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Velte, Patrick

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RESEARCH ARTICLE



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Environmental performance, carbon performance and earnings management: Empirical evidence for the European capital market

Patrick Velte

Leuphana University of Lüneburg, Institute of Management, Accounting & Finance (IMAF), Lüneburg, Germany

Correspondence

Patrick Velte, Leuphana University of Lüneburg, Institute of Management, Accounting & Finance (IMAF), Universitaetsallee 1, 21335 Lüneburg, Germany. Email: velte@leuphana.de

Abstract

The purpose of this study is to examine the relationship between environmental performance, carbon performance and earnings management. This analysis includes panel regressions as empirical-quantitative (archival) research methods and looks at the 2014-2018 financial years of companies listed on the STOXX Europe 600 (1,509 firm-year observations). Environmental (carbon) performance proxies are included as independent variables, and with two earnings quality measures, accrual-based earnings management (ACC) and real earnings management (REM) as dependent variables. Our findings align with prior research on sustainability performance and indicate that environmental (carbon) performance reduces ACC but increases REM. After including Granger causality tests, we find no indications of a bidirectional relationship. This analysis makes a key contribution to prior studies as this appears to be the first on the relationship between environmental (carbon) performance and earnings management in the European capital market. The study has major implications for business practice, regulators and research. Managers might use environmental and carbon strategies for greenwashing policies as this change in earnings management can be hardly detected by other stakeholders.

KEYWORDS

carbon performance, corporate governance, earnings management, earnings quality, environmental performance

1 | INTRODUCTION

Environmental and climate change strategies have increasingly become a part of business practice and research (Jung, Herbohn, & Clarkson, 2018; Nuber, Velte, & Hörisch, 2020). Shareholders and other stakeholder groups demand more environmental, social, and governance (ESG) issues, and are looking at this from an international perspective, spurred on by pressures from public interests entities (PIEs) (Carroll, 1999). With carbon emissions being key to environmental performance (Bebbington & Larrinaga-González, 2008; Busch, Johnson, & Pioch, 2020), they have been at the forefront of media attention and public discussion ("Fridays for Future"). The European Commission (EC) has set a GHG reduction target of 40% for 2030 and developed a vision of an 80–95% decarbonized society by 2050. The EU EMS trading system (EC, 2018) has become the key instrument to help reach these goals.

With some stakeholders putting pressure on management to increase environmental and carbon performance, two consequences

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may occur: greenwashing and information overload as symbolic environmental management strategies (Ben-Amar & Mcllkenny, 2015; Garcia Martin & Herrero, 2020). As prior research shows, governancerelated determinants can increase environmental performance, and firms' financial consequences of environmental (carbon) issues can be positive. We can assume then that environmental (carbon) performance is also connected with a change in financial reporting behavior. The motivation of this relationship can be justified as follows: The risks of greenwashing and information overload increase if firms do not carefully integrate financial and ESG issues into their risk management and reporting systems (Lemma, Shabestari, Freedman, & Mlilo, 2020). A successful climate change policy of the firm requires "integrated thinking" of financial and non-financial items, especially environmental and carbon performance, not self-reported for impression management and symbolic uses of these terms. Since environmental activities and earnings management practices are conducted simultaneously, business practice will need to find those places where the two are interdependent, if we look at these issues in a realistic manner (Lemma et al., 2020).

In our analysis, we rely on an *agency-theoretical* framework and discuss a possible positive and negative impact of environmental (carbon) performance on earnings management. Earnings management can be seen through accrual-based earnings management (ACC) or real earnings management (REM) (Dechow, Ge, & Schrand, 2010). As ACC can be detected more easily by stakeholders than REM, we assume a shift from ACC to REM in business practice, though the increased environmental (carbon) performance, but in the form of greenwashing policies.

Many empirical studies have analyzed the impact of ESG performance on earnings quality during the last decade (e.g., Cheng & Kung, 2016; Chi, Shen, & Kang, 2008). The majority of studies stated that ESG performance and earnings quality are positively linked (Velayutham, 2018; Velte, 2020). Our study makes a major contribution to the prior research (e.g., Bozzolan, Fabrizi, Mallin, & Michelon, 2015; Fauser, 2019; Lemma et al., 2020; Luo & Wu, 2019). The majority of prior research analyzes the link between ESG performance on earnings quality (e.g., Bozzolan et al., 2015; Fauser, 2019) and studies mainly rely on ACC (e.g., Lemma et al., 2020; Luo & Wu, 2019). We extend this research strength as follows: First, we are not interested in total ESG performance in contrast to Fauser (2019) and Bozzolan et al. (2015). In view of current climate change discussions, we concentrate on environmental performance and carbon performance as its main subpillars and their contributions to ACC and REM. We only identify two current papers that link carbon performance and earnings quality, one by Luo and Wu (2019) and the other, Lemma et al. (2020). Lemma et al. (2020) and Luo and Wu (2019) rely solely on the impact of carbon emissions and disclosure of various measures of ACC. As ACC makes up only one small part of earnings management, we include a broader range of earnings quality in order to analyze a possible shift from accrual-based to real earnings management.

Second, as reversed causality is a major challenge in prior research, we analyze a *possible bidirectional relationship*, using Granger causality tests (Granger, 1969) in order to increase the validity of our study. The inclusion of a bidirectional relationship has occasionally been included with regard to total ESG performance, but never related to environmental and carbon performance. Third, prior studies neglected to identify the European capital market as an international promoter of climate change policy on that topic. A European crosscountry study, conducted by Fauser (2019), did include materialitybased total ESG scores and earnings management proxies. To the best of our knowledge, we are the first study to a focus on environmental and carbon performance and their impact on both ACC and REM for the European capital market.

We motivate our sample as follows. As climate change policy has taken center stage on the continent, the European capital market represents a unique and relevant setting for environmental and carbon research. In 2005, the EU introduced an emissions trading system (ETS) for certain high polluting corporations. Since the 2017 financial year, the non financial reporting directive (NFRD) of the European Commission (EC) has required selected public interest entities (PIEs) to publish a non-financial declaration (EC. 2014). As part of the European Green Deal 2020, the EC recently announced a review of the NFRD and a renewed sustainable finance strategy (EC, 2020). The goal for these European standards is to increase the quality of climate-related disclosures for listed corporations. As a first step, the EC published non-binding guidelines on climate change reporting in 2019 (EC. 2019), which falls in line with the recommendations of the G20 Task Force on climate-related financial disclosures (TFCD, 2017). The EC has recently been discussing the implementation of a mandatory climate change reporting program that integrates financial reporting. This strategy should help decrease greenwashing behavior and improve the quality of financial and non-financial reporting. In summary, we are making a major contribution to the current research with our integration of both environmental and carbon performance, both ACC and REM, and tests for reversed causality for the European capital market.

We provide a *summary* of our method and results. On the basis of 1,509 firm-year observations for the 2014–2018 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. According to our empirical quantitative (archival) research, using panel regressions, we found a negative impact of environmental (carbon) performance on ACC and a positive impact on REM. Thus, we assume a shift from ACC to REM is the consequence of increased environmental and carbon activities as greenwashing policies. Granger causality tests do not show any indications for a bidirectional relationship. Our results remain constant after several robustness checks including looking at other subpillars of environmental performance and alternative ACC measures.

Our study has major *implications* for business practice, regulators and research, especially in light of the recent EU Green Deal and the future challenges on green finance and climate change reporting within the European member states. The interactions between environmental and earnings management should be included more often in future discussions and should also include possible improvements 44 WILE FY Corporate Social Responsibility and

Our analysis is structured as follows. First, we present an agency and stakeholder theoretical foundation, a short literature review on the relationship between ESG and earnings management, and then our main hypotheses. The data and methodology of the empirical analysis will include sample selection, main variables and regression models. We will then focus on the research results of the correlation, regression and robustness analyses. A summary and the limitations of the study will follow.

2 THEORETICAL FRAMEWORK. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 Theoretical foundation

Many theories explain the relationship between environmental performance and earnings management (e.g., stakeholder theory, agency theory, legitimacy theory, signaling theory), with the conflicting agency theory (Jensen & Meckling, 1976; Ross, 1973) and stakeholder theory (Freeman, 1984) being most popular. Agency theory assumes an opportunistic management behavior (Jensen & Meckling, 1976) and recognizes a *positive* link between environmental performance and earnings management. Managers may use environmental activities as a device to mask opportunistic (earnings) behavior (Velavutham, 2018). If firms use environmental performance as a greenwashing policy (e.g., reducing CO₂ emissions while also decreasing production units without a clear change of their business model), they may also be actively engaged in earnings management. Thus, environmental performance indicates a reputational insurance that gives managers a license to present a negative financial reporting quality (Kim, Park, & Wier, 2012).

Unlike agency theory, stakeholder theory assumes the intrinsic motivation of top management that aims to satisfy the interests of primary stakeholder groups (Freeman, 1984). The management and the business are responsible for society and should balance financial and non-financial goals in line with the famous triple bottom line framework (Freeman, 1984). Thus, stakeholder theory assumes that top management will provide decision-useful financial and environmental reporting, which will lead to increased environmental performance and earnings quality (Velayutham, 2018; Velte, 2016). Focusing on this negative environmental performance-earnings management connection, sustainable companies prefer to foster a longterm relationship with their shareholders and other stakeholders. Managers who engage in substantive environmental activities are less likely to manage earnings because earnings management conflicts with stakeholder interests (Velayutham, 2018).

While a positive or negative link between environmental (carbon) performance and earnings management is possible according to our theoretical framework, we decided to focus on agency theory for the following reasons: First, the literature states that current climatechange policies and reporting practices that influences environmental (carbon) performance, are not very successfully conducted by European companies (e.g., Fauser, 2019); Second, we have stressed that the EC has been discussing the idea of increasing regulations on climate-change strategies and their reporting within listed corporations (EC, 2020). The EC states that substantive management strategies in environmental activities must be increased and greenwashing policies should be prevented. Third, as integrated reporting practice is rather low in Europe (e.g., KPMG, 2017), we assume that environmental (carbon) performance leads to lower earnings quality, in general.

Thus, we leave out stakeholder theory and focus our analysis instead

2.2 Literature review

on agency theory.

In recent years, an increasing number of researchers have studied environmental performance, especially carbon-related aspects, to analyze possible financial consequences, governance-related determinants, and the bidirectional link between carbon performance and carbon disclosure (e.g., Stanny & Ely, 2008). In prior literature reviews, we have seen an increasing amount of studies that stress the heterogeneity and diversity of carbon research (e.g., Busch et al., 2020; Hahn, Reimsbach, & Schiemann, 2015; Stechemesser & Guenther, 2012; Velte, Stawinoga, & Lueg, 2020; Zhang & Liu, 2020). It is assumed that a high governance quality leads to better carbon performance and that an increased carbon performance will be associated with positive firms' financial consequences. With regard to corporate governance variables, board effectiveness has a positive impact on participation in the CDP (Ben-Amar & Mcllkenny, 2015), while board gender diversity has a positive impact on carbon performance (Garcia Martin & Herrero, 2020). With regard to financial consequences, carbon disclosure has a big impact on market reactions, such as decreases in cumulative abnormal returns (Lee, Park, & Klassen, 2015) or increased financial performance (Robiana & Madaleno, 2020). Moreover, there are indications that carbon performance and carbon disclosure are connected (e.g., Giannarakis, Zafeiriou, Arabatzis, & Partalidou, 2018; Giannarakis, Zafeiriou, & Sariannidis, 2017; Hassan & Romilly, 2018). Despite this, a relationship between carbon performance and earnings quality is only included in two studies (Lemma et al., 2020; Luo & Wu, 2019). Lemma et al. (2020), basing their findings on a sample of South African firms, found that corporations with higher carbon risk exposure provided financial statements of poorer quality, with voluntary carbon disclosure having partially mediated this link. Relying on an international sample of firms, Luo and Wu (2019) also stressed that carbon transparency was negatively related to earnings management. To the best of our knowledge, an empirical quantitative study on the impact of environmental (carbon) performance on earnings management has never been conducted for the European capital market. Moreover, reversed causality tests and REM proxies are not included in prior research on that topic. This points to a major research gap.

While carbon performance is not a common research topic, more research on the impact of environmental performance and earnings

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quality indicates contradictory results (see Velayutham, 2018). However, the majority of studies found a negative impact of environmental performance on earnings management in line with stakeholder theory (e.g., Lee, 2017; Litt, Sharma, & Sharma, 2013). Earlier, we noted that our study differentiates between two earnings management variables, namely ACC and REM. Abnormal accruals are the difference between annual result and operational cash flow and are associated with increased earnings management and thus reduced earnings quality (Dechow et al., 2010). Based on the model by Jones (1991), many modifications of accrual-based models have been established so far (e.g., Kothari, Leone, & Wasley, 2005). Accruals models address accounting policy in the accounts after the balance sheet date. As ACC must be explained in the notes, there is a higher risk to senior management that earnings management strategies will be scrutinized by shareholders and other stakeholders. Investors may punish the company with decreased market value if there is an obvious degree of earnings management. In contrast to ACC, accounting policies before the balance sheet date, as REM, are also included in prior research designs. Roychowdhury (2006, p. 337) defines REM 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 ACC, REM represents a type of "hidden" accounting policy in place of real business transactions (e.g., M&As), with the capital market unable to clearly evaluate the degree of earnings management in these transactions. Thus, for senior management, REM tends to be more successful. In this context, researchers assume different relationships, with many researchers noting that ESG performance (e.g., Kim et al., 2012; Litt et al., 2013) leads to lower ACC as the risks of negative capital market reactions on ACC are rather high. There are also indications that ESG performance leads to lower ACC, but is also linked to higher REM (e.g., Fauser, 2019). Therefore, firms tend to shift their earnings management strategy from ACC to REM because of that "hidden" earnings management.

Looking at the foundation of agency theory and the results of past empirical research (e.g., Lemma et al., 2020; Luo & Wu, 2019), we assume that environmental (carbon) performance is negatively associated with ACC but positively connected to REM. In line with greenwashing policy and opportunistic management behavior, managers decrease the amount of ACC by increasing the environmental (carbon) performance in order to increase stakeholder attractiveness and to signal a substantive environmental strategy. However, as REM can hardly be detected by other stakeholders, senior managers will simultaneously increase their REM activities because, in our opinion, stakeholders will not be aware of these practices. Insofar, we state:

- **H1** Environmental (carbon) performance is linked with a decreased amount of ACC.
- H2 Environmental (carbon) performance is linked with an increased amount of REM.

3 | DATA AND METHODOLOGY

3.1 | Sample selection

The original sample consisted of 600 companies from 17 European countries, all of them listed on the STOXX Europe 600 stock market index for the 2014–2018 financial years. We chose Europe because of the increased regulations put on sustainable finance and reporting over the last few years. We began with the 2014 financial year, since that was the year when the European standard setter published the new directive on non-financial (as well as environmental) disclosures. The companies we included represent approximately 90% of the free-float market capitalization of the European stock market. The primary data were obtained from the Thomson Reuters database in January 2020. Like the prior research, we excluded all financial services companies due to their specific capital structure and regulatory requirements. Missing (non)-financial information meant fewer firm-year observations. Table 1 provides an overview of the final sample of 1,509 firm years-observations.

3.2 | Independent variables

We chose the firms' environmental and carbon performance from the Thomson Reuters Eikon database as *dependent variables*. The ESG score consists of 178 specific line items, which are assigned to the environmental, social, and governance pillar scores. On the one hand, we concentrate on the environmental pillar score (*E_SCORE*) as a measure of a firms' overall environmental performance. ASSET4 collects 61 line items that relate to a firms' environmental impact and policies in order to construct a rank-based score that ranges from 0 to 100. This proprietary-weighted aggregate pillar score (*z*-score) captures the firm's environmental performance in relation to the performance of all other firms in the same industry. We are also interested in carbon performance (*CARBON*) as total CO2 emissions score and one of the key subpillars of environmental performance.

As robustness checks, we modified our independent variables as follows: The three main categories of the *E_SCORE* are *EMISSION*, *INNOVATION*, and *RESOURCE*. They represent each firm's performance with respect to emission reduction, product innovation, and use of resources.

3.3 | Dependent variables

Our dependent variables ACC and REM have been widely used in prior research when looking for the connections between environmental performance and earnings quality (e.g., Kim et al., 2012). We used the model devised by Kothari et al. (2005) to find the key ACC variable in recent earnings management studies (Velayutham, 2018). Kothari et al. (2005) alleviate the problem found with the basic Jones model (1991) and its misspecification when applied to samples experiencing non-random performance. For all companies in the same industry with at least eight observations in each year, we estimated

	2014	2015	2016	2017	2018
Listed European companies in the STOXX Europe 600	600	600	600	600	600
Less					
Financial services firms	131	131	131	131	131
Observations with missing firm-level data on Thomson Reuters Datastream database	160	149	145	126	256
Final sample (base regression) $n = 1,509$	309	320	324	343	213

the following equation to etablish industry-specific parameters for measuring the non-discretionary part of total accruals (*NDA*):

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$$TA_{it}/A_{it-1} = \alpha_0(1/A_{it-1}) + \alpha_1(delta REV_{it} - delta REC_{it})A_{it-1} + \alpha_2 PPE_{it}/A_{it-1} + \alpha_3 IBXI_{it-1}/A_{it-1} + \varepsilon_t.$$
(1)

Total accruals (TA) are the difference between net income after tax (NPAT) and operating cash flows (CFO). Delta REV represents the change in net revenues in year t from year t-1. Delta REC represents the change in net receivables. PPE is gross property, plant and equipment, and IBXI is income before extraordinary items at year t-1, and A_{it-1} is lagged total assets. In order to control for abnormal performances, we used the model from Kothari et al. (2005), to lag the ROA. We collected firm level data on earnings management and additional variables (such as controls) for the years 2014–2018 from Thomson Financial Datastream.

Our REM variable includes three factors (Cohen, Krishnamoorthy, & Wright, 2008; Roychowdhury, 2006): (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 defined as the residual from the relevant models estimated by year and the two-digit SIC industry code. As a result, a combined measure of these three variables (*REM*) were used.

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

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

 CFO_t represents cash flow from operations in year t, A is total assets, S is net sales and *delta* S 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., e_t) from the corresponding industry-year model and the firm-year's sales and lagged assets.

Second, we estimate abnormal production costs (*AB_PROD*). Prior studies (Cohen et al., 2008; Roychowdhury, 2006) define production costs as the sum of *COGS* and change in inventory during the year, while they express expenses as a linear function of contemporaneous sales. Thus, we estimate the following model for normal *COGS*:

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

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

$$delta INV_t / A_{t-1} = \alpha_0 + \alpha_1 (1/A_{t-1}) + \beta_1 (delta S_t / A_{t-1})$$

$$+\beta_2(delta\,\mathbf{S}_{t-1}/\mathbf{A}_{t-1})+\varepsilon_t.$$
(4)

*delta INV*_t is the change in inventory in year t. In line with Roychowdhury (2006) and Cohen et al. (2008), we define production costs as $PROD_t = COGS + delta \ INV_t$. With reference to Equations (3) and (4), we estimate normal production costs:

$$PROD_{t}/A_{t-1} = \alpha_{0} + \alpha_{1}(1/A_{t-1}) + \beta_{1}(S_{t}/A_{t-1}) + \beta_{2}(delta S_{t}/A_{t-1}) + \beta_{3}(delta S_{t-1}/A_{t-1}) + \varepsilon_{t}.$$
(5)

Abnormal production cost (AB_PROD) is the residual from the model.

Third, we use abnormal discretionary expenses (*AB_EXP*). In line with Roychowdhury (2006) and Cohen et al. (2008), we estimate the normal level of discretionary expenses as:

$$\mathsf{DISEXP}_{t}/\mathsf{A}_{t-1} = \alpha_0 + \alpha_1(1/\mathsf{A}_{t-1}) + \beta(\mathsf{S}_{t-1}/\mathsf{A}_{t-1}) + \varepsilon_t. \tag{6}$$

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

Finally, we estimate 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*.

3.4 | Control variables

We include several *control variables* commonly used in this research area (e.g., Fauser, 2019; Lemma et al., 2020; Luo & Wu, 2019). With regard to *corporate governance variables* as controls in our model, we assume a positive impact on environmental (carbon) performance. First, board independence (*BOARDIN*) calculates the ratio of independent directors on the board as reported. Second, the existence of a sustainability committee within the board of directors (*SUSTC*) is included. Third, board size (*BOARDS*) represents the logarithm for the amount of board members. Forth, we include the number of board meetings (*BOARDM*). Finally, we control for the existence of a ESG-linked management compensation system.

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In terms of other firm characteristics, we include, whether firms are part of the EU ETS, since environmentally sensitive industries might be more active in environmental strategies. Moreover, we include firm size (*SIZE*), measured by the natural logarithm of total assets, because bigger companies often benefit from economies of scale or scope, which may be difficult to imitate. Furthermore, total debts divided by total assets (*LEV*) as leverage is included as control variable. A dummy variable is included for industry-specific differences in environmental strategies (*IND*). We also include the market-to-book equity ratio (*MTB*). Regarding book-related 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.

For *country-related governance variables*, a dummy variable is used, depending on whether there is a civil law country or a code law country present (*CIVIL*). Finally, we use the environmental enforcement range (*ENF*).

A summary of the respected variables is included in Table 2.

3.5 | Regression model

We test hypotheses H1 and H2, on whether environmental performance (*E_SCORE*) and carbon performance (*CARBON*) have a positive impact on earnings management, using ACC and REM as proxies. Based on significant Lagrange Multiplier Tests, *F* tests for overall significance, and Hausman Tests, we use panel data regressions. We conduct the Durbin–Wu–Hausman test to choose either the random effects or fixed effects models for the various regression analyses. In view of our results, we choose the random effects model. We calculate variance inflation factors (VIF) to test for multicollinearity. If the VIF is higher than 10, multicollinearity might occur (Hair, Black, Babin, & Anderson, 2009). However, in our data, no VIF exceeds 4.52, thus multicollinearity should

TABLE 2Variables of the study

Panel A: Dep	endent variables
ACC	Absolute value of discretionary accruals (signed discretionary accruals), where discretionary accruals are computed using the Kothari et al. (2005) model including lagged ROA as regressor
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 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
REM	Sum of REM proxies, measured as AB_CFO – AB_PROD + AB_EXP
Panel B: Inde	pendent variables
E_SCORE	Environmental performance obtained from Eikon, adjusted by the industry averages
CARBON	Natural logarithm of Total CO ₂ emissions = scope 1 emissions + scope 2 emissions, obtained from Eikon
EMISSION	Emission reduction score obtained from Eikon, adjusted by the industry averages
INNOVATION	Innovation score obtained from Eikon, adjusted by the industry averages
RESOURCE	Resource use score obtained from Eikon, adjusted by the industry averages
Panel C: Cont	trol variables
Corporate gov	vernance variables
BOARDI	Ratio of independent board members * 100 obtained from Eikon
SUSTC	Dummy variable for (1) existence of a sustainability committee and (0) otherwise, obtained from Eikon
BOARDS	Natural logarithm of the number of board members, obtained from Eikon
BOARDM	Natural logarithm of the number of board meetings, from from Eikon
ESGC	Dummy variable for (1) existence of ESG-linked management compensation and (0) otherwise, obtained from Eikon
Other firm cha	aracteristics
ETS	Dummy variable (1) part of EU emission trade system and (0) otherwise
SIZE	Natural logarithm of total assets, obtained from Eikon
ROA_adj	Industry mean-adjusted ROA in the previous year, where ROA is measured as income before extraordinary items, scaled by lagged total asset, obtained from Eikon
MTB	Ratio of the total market value of equity to the book value of equity, obtained from Eikon
LEV	Total debts divided by total assets, obtained from Eikon
IND	Dummy for industries using Thomson Reuters general industry classification index, where (1) industrials, (2) utility, and (3) transportation
Country-relate	ed governance variables
ENF	Environmental enforcement range, obtained from WEF executive questionnaire
CIVIL	Dummy variable for (1) civil law country and (0) code law country, hand-collected

TABLE 3 Descriptive statistics

Variables	Mean	SD	Min	Median	Max
Panel A: Depen	dent variat	oles			
ACC	0.039	0.365	-0.201	0.040	1.253
REM	0.010	0.305	-0.352	0.015	1.014
Panel B: Indepe	ndent varia	ables			
E_SCORE	0.556	0.153	0.052	0.602	0.915
CARBON	13.00	2.45	4.73	12.83	19.08
EMISSION	0.593	0.225	0.025	0.625	0.906
INNOVATION	0.565	0.218	0.231	0.570	0.921
RESOURCE	0.589	0.212	0.103	0.602	0.901
Panel C: Contro	l variables				
BOARDI	56.231	22.140	0.000	56.191	100.000
SUSTC	0.532	0.398	0.000	1.000	1.000
BOARDS	10.541	3.892	2.000	12.000	30.000
BOARDM	8.439	3.549	1.000	8.000	36.000
ESGC	0.410	0.429	0.000	0.000	1.000
ETS	0.329	0.398	0.000	0.000	1.000
SIZE	16.012	1.689	8.439	16.000	21.000
ROA_adj.	4.213	10.232	-32.232	4.210	189.312
МТВ	2.099	3.123	0.510	1.429	89.321
LEV	0.525	0.219	0.01	0.601	2.549
IND	1.231	0.498	1.000	1.000	3.000
ENF	5.323	0.698	3.398	5.109	6.323
CIVIL	0.659	0.423	0.000	1.000	1.000

not affect our results. Since OLS-estimated standard errors as well as the often used White robust standard errors produce mis-specified test statistics when either of the two forms of autocorrelation is present, we employ the Rogers estimator to obtain heteroscedasticity- and serial autocorrelation-consistent standard errors.

For our hypotheses, the following regression models apply:

$$\begin{split} \mathsf{ACC}_{it} &= \alpha + \beta_1 \mathsf{E}_{\mathsf{S}} \mathsf{SCORE}^*_{it} + \beta_2 \mathsf{BOARDI}_{it} + \beta_3 \mathsf{SUSTC}_{it} + \beta_4 \mathsf{BOARDS}_{it} \\ &+ \beta_5 \mathsf{BOARDM}_{it} + \beta_6 \mathsf{ESGC}_{it} + \beta_7 \mathsf{ETS}_{it} + \beta_8 \mathsf{SIZE}_{it} + \beta_9 \mathsf{LEV}_{it} + \beta_{10} \mathsf{IND}_{it} \\ &+ \beta_{11} \mathsf{MTB}_{it} + \beta_{12} \mathsf{ROA}_{a} dj_{it} + \beta_{13} \mathsf{CIVIL}_{it} + \beta_{14} \mathsf{ENF}_{it} + \epsilon_{it}. \end{split}$$

"*" with regard to regression models 2 and 5–7, *E_SCORE* is substituted by *CARBON* (model 2), *EMISSION* (model 5), *INNOVATION* (model 6), and *RESOURCE* (model 7).

$$\begin{split} \mathsf{REM}_{it} &= \alpha + \beta_1 \mathsf{E}_{\mathsf{S}} \mathsf{CORE}^*_{it} + \beta_2 \mathsf{BOARDI}_{it} + \beta_3 \mathsf{SUSTC}_{it} + \beta_4 \mathsf{BOARDS}_{it} \\ &+ \beta_5 \mathsf{BOARDM}_{it} + \beta_6 \mathsf{ESGC}_{it} + \beta_7 \mathsf{ETS}_{it} + \beta_8 \mathsf{SIZE}_{it} + \beta_9 \mathsf{LEV}_{it} \\ &+ \beta_{10} \mathsf{IND}_{it} + \beta_{11} \mathsf{MTB}_{it} + \beta_{12} \mathsf{ROA}_a \mathsf{adj}_{it} + \beta_{13} \mathsf{CIVIL}_{it} \\ &+ \beta_{14} \mathsf{ENF}_{it} + \epsilon_{it}. \end{split}$$

"*" with regard to regression models 4 and 8–10, *E_SCORE* is substituted by *CARBON* (model 4), *EMISSION* (model 8), *INNOVATION* (model 9), and *RESOURCE* (model 10).

4 | RESEARCH RESULTS

4.1 | Descriptive statistics

Table 3 provides an overview of the descriptive statistics for the dependent variables (Panel A), independent variables (Panel B) and control variables (Panel C). The environmental performance scores in Panel A range from 0 to 1. The mean (median) scores in our sample are 0.556 (0.602) for *E_SCORE*, and 13.00 (12.83) for *CARBON*. The firms we include have a mean ACC value of 0.039 (median: 0.040), indicating an income-increasing accruals policy. Our *REM* measure indicates that the firms conduct, on average, a small degree of *REM* (mean: 0.010; median: 0.015).

4.2 | Correlation results

Table 4 presents the Pearson correlation matrix for the dependent, independent and control variables. Since *CARBON* as a component of *E_SCORE* is significantly linked to *E_SCORE* (0.83***), we run separate regressions. For robustness checks, since correlation values between *EMISSION*, *INNOVATION* and *RESOURCE* are also very high and significant, we run separate regression models as robustness checks. Furthermore, both *E_SCORE* and *CARBON* are negatively linked to *ACC* and positively related to *REM*.

4.3 | Regression results

Table 5 provides the results of our panel regressions. Both *E_SCORE* and *CARBON* are negatively related to *ACC*. Thus, firms with higher environmental and carbon performance have a lower amount of accrual-based earnings management in line with H1. With regard to *REM*, a significant and positive link can be stated in all models. Thus, firms' environmental and carbon performance lead to a higher degree of real earnings management as H2 also assumes. There seems to be a shift from ACC to REM for firms with increased environmental (carbon) performance. The regression results are presented in Table 5.

5 | CAUSALITY TESTS AND ROBUSTNESS CHECKS

Literature assumes that earnings management may also be the driver of environmental and carbon performance (Grougiou, Leventis, Dedoulis, & Owusu-Ansah, 2014). Therefore, some researchers focus on the earnings management-ESG performance link but come up with mixed results (e.g., Choi, Lee, & Park, 2013; Grougiou et al., 2014; Velte, 2019). In order to address possible reversed causality problems, we conduct Granger causality tests (Dumitrescu & Hurlin, 2012; Granger, 1969). The Granger causality test results show a unidirectional and not a bidirectional relationship between environmental

Var	riables	1	2	ო	4	5	9	7	8	6	10	11	12	13	14	5	16	17	18 1	9 20
4	ACC	1																		
7	REM	-0.323*	1																	
ო	E_SCORE	-0.34**	0.35**	1																
4	CARBON	-0.47**	0.26**	0.83***	1															
5	EMISSION	-0.38**	0.39**	0.79***	0.82***	1														
9	INNOVATION	-0.46**	0.44**	0.84***	0.74***	0.87***	1													
~	RESOURCE	-0.27*	0.36**	0.77***	0.73***	0.82***	0.75***	1												
œ	BOARDI	-0.27**	-0.25**	0.19**	0.23**	0.20**	0.16**	0.19**	1											
6	SUSTC	-0.25**	-0.14**	0.22*	0.19**	0.24**	0.20**	0.36**	0.22*	1										
10	BOARDS	0.25	0.21	0.25	0.20	0.15*	0.11^{*}	0.21	0.19**	0.13	1									
11	BOARDM	0.21	0.15	0.17	0.15	0.18*	0.20	0.19*	0.14	0.21**	0.23***	1								
12	ESGC	-0.14*	-0.18	0.15*	0.18**	0.20*	0.16**	0.19**	0.21***	0.24**	0.11^{*}	-0.15	1							
13	ETS	-0.24**	0.35**	0.25**	0.02	0.21*	0.17**	0.21*	0.21	0.30*	0.09	0.13	0.13	1						
14	SIZE	0.43***	0.34**	0.41***	0.34**	0.32**	0.29*	0.24**	0.21**	0.22**	0.33***	0.13**	0.19**	0.12	1					
15	ROA_adj.	0.24**	0.25**	0.26**	0.26**	0.21**	0.21**	0.19*	0.16*	0.11**	0.23***	0.22**	0.11^{*}	0.17	0.32***	1				
16	MTB	0.32	-0.15**	0.22**	0.15**	0.17**	0.11^{*}	0.14**	0.11**	-0.11*	-0.21**	0.11	-0.09	0.21	0.132**	0.12**	1			
17	LEV	0.13**	0.14**	0.15	0.22**	0.21**	0.15**	0.13*	0.13	-0.03	0.14	0.09	-0.12**	0.11*	0.12** -	-0.12**	-0.12**	1		
18	DNI	0.14	0.21	0.15	0.11	0.11*	0.11	0.16*	0.13	0.15*	0.16	0.12*	0.11	0.13**	0.15	0.14	0.23	0.11	1	
19	ENF	0.11^{*}	0.15*	0.11**	0.21*	0.22**	0.15*	0.19*	0.23	0.11*	0.27	0.21*	0.21	0.13*	0.22*	0.12	-0.15	0.21*	-0.12* 1	
20	CIVIL	0.16**	0.19*	0.15*	0.13	-0.14^{*}	0.16	0.21*	0.13	0.04	0.15	0.22**	0.17	0.12**	0.15*	0.14	-0.15*	0.13* -	-0.11* 0	.22 1
Voto.		ltinlind with	(1)																	

 TABLE 4
 Pearson correlation matrix

th (-1).

Note: CARB *p < .1. **p < .05. ***p < .01.

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performance and carbon performance on the one hand and ACC and REM on the other hand (see Table 6).

In order to test the sensitivity of our main regressions, we conduct several robustness checks, with Table 7 summarising the results. In more detail, we run separate regressions on the impact of *EMIS-SION*, *INNOVATION* and *RESOURCE* as three subpillars of the *E_SCORE* for both *ACC* (models 5–7) and *REM* (models 8–10). Our main results remain constant, with a negative impact on *ACC* and a positive influence on *REM*. Moreover, in line with prior research (Lemma et al., 2020), we use the Scope 1 CO2 emissions divided by total sales revenues as an alternative inverse proxy for carbon performance, along with the modified Jones model by Dechow, Sloan, and Sweeney (1995) as an alternative variable for *ACC*. In both cases, our main regression results that carbon performance leads to decreased *ACC* and increased *REM* remain constant (please note that the regression results are not tabulated).

Our regression results align well with our agency theoretical framework which assumes a positive relationship between environmental (carbon) performance and earnings management. Our results indicate that managers use environmental (carbon) performance as a virtuous symbol in order to mask their negative influence on financial reporting. As ACC can be detected by external stakeholders more easily than *REM*, managers tend to opportunistically shift from ACC to *REM*, liking ignoring stakeholder interests. Our results are also in line with prior research on ESG performance (e.g., Fauser, 2019) and AEM (Lemma et al., 2020; Luo & Wu, 2019), as well as with literature reviews on the ESG-earnings management link (Velayutham, 2018; Velte, 2020), which implies that environmental performance influences earnings management and not the other way around.

6 | CONCLUSIONS, LIMITATIONS AND RESEARCH RECOMMENDATIONS

The purpose of this study was to analyse the impact of environmental (E_SCORE) and carbon performance (CARBON) on earnings management for corporations listed on the STOXX Europe 600. To the best of our knowledge, this is the first empirical study of the European capital market and one of the first studies on carbon performance. The analysis comprised 1,509 firm-years observations, covering the 2014-2018 financial years and was based on an agency-theoretical framework. According to our panel regressions, we found that environmental (carbon) performance has a negative impact on the degree of accrual-based earnings management (ACC). However, we stressed an increased amount of real earnings management (REM) resulting from higher environmental (carbon) performance. Thus, in line with other agency-theoretical framework and prior research on that topic (e.g., Fauser, 2019), firms may be shifting from ACC to REM as a possible means of greenwashing and a symbolic use of environmental issues by increasing their environmental (carbon) performance. Additional analysis with regard to Granger causality tests indicate that the relationship between environmental (carbon) performance and earnings management is unidirectional and not bidirectional. Our main regression results remain constant after several robustness checks on *EMISSION, INNOVATION* and *RESOURCE* as three subpillars of environmental performance and surrogates for carbon performance and ACC.

Our results align with prior research (e.g., Fauser, 2019; Velte, 2019) that finds ESG activities may be related to earnings quality. We except our study is useful to researchers, regulators and practice to increase firms' motivation for environmental and carbon activities and for lowering earnings management. We state selective implications as follows: In view of the EC's current Green Deal, regulators should be aware of the connections between financial and nonfinancial reporting. Greenwashing behavior can only be decreased with a properly integrated financial and environmental management system (Bozzolan et al., 2015). Recently, Busch et al. (2020) stressed the complexity of carbon performance data. We noted a wide variance in carbon performance variables in business practice. Thus, the comparability of carbon performance between specific companies and/or branches is very low. This challenge can be also stated by seeing carbon emissions as the most relevant carbon performance proxies. While many firms rely on Scope 1 and Scope 2 emissions, Scope 3, which relates to sustainable supply chain management, is often neglected in carbon disclosure. In view of this, future regulations on climate change policies, which are currently discussed by the EC, will

TΑ	BL	Е	5	Random	effects	regression	results
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	ACC		REM			
Variables	Model 1	Model 2	Model 3	Model 4		
E_SCORE	-0.427***	-	0.223***	-		
CARBON	-	-0.430***	-	0.265***		
BOARDI	-0.214**	-0.243**	0.164*	0.175*		
SUSTC	-0.164***	-0.165***	0.115	0.153		
BOARDS	0.189*	0.196*	0.259*	0.233*		
BOARDM	0.043	0.129*	0.255*	0.189*		
ESGC	-0.243*	-0.256*	-0.199**	-0.211**		
ETS	0.131**	0.153**	0.114**	0.125**		
SIZE	0.464**	0.544**	0.513**	0.453**		
ROA_adj.	0.153**	0.187**	0.153**	0.145**		
LEV	0.244**	0.221**	0.215**	0.241**		
МТВ	0.124**	0.142**	0.113	0.153		
IND	0.132*	0.122*	0.113*	0.153*		
ENF	-0.143**	-0.113**	0.156**	0.168**		
CIVIL	1.661**	1.572**	1.543**	1.320**		
Constant	1.324	1.338	0.798	0.987		
Observations	1,509	1,509	1,509	1,509		
R ² _{adj.}	0.215	0.226	0.222	0.217		
F statistics	78.343**	73.424**	49.232**	48.143**		

Note: CARBON is multiplied with (-1).

*p < .1.

**p < .05.

***p < .01.

TABLE 6 Granger causality test

	ACC		REM		
	Chi ²	p Value	Chi ²	p Value	Relationship According to Granger Causality Test
E_SCORE does not Granger-cause ACC (REM)	26.636	0.036**	32.628	0.029**	Unidirectional
ACC (REM) does not Granger-cause E_SCORE	9.519	0.379	8.159	0.324	
CARBON does not Granger-cause ACC (REM)	23.123	0.045**	36.564	0.035**	Unidirectional
ACC (REM) does not Granger-cause CARBON	8.253	0.326	9.535	0.252	

Note: This table presents results from Granger causality tests (Granger, 1969). When there is reject (*p* < 0.01/0.05/0.10), there is Granger causality. Significance: ***: 0.01; **: 0.05; *: 0.1

TABLE 7 Robustness checks

	ACC			REM		
Variables	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
EMISSION	-0.427***	-	-	0.282***	_	-
INNOVATION	-	-0.430***	_	-	0.228***	-
RESOURCE	-	-	-0.321**	-	_	0.201**
BOARDI	-0.234*	-0.226*	-0.253*	0.154*	0.132*	0.113**
SUSTC	-0.189***	-0.117***	-0.153**	0.115	0.153	0.124*
BOARDS	0.036*	0.049*	0.055	0.025	0.043	0.056*
BOARDM	0.076*	0.033*	0.044	0.046	0.068	0.076*
ESGC	-0.225**	-0.213**	-0.221*	-0.214*	-0.201**	-0.197*
ETS	0.113**	0.125**	0.109*	0.153*	0.125*	0.119*
SIZE	0.369*	0.401*	0.389**	0.423*	0.438*	0.427*
ROA_adj.	0.132**	0.176**	0.124**	0.132**	0.153**	0.144**
LEV	0.221*	0.219*	0.231**	0.189**	0.142**	0.126**
МТВ	0.139**	0.132**	0.142**	0.153	0.142	0.132
IND	0.121*	0.152*	0.149*	0.113*	0.122*	0.124*
ENF	-0.182*	-0.132*	-0.143*	0.123*	0.132*	0.143*
CIVIL	1.232**	1.441**	1.245**	1.212**	1.243**	1.252**
Constant	1.424	1.275	1.316	0.893	0.892	0.924
Observations	1,509	1,509	1,509	1,509	1,509	1,509
R ² _{adj.}	0.224	0.232	0.235	0.255	0.214	0.211
F statistics	77.665**	72.265**	72.221**	48.314**	49.066**	48.232**

*p < .1.

p < .01.

need to discuss whether a core set of carbon performance variables should be mandatory for capital market-oriented firms. As sustainable investors and other stakeholders demand reliable financial and environmental reporting and a substantive climate change strategy from a firm, especially in the European capital market, the recognition of environmental aspects in business strategy must align with reduced earnings management. As recent empirical research has been primarily concentrating on accrual-based models, the implementation of *REM* and other earnings proxies in future research designs will be vital. Moreover, future research should include the possible moderating or mediating factors of ESG affecting earnings quality. We conclude that environmental (carbon) strategies and earnings management represent synchronous activities at the senior levels. Our results indicate that environmental (carbon) strategies tend to be purely symbolic and dovetail with greenwashing practices. As ACC can be discovered more easily by stakeholders in comparison to REM, managers are likely to stress that they implemented a substantive sustainability management system because both environmental (carbon) performance and accrual-related earnings will score higher. Earnings management strategies have been shifted from ACC to REM, often ignoring stakeholder interests. Thus, as senior managers assume that these practices will go undetected, they seem to be fully

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^{**}p < .05. ***p < .01.

TABLE 7a	Robustness checks	(CARBON_	REL and	ACC_m	od)
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Variables	ACC	ACC_mod	ACC_mod	REM
	Model 11	Model 12	Model 13	Model 14
CARBON_REL	-0.321***	-	0.202***	0.225***
CARBON	-	-0.323***	-	-
BOARDI	-0.202**	-0.213**	0.142*	0.134*
SUSTC	-0.153**	-0.121**	0.113**	0.142*
BOARDS	0.221*	0.124*	0.176*	0.201*
BOARDM	0.124	0.057	0.124**	0.143**
ESGC	-0.265**	-0.198**	-0.113*	-0.124*
ETS	0.095**	0.198**	0.122**	0.146**
SIZE	0.398***	0.476**	0.224**	0.342**
ROA_adj.	0.152**	0.153**	0.113**	0.145**
LEV	0.223**	0.135**	0.198**	0.213**
МТВ	0.187***	0.164**	0.135*	0.154*
IND	0.094**	0.092*	0.113**	0.124**
ENF	-0.123**	-0.043*	0.124**	0.144**
CIVIL	1.321**	1.761*	0.123**	1.221*
Constant	1.242	1.221	0.664	0.537
Observations	1,501	1,501	1,501	1,501
R ² _{adj.}	0.223	0.215	0.201	0.203
F statistics	77.224**	74.643**	48.153**	46.023**

Note: The CARBON and CARBON_REL is multiplied with (-1).

**p < .05.

***p < .01.

aware of their actions and focus on *REM* and decreased earnings quality.

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 (2014-2018). The impact of European regulatory changes, such as the recent environmental incentives of the last few years, would be more apparent in long-term studies. Longer time frames aid in designing future research projects. Second, this study only includes environmental performance proxies and remains silent on other kinds of nonfinancial performance (e.g., social and governance issues). As sustainable investors demand an integration of ESG and financial factors for their financial analysis, aspects aside from environmental performance might also be relevant in future studies. Third, as we only rely on ACC and REM, the literature proposes alternative earnings quality measures, such as earnings smoothing, conservatism, and loss avoidance (e.g., Cheng & Kung, 2016), which should be included in future studies. The validity of accruals as proxies is criticized because of the complexity of variables used in prior research (e.g., Dechow et al., 2010). Finally, while we address endogeneity concerns (e.g., reversed causality) by including Granger causality tests, advanced regression methods, for example, two or three stage least squares (SLS) or generalized method of moments (GMM) models with instrumental variables (IV) (Wintoki, Linck, & Netter, 2012) for analyzing the ESG-earnings management

link are useful. As a summary, environmental performance and earnings management leaves many questions open for future empirical research.

ORCID

Patrick Velte D https://orcid.org/0000-0001-5960-8449

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