diverse board matter? A mediation analysis of board racial diversity and firm performance", *Corporate Governance: The International Journal of Business in Society*, Vol. 20 No. 7, pp. 1223-1241, doi: 10.1108/CG-02-2020-0081.

Vitolla, F., L'Abate, V., Petruzzella, F., Raimo, N. and Salvi, A. (2023), "Circular economy disclosure in sustainability reporting: the effect of firm characteristics", *Sustainability*, Vol. 15 No. 3, p. 2200, doi: 10.3390/su15032200.

Yokessa, M. and Marette, S. (2019), "A tax coming from the IPCC carbon prices cannot change consumption: evidence from an experiment", *Sustainability*, Vol. 11 No. 18, p. 4834, doi: 10.3390/su11184834.

Zivin, J.G. and Neidell, M. (2009), "Days of haze: environmental information disclosure and intertemporal avoidance behavior", *Journal of Environmental Economics and Management*, Vol. 58 No. 2, pp. 119-128, doi: 10.1016/j.jeem.2009.03.001.

Further reading

Kumari, P.R., Makhija, H., Sharma, D. and Behl, A. (2022), "Board characteristics and environmental disclosures: evidence from sensitive and non-sensitive industries of India", *International Journal of Managerial Finance*, Vol. 18 No. 4, pp. 677-700, doi: 10.1108/IJMF-10-2021-0547.

Papke, L.E. and Wooldridge, J.M. (2023), "A simple, robust test for choosing the level of fixed effects in linear panel data models", *Empirical Economics*, Vol. 64 No. 6, pp. 2683-2701, doi: 10.1007/s00181-022-02337-y.

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