CORPORATE BIODIVERSITY REPORTING AND EARNINGS MANAGEMENT: DOES A CRITICAL MASS OF FEMALE DIRECTORS HAVE AN IMPACT?

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Abstract

This study addresses the relationship between corporate biodiversity reporting (CBR) and earnings management as well as the moderating impact of board gender diversity (BGD). Due to increased regulatory pressure, we relied on a sample of STOXX Europe 600 firms (1,537 firm-year observations) for the business years 2017–2021. In line with the moral licensing hypothesis, we assume that CBR and our two main proxies of earnings management (accruals-based and real earnings management) are positively related, and a critical mass of female directors may weaken this link. Our regression results align with these assumptions and prior research on similar relationships. Moreover, we conduct several endogeneity checks, which support our main results. This study mainly contributes to prior research as it is the first one on the link between CBR and earnings management. We stress major implications for researchers, standard setters, and business practitioners. Biodiversity represents a key sub-pillar of sustainability reporting with an impact on financial reporting, indicating the need for integrated thinking, which should be promoted in future empirical research.

Keywords: Sustainability Reporting, Earnings Management, Board Gender Diversity, Biodiversity, Corporate Governance

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1. INTRODUCTION

Since the financial crisis of 2008–2009, an increased number of stakeholders demand a decision useful corporate sustainability reporting of Public Interest Entities (PIEs), whereas environmental topics are highlighted (Adu et al., 2022). As environmental reporting refers to various topics, climate issues relate to the greatest public awareness yet (e.g., Garcia Martin & Herrero, 2020). From an international perspective, the Paris Climate Agreement and the increased climate activism of NGOs may be the reason for this. However, the 2022 United Nations Biodiversity Conference (COP15) in Montreal has increased the global awareness of corporations and their stakeholders on corporate biodiversity reporting (CBR). We contribute to the limited research on the disclosure of a firm's biodiversity initiatives, e.g., biodiversity policies, processes, and activities, meant to protect native biodiversity (Haque & Jones, 2020). Biodiversity can be broadly defined as the variety of life on earth and the vast

array of genetically distinct populations within species, communities, and ecosystems (Haque & Jones, 2020). Solid biodiversity reporting represents a key element of sustainability reporting, reflecting various stakeholder demands. Thus, corporate biodiversity activities are included in environmental, social and governance (ESG) reports and it has interconnections with the UN Sustainable Development Goals (SDGs), e.g., SDG 15. While PIEs intensively increase their activities on CBR, it is still voluntary in most regimes. In view of the limited objectivity and comparability of biodiversity information, greenwashing and information overload as symbolic environmental management strategies may be the consequences (Mahoney et al., 2013). Top managers may either use CBR as a possibility for self-impression management or a symbolic information tool or substantially include biodiversity strategies to reach successful sustainable transformation.

As environmental reporting and financial reporting are massively linked, we are interested in the impact of CBR on earnings management. A great amount of prior research has analyzed the overall impact of corporate sustainability performance and reporting on earnings management during the last decade with heterogeneous results (e.g., Shi et al., 2022; Kumar et al., 2023; Ehsan et al., 2020). Most of the prior studies have analyzed the link between total corporate social responsibility (CSR) performance and earnings management (e.g., Bozzolan et al., 2015; Fauser, 2019). Accruals-based- and real earnings management represent the two major variables in this context including both accounting policies before and after the balance sheet date. While few studies have focused on environmental reporting (e.g., Alipour et al., 2019; Gerged et al., 2018; Patten & Trompeter, 2003), we know very little about the influence of sub-pillars of environmental outputs on earnings management. There are few indications that air pollution (Jiang et al., 2022; Yang & Tang, 2022) and carbon performance (Lemma et al., 2020; Velte, 2021) relate to earnings management. However, scholars did not explicitly rely on CBR, whereas it is included in overall SDG and ESG reporting.

Our study makes a major contribution to the prior research as we are not interested in the overall relationship between CSR or environmental reporting on earnings management. Instead, in view of current biodiversity discussions and managerial challenges, we concentrate on CBR and its contribution to accruals-based and real earnings management. To the best of our knowledge, we are the first to study this relationship. The motivation to concentrate on this relationship is justified as follows: greenwashing and information overload may occur if top management does not carefully include biodiversity risks in the risk management and reporting systems (Haque & Jones, 2020). Reliable biodiversity policies require an "integrated thinking" process of financial and biodiversity information, leading to substantive reporting systems instead of self-impression management. Since biodiversity efforts and earnings management practices are conducted simultaneously, we like to address this research gap with the present study. Moreover, we are interested in the moderating impact of a critical mass of female directors on the relationship between CBR and earnings management. The impact of board gender diversity (BGD) on either corporate environmental reporting (e.g., Gerged et al., 2023) or earnings management (e.g., El-Dyasty & Elamer, 2023) has been analyzed to a great extent. Many related studies have stressed the positive impact of female directors on environmental reporting and earnings quality (e.g., Velte, 2017). In detail, BGD as a major sustainable corporate governance mechanism addresses the leading and monitoring function within the board, which leads to increased quality of sustainability and financial reporting. Haque and Jones (2020) and Carvajal et al. (2021) have focused on the impact of board gender diversity on CBR and stressed a positive relationship. Two studies found a moderating effect of BGD on the negative link between CSR performance and earnings management (Toukabri & Kateb, 2023; Sial et al., 2019). However, CBR has not been included in prior empirical research yet. Thus, our following two research questions mainly contribute to the prior literature on the link between corporate sustainability and earnings management:

RQ1: What is the relationship between CBR and earnings management?

RQ2: Does BDG moderate the link between CBR and earnings management?

First, we rely on the moral licensing and moral track hypotheses and discuss the possible positive and negative influence of CBR on earnings management. Earnings management is operationalized via accrual-based earnings management or real earnings management (Dechow et al., 2010). Accruals-based earnings management may be detected more easily by stakeholders than real earnings management, thus both proxies are included in line with prior research (Shi et al., 2022). Second, as endogeneity concerns are a major challenge in related research topics, especially reverse causality, we include two-stage least squares (2SLS) regressions and instrumental variables (IV) as robustness check. Third, we like to focus on the European capital market due to the great regulatory efforts on environmental reporting. The European capital market is a unique setting for environmental and biodiversity research in comparison to other settings. In line with the introduction of an emissions trading system (ETS) for certain high-polluting corporations, selected PIEs must publish a non-financial declaration since the 2017 financial year (European Commission [EC], 2014). As part of the European Green Deal project, according to a new EU Directive on Corporate Sustainability Reporting (EC, 2022), an increased number of firms have to publish a full sustainability report with bio-diversity information during the next years. Moreover, due to the EU Taxonomy Regulation (EC, 2020), biodiversity represents one of the six goals for selecting environmental business activities. Consequently, biodiversity research on the European capital market is useful. To the best of our knowledge, we are also the first study on environmental reporting, earnings management, and BGD for the European capital market.

Based on 1,537 firm-year observations for the 2017–2021 financial years, we chose the STOXX Europe 600, an index of the 600 biggest European

companies, while controlling for various corporate governance variables, other firm characteristics, and country-related variables. Our panel regressions indicate a positive impact of CBR on accruals-based and real earnings management. Thus, managers use biodiversity information to mask their opportunistic behavior regarding financial reporting. However, BGD as a moderating variable weakens this relationship. The leadership and monitoring function of female directors helps to decrease the opportunistic influence of executives. Our results remain constant after several robustness and endogeneity checks.

Our study has major implications for researchers, standard setters, and business practitioners. This mainly relates to the current controversial discussions on the EU Green Deal and the development of biodiversity disclosure within the European member states. The interrelations between biodiversity and earnings management should be focused on in future discussions and should also include sustainable corporate governance efforts in order to prevent greenwashing policies.

Our analysis is structured as follows. Section 2 presents the theoretical framework, a literature review on the relationship between environmental (biodiversity) reporting and earnings management, and the main hypotheses. Section 3 presents the empirical analysis methodology, which will include the sample, main variables, and regression models. Then, we focus on the research results of the correlation, regression, and robustness analyses in Section 4. After an interpretation and discussion of our results in Section 5, a summary will follow in Section 6, along with a statement of selected limitations and recommendations for future research.

2. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

2.1. Theoretical foundation

Prior literature reviews (Kumar et al., 2023; Ehsan et al., 2020; Santos-Jaén et al., 2021; Velte, 2020) and meta-analyses (Shi et al., 2022) on corporate sustainability and earnings quality separate between two controversial relationships. On the one hand, based on the moral licensing hypothesis and classical principal-agent theory (Ross, 1973; Jensen & Meckling, 1976), corporate environmental (biodiversity) reporting and earnings management are positively related (Shi et al., 2022). The moral licensing hypothesis assumes that top managers engage in opportunistic behavior after obtaining a "license" from environmental efforts. Due to rent-seeking activities, e.g., biodiversity reporting, agency problems arise, as executive directors carry out earnings management to mask their problems (Shi et al., 2022). Conflicts of interest and information asymmetries between management and investors will increase the probability of opportunistic management behavior (Jensen & Meckling, 1976). Managers may use CBR as a CSR-washing policy (e.g., symbolic use of reporting without any substantial improvements in environmental management), which may lead to increased earnings management. CBR relates to a lack of comparability and objectivity in recent business practice (Haque & Jones, 2020). This mainly relates to the measurement of the impact of business activities on biodiversity risks. Biodiversity disclosures can be classified as reputational insurance that gives executives a license to prepare a negative financial reporting quality (Shi et al., 2022). Thus, according to the moral licensing hypothesis and principal-agent theory, a positive link between CBR and earnings management is assumed.

On the other hand, based on the moral track hypothesis and the stakeholder theory (Freeman, 1984), corporate environmental (biodiversity) reporting and earnings management are negatively related (Shi et al., 2022). The moral track hypothesis assumes that executives will include a broad range of stakeholder demands in their strategic and operational business activities. As stakeholders have mainly increased in decision-useful environmental information as part of a sustainability report, top managers will have intrinsic motivations to satisfy the interests of primary stakeholder groups (Freeman, 1984). The management feels responsible for society and should find a useful balance between financial and environmental goals in line with the triple bottom line concept of corporate sustainability (Freeman, 1984). Biodiversity information presents an important signal to the stakeholders that the firm includes best practices of biodiversity management in line with financial reporting. Thus, stakeholder theory assumes that top management will provide decision-useful CBR and financial reporting (Shi et al., 2022). Focusing on this negative link between biodiversity disclosure and earnings management, sustainable firms intend to promote a long-term relationship with their shareholders and other stakeholders, e.g., suppliers, customers, and NGOs. Earnings management is not in line with stakeholder demands to present a reliable financial report. Thus, according to the moral track hypothesis, and stakeholder theory, firms with increased extent of CBR are less likely to manage earnings.

Based on our theoretical framework, either a positive or a negative relationship between CBR and earnings management is realistic. However, we decided to focus on the moral licensing hypothesis and the principal agency theory for the following reasons: First, the literature states that recent biodiversity policies and disclosure efforts are not satisfying by European companies (e.g., Haque & Jones, 2020). Second, the EC initiated several regulations on sustainable corporate governance, finance, and reporting during the last years as part of the EU Green Deal project. As these regulations also include biodiversity aspects, CBR is still voluntary yet and linked to decreased comparability and reliability. Third, the European standard setter does not promote integrated reporting of financial and sustainability information. Consequently, integrated reporting remains rather unattractive in Europe yet (e.g., KPMG, 2022). Thus, we assume that CBR and earnings management are positively related. Thus, we concentrate our analysis on principal-agent theory.

2.2. Literature review and hypotheses development

2.2.1. Biodiversity disclosure and earnings management

Earlier, we stressed that our study separates between two earnings management variables (accruals-based and real earnings management).

Abnormal accruals can be defined as the difference between annual results and operational cash flow. They relate to increased earnings management and thus reduced earnings quality (Dechow et al., 2010). Based on the basic model developed by Jones (1991), there are many modifications of accruals-based models of earnings management in the literature (e.g., Kothari et al., 2005). Accruals models indicate accounting policies in the accounts after the balance sheet date. As accruals policies must be described in the notes, there is a higher probability that earnings management strategies will be scrutinized by shareholders and other stakeholders. Capital providers may punish firms with increased capital costs if the quality of the financial reports is rather low. While prior studies on the link between environmental outputs and earnings quality massively include accruals-based proxies, real earnings management as accounting policies before the balance sheet date is also important. However, real earnings management was focused on fewer studies. Roychowdhury (2006, p. 337) as a dominant reference defines real earnings management as "departures from normal operational practices, motivated by managers' desire to mislead at least some stakeholders into believing certain financial reporting goals have been met in the normal course of operations". The most common proxies are abnormal cash flow from operations, abnormal production costs, and abnormal expenses (Roychowdhury, 2006). In comparison to accruals-based management, real earnings management represents a type of "hidden" accounting policy in place of real business transactions (e.g., M&As), with the stakeholders unable to clearly check the volume of earnings quality in this context and thus highly attractive for executives.

A great variety of studies has analysed the impact of corporate sustainability performance and reporting on earnings management during the last decade. Prior meta-analyses (Shi et al., 2022) and literature re-views (Kumar et al., 2023; Ehsan et al., 2020; Santos-Jaén et al., 2021) highlight the heterogenous use of variables and research results. In the following, we concentrate on fewer studies on environmental performance and reporting, especially on the European capital market. The European capital market was rarely included in prior archival research on that topic. From a cross-country perspective, Velte (2021) addressed environmental performance and related sub-pillars (emissions, innovation, and resource use as well as carbon performance) and stressed a negative impact on accruals-based earnings management and a positive influence on real earnings management. However, Kyaw et al. (2017) did not find any significant results. European country-specific research indicated both a negative impact of environmental performance on accruals-based management (France: Ben Amar & Chakroun, 2018) and a positive relationship (France and Spain: Borralho et al., 2022). According to a study in Portugal, environmental reporting leads to better earnings persistence (Pereira et al., 2023). A German study also stressed a negative impact of environmental performance on accruals-based earnings management and an insignificant impact on real earnings management (Velte, 2019). Sun et al. (2010), based on a UK sample, did not find any impact of environmental reporting on earnings management. While the European studies come to inconclusive results, we also mention studies in other regimes to deduce our hypotheses. A Canadian study documented a positive impact of environmental performance on accruals-based earnings management (Gargouri et al., 2010). A similar positive link between environmental reporting and accruals management was also stated by Siueia and Wang (2019) for a setting in Mozambique. Moreover, based on a US setting, environmental strengths did not influence accruals, while environmental concerns relate to income-decreasing earnings management (Heltzer, 2011). Khuong et al. (2023) found that environmental reporting decreases accruals management but increases real earnings management in Vietnam. Lemma et al. (2020) focused on a sample of firms in South Africa and found a positive impact of carbon performance on accruals-based earnings management, while carbon reporting mediates this relationship.

In line with principal-agent theory and the results of past empirical research, we assume that CBR is positively connected to earnings management. Based on the moral licensing hypothesis and opportunistic management behavior, managers use CBR as a symbolic instrument for self-impression management and to mask their behavior. Consequently, we state as first hypothesis (*H1*):

H1: CBR and earnings management are positively related.

2.2.2. The moderating influence of a critical mass of female directors on the link between biodiversity disclosure and earnings management

As we assume an opportunistic management behavior in line with principal-agent theory (Ross, 1973; Jensen & Meckling, 1976), various solutions are proposed to reduce related agency conflicts between management, shareholders, and other stakeholder groups (Shleifer & Vishny, 1997). The implementation of solid corporate governance mechanisms can overcome these agency problems and may reduce the negative impact of CBR and earnings management. Corporate governance may push executives to rethink their biodiversity and financial reporting strategy in line with stakeholder needs (Freeman, 1984). As a main separation between internal corporate governance (board of directors) and external corporate governance (ownership and other stakeholder pressure), we focus on board composition in this analysis. In detail, sustainable board governance as the inclusion of environmental goals in the leadership and monitoring function of the board of directors, highlights the need for a successful sustainability transformation of firms. BGD represents the most prominent sustainable board variable in recent empirical research (Velte, 2017). In particular, female directors promote board dynamics by addressing environmental and social topics on the boards. The literature stresses that female and male directors have different views on sustainability topics because of former experiences through social interactions (Nuber & Velte, 2021). Researchers state that women are more aware and care more about environmental and social issues and show increased sensitivity within boards of directors (Number &

Velte, 2021). BGD relates to various ethical values and traits in decision-making. In this context, studies found that female directors perceive environmental risks differently from male colleagues (Bord & O'Connor, 1997). As biodiversity risks can be classified as one of the major environmental risks in business (Haque & Jones, 2020), we assume that female directors on the board will push top managers to include substantive biodiversity management, which also leads to both increased biodiversity disclosure and financial reporting quality.

However, we are aware of researchers, who claim that women on boards may only fundamentally change environmental strategies and processes if they reach a critical mass (Songini et al., 2021). According to critical mass theory (Kanter, 1977), a critical mass of female directors is needed to increase the probability of substantive biodiversity management and ambitious targets, which will also lead to decision usefulness of related disclosure. It will also promote the implementation of sound financial reporting, leading to reduced earnings management policies. In view of these aspects, we rely on critical mass theory (Kanter, 1977) and include a minimum quorum of at least 30% female directors on boards. As this quorum will be linked with increased board dynamics toward environmental efforts, we assume that a critical mass of BGD will weaken the negative impact of biodiversity disclosure on earnings management.

Prior research has also stressed the positive impact of board gender diversity on environmental reporting (Baalouch et al., 2019; Rao et al., 2012; Post et al., 2011) and financial reporting quality (e.g., Ahmed, 2023). Burkhardt et al. (2020), based on a cross-country European study, also stressed that a critical mass of female directors leads to increased environmental performance. Few studies found similar results for other regimes (Nuber & Velte, 2021; Birindelli et al., 2019; Cordeiro et al., 2020; He & Jiang, 2019). Haque and Jones (2020) also documented a positive impact of BGD on CBR for the European capital market. However, we only identify one study with a moderating effect of board gender diversity on the impact of environmental performance on earnings management (Toukabri & Kateb, 2023). The authors addressed a US American sample of firms and found that the negative relationship between environmental performance and accruals management was more pronounced by BGD.

Based on critical mass theory and prior studies, we state the following hypothesis (*H2*):

H2: The positive relationship between CBR and earnings management will be weakened by BGD.

3. RESEARCH METHODOLOGY

3.1. Sample selection

Our original sample includes 600 companies from 17 European countries, all of them listed on the STOXX Europe 600 stock market index for the 2017–2021 financial years. As we already mentioned in the introduction, the European capital market represents a unique setting due to several sustainable finance, reporting, and corporate governance regulations since the last decade. We start with the 2017 financial year as the first year of mandatory publication of a non-financial declaration for specific PIEs (EC, 2014). The start of the EU Green Deal project 2019 and the related sustainable finance regulations (e.g., EU Taxonomy Regulation 2020) were also addressed in our time frame. The included firms represent approximately 90 percent of the free-float market capitalization of the European stock market. The primary data were obtained from the Refinitiv database in December 2022. In line with prior research, all financial services companies were dropped due to their specific capital structure and regulatory requirements on reporting finance, and corporate governance. Missing (non)-financial information meant fewer firm-year observations. Table 1 summarizes the selection of the final sample of 1,537 firm years-observations.

Table 1. Final sample

Sample selection	*2017*	*2018*	*2019*	*2020*	*2021*
Listed European companies in the STOXX Europe 600	600	600	600	600	600
Less					
Financial services and related firms	130	130	130	130	130
Observations with missing firm-level data on the Refinitiv database	157	160	164	153	179
Final sample (base regression) n = 1,537	313	310	306	317	291

Source: Author's calculations.

3.2. Variables

3.2.1. Independent variables

We have chosen two independent variables on corporate reporting on biodiversity activities (CBR) from the Refinitiv database as independent variables. First, the *BD_SCORE* was constructed as the sum of seven dummy variables representing a firm's disclosure of biodiversity initiatives as disclosed by the sampled firms and compiled by Refinitiv. These are: 1) biodiversity policies and processes, 2) restoration or protection of biodiversity, 3) reduction of impact, 4) reduction of toxic chemicals, 5) recycling of hazardous waste, or wastewater, 6) biodiversity impact on land use, and 7) management monitoring of biodiversity initiatives. Second, we used the corporate reporting on *biodiversity impact assessments* (*BDA*). This dummy variable represents whether firms monitor their impact on biodiversity through the balanced scorecard or key performance indicators.

3.2.2. Dependent variables

We also include two proxies of earnings management, which are dominantly used in prior archival research on this topic (e.g., Velte, 2019). First, to address accruals-based earnings management, we used the accruals model by Kothari et al. (2005) to select the key earnings management (*ACC*) variable. Based on the basic Jones model (1991),

Kothari et al. (2005) alleviated the problem applied to samples experiencing non-random performance. For all companies in the same industry with at least eight observations each year, we estimated the following equation to establish industry-specific parameters for measuring the non-discretionary part of total accruals (*NDA*):

$$TA_{it}/A_{it-1} = \alpha_0 (1/A_{it-1}) + \alpha_1 (delta\_REV_{it} - delta\_REC_{it})A_{it-1} + \alpha_2 PPE_{it}/A_{it-1} + \alpha_3 IBXI_{it-1}/A_{it-1} + \varepsilon_{it} \quad (1)$$

Total accruals (*TA*) are the difference between net-income after tax (NPAT) and operating cash flows (CFO). *Delta_REV* is the change in net revenues in year *t* from year *t-1*. *Delta_REC* represents the change in net receivables. *PPE* represents gross property, plant, and equipment, and *IBXI* is income before extraordinary items at year *t-1*, and A_{it-1} is lagged in total assets. To control for abnormal performances, we used the model of Kothari et al. (2005) with a lag from *ROA*. We collected firm-level data on earnings management and additional variables (such as controls) from Refinitiv.

Second, to include real earnings management, we focus on the *REM* variable and three basic factors (Cohen et al., 2008; Roychowdhury, 2006), which are also often used in prior studies: 1) abnormal levels of operating cash flows (*AB_CFO*), 2) abnormal production costs (*AB_PROD*), and 3) abnormal discretionary expenses (*AB_EXP*). Abnormal levels of the three REM measures are the residual from the relevant models estimated by year and the 2-Digit SIC (Standard Industrial Classification) code. As a result, a combined measure of these three variables (REM) was included.

First, Roychowdhury's (2006) model was used to measure the normal level of operating cash flows (*CFO*):

$$CFO_t/A_{t-1} = \alpha_0 + \alpha_1 (1/A_{t-1}) + \beta_1 (S_t/A_{t-1}) + \beta_2 (delta\_S_t/A_{t-1}) + \varepsilon_t \quad (2)$$

CFO_t is cash flow from operations in year *t*, *A* is total assets, S_t is net sales and $delta\_S_t$ is the difference between net sales in *t* and *t-1*. For every firm-year, abnormal cash flow from operations (*AB_CFO*) is the residual (i.e., ε_t) from the corresponding industry-year model and the firm-year's sales and lagged assets.

Second, we estimate abnormal production costs (*AB_PROD*). Roychowdhury (2006) defines production costs as the sum of costs of goods (*COGS*) and changes in inventory during the year, while expenses are a linear function of contemporaneous sales. Thus, we estimate normal *COGS* can be classified as:

$$COGS_t/A_{t-1} = \alpha_0 + \alpha_1 (1/A_{t-1}) + \beta (S_t/A_{t-1}) + \varepsilon_t \quad (3)$$

$COGS_t$ is the costs of goods sold in year *t*. Similarly, we use the model for normal inventory growth (*INV*):

$$delta\_INV_t/A_{t-1} = \alpha_0 + \alpha_1 (1/A_{t-1}) + \beta_1 (delta\_S_t/A_{t-1}) + \beta_2 (delta\_S_{t-1}/A_{t-1}) + \varepsilon_t \quad (4)$$

$Delta\_INV_t$ is the change in inventory in year *t*. According to Roychwdhury (2006) and Cohen et al. (2008), production costs are defined as $PROD_t = COGS + delta\_INV_t$. With reference to eq. (3) and (4), we estimate normal production costs:

$$PROD_t/A_{t-1} = \alpha_0 + \alpha_1 (1/A_{t-1}) + \beta_1 (S_t/A_{t-1}) + \beta_2 (delta\_S_t/A_{it-1}) + \beta_3 (delta\_S_{t-1}/A_{it-1}) + \varepsilon_t \quad (5)$$

Abnormal production cost (*AB_PROD*) is the residual from the model. Third, we use abnormal discretionary expenses (*AB_EXP*). Based on Roychowdhury (2006) and Cohen et al. (2008), we estimate the normal level of discretionary expenses as:

$$DISEXP_t/A_{t-1} = \alpha_0 + \alpha_1 (1/A_{t-1}) + \beta (S_{t-1}/A_{t-1}) + \varepsilon_t \quad (6)$$

$DISEXP_t$ is the discretionary expenses in year *t*, defined as the sum of R&D, advertising, and general and administrative expenses (G&A or SG&A). For every firm-year, abnormal discretionary expenditure (*AB_EXP*) represents the residual from the model.

Finally, we select the combined measures of *REM* by aggregating the three individual proxies, *AB_CFO*, *AB_PROD*, and *AB_EXP*. In order to measure the direction of each REM variable, the combined measure (*REM*) is calculated as (*AB_CFO – AB_PROD + AB_EXP*).

3.2.3. Moderator variable

We include a critical mass of female directors on boards of directors (*GEND*) as moderator variable. It represents a dummy variable equal to 1 if at least 30% of the board directors are female. Refinitiv includes the ratio of female members on the board. We self-create our *GEND* variable if the critical mass of at least 30% of female directors is reached.

3.2.4. Control variables

We include several control variables commonly used in this research area (e.g., Sial et al., 2019; Fauser, 2019; Velte, 2019). We include corporate governance, other firm characteristics as well as country governance proxies. Regarding corporate governance variables as controls in our model, we assume a positive impact on CBR and a negative impact on earnings management. It is our intention to include both traditional and sustainable board governance

to realize an adequate variety of corporate governance attributes. First, as in traditional board governance, board independence (*BOARDIN*) is the ratio of independent directors on the board as reported. Second, to recognize sustainable board structures, the existence of a sustainability committee within the board of directors (*SUSTC*) is included. Third, board size (*BOARDS*) represents the logarithm for the number of board members. Forth, we use the number of board meetings (*BOARDM*). Finally, to address the incentive function of corporate governance, we control for the inclusion of a sustainability-linked executive compensation system (*CSRCOMP*).

As other firm characteristics, we recognize, whether corporations are part of the EU emissions trading system since environmentally sensitive industries might be more active in environmental strategies (*ETS*). Moreover, we include the natural logarithm of total assets as firm size (*SIZE*), because bigger firms benefit from economies of scale or scope, which may be difficult to imitate. Furthermore, total debts divided by total assets as leverage (*LEV*) is included as the control variable. The market-to-book (*MTB*) equity ratio leads to increased awareness of investors. Regarding accounting-based financial performance, we use the industry mean-adjusted return on assets (*ROA_adj*) as income before extraordinary items, scaled by lagged total assets and assume a negative impact on earnings management.

Two country-related governance variables are also included. First, we address whether there is a civil law country or a code law country (*CIVIL*). Finally, we use the environmental enforcement range (*ENF*). Both controls should be positively linked to CBR and negatively linked with earnings management.

A summary of included variables is presented in Table 2.

Table 2. Variables of the study

Variables	*Description*
Panel A: *Dependent variables*	
ACC	The absolute value of discretionary accruals (signed discretionary accruals), where discretionary accruals are computed using the Kothari et al. (2005) model including lagged ROA as a regressor
REM	The sum of *REM* proxies, measured as *AB_CFO – AB_PROD + AB_EXP* *AB_CFO*: level of abnormal cash flows from operations. *AB_PROD*: Level of abnormal production costs, where production costs are defined as the sum of the cost of goods sold and the change in inventories. *AB_EXP*: Level of abnormal discretionary expenses, where discretionary expenses are the sum of R&D expenses, advertising expenses, and SG&A expenses.
Panel B: *Independent variables*	
BD_SCORE	The sum of seven dummy variables representing a firm's disclosure of biodiversity initiatives as disclosed by the sampled firms and compiled by Refinitiv. These are: 1) biodiversity policies and processes, 2) restoration or protection of biodiversity, 3) reduction of impact, 4) reduction of toxic chemicals, 5) recycling of hazardous waste, or wastewater, 6) biodiversity impact on land use, and 7) management monitoring of biodiversity initiatives (Refinitiv)
BDA	Dummy variable = 1, if the company monitors its impact on biodiversity through the balanced scorecard or key performance indicators (KP) or 0, if not (Refinitiv)
Panel C: *Moderator variable*	
GEND	The dummy variable taking the value 1 if a critical mass of at least three women or 30 percent on the board of directors exists, 0 = otherwise
Panel D: *Control variables*	
Corporate governance variables	
BOARDIN	The ratio of independent board members x 100, obtained from Refinitiv
SUSTC	Dummy variable for (1) the existence of a sustainability board committee and (0) otherwise, obtained from Refinitiv
BOARDS	Natural logarithm of the number of board members, obtained from Refinitiv
BOARDM	Natural logarithm of the number of board meetings, obtained from Refinitiv
CSRCOMP	Dummy variable for (1) existence of sustainability-linked executive compensation and (0) otherwise, obtained from Refinitiv
Other firm characteristics	
ETS	Dummy variable (1) part of EU Emission Trade System and (0) otherwise
SIZE	Natural logarithm of total assets, obtained from Refinitiv
LEV	Total debts divided by total assets, obtained from Refinitiv
MTB	The ratio of the total market value of equity to the book value of equity (BVE), obtained from Refinitiv
ROA_adj	Industry mean-adjusted ROA in the previous year, where ROA is measured as income before extraordinary items, scaled by lagged total assets, obtained from Refinitiv
Country-related governance variables	
CIVIL	Dummy variable for (1) civil law country and (0) code law country, hand-collected
ENF	Environmental enforcement range, obtained from the WEF Executive questionnaire

3.3. Empirical methods

We test our hypotheses *H1* and *H2*, about whether corporate biodiversity disclosure (*BD_SCORE* and *BDA*) has a positive impact on earnings management, using *ACC* and *REM* as proxies. Moreover, the moderating effect of a critical mass of females on the board (*GEND*) weakens this relationship. The base regression models state the following:

$$ACC_{it}\,(REM_{it}) = \alpha + \beta_1 BD\_SCORE_{it}\,(BDA_{it}) + \beta_2 GEND_{it} + \beta_3 BOARDIN_{it} + \beta_4 SUSTC_{it} + \beta_5 BOARDS_{it} + \beta_6 BOARDM_{it} + \beta_7 CSRCOMP_{it} + \beta_8 ETS_{it} + \beta_9 SIZE_{it} + \beta_{10} LEV_{it} + \beta_{11} MTB_{it} + \beta_{12} ROA\_adj_{it} + \beta_{13} CIVIL_{it} + \beta_{14} ENF_{it} + \varepsilon_{it} \quad (7)$$

$$ACC_{it}\,(REM_{it}) = \alpha + \beta_1 BD\_SCORE_{it}\,(BDA_{it}) + \beta_2 GEND_{it} + \beta_3 BD\_SCORE_{it}(BDA_{it}) * GEND_{it} + \beta_4\, BOARDIN_{it} + \beta_5\, SUSTC_{it} + \beta_6\, BOARDS_{it} + \beta_7\, BOARDM_{it} + \beta_8\, CSRCOMP_{it} + \beta_9\, ETS_{it} + \beta_{10}\, SIZE_{it} + \beta_{11}\, LEV_{it} + \beta_{12}\, MTB_{it} + \beta_{13}\, ROA\_adj_{it} + \beta_{14}\, CIVIL_{it} + \beta_{15}\, ENF_{it} + \varepsilon_{it} \quad (8)$$

We included time, industry, and country-fixed effects in the regression models. Panel data structure recognizes effects that are not detectable in pure cross-sectional and time-series models. Due to possible within-cluster correlations, a GLS random effects (RE) estimator with firm-clustered standard errors (Huber-White sandwich estimator) was included. The model applies autocorrelation and heteroscedasticity robust standard errors. Collinearity diagnostics based on variance inflation factors (VIF) (mean VIF = 2.56; highest VIF = 2.88) are not linked to significant multicollinearity concerns. The random intercept model was chosen because we were interested in higher-level processes in our data that were not captured by removing higher-level variance through transformation. The choice of a random effect could also be justified by the Hausman test (p-value = 0.2021).

4. RESULTS

4.1. Descriptive statistics

Table 3 summarizes the descriptive statistics with the number of observations (N), means, standard deviations (SDs), minimums (Min), medians, and maximums (Max). Referring to our dependent variables (*ACC* and *REM*), included firms have a mean *ACC* value of 0.037 (*median* = 0.031), indicating an income-increasing accruals policy. Our *REM* measure indicates that the firms conduct, on average, a small degree of *REM* (*mean* = 0.011; *median* = 0.0154). As independent variables (*BD_SCORE* and *BDA*), the mean (median) scores in our sample are 2.675 (0.000) for *BD_SCORE*, and 0.134 (0.000) for *BDA*, indicating a low degree of biodiversity disclosure. We also stress that our moderator variable (*GEND*) has a low value (mean = 0.187; median = 0.000).

Table 3. Descriptive statistics

Variables	*Mean*	*SD*	*Min*	*Median*	*Max*
***Panel A**: Dependent variables*					
ACC	0.037	0.362	-0.223	0.0309	1.221
REM	0.012	0.301	-0.365	0.0154	1.165
***Panel B:** Independent variables*					
BD_SCORE	2.675	1.798	0.000	0.000	8.000
BDA	0.134	0.043	0.000	0.000	1.000
***Panel C:** Moderator variable*					
GEND	0.187	0.037	0.000	0.000	1.000
***Panel D:** Control variables*					
BOARDIN	55.135	21.564	0.000	57.034	100.000
SUSTC	0.698	0.356	0.000	1.000	1.000
BOARDS	10.465	3.934	2.000	13.000	28.000
BOARDM	8.231	3.287	2.000	7.000	31.000
CSRCOMP	0.651	0.324	0.000	1.000	1.000
ETS	0.377	0.354	0.000	0.000	1.000
SIZE	18.664	1.878	8.365	19.423	20.000
LEV	0.434	0.221	0.023	0.256	1.212
ROA_adj.	3.231	9.323	-19.121	3.876	53.769
MTB	1.978	2.978	0.578	1.591	76.321
ENF	4.980	0.719	3.019	5.018	5.987
CIVIL	0.598	0.441	0.000	1.000	1.000

4.2. Correlation results

Table 4 presents the Pearson correlation matrix for the dependent, independent, moderator, and control variables. Since *BD_SCORE* and *BDA* are significantly correlated, we run separate regressions. In line with our assumptions, our two variables of biodiversity disclosure (*BD_SCORE* and *BDA*) are positively and significantly related to our two proxies of earnings management (*ACC* and *REM*). Moreover, our included moderator variable (*GEND*) was positively related to *BD_SCORE* and *BDA* as well as negatively related to ACC and REM. This is in line with our assumptions. Thus, there were the first indications that corporate biodiversity disclosure and earnings management are positively related, and female directors on the board may weaken this relationship.

4.3. Basic regression analyses and robustness checks

Table 5 provides an overview of the results of the basic regressions. Model 1 and Model 2 show that *BD_SCORE* (*BDA*) is positively related to *ACC*. Moreover, Models 3 (4) stress that *BD_SCORE* (*BDA*) is positively linked with *REM*. Thus, firms with higher biodiversity disclosure have a higher amount of accruals-based and real earnings management in line with *H1*. Referring to *H2*, in Models 5–8, we also stress that our moderator variable (*BD_SCORE* (*BDA*) * *GEND*) is positively related to *ACC* and *REM*, but the effect is weaker in comparison to Models 1–4. Thus, female board members weaken the positive impact of biodiversity disclosure on earnings management in all regression models.

Prior literature on related research topics has highlighted the existence of endogeneity problems (Wintoki et al., 2012). In this paper, while we employed panel data methods, two major problems may have arisen. First, earnings management may have been increased because of firm-specific factors other than CBR (self-selection bias) or there may have been a dynamic link between CBR and earnings management (reversed causality). In line with prior studies, we address these endogeneity concerns using two-stage least squares (2SLS) with instrumental variables. To perform this method, we constructed the industry-year averages of our independent variables (*BD_SCORE* and *BDA*) in line with prior research. These averages excluded the focal firm of analysis and were therefore regarded as exogeneous to earnings management. We also dropped industry-year combinations with fewer than 10 observations. The results shown in Table 6 are consistent with our main regressions. The second-stage coefficients for *BD_SCORE* and *BDA* were positive and statistically significant to earnings management. Post-estimation analysis confirmed the strength and relevance of our instrument.

Table 4. Pearson correlation matrix

Variables	*ACC*	*REM*	*BD_SCORE*	*BDA*	*GEND*	*BOARDIN*	*SUSTC*	*BOARDS*	*BOARDM*	*CSRCOMP*	*ETS*	*SIZE*	*ROA_adj*	*MTB*	*LEV*	*ENF*	*CIVIL*
ACC	1																
REM	-0.36*	1															
BD_SCORE	0.32**	0.37**	1														
BDA	0.36**	0.26**	0.90***	1													
GEND	-0.33**	-0.38**	0.43**	0.54**	1												
BOARDIN	-0.23**	-0.22**	0.11*	0.10*	0.10**	1											
SUSTC	-0.21**	-0.24**	0.20**	0.34**	0.25*	0.21	1										
BOARDS	0.15*	0.27*	0.20	0.14*	0.22*	0.14*	0.12*	1									
BOARDM	0.18	0.12	0.10	0.11*	0.01	0.14**	0.01	0.22**	1								
CSRCOMP	-0.21**	-0.19*	0.22*	0.24**	0.17	0.11**	0.12*	0.12	0.02	1							
ETS	0.12*	0.21*	0.21**	0.11*	0.14*	0.01	0.14*	0.05*	0.12	0.03	1						
SIZE	0.23**	0.31*	0.33**	0.37**	0.21*	0.12*	0.04*	0.22**	0.16*	0.11*	0.21	1					
ROA_adj.	0.21**	0.21**	0.12*	0.22**	0.13*	0.01	0.16*	0.12**	0.21*	0.24*	0.04	0.22**	1				
MTB	0.22*	0.12**	0.15*	0.11*	0.22*	0.14*	0.22*	0.11*	0.03	-0.14	0.18	0.21*	0.01	1			
LEV	0.24*	0.11*	-0.21*	-0.13*	0.12*	0.02*	0.12	0.03	0.12*	-0.05*	0.21**	0.01	0.21	0.05	1		
ENF	0.15*	0.11*	0.14*	0.16*	0.15*	0.11**	0.04	0.12*	0.01	0.12	0.12*	0.04	0.25	-0.11	0.14	1	
CIVIL	0.12*	0.21*	0.22**	0.27**	0.22**	0.01	0.11	0.22*	0.15*	0.19	0.16*	0.01	0.05	0.01	0.01	0.15	1

*Note: Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.*

Table 5. Basic regression results (Hypotheses 1–2)

Variables	*ACC*		*REM*	
	Model 1	*Model 2*	*Model 3*	*Model 4*
BD_SCORE	2.153**	-	2.535**	-
BDA	-	2.443**	-	2.143**
GEND	-0.298**	-0.212**	-0.298**	-0.251**
BOARDIN	-0.203**	-0.254**	-0.221**	-0.144**
SUSTC	-0.154**	-0.124***	-0.133**	-0.144**
BOARDS	0.132*	0.121*	0.113*	0.153*
BOARDM	0.067	0.059	0.076	0.087
CSRCOMP	-0.143**	-0.121*	-0.165*	-0.143**
ETS	0.153*	0.124*	0.143*	0.122*
SIZE	0.232**	0.243**	0.224**	0.212**
ROA_adj.	0.221**	0.215**	0.202**	0.201**
LEV	0.202**	0.253**	0.224**	0.211**
MTB	0.242**	0.221**	0.211**	0.221**
ENF	0.123*	0.109*	0.112*	0.115*
CIVIL	1.212*	1.254*	1.212*	1.221*
Constant	1.275	1.255	0.257	0.265
Observations	1,537	1,537	1,537	1,537
R^2 adj.	0.223	0.204	0.213	0.209
F-statistics	78.343**	73.424**	49.232**	48.143**

Variables	*ACC*		*REM*	
	Model 5	*Model 6*	*Model 7*	*Model 8*
BD_SCORE	1.565**	-	2.205**	-
BDA	-	2.321**	-	2.242**
GEND	-0.292**	-0.222**	-0.296**	-0.232**
*BD_SCORE * GEND*	-1.212*	-	-1.03*	-
*BDA * GEND*	-	-1.143*	-	-1.232*
BOARDIN	-0.221**	-0.254**	-0.203**	-0.131**
SUSTC	-0.134**	-0.142***	-0.153**	-0.124**
BOARDS	0.121*	0.143*	0.104*	0.134*
BOARDM	0.089	0.076	0.075	0.067
CSRCOMP	-0.132**	-0.125*	-0.132*	-0.132**
ETS	0.143*	0.126*	0.133*	0.125*
SIZE	0.254**	0.225**	0.232**	0.232**
ROA_adj.	0.225**	0.205**	0.243**	0.235**
LEV	0.222**	0.226**	0.252**	0.207**
MTB	0.217**	0.205**	0.204**	0.215**
ENF	0.176*	0.163*	0.118*	0.174*
CIVIL	1.216*	1.205*	1.282*	1.215*
Constant	1.165	1.154	0.365	0.375
Observations	1,537	1,537	1,537	1,537
R^2 adj.	0.214	0.215	0.204	0.218
F-statistics	77.567**	75.038**	50.387**	49.232**

*Note: Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.*

Table 6. Endogeneity checks (2SLS/IV; second stage)

Variables	*ACC*		*REM*	
	Model 9	*Model 10*	*Model 11*	*Model 12*
BD_SCORE	2.043**	-	2.415**	-
BDA	-	2.212**	-	2.180**
GEND	-0.214**	-0.211**	-0.254**	-0.216**
Controls	YES	YES	YES	YES
Constant	1.232	1.224	0.213	0.221
Observations	1,537	1,537	1,537	1,537
R^2 adj.	0.201	0.219	0.202	0.202
F-statistics	78.343**	73.424**	49.232**	48.143**
Variables	*ACC*		*REM*	
	Model 13	*Model 14*	*Model 15*	*Model 16*
BD_SCORE	1.354**	-	2.132**	-
BDA	-	2.221**	-	2.332**
GEND	-0.211**	-0.252**	-0.234**	-0.154**
*BD_SCORE * GEND*	-1.198*	-	-1.143*	-
Controls	YES	YES	YES	YES
Constant	1.121	1.114	0.221	0.241
Observations	1,537	1,537	1,537	1,537
R2adj.	0.214	0.215	0.204	0.218
F-Statistics	77.567**	75.038**	50.387**	49.232**

*Note: Significance levels: * p < 0.1; ** p < 0.05; *** p < 0.01.*

5. DISCUSSION OF THE RESULTS

Our regression results align well with our agency's theoretical framework which assumes a positive relationship between CBR and earnings management. Our results indicate that managers use corporate biodiversity disclosure as a virtuous symbol to mask their negative influence on financial reporting. This may be explained by increased managerial discretion in biodiversity communication and decreased objectivity. Our results are also in line with prior research on the link between general environmental reporting and earnings management, contrasting the information needs of shareholders and other stakeholders (Shi et al., 2022). Moreover, we are in line with critical mass theory (Kanter, 1977) that a critical mass of female directors may weaken the positive impact of CBR on earnings management. BDG represents a major corporate governance and monitoring instrument that should lead to ethical management behavior and substantive use of biodiversity reporting for successful stakeholder management.

6. CONCLUSION

The aim of this study was to analyze the influence of corporate biodiversity disclosure on earnings management for corporations listed on the STOXX Europe 600. Moreover, the moderating role of a critical mass of female directors in this relationship was analyzed. To the best of our knowledge, we present the first empirical study of this research topic, based on the European capital market. The analysis comprised 1,537 firm-year observations, covering the 2017–2021 financial years, and was based on an agency-theoretical framework. According to our panel regressions, we found that corporate biodiversity disclosure has a positive impact on the degree of accrual-based and real earnings management. Thus, in line with our agency-theoretical framework and prior research on related topics (e.g., Shi et al., 2022), firms use biodiversity reporting as a possible means of CSR washing to mask their opportunistic behavior, leading to lower earnings quality. Our main regression results remain constant after several endogeneity checks, based on 2SLS and IV.

Our results align with prior research that finds environmental reporting and financial reporting quality are connected. Our study is useful to researchers, regulators, and practice to increase firms' motivation for biodiversity efforts and the integration of environmental and financial reporting. Some implications should be highlighted: the recent EU Green Deal project stresses the need to promote an adequate quality of financial and sustainability reporting. CSR washing and information overload can only be decreased with a properly integrated financial and environmental management system (Bozzolan et al., 2015). Biodiversity reporting and performance lack comparability and validity. Due to managerial discretions, shareholders and other stakeholders have limited possibilities to analyze the reliability of biodiversity information. While biodiversity is still voluntary on the European capital market, we stress the increased EU regulations on biodiversity, related to sustainable finance, reporting, and corporate governance. The new sustainability reporting according to the Corporate Sustainability Reporting Directive (CSRD) 2022 and the European Sustainability Reporting Standards (ESRS) includes explicit reporting requirements for biodiversity. However, based on an individual materiality judgment, firms may choose to delete biodiversity information in the sustainability report if they declare it as not material. As biodiversity represents one of the six environmental goals of the EU Taxonomy Regulation, stakeholders will push management to prepare solid biodiversity disclosure with a description of the potential financial effects of biodiversity aspects.

We conclude that biodiversity strategies and earnings management represent synchronous activities at the senior levels. Our results indicate that biodiversity disclosure tends to be purely symbolic and dovetail with CSR washing. Corporate governance mechanisms, e.g., board composition may overcome these risks. The implementation of a critical mass of female directors creates board dynamics which decrease the opportunistic behavior of executive directors in line with stakeholders' interests.

Moreover, we would like to stress the primary limitations of our study and provide useful research recommendations. First, we have been referring to a rather brief time period (2017–2021). The impact of the EU Green deal regulations, such as the CSRD and the EU Taxonomy Regulation should be included in future research designs. Second, this study only includes biodiversity and neglects other environmental topics (e.g., climate change, circular economy) or social aspects. The connections between the six environmental goals of the EU Taxonomy Regulation should be recognized in future studies. Third, we only rely on female directors on the board as a corporate governance mechanism. There are many other possibilities, e.g., board independence, sustainability board committees, or sustainability-related compensation, to extend our knowledge on the moderating effect of corporate governance on the link between biodiversity disclosure and financial reporting. In summary, sustainability reporting and earnings management leaves many questions open for future empirical research.

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