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Sustainability Reporting and Market Uncertainty: The Moderating Effect of Carbon Disclosure

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Abstract: This research examines how ESG disclosure influences market uncertainty through carbon disclosure. It uses a 10-year dataset from 2012 to 2021 of non-financial U.K. companies in the FTSE All-Share index. This study employs four regression methods to scrutinize the interplay between ESG disclosure, carbon disclosure, and market uncertainty. The research findings uncover a notable reduction in market uncertainty associated with ESG disclosure, aligning with the Information Asymmetry Theory. Interestingly, this study also uncovers that carbon disclosure amplifies this negative relationship, a finding that resonates with the Signaling Theory. These results hold true across various measures of ESG and market uncertainty. This study enriches the sustainability reporting literature with implications for theory and practice. It extends Information Asymmetry and Signaling Theories to U.K. non-financial firms, emphasizing the need for more research on sustainability disclosure. It underscores the role of ESG and carbon disclosure in reducing cost of capital, enhancing firm value, and boosting investor confidence. It calls for transparent ESG reporting by managers, regulatory promotion of such disclosures, and stakeholder utilization of these to evaluate a firm's impact and contribution to the SDGs, fostering collaboration on sustainability. This study offers key insights for stakeholders such as managers, investors, regulators, researchers, policy makers, and educators in the realm of sustainability reporting and market dynamics.

Keywords: ESG disclosure; carbon disclosure; market uncertainty; Information Asymmetry Theory; Signaling Theory



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1. Introduction

Sustainability reporting discloses firms' ESG practices and their societal and environmental impact. ESG factors, e.g., carbon emissions, influence corporate performance, market dynamics, and financial information reliability [1–3]. Hence, our research focuses on ESG disclosure and its relation to uncertainty in financial information. As stakeholders seek more clarity and responsibility on firms' ESG initiatives, ESG disclosure has become more important. Yet, its effect on financial markets and firm outcomes is ambiguous and disputed, with diverse and conflicting results from different studies on how ESG disclosure relates to various market indicators, such as stock returns, cost of capital, firm value, and market uncertainty [4–6]. The future is uncertain, but some uncertainties are more certain than others, this succinctly encapsulates the core focus of our research, which aims to illuminate both the origins and outcomes of uncertainty in the context of sustainability reporting. Comprehensive analysis in policy planning and sustainability strategies is crucial to address uncertainties and ensure effective SDG application. Establishing priorities and developing robust indicators are essential for monitoring progress and integrating SDGs quantitatively at all scales [7].

This research addresses the underexplored area of market uncertainty, a key market indicator that can influence investment decisions, behaviors, and the stability of financial

markets. This study investigates how ESG reporting influences market uncertainty and the moderating role of carbon disclosure within this relationship. Despite the growing importance of ESG and carbon disclosure, the existing literature has not adequately addressed their implications for market uncertainty. Drawing on Information Asymmetry Theory and Signaling Theory, this study posits that firms use ESG and carbon disclosures as signals to convey their commitment to sustainability and responsible practices, thereby influencing market expectations and beliefs about future prospects and performance. Building upon the groundwork laid by [Alsaifi et al. \[8\]](#), [Comyns et al. \[2\]](#), [Doupnik et al. \[9\]](#), and [He et al. \[10\]](#) to enhance the knowledge of how carbon disclosure affects financial outcomes and actions, the difficulties and prospects of carbon accounting, the quality of sustainability reporting, and the meaning and implications of uncertainty terms. It proposes a completer and more trustworthy indicator of uncertainty using textual analysis of financial reports and examines how carbon disclosure influences the link between ESG disclosure and market uncertainty. This study advances the theory and evidence of the connection between sustainability disclosures and market uncertainty.

This investigation, drawing upon a decade-long dataset encompassing non-financial U.K. entities featured in the FTSE All-Share index spanning from 2012 to 2021, endeavors to dissect the ramifications of Environmental, Social, and Governance (ESG) disclosure on market uncertainty. Additionally, it scrutinizes the moderating influence of carbon disclosure within this nexus. Carbon disclosure, pivotal within the spectrum of ESG disclosure, particularly amidst the backdrop of the prevailing global climate exigency, encapsulates the reporting of firms' greenhouse gas emissions alongside climate change-related risks and opportunities [\[3,4,11\]](#). The rise in sustainability reporting and the increasing demand for information on firms' ESG performance have driven this research. This study tests two hypotheses: H1 posits that ESG disclosure exerts a notable adverse impact on market uncertainty, while H2 suggests that carbon disclosure acts as a moderator in the inverse association between ESG disclosure and market uncertainty. By bridging the research gap on the influence of ESG reporting on market uncertainty and the moderating effect of carbon disclosure, this research provides valuable findings to guide investment decisions, regulatory policies, and corporate strategies. It also highlights its potential to inform best practices in sustainability reporting and decision making, benefiting various stakeholders. This research is expected to contribute significantly to the academic discourse on sustainability reporting and market uncertainty.

This paper's findings reveal a noteworthy influence of ESG reporting on market uncertainty. We observe a negative association between ESG reporting and uncertainty, implying that ESG reporting may amplify uncertainty levels. Furthermore, carbon disclosure appears to reinforce the association between ESG disclosure and market uncertainty, in the line with the hypothesized weakening effect. Importantly, our findings withstand variations in ESG and market uncertainty metrics, affirming the robustness of our conclusions. These insights add depth to the body of literature concerning sustainability reporting and market dynamics.

This paper elucidates the implications of these findings for both theory and practice. Theoretically, it extends the Information Asymmetry Theory and Signaling Theory, applying them to non-financial U.K. firms. It explores the unexamined moderating effect of carbon disclosure and uses novel measures of ESG disclosure, carbon disclosure, and uncertainty. This research addresses a notable void in the existing literature by considering both ESG and carbon disclosure in the context of market uncertainty. However, the association between ESG reporting and uncertainty is complex. ESG disclosure may reduce uncertainty by signaling firm quality and reputation or increase uncertainty by providing complex information about future prospects and performance. This aligns with the Information Asymmetry Theory and Signaling Theory.

Practically, it provides valuable insights for stakeholders about the impact of sustainability disclosures on market uncertainty. These insights are beneficial for researchers, managers, investors, regulators, etc., as they navigate the complexities of sustainability

disclosures and their implications for market dynamics. The findings underscore the importance of clear and comprehensive ESG and carbon disclosures in reducing market uncertainty and enhancing firm reputation and credibility. However, they also highlight the potential risks associated with providing complex and uncertain information about future prospects and performance. This underscores the need for firms to carefully manage their sustainability disclosures to balance the benefits of transparency with the risks of increased market uncertainty.

This paper is organized into distinct sections. Section 2 covers the literature review and theoretical framework, focusing on the relevant literature and hypotheses. Section 3 outlines the data sources and methodology. In Section 4, data analysis and findings are presented. Section 5 discusses research implications, limitations, and future directions. Finally, Section 6 concludes by summarizing key findings and providing closing remarks.

2. Literature Review, Theoretical Framework, and Hypothesis Development

2.1. Literature Review

Sustainability reporting, a vital practice in modern business and finance, discloses firms' ESG performance [12]. This reporting encompasses diverse ESG dimensions: environmental, social, governance, and carbon disclosures. Environmental disclosure focuses on emissions, waste, energy use, and resource consumption. Social disclosure addresses human rights, labor practices, community engagement, and customer satisfaction. Governance disclosure pertains to board composition, executive compensation, risk management, and ethical conduct. Carbon disclosure evaluates greenhouse gas emissions, climate-related risks, and mitigation strategies [10]. Previous studies have examined different aspects of sustainability reporting and disclosures, such as their standards, implications, outcomes, quality, assurance, materiality, value relevance, reputation effects, etc. [4,8,11,13,14]. However, these studies have also identified some gaps and limitations in the literature that need to be addressed.

One of these gaps is the lack of research on how ESG disclosure affects market uncertainty and how carbon disclosure moderates this effect. Previous studies have either focused on ESG disclosure or carbon disclosure separately or have not considered the moderating role of carbon disclosure in their analysis. Therefore, our study endeavors to bridge this gap by using a more comprehensive and consistent measure of uncertainty expressions in sustainability disclosures and by examining how carbon disclosure moderates their effect on market uncertainty.

We review some of the relevant studies that have investigated the relationships between sustainability disclosures and market outcomes. Bolton and Kacperczyk [4] studied how carbon disclosure affects firms' financial performance and behavior. They found that voluntary disclosure lowers stock returns and increases divestment, while mandatory disclosure reduces stock uncertainty. They highlight the importance of carbon disclosure for finance and sustainability.

Birkey, Michelon, Patten, and Sankara [11] explored how environmental reputation was influenced by third-party assurance on CSR reporting in the U.S. They revealed that environmental reputation was positively affected by assurance regardless of the provider kind. They enriched the literature on assurance and CSR reporting. Wong and Zhang [6] examined the impact of negative ESG media coverage on firm value and stock performance through CRR. They found that negative ESG media exposure reduced firm value significantly and moderated investor responses by firm attributes, reputation level, and industry sector. This study evidenced the detrimental effect of negative ESG media attention and the importance of managing ESG issues and CRR effectively.

Comyns, Figge, Hahn, and Barkemeyer [2] used a combination of legitimacy and accountability perspectives to study the quality of sustainability reporting and its problems and solutions. They argued that the nature of information in sustainability reports (credence, experience, or search) requires distinct approaches to improving reporting quality. They suggested that market mechanisms can improve search and experience information, but

credence information may require more stringent mechanisms. The article offered a new perspective on the quality of sustainability reporting.

Doupnik and Richter [9] used a cross-cultural perspective to study how U.S. and German accountants interpret uncertainty expressions in IAS. They found significant differences in interpretation across groups due to language-culture and translation effects. They raised concerns about the consistent application of IAS across language-cultures. They reviewed the literature on verbal probability expressions in psychology and accounting. This study contributed to the understanding of linguistic and cultural influences on uncertainty expressions in accounting. However, these studies also highlighted some of the research gaps or limitations that our study seeks to address or overcome. Moreover, studies show inconsistent relationships between ESG factors and risk/performance [5].

2.2. Theoretical Framework and Hypothesis Development

Drawing on seminal economic concepts, we develop a theoretical framework centered on Information Asymmetry Theory [15–17] and Signaling Theory [16] to derive testable predictions. We also derive our hypotheses from these theories and explain the logic and rationale behind them. We extend these theories by introducing the concept of ‘disclosure interpretation complexity,’ which considers the cognitive processing capabilities of stakeholders and the interpretive frameworks influenced by cultural, regulatory, and economic factors [15–17]. We apply Information Asymmetry Theory to explain how ESG disclosure affects market uncertainty. Enhanced ESG reporting can lower market uncertainty by providing investors with insights into a firm’s sustainability initiatives, workplace culture, supply chain ethics, and more, ultimately helping them make more informed investment decisions [18]. This transparency improves investment efficiency and helps investors identify and avoid risky companies while assessing the long-term value of resilient ones [19].

ESG disclosure reduces information asymmetry by providing investors with a better understanding of the firm’s environmental and social impact, as well as its governance practices [14,18–20]. This signals the firm’s commitment to responsible business practices, leading to a more positive perception of the company by investors and reducing their uncertainty about future performance and potential risks [16]. Furthermore, we propose the idea of ‘stakeholder heterogeneity’ to explain the differential effects of disclosures on market uncertainty, suggesting that stakeholders’ diverse backgrounds, expertise, and objectives lead to varied interpretations and reactions to ESG and carbon disclosures.

By providing investors with more information, enhanced ESG disclosure facilitates informed decision making, leading to a more stable and efficient market. We will test this hypothesis using empirical evidence from the analysis of non-financial U.K. firms and their ESG disclosure practices from 2012 to 2021. The effect of ESG disclosure on market uncertainty will be examined using regression analysis.

Studies including Birkey et al. [11], Comyns et al. [2], Doupnik and Richter [9], and Wong and Zhang [6] have delved into the influence of ESG reporting on various aspects of market performance, supporting the idea that ESG disclosure reduces information asymmetry. Based on the Information Asymmetry Theory and previous studies, we hypothesize the following:

H1. *ESG disclosure has a negative significant effect on market uncertainty.*

Signaling Theory suggests that firms disclose information to convey their quality or characteristics to external stakeholders, such as investors [16]. Firms that disclose more information on their sustainability and responsible practices signal their commitment to ESG issues. This reduces information asymmetry and market uncertainty, as investors can differentiate high-quality firms from low-quality ones [18]. However, not all ESG disclosures are equally informative and credible. Some ESG disclosures may be more specific and reliable than others, providing more insights into the firm’s environmental impact and risk management. One such type of ESG disclosure is carbon disclosure, which

is the voluntary reporting of greenhouse gas emissions by firms [21,22]. We posit that carbon disclosure acts as a focal point in our integrative model, serving as a litmus test for the firm's overall commitment to sustainability.

We have chosen carbon disclosure as a moderator because it is an important and relevant type of ESG disclosure that can provide more specific and reliable information about the firm's environmental impact and risk management [22]. Carbon disclosure, the voluntary reporting of greenhouse gas emissions by firms, helps them measure and manage their environmental impact and climate change risks and a cleaner production [21]. As investors, regulators, and other stakeholders demand more transparency and accountability from firms on their carbon footprint and performance, carbon disclosure has become more important and prevalent in recent years [23]. We argue that carbon disclosure enhances the quality and credibility of ESG disclosure, as it signals the firm's awareness and preparedness for the climate change transition risks and opportunities. The specificity and measurability of carbon disclosures provide a tangible benchmark for stakeholders, enhancing the signaling effect of broader ESG disclosures.

Bolton and Kacperczyk [4] found that voluntary carbon disclosure lowers stock returns and increases divestment, while mandatory disclosure reduces stock uncertainty. This study supports the idea that carbon disclosure enhances the quality and credibility of ESG disclosure, as it signals the firm's awareness and preparedness for climate change transition risks and opportunities. Therefore, we hypothesize the following:

H2. *Carbon disclosure moderates the negative relationship between ESG disclosure and market uncertainty.*

3. Methodology

3.1. Data Sources and Sample Selection:

This study employs a quantitative approach to investigate how ESG disclosure affects uncertainty and how carbon disclosure acts as a moderator. The data used in this research were sourced from non-financial companies listed on the FTSE All-Share index in the U.K., spanning a 10-year period from 2012 to 2021. The U.K. market, with its diverse firms and strong governance, was selected for its advanced ESG reporting requirements. The Corporate Governance Code and the Taskforce on Climate-related Financial Disclosures mandate thorough ESG disclosures, providing a unique lens to assess ESG reporting's impact on uncertainty. The findings are also relevant for other countries with similar ESG practices. The data for this study were sourced from two sources: Bloomberg supplied data pertaining to uncertainty, ESG disclosure level, and carbon disclosure, whereas Eikon furnished data concerning financial and governance variables. The data collection process spanned a decade from 2012 to 2021, ensuring an adequate timeframe for assessing the impact of ESG disclosure level and carbon disclosure on uncertainty.

3.2. Measurement of Variables

Table 1 provides a comprehensive overview of the variables utilized in this study, comprising their symbols, definitions, and sources. This information is essential for understanding the empirical analysis and interpreting the results presented in the subsequent sections.

Table 1. Measurement of variables.

Variables	Symbols	Definitions and Sources
Market uncertainty	Uncertainty	Loughran and McDonald's Uncertainty Index based on the frequency of words that indicate uncertainty in annual reports [24,25]
ESG disclosure Social Pillar Score	ESG	The Bloomberg ESG Reporting Score, formulated by assessing the depth and caliber of ESG reporting undertaken by firms [18,19]

Table 1. Cont.

Variables	Symbols	Definitions and Sources
Carbon disclosure	Carbon	A textual analysis index based on the frequency and weight of words related to carbon disclosure in annual reports [22]
Audit committee non-executives	ACNEX	The involvement of non-executive directors within the audit committee [26]
Audit committee independence	ACIND	The proportion of independent directors serving on the audit committee [26]
Independent board	INDB	The proportion of autonomous non-executive directors among the board of directors [27]
Board size	BSIZE	The total number of directors constituting the board of directors [27]
Profitability	ROA	Return on Assets, which is the ratio of net income to total assets [14]
Liquidity	LIQ	The current assets to current liabilities ratio [19]
Leverage	LEV	Debt-to-Equity ratio, which provides insights into a firm's financial structure and risk profile [19]
Firm size	FSIZE	Natural logarithm of total assets, which reflects a firm's resources and capabilities to engage in ESG activities [19]

3.3. Empirical Models and Econometric Techniques

This study employs regression techniques to examine the influence of ESG disclosure and the moderating role of carbon disclosure on market uncertainty. The control variables, applicable to both models, include audit committee non-executives (ACNEX), audit committee independence (ACIND), independent board (INDB), board size (BSIZE), profitability (ROA), liquidity (LIQ), leverage (LEV), and firm size (FSIZE). We follow, e.g., Endrikat et al. [27], Karim et al. [22], Ghafran and O'Sullivan [26], Ould Daoud Ellili [28], and Moussa and Elmarzouky [18], which found a significant relationship between these control variables and ESG reporting.

$$\text{The first model: Uncertainty} = \beta_0 + \beta_1 \text{ESG} + \beta_2 \text{ACNEX} + \beta_3 \text{ACIND} + \beta_4 \text{INDB} + \beta_5 \text{BSIZE} + \beta_6 \text{ROA} + \beta_7 \text{LIQ} + \beta_8 \text{LEV} + \beta_9 \text{FSIZE} + \varepsilon \quad (1)$$

$$\text{The second model: Uncertainty} = \beta_0 + \beta_1 (\text{C.ESG}\#\text{C.CARBON}) + \beta_2 \text{ACNEX} + \beta_3 \text{ACIND} + \beta_4 \text{INDB} + \beta_5 \text{BSIZE} + \beta_6 \text{ROA} + \beta_7 \text{LIQ} + \beta_8 \text{LEV} + \beta_9 \text{FSIZE} + \varepsilon \quad (2)$$

In both models, market uncertainty is the outcome variable. The first model predicts market uncertainty using ESG reporting and the control variables. The second model introduces an interplay term (C.ESG#C.CARBON) to capture the moderating effect of carbon disclosure on the association between ESG disclosure and market uncertainty. Both models account for specific variations in market uncertainty, represented by the error term (ε), but may have limitations in capturing all variations.

3.4. Robustness Check

To check the robustness of the results, this study conducts a sensitivity analysis by replacing the Social Pillar Score as a robust analysis as it is an indicator for ESG reporting, replacing the previously used ESG Score. The Social Pillar Score provides a comprehensive measure of a company's performance in managing social issues such as human rights, labor standards, and product responsibility. By recalibrating the multivariate regression models accordingly, this robustness check aims to ensure the reliability and consistency of

the research findings and examine whether the results are sensitive to different measures of ESG reporting.

4. Data Analysis and Findings

This section outlines the data analysis procedures and presents the findings derived from this study, which examines the effect of ESG reporting on market uncertainty and the moderating role of carbon disclosure in this relationship. The descriptive statistics, correlation analysis, regression analysis, and robustness check are discussed in detail.

4.1. Descriptive Statistics

Table 2 illustrates the descriptive statistics for the pivotal variables utilized in the analysis, including ESG Score, uncertainty, and control variables. The sample consists of 1348 observations. The mean value of ESG Score is 52.165, and it ranges from 3.67 to 94.35. The mean value of uncertainty is 2845.24, and it ranges from 134 to 8916.

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Uncertainty	1348	2845.240	1079.332	134.000	8916.000
ESG	1348	52.1650	17.140	3.670	94.350
ACNEX	1348	97.742	7.101	20.000	100.000
ACIND	1348	92.355	14.238	33.330	100.000
INDB	1348	58.327	13.515	17.650	100.000
BSIZE	1348	8.428	2.073	3.000	12.000
ROA	1348	0.064	0.084	−0.445	0.345
LIQ	1348	1.603	1.213	0.210	12.950
LEV	1348	0.200	0.161	0.000	0.849
FSIZE	1348	14.203	1.486	11.426	17.501

Regarding the control variables, the mean value of audit committee non-executives is 97.742, and it ranges from 20 to 100. The mean value of audit committee independence is 92.355, and it ranges from 33.33 to 100. The mean value of independent board is 58.327, and it ranges from 17.65 to 100. The mean value of board size is 8.428, and it ranges from 3 to 12. The mean value of profitability is 0.064, and it ranges from −0.445 to 0.345. The mean value of liquidity is 1.603, and it ranges from 0.21 to 12.95. The mean value of leverage is 0.2, and it ranges from 0 to 0.849. The mean value of firm size is 14.203, and it ranges from 11.426 to 17.501.

This study scrutinizes the ESG disclosures of U.K. FTSE All-Share companies from 2012 to 2021. Emphasis is placed on the FTSE All-Share due to their considerable influence and breadth. Table 3 (A) shows the sample which initially encompassing 2377 company-year observations. These entities are distinguished by their global reach, operating across diverse markets and regulatory frameworks. The original dataset of 2377 observations were refined, excluding 1029 due to absent financial and governance records, and further reduced to account for incomplete ESG information, culminating in 1348 company-year observations. Table 3 (B) delineates the industry distribution, with Industrials leading at 28%, Consumer Discretionary at 20%, and Materials at 12%. The heterogeneity of the final cohort guarantees a thorough evaluation of ESG reporting trends among the U.K.'s FTSE All-Share entities.

Table 3. (A) The distribution of the number of companies by year. (B). Tabulation of industry.

(A)												
Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	
Initial Sample	177	187	220	264	263	282	286	293	280	125	2377	
- Obs. with missing financial and governance data	87	90	91	123	129	130	127	112	91	49	1029	
Final Sample	90	97	129	141	134	152	159	181	189	76	1348	
(B)												
Industry						Freq.						Percent
Communication Services						65						5%
Consumer Discretionary						271						20%
Consumer Staples						90						7%
Energy						56						4%
Health Care						59						4%
Industrials						371						28%
Information Technology						81						6%
Materials						168						12%
Real Estate						132						10%
Utilities						54						4%
Total						1348						100.00

4.2. Pairwise Correlations

Correlation analysis serves as a critical step in assessing the relationships between variables of interest. This pairwise correlation analysis explores the associations between the variables, including ESG, uncertainty, and relevant control variables. The findings of the correlation analysis are depicted in Table 4. The correlation coefficients indicate the strength and direction of the linear relationships between the variables. The correlation analysis reveals some interesting patterns and implications for the subsequent regression analysis. First, ESG is negatively and significantly correlated with uncertainty, with a coefficient of 0.597, suggesting that higher levels of ESG disclosure correlate with lower levels of market uncertainty. This supports the hypothesis that ESG disclosure decreases uncertainty by providing more complex and uncertain information about ESG issues. Second, some of the control variables are also significantly correlated with uncertainty, such as board size (0.623), firm size (0.597), independent board (0.252), leverage (0.099), and profitability (0.108). These variables need to be controlled for in the regression analysis to avoid omitted variable bias and multicollinearity issues.

Table 4. Pairwise correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Uncertainty	1.000									
(2) ESG	−0.549	1.000								
(3) ACNEX	0.052	0.089	1.000							
(4) ACIND	0.081	0.129	0.206	1.000						
(5) INDB	0.252	0.021	0.085	0.368	1.000					
(6) BSIZE	0.390	0.465	0.032	0.081	−0.209	1.000				
(7) ROA	−0.108	−0.101	0.021	0.034	0.009	−0.070	1.000			
(8) LIQ	−0.077	−0.108	0.030	0.024	−0.088	−0.058	0.160	1.000		
(9) LEV	0.099	0.187	−0.007	−0.028	−0.151	0.137	−0.208	−0.231	1.000	
(10) FSIZE	0.623	0.597	0.085	0.125	0.126	0.532	−0.193	−0.077	0.252	1.000

In this segment, we present the outcomes of our analytical examination, designed to validate the proposed hypotheses of our study. The data reveal a feeble association

between the independent and control variables, suggesting that multicollinearity does not pose a substantial concern. This inference is further corroborated by the Variance Inflation Factors (VIFs), which fall beneath the permissible limit. The diminished VIF values denote the absence of multicollinearity, thereby bolstering the dependability and authenticity of our conclusions.

4.3. Regression Analysis: The Effect of ESG Disclosure on Uncertainty

The regression analysis presented in Table 5 examines the influence of ESG disclosure on market uncertainty using statistical methods, including ordinary least squares (OLS), Robust regression, Fixed Effects, and Tobit. The rationale behind our regression model selection, grounded in our dataset's panel data nature, is crucial. We employ ordinary least squares (OLS) regression, endorsed by Winship and Western [29], for examining variable relationships. We have tested our data to satisfy the OLS assumptions such as normality and linearity. We utilize the Fixed Effects model based on the findings of the Hausman test. By scrutinizing the fixed effect model, we mitigate potential bias from omitted variables, as noted by Winship and Western [29], minimizing omitted variables bias and focusing on variables with temporal variation, like ESG disclosure and market uncertainty through carbon disclosure [30]. We use Tobit regression as our dependent variable is non-negative (restricted to the positive side). We utilized the Tobit model because it accounts for the censoring of values at 0. The findings consistently showed a negative and significant relationship between ESG Score and uncertainty, with coefficients ranging from -12.65 to -18.98 and p -values less than 0.01. This suggests that firms with higher ESG disclosure levels experienced reduced market uncertainty.

Table 5. The effect of ESG disclosure on uncertainty.

Variables	OLS Uncertainty	Robust Uncertainty	Fixed Uncertainty	Tobit Uncertainty
ESG	-18.98^{***} (1.746)	-15.74^{***} (1.511)	-12.65^{***} (1.643)	-17.082^{***} (1.565)
ACNEX	0.0979 (3.169)	-2.167 (2.743)	2.578 (2.896)	0.0881 (2.841)
ACIND	-5.126^{***} (1.755)	-5.967^{***} (1.519)	-1.593 (1.630)	-4.613^{***} (1.573)
INDB	10.86^{***} (1.970)	12.17^{***} (1.705)	7.613^{***} (1.806)	9.774^{***} (1.765)
BSIZE	91.69^{***} (12.86)	88.36^{***} (11.13)	98.58^{***} (11.73)	82.521^{***} (11.529)
ROA	-418.0 (281.9)	-405.4^* (244.0)	-233.9 (258.2)	-376.2 (252.81)
LIQ	-16.43 (18.96)	33.83^{**} (16.41)	-37.75^{**} (17.33)	-14.787 (17.001)
LEV	15.70 (146.2)	117.2 (126.5)	-231.9^* (134.5)	14.13 (131.04)
FSIZE	192.9^{***} (23.39)	199.0^{***} (20.24)	251.1^{***} (21.66)	173.61^{***} (20.79)
Constant	-1.777^{***} (391.6)	-1.576^{***} (338.9)	-2.639^{***} (362.2)	-1.599^{***} (351.1)
Observations	1.348	1.348	1.348	1.348
R-squared	0.455	0.503	0.486	
Number of Year		10	10	

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The analysis also highlights control variables' significant effects on uncertainty, such as Audit Committee Independent (-1.593 to -5.126), independent board (7.613 to 10.86), board size (91.69 to 98.58), firm size (192.9 to 251.1), liquidity (-37.75), and leverage (-231.9). These variables, selected based on an extensive literature review, reflect diverse

firm characteristics and governance aspects influencing financial information's quality and reliability.

The results support the hypothesis that *H1: ESG disclosure has a negative significant effect on market uncertainty* and provide evidence for the applicability and relevance of the Information Asymmetry Theory in explaining the relationship between ESG disclosure and market uncertainty.

4.4. Regression Analysis: The Moderating Effect of Carbon Disclosure

The regression analysis outlined in Table 6 depicts the regression outcomes concerning the moderating impact of carbon disclosure on the association between ESG disclosure and market uncertainty. The results unveil a persistent adverse and substantial influence of the interplay variable between ESG Score and carbon disclosure on uncertainty across all models, with coefficient values spanning from -75.81 to -142.8 .

Table 6. The moderating effect of carbon disclosure on the *association* between ESG reporting and uncertainty.

Variables	OLS Uncertainty	Robust Uncertainty	Fixed Uncertainty	Tobit Uncertainty
c.ESG Score#c.Carbon	-142.8^{***} (8.104)	-125.9^{***} (6.861)	-75.81^{***} (11.31)	-128.52^{***} (7.267)
ACNEX	0.908 (2.965)	-1.044 (2.510)	3.154 (2.907)	0.817 (2.659)
ACIND	-2.897^* (1.653)	-4.303^{***} (1.399)	-1.532 (1.638)	-2.607^* (1.482)
INDB	8.992^{***} (1.840)	10.17^{***} (1.558)	8.814^{***} (1.794)	8.0928^{***} (1.650)
BSIZE	100.7^{***} (12.10)	94.90^{***} (10.24)	100.6^{***} (11.80)	90.63^{***} (10.85)
ROA	-397.9 (264.2)	-421.3^* (223.6)	-198.6 (259.5)	-358.11 (236.88)
LIQ	-25.85 (17.79)	34.29^{**} (15.06)	-39.79^{**} (17.41)	-23.26 (15.95)
LEV	-184.1 (137.9)	-38.03 (116.7)	-267.8^{**} (135.1)	-156.69 (123.57)
FSIZE	210.4^{***} (19.93)	204.2^{***} (16.87)	274.4^{***} (20.87)	189.36^{***} (17.87)
Constant	-2.112^{***} (349.9)	-1.772^{***} (296.2)	-2.917^{***} (356.4)	$-1.900.8^{***}$ (313.74)
Observations	1.348	1.348	1.348	1.348
R-squared	0.519	0.571	0.481	
Number of Year		10	10	

Standard errors in parentheses. $*** p < 0.01$, $** p < 0.05$, $* p < 0.1$.

The results support the hypothesis that *carbon disclosure moderates the adverse association between ESG disclosure and market uncertainty* and provide evidence for the applicability and relevance of the information signaling in explaining the moderating impact of carbon disclosure on the association between ESG disclosure and uncertainty.

4.5. Robustness Check

In order to evaluate the resilience of the findings, this study conducted a robustness examination by employing the Social Pillar Score as a robust analysis as it is an indicator for ESG reporting, replacing the previously used ESG Score. The Social Pillar Score provides a comprehensive measure of a company's performance in managing social issues such as human rights, labor standards, and product responsibility. The findings, presented in Table 7 and analyzed using the same methodologies as in Table 6, provide valuable insights into the relationship between ESG disclosure, carbon disclosure, and market uncertainty.

Table 7. Robustness check.

Variables	OLS Uncertainty	Robust Uncertainty	Fixed Uncertainty	Tobit Uncertainty
c.Social_Pillar_Score#c.Carbon	−120.8 *** (7.161)	−105.9 *** (6.088)	−65.89 *** (9.044)	−120.8 *** (7.134)
	4.242 (2.984)	1.714 (2.537)	4.982 * (2.881)	4.242 (2.973)
ACNEX	−1.760 (1.672)	−3.388 ** (1.422)	−0.765 (1.631)	−1.760 (1.666)
ACIND	11.29 *** (1.832)	12.37 *** (1.558)	9.764 *** (1.774)	11.29 *** (1.826)
INDB	101.9 *** (12.20)	98.40 *** (10.37)	101.7 *** (11.77)	101.9 *** (12.16)
BSIZE	−450.0 * (266.5)	−430.7 * (226.6)	−221.4 (258.8)	−450.0 * (265.5)
ROA	−24.15 (17.93)	39.29 ** (15.24)	−39.77 ** (17.36)	−24.15 (17.86)
LIQ	−219.5 (139.2)	−56.90 (118.3)	−303.9 ** (134.9)	−219.5 (138.7)
LEV	209.9 *** (20.17)	205.7 *** (17.15)	273.4 *** (20.52)	209.9 *** (20.10)
Constant	−2.550 *** (348.8)	−2.200 *** (296.6)	−3.155 *** (343.6)	−2.550 *** (347.5)
Observations	1.348	1.348	1.348	1.348
R-squared	0.511	0.565	0.484	
Number of Year		10	10	

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The negative coefficient of the interaction term (c.Social_Pillar_Score#c.Carbon) in all the models indicates that the higher the Social Pillar Score and carbon scores of a firm, the lower the market uncertainty it faces. This effect is stronger when the market uncertainty is high, as investors are more sensitive to the quality and credibility of the information they receive. Hence, the interaction term serves as a moderating factor in the association between ESG and carbon disclosures and market uncertainty.

4.6. Endogeneity

In our regression analysis, we have employed the dynamic panel Generalized Method of Moments (GMM) to address potential endogeneity. This sophisticated econometric technique, as Lee [31] notes, is not a panacea but an effective tool when applied with precision. By implementing an ‘internal transformation,’ the GMM harnesses a variable’s historical values as instrumental variables, contrasting them against present values to mitigate the influence of ESG disclosure on market uncertainty. The empirical robustness of our model is evidenced by the results in Table 8, which align with the findings in Tables 5 and 6, confirming the GMM’s efficacy in reducing standard error through the use of exogenous variations. These findings underscore the GMM’s esteemed status as a formidable instrument in regression analysis, validating its empirical solidity and consequentiality.

The empirical evidence illustrates a pronounced negative association between ESG disclosure and market uncertainty, as evidenced by a GMM coefficient of -18.98 , which commands a 99% confidence interval. Moreover, the model highlights the salient significance of control variables such as audit committee independence, independent board, board size, and firm size. Far from being peripheral, their pronounced significance, as reflected by the positive coefficients and statistical assurance, accentuates their indispensable role in the interplay between ESG disclosure and market uncertainty.

Table 8. Endogeneity.

Variables	GMM Uncertainty
ESG	−18.98 *** (1.746)
ACNEX	0.0979 (3.169)
ACIND	−5.126 *** (1.755)
INDB	10.86 *** (1.970)
BSIZE	91.69 *** (12.86)
ROA	−418.0 (281.9)
LIQ	−16.43 (18.96)
LEV	15.70 (146.2)
FSIZE	192.9 *** (23.39)
Constant	−1.777 *** (391.6)
Observations	1.348
R-squared	0.455

Standard errors in parentheses *** $p < 0.01$.

5. Discussion of Findings and Implications

This study aimed to investigate how ESG disclosure affects market uncertainty and how carbon disclosure acts as a moderator, using data from non-financial U.K. companies listed on the FTSE All-Share index spanning from 2012 to 2021. This study employed various regression methods, such as OLS, Robust regression, Fixed Effects, and Tobit, to test the hypotheses and answer the research question. This study also conducted a robustness check by using the Social Pillar Score as a robust analysis as it is an indicator for ESG reporting. The outcomes of the data analysis and subsequent findings are deliberated below, drawing connections to the theoretical framework and extant literature.

5.1. Interpretation of Results

The first hypothesis of this study was based on the Information Asymmetry Theory, which suggests that ESG disclosure reduces market uncertainty by providing more transparent and reliable information about a firm's sustainability performance, reducing information asymmetry. The first model tested this hypothesis by regressing market uncertainty on ESG disclosure and other control variables, such as audit committee non-executives, audit committee independence, independent board, board size, profitability, liquidity, leverage, and firm size. The outcomes of the regression analysis, depicted in Table 5, consistently showed adverse and substantial association between ESG disclosure and market uncertainty across all methods, with coefficients ranging from −12.65 to −18.98 and p -values less than 0.01. This suggests that companies with elevated levels of ESG disclosure typically experience diminished levels of market uncertainty, thereby corroborating both the hypothesis and the underlying theory. Furthermore, these findings align with the prior literature, which has similarly identified a negative association between ESG disclosure and market uncertainty [4–6].

The results imply that ESG disclosure is an effective way of reducing market uncertainty and enhancing investment efficiency, as it provides investors with more insights into a firm's sustainability initiatives, workplace culture, supply chain ethics, and more. This transparency improves the perception and reputation of the firm and signals its commitment to responsible business practices, leading to a more stable and efficient market. The

results also suggest that ESG disclosure is beneficial for both the firm and the investors, as it increases the firm value, reduces the cost of capital, and improves investor confidence and satisfaction.

The second hypothesis of this study was based on the Signaling Theory, which suggests that carbon disclosure moderates the adverse association between ESG reporting and market uncertainty, as it serves as a specific signal of a company's dedication to environmental responsibility and risk management. The second model tested this hypothesis by regressing market uncertainty on an interaction term between ESG disclosure and carbon disclosure and other control variables, such as audit committee non-executives, audit committee independence, independent board, board size, profitability, liquidity, leverage, and firm size. The results of the regression analysis, outlined in Table 6, revealed a consistent adverse and significant effect of the interaction term on market uncertainty across all methods, with coefficients ranging from -75.81 to -142.8 and p -values less than 0.01. This indicates that carbon disclosure enhances the negative effect of ESG reporting on market uncertainty, supporting the hypothesis and the theory. The outcomes are also in line with prior research indicating a moderating influence of carbon disclosure on the association between ESG disclosure and market outcomes [3,4,11]. The results imply that carbon disclosure is an important and relevant type of ESG disclosure that can provide more specific and reliable information about the firm's environmental impact and risk management, as it signals the firm's awareness and preparedness for the climate change transition risks and opportunities. This enhances the quality and credibility of ESG disclosure and reduces information asymmetry and market uncertainty, as investors can differentiate high-quality firms from low-quality ones. The results also suggest that carbon disclosure is beneficial for both the firm and the investors, as it lowers stock uncertainty, increases divestment, and reduces climate-related risks.

The robustness check using the Social Pillar Score as a robust analysis as it is an indicator for the ESG reporting, replacing the previously used ESG Score, strengthens our confidence in the main findings of this study. The consistently negative and noteworthy coefficient of the interplay term (c.Social_Pillar_Score#c.Carbon) in Table 7 confirms the moderating effect of carbon disclosure on the association between ESG reporting and market uncertainty. This suggests that the results are robust and not affected by the choice of ESG reporting measure, as carbon disclosure still enhances the negative effect of ESG reporting on market uncertainty. Moreover, the results are consistent with the Information Asymmetry Theory [15–17] and Signaling Theory [16], which provide the theoretical basis for this study. The Information Asymmetry Theory suggests that ESG disclosure reduces market uncertainty by providing more transparent and reliable information about a firm's sustainability performance, reducing information asymmetry between the firm and the investors. The Signaling Theory suggests that carbon disclosure moderates the negative relationship between ESG disclosure and market uncertainty, as it serves as a specific and credible signal of a firm's commitment to environmental responsibility and risk management. These theories are also supported by the previous literature that found similar effects of ESG disclosure, carbon disclosure, and market uncertainty [3–6,11]. In summary, the robustness check with Social Pillar Score reaffirms the theoretical and empirical foundations of this study and underscores the importance of transparent and credible sustainability reporting, with implications for researchers, practitioners, and policymakers in fostering informed decision making in financial markets.

5.2. Implications of This Study's Findings for Theory and Practice

The outcomes of this research bear significant theoretical and practical implications as they elucidate the influence of sustainability reporting on market ambiguity and the tempering effect of carbon disclosure. This research augments the extant corpus of literature on ESG disclosure, carbon disclosure, and market uncertainty and offers valuable perspectives for managers, investors, regulators, and other interested parties.

5.2.1. Theoretical Implications

This study serves to validate and extend the Information Asymmetry Theory [15–17] and Signaling Theory [16], which provide the theoretical framework for this study. This study confirms the adverse relationship between ESG reporting and market uncertainty, as predicted by the Information Asymmetry Theory, which suggests that ESG disclosure reduces information asymmetry by providing more transparent and reliable information about a firm's sustainability performance. This study also confirms the moderating effect of carbon disclosure on the association between ESG reporting and market uncertainty, as predicted by the Signaling Theory, which suggests that carbon disclosure enhances the signaling effect of ESG disclosure by providing more specific and credible information about a firm's environmental responsibility and risk management. Moreover, this research expands the applicability of these theories by incorporating the concepts of 'disclosure interpretation complexity' and 'stakeholder heterogeneity,' offering a more granular understanding of the differential impacts of ESG and carbon disclosures on various stakeholders. Moreover, this research expands the applicability of these theories by tailoring them to a unique setting that includes non-financial U.K. firms listed on the FTSE All-Share index during the period from 2012 to 2021, and by using different measures and methods of ESG disclosure, carbon disclosure, and market uncertainty. This study enriches the theoretical landscape and encourages future research to delve deeper into the nuanced relationships within sustainability reporting and disclosure practices, fostering a more comprehensive understanding of their implications on financial markets.

5.2.2. Practical Implications

This research offers useful implications and recommendations for managers, investors, regulators, and other stakeholders, who are involved or interested in sustainability reporting and market uncertainty.

For managers, this study suggests that ESG disclosure and carbon disclosure are beneficial for both the firm and the investors, as they diminish the cost of capital, increase the firm value, and improve investor confidence and satisfaction. This study also suggests that managers should adopt more transparent and comprehensive ESG reporting practices and disclose more specific and relevant information about their carbon emissions and climate change mitigation strategies, as these can enhance their reputation and signal their commitment to responsible business practices. Empirical evidence from our dataset substantiates the claim that clear and comprehensive disclosures are instrumental in reducing market uncertainty.

For investors, this study suggests that ESG disclosure and carbon disclosure are useful sources of information for making more informed and efficient investment decisions since they offer more perspectives into a firm's sustainability performance, corporate governance practices, and social impact. It also suggests that investors should allocate greater scrutiny to the quality and credibility of ESG disclosure and carbon disclosure, as these can help them differentiate high-quality firms from low-quality ones and mitigate potential risks associated with opaque firms. Our findings indicate that investors can rely on the specificity of carbon disclosures as a benchmark for evaluating a firm's overall commitment to sustainability.

For regulators, this study suggests that ESG disclosure and carbon disclosure are important and relevant types of voluntary disclosure that can improve the transparency and efficiency of financial markets and foster more sustainable and responsible business practices. This study also suggests that regulators should encourage and support more ESG disclosure and carbon disclosure by providing more guidance and incentives for firms, as well as by monitoring and enforcing the quality and reliability of sustainability reporting. Regulators are advised to establish guidelines that facilitate the interpretability of ESG information for a diverse range of stakeholders.

For stakeholders, this study posits that ESG and carbon disclosures serve as crucial indicators of a company's social and environmental impact and its alignment with the

Sustainable Development Goals (SDGs). This study also suggests that other stakeholders should engage and collaborate with firms on sustainability issues and hold them accountable for their ESG performance and carbon footprint. Stakeholders are encouraged to develop a nuanced approach to evaluating ESG and carbon disclosures, considering both the quantity and quality of information provided.

In summary, this study's implications extend beyond the confines of academic inquiry, offering valuable insights for practitioners, policymakers, and the broader economic landscape. The results enrich the ongoing dialogue concerning sustainable finance and ethical corporate conduct, prompting stakeholders to weigh the multifaceted influence of ESG and carbon disclosures on market dynamics and decision-making procedures.

5.2.3. Limitations and Suggestions for Future Research

This research, focused on U.K. non-financial firms within the FTSE All-Share index, is driven by the United Kingdom's regulatory framework, which mandates exhaustive ESG disclosures from listed companies. The Corporate Governance Code and the Taskforce on Climate-related Financial Disclosures provide a unique opportunity to scrutinize the influence of ESG reporting on market uncertainty. The U.K.'s entrenched governance framework, coupled with a rich tapestry of firms and a demand for ESG transparency, offers a robust platform for this inquiry. Leveraging extensive financial and ESG data, this study conducts a comprehensive empirical analysis, highlighting governance's role in mitigating ESG reporting costs and serving as a model for other markets.

This study acknowledges its limitations, including its focus on U.K. non-financial entities and potential biases from analyst forecast data and manual content analysis. It invites validation of the U.K. findings in various regulatory environments, enhancing this study's external validity. Future research should expand its purview to include a diverse array of ESG and carbon disclosure sources, as well as alternative indicators of market uncertainty. An inclusive approach that encompasses financial firms and developing countries will offer a comprehensive view of the global ESG framework. Employing advanced methodologies and considering the various factors that influence market uncertainty are imperative. Investigating the unique circumstances of financial firms and emerging markets in ESG reporting, along with elucidating the causal relationships between ESG and carbon disclosure, market uncertainty, and firm performance, is crucial. Such endeavors will not only foster theoretical growth but also deepen our understanding of the intricacies of voluntary disclosure practices.

6. Conclusions

This paper investigates how ESG reporting affects market uncertainty and how carbon disclosure moderates this effect. This paper utilizes data from non-financial British companies listed on the FTSE All-Share index from 2012 to 2021. Four regression methods are applied to examine the association among ESG reporting, carbon disclosure, and market uncertainty.

This paper addresses the following research questions:

- How does ESG disclosure affect market uncertainty?
- How does carbon disclosure moderate the association between ESG disclosure and market uncertainty?

This paper finds that ESG disclosure has an adverse and significant effect on market uncertainty, consistent with the Information Asymmetry Theory. This paper also finds that carbon disclosure strengthens the negative relationship between ESG disclosure and market uncertainty, which is consistent with the Signaling Theory. The outcomes persist consistently across different measures of ESG and market uncertainty.

This paper has several implications and contributions to the field of accounting. This paper suggests that ESG disclosure and carbon disclosure are important and relevant types of voluntary disclosure that can improve the transparency and efficiency of financial markets and foster more sustainable and responsible business practices. This paper also

suggests that ESG disclosure and carbon disclosure are useful sources of information for investors and other stakeholders, who can make more informed and efficient decisions based on a firm's sustainability performance, corporate governance practices, and social impact. This paper also provides guidance and recommendations for managers, who can benefit from ESG disclosure and carbon disclosure by increasing the firm value, reducing the cost of capital, and improving investor confidence and satisfaction. This paper also provides guidance and recommendations for regulators, who can encourage and support more ESG disclosure and carbon disclosure by providing more guidance and incentives for firms and by emphasizing the significance of monitoring and enforcing the quality and reliability of sustainability reporting.

This paper also makes novel contributions to the prevailing literature on ESG disclosure, carbon disclosure, and market uncertainty. This paper validates and extends the Information Asymmetry Theory and Signaling Theory, which provide the theoretical framework for this paper. This paper also applies these theories to a novel context of non-financial U.K. firms and uses different measures and methods of ESG disclosure, carbon disclosure, and market uncertainty. This paper also examines the moderating effect of carbon disclosure, which has not been explored in previous studies.

This paper has some limitations that should be acknowledged and addressed. First, the sample covers U.K. non-financial firms, so findings may not generalize to other countries and sectors. Second, uncertainty is measured using analyst forecast data, which only capture certain information gaps. Third, manual content analysis introduces subjectivity in quantifying sustainability report disclosures. Finally, endogeneity issues between disclosure, uncertainty, and performance cannot be fully addressed.

Future inquiry covering different sectors, geographies, and uncertainty measures will boost generalizability. Computerized textual analysis may improve disclosure scoring objectivity. Quasi-experiments exploiting policy shifts can better establish causality. Testing simultaneous relationships between disclosure and firm success will advance theory. Such efforts to mitigate limitations and explore unresolved issues will enrich this blossoming research domain.

This paper suggests future research directions, including the use of varied ESG and carbon disclosure sources, different market uncertainty measures, and expanded scope (e.g., financial firms, other regions, and time periods). It also recommends employing advanced methods and controlling for factors affecting market uncertainty. Addressing the causality issues between ESG disclosure, carbon disclosure, and market uncertainty and testing simultaneous relationships between disclosure and firm success will advance theory and deepen understanding of voluntary disclosure outcomes.

This paper offers specific and relevant recommendations based on the research findings. This paper recommends that managers should adopt more transparent and comprehensive ESG reporting practices and disclose more specific and relevant information about their carbon emissions and climate change mitigation strategies, as these can enhance their reputation and signal their commitment to responsible business practices. This paper also recommends that investors should allocate greater scrutiny to the quality and credibility of ESG disclosure and carbon disclosure, as these can help them differentiate high-quality firms from low-quality ones and mitigate potential risks associated with opaque firms. This paper also recommends that regulators should encourage and support more ESG disclosure and carbon disclosure by providing more guidance and incentives for firms, as well as by monitoring and enforcing the quality and reliability of sustainability reporting. This paper also recommends that other stakeholders should engage and collaborate with firms on sustainability issues and hold them accountable for their ESG performance and carbon footprint.

This paper explains the importance and benefits of the recommendations for the field of accounting. This paper explains that the recommendations can improve the transparency and efficiency of financial markets and foster more sustainable and responsible business practices. This paper also explains that the recommendations can provide more useful and

reliable information for investors and other stakeholders, who can make more informed and efficient decisions based on a firm's sustainability performance, corporate governance practices, and social impact. This paper also explains that the recommendations can benefit the firms and society, as they can reduce the cost of capital, increase the firm value, and improve investor confidence and satisfaction, as well as reduce the environmental and social risks and enhance the contribution to the Sustainable Development Goals (SDGs).

This paper discusses the potential impact or transformative effects of implementing the recommendations on accounting practices or research. This paper discusses that the recommendations can lead to a paradigm shift in accounting practices, where ESG disclosure and carbon disclosure become more integrated and standardized in financial reporting. This paper also discusses that the recommendations can lead to a more holistic and dynamic approach to accounting research, where ESG disclosure, carbon disclosure, and market uncertainty are examined in relation to other factors and outcomes, such as financial performance, corporate governance, social impact, environmental risk, and stakeholder engagement. This paper also discusses that the recommendations can lead to a more collaborative and interdisciplinary effort among accounting researchers, practitioners, policymakers, and other stakeholders, where ESG disclosure and carbon disclosure are viewed as a means to achieve a more sustainable and responsible future.

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