Journal of Contemporary Accounting & Economics 21 (2025) 100500

Contents lists available at ScienceDirect

Journal of Contemporary Accounting & Economics

journal homepage: www.elsevier.com/locate/jcae

From corporate emissions to financial statements: Understanding accounting conservatism in the wake of carbon risks

Farhana Islam [a], Sudipta Bose [b], Sammy Xiaoyan Ying [c,*], Syed Shams [d]

[a] Department of Accounting and Finance, School of Business and Economics, North South University, Dhaka, Bangladesh
[b] Discipline of Accounting and Finance, Newcastle Business School, The University of Newcastle, Sydney, NSW 2000, Australia
[c] Discipline of Accounting and Finance, Newcastle Business School, University of Newcastle, Sydney, NSW 2000, Australia
[d] School of Commerce, University of Southern Queensland, Brisbane, Qld 4300, Australia

ARTICLE INFO

Keywords:
Carbon risk
Carbon emission
Accounting conservatism
IFRS
ISSB
Cross-country

ABSTRACT

We examine the relationship between carbon risk and accounting conservatism using 7,636 firm-year observations from 29 countries. Using firms' carbon emissions as a proxy for carbon risk, we find that firms with higher carbon risk exhibit greater conditional accounting conservatism. However, this positive relationship is weaker in firms with stronger corporate governance and higher institutional ownership, suggesting that effective internal and external monitoring reduces the reliance on conservative reporting in response to carbon-related exposures. Further analysis shows that the relationship becomes more pronounced after the 2015 Paris Agreement. The effect is also stronger in countries with active emissions trading schemes (ETS), higher governance quality, and stakeholder-oriented business cultures. These findings offer timely and policy-relevant insights for regulators, standard-setters, and policymakers, particularly in light of the introduction of IFRS S2 by the International Sustainability Standards Board (ISSB), which mandates climate-related financial disclosures and emphasizes the importance of integrating carbon risk into core financial reporting practices.

1. Introduction

Unprecedented global warming and severe weather events, resulting from the increasing concentration of greenhouse gases (GHG), have drawn growing attention to corporate environmental accountability for climate change (Stern and Taylor, 2007; Task Force on Climate-Related Financial Disclosures [TCFD], 2017; Intergovernmental Panel on Climate Change [IPCC], 2019).[1] There are increasing concerns about the adverse impacts of climate-related risks on businesses and the global economy (KPMG, 2015; Australian Accounting Standards Board [AASB] & Auditing and Assurance Standards Board [AAUSB], 2019; International Accounting Standards Board [IASB], 2020). In response, regulatory bodies are beginning to formalize disclosure requirements. Notably, the International

* Corresponding author.
E-mail addresses: farhana.islam06@northsouth.edu (F. Islam), sudipta.bose@newcastle.edu.au (S. Bose), sammy.ying@newcastle.edu.au (S.X. Ying), syed.shams@usq.edu.au (S. Shams).

[1] Several global initiatives have been established to tackle climate change. For example, in 2015, 195 countries signed the Paris Agreement, committing to limit global temperatures increases to 1.5°C above pre-industrial levels (United Nations Framework Convention on Climate Change [UNFCCC], 2015). The United Nations Environment Programme Finance Initiative [UNEP FI] (2021) has also established the Net-Zero Banking Alliance, comprising 53 banks from 27 countries, which are committed to aligning their lending and investment portfolios with net-zero emissions by 2050.

https://doi.org/10.1016/j.jcae.2025.100500
Received 10 March 2024; Received in revised form 13 August 2025; Accepted 22 August 2025
Available online 29 August 2025

Sustainability Standards Board (ISSB) issued IFRS S2, which mandates climate-related disclosures,[2] including the financial impacts of climate risks, and aligns closely with the recommendations of the Task Force on Climate-Related Financial Disclosures [TCFD]. As a result, firms are facing mounting pressure to mitigate carbon risks. A firm's carbon risk is driven by uncertainties surrounding several combined factors, including future climate change regulation; regulatory compliance costs and potential litigation; physical risks such as severe weather and the costs of measuring and monitoring emissions (Matsumura et al., 2014; Griffin et al., 2017; Bose et al., 2021; Bose et al., 2025a,b). Carbon risk creates a unique business challenge with long-term impacts and irreparable consequences, distinguishing it from other types of environmental risk (Lash and Wellington, 2007; Bose et al., 2021; Bose et al., 2025a,b).

Corporate carbon risk has emerged as a crucial factor in the decision-making processes of capital market participants, particularly among investors and firms (Matsumura et al., 2014; Griffin et al., 2017; Jung et al., 2018; Bose et al., 2021; Bose et al., 2025a,b). Several studies in the accounting literature demonstrate that corporate exposure to carbon risk significantly affects investors' valuations (e.g., Matsumura et al., 2014; Clarkson et al., 2015; Griffin et al., 2017; Jung et al., 2018; Griffin et al., 2020; Bose et al., 2021). Aligning with this trend, firms are increasingly integrating carbon risk considerations into their strategic decisions, including investment, financing choices, dividend policies, and risk management (Balachandran and Nguyen, 2018; Bose et al., 2021). Despite its significance in corporate decision making, corporate carbon risk is predominantly examined in contexts external to financial reporting. Little is known about whether firms embed carbon risk considerations into their financial reporting decisions.

Motivated by the need to better understand the significance of carbon risk in corporate decision making, and particularly in financial reporting, we examine the relationship between corporate carbon risk exposure and financial reporting conservatism. By examining this link, we respond to recent calls for greater insight into the financial reporting implications of climate-related risks (AASB and AAUSB, 2019; IASB, 2020). As highlighted by accounting regulators, "entities can no longer treat climate-related risks as merely a matter of corporate social responsibility and may need to consider them also in the context of their financial statements" (AASB and AAUSB, 2019, p.3). This focus has become even more pressing with the introduction of IFRS S2 by the ISSB, which mandates climate-related disclosures, including the financial impacts of carbon risk, and reinforces the importance of integrating climate risk into core financial reporting frameworks.

We are interested in whether corporate carbon risk is manifested in an essential attribute of financial reporting, namely, conditional accounting conservatism.[3] Understanding the underlying dynamics of conditional accounting conservatism in the context of carbon risk exposure is imperative, as it sheds light on whether corporate accountability to climate change influences the properties of financial reporting (Basu, 2005). Conditional accounting conservatism imposes asymmetric verification requirements, leading to the timelier recognition of losses (bad news) compared to gains (good news), a concept referred to as the asymmetric timeliness of earnings (Basu, 1997; García Lara et al., 2011). The existing literature consistently documents the informational benefits of conditional accounting conservatism and shows that contracting parties, including equity investors and lenders, demand such conservatism to reduce information asymmetry and mitigate concerns about future uncertainty (Ahmed et al., 2002; Zhang, 2008; García Lara et al., 2011; Kim and Zhang, 2016b; Goh et al., 2017).

Our study also draws on valuable insights from recent research that examines the association between corporate social responsibility (CSR) performance and accounting conservatism (Burke et al., 2020; Anagnostopoulou et al., 2021), but it differs by focusing specifically on carbon risk, proxied by carbon emissions, as a more specific and verifiable aspect of firm environmental performance. Focusing on environmental performance offers clearer insights than relying on aggregate CSR measures, as it avoids potential confounding effects from non-environmental CSR dimensions (Cohen et al., 2023). Research shows that firms allocate more resources to actions benefiting primary stakeholders, such as employees, suppliers, and customers, while the effects of firms' actions toward secondary stakeholders, particularly the natural environment, are more diffused (Perrault and Quinn, 2018). Moreover, carbon emissions are more directly observable and verifiable than an aggregate measure of CSR, which often lack standardized measurement frameworks and encompass a wide range of issues, including human rights, diversity, labour practices, governance, and product quality (Perrault and Quinn, 2018; Downar et al., 2021). By focusing on carbon risk, our study provides deeper insights into how a specific and measurable dimension of environmental performance influences accounting conservatism.

We posit that a firm's carbon risk plays a significant role in managerial decisions regarding the degree of conditional conservatism in financial reporting. As investors may lack access to private information, carbon risk can heighten information asymmetry and increase contracting costs. To mitigate these costs, firms are incentivized to adopt conservative reporting practices, which help reduce information asymmetry and address capital market concerns about the future uncertainties associated with carbon risk. Based on this reasoning, we hypothesize that firms with higher carbon risk will exhibit a greater degree of conditional accounting conservatism.

We employ a cross-country empirical setting to examine the relationship between carbon risk and conditional accounting conservatism using 7,636 firm-year observations from 29 countries. Our sample includes all firms that responded to the CDP (previously Carbon Disclosure Project) questionnaire from 2007 to 2019. Carbon risk is measured using firm-level carbon emissions

[2] https://www.ifrs.org/content/dam/ifrs/publications/pdf-standards-issb/english/2023/issued/part-a/issb-2023-a-ifrs-s2-climate-related-disclosures.pdf?bypass=on (accessed on 12 July 2025).

[3] Conditional and unconditional accounting conservatism are two distinctive but related constructs. Conditional conservatism focuses on the asymmetric timeliness of earnings, whereas unconditional conservatism emphasizes lower book values relative to market values. The key distinction lies in the timing and nature of information use: conditional conservatism "reveals information when it is received in future periods," while unconditional conservatism "only utilizes information known at the inception of the asset's life" (Basu, 2005, p. 313). Following prior research (Goh et al., 2017; Hsieh et al., 2019; Burke et al., 2020), our study concentrates on conditional conservatism, as it conveys new information from management to investors, whereas unconditional conservatism reflects minimal new information (Basu, 2005).

(Matsumura et al., 2014; Griffin et al., 2017; Bose et al., 2021; Bose et al., 2025a,b), while conditional conservatism is proxied by the firm-specific *C-score*, following Khan and Watts (2009). We find consistent and robust evidence of a significant positive relationship between carbon risk and conditional accounting conservatism.

To further explore the relationship between carbon risk and conditional accounting conservatism, we examine whether this relationship varies with the strength of internal and external monitoring mechanisms. We find that the relationship is less pronounced for firms with stronger corporate governance performance and higher institutional investors' ownership. Our findings remain robust across several approaches addressing endogeneity concerns, including Heckman's (1979) two-stage analysis, propensity score matching (PSM), change-on-change analysis, and an instrumental variable (IV) approach. Additional analyses show that the positive relationship between carbon risk and conditional accounting conservatism is stronger in the post-2015 Paris Agreement period. Moreover, leveraging our large international sample, we further analyse how institutional contexts influence the relationship. We find that the relationship is more pronounced for firms operating in countries that participate in emissions trading schemes (ETSs), exhibit higher governance quality, and have stakeholder-oriented business cultures.

Our study makes several important contributions. First, it responds to recent calls by the TCFD (2017) and accounting regulators (e.g., AASB and AAUSB, 2019; IASB, 2020), as well as the introduction of IFRS S2 by the ISSB, for a better understanding of the implications of carbon risk in financial reporting. To our knowledge, this is one of the first studies to examine the impact of carbon risk on financial reporting conservatism. While recent research highlights the relevance of carbon risk in non-financial reporting (Griffin and Jaffe, 2018; Dey et al., 2024), little is known about its implications for financial reporting—a primary channel through which firms communicate with stakeholders. Using extensive firm-level data from 29 countries, we provide evidence that firms consider carbon risk exposure when shaping their financial reporting strategies. Second, we extend the literature on conditional conservatism by demonstrating the role of carbon risk in shaping this key attribute of financial reporting. Despite ongoing debate over the desirability of accounting conservatism and substantial research on the informational effects of conditional conservatism (Ahmed et al., 2002; Zhang, 2008; García Lara et al., 2011; Kim and Zhang, 2016b; Goh et al., 2017; Hsieh et al., 2019), relatively little is known about the key determinants of firms' conservative reporting behaviours. The growing body of literature has identified factors such as corporate governance (García Lara et al., 2009), institutional ownership (Ramalingegowda and Yu, 2012), and business strategy (Hsieh et al., 2019) as influential. We contribute to this strand of research by highlighting that conditional conservatism can also be understood as a strategic managerial response to minimize contracting costs arising from heightened information demands and uncertainty associated with corporate carbon risk. Third, our study offers insights into cross-country differences in the financial implications of carbon risk. We show that the impact of carbon risk on conditional conservatism varies based on countries' participation in emissions trading schemes (ETSs), the quality of country-level governance, and the degree of stakeholder orientation. These findings suggest institutional heterogeneity in how firms manage carbon risk. Finally, our study contributes to the emerging literature on the implications of climate risk for business decisions. Recent evidence indicates that managers are increasingly incorporating climate risk into decisions related to investment, financing, dividend policy, and risk management (Balachandran and Nguyen, 2018; Huang et al., 2018). By establishing a link between carbon risk and conservative financial reporting, we demonstrate that carbon risk is not only relevant to operational and strategic choices but is also integrated into firms' financial reporting decisions in response to a carbon-constrained economy.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and develops the study's hypotheses. Section 3 outlines the research design. Section 4 presents the main empirical results along with robustness checks. Section 5 provides additional analyses, and Section 6 concludes the paper.

2. Literature review and hypotheses development

2.1. Carbon risk

Carbon risk is important for business decision-making due to its various undesirable consequences (Lash and Wellington, 2007; Bebbington and Larrinaga-Gonzalez, 2008; Bose et al., 2025a,b). Risks associated with operational disruptions from future physical climate events can lead to higher operating costs and reduced earnings (Matsumura et al., 2014; Griffin et al., 2017; Bose et al., 2024a, b; Bose et al., 2025a,b). Carbon risk also encompasses the potential for lawsuits, regulatory compliance obligations, and tax burdens for firms with high emission levels (Matsumura et al., 2014; Griffin et al., 2017; Bose et al., 2021; Bose et al., 2025a,b). High emitters may face additional costs related to carbon risk, such as increased prices for emissions permits, investments in costly carbon reduction technologies, and enhanced risk management efforts (Bose et al., 2021). Moreover, excessive carbon emissions may lead to negative reactions from environmentally conscious stakeholders, including customer and investor boycotts, which can damage a firm's reputation and result in financial losses (Luo and Balvers, 2017). These undesirable consequences demonstrate the substantial financial implications of corporate carbon risk.

Consistent with its the financial consequences, the implications of corporate carbon risk for decisions made by market participants and firm managers are well documented in the extant literature. From a capital market perspective, a growing stream of research suggests that firms' carbon risk exposure is relevant to both investors and lenders across countries (Matsumura et al., 2014; Griffin et al., 2017; Jung et al., 2018). Extensive evidence shows that investors penalize firms with higher carbon emissions by reducing their equity valuations, as current emission levels signal a firm's exposure to carbon risk (e.g., Chapple et al., 2013; Matsumura et al., 2014; Clarkson et al., 2015; Griffin et al., 2017; Cooper et al., 2018; Griffin et al., 2020; Bose et al., 2025a,b). For example, Matsumura et al. (2014) find a market-implied equity price reduction of US$212 per ton of carbon emissions, while Griffin et al. (2017) report a reduction of US$79 per ton among US S&P 500 firms. Chapple et al. (2013) document an overall valuation discount of AU$17 to AU $26 per ton for Australian firms, and Clarkson et al. (2015) report a €75 discount per ton of uncovered carbon emissions for European firms. More recently, using a sample of the 500 largest global firms reported to CDP (formerly Carbon Disclosure Project), Choi and Luo (2021) find a negative association between carbon emissions and firm value. Similarly, studies show that carbon risk is also a critical consideration for lenders, with higher emissions associated with increased cost of debt (Jung et al., 2018; Herbohn et al., 2019). Taken together, the literature consistently demonstrates that capital providers—both investors and lenders—factor corporate carbon risk into their decision-making, as it introduces uncertainty regarding firms' future performance.

2.2. Accounting conservatism

Conditional accounting conservatism is defined as the "tendency to require a higher degree of verification for recognizing good news as gains than to recognize bad news as losses" (Basu, 1997, p. 7). It reflects the timelier recognition of bad news in earnings relative to good news, a concept also referred to as the asymmetric timeliness of earnings (Basu, 1997). The substantial research interest in conditional conservatism is largely driven by divergent views between practitioners and regulators regarding its desirability. Many practitioners regard conservatism as a fundamental attribute of high-quality financial reporting. However, this favourable perspective is not fully shared by standard-setters, who remain cautious about endorsing conservatism in accounting standards (Hsieh et al., 2019).

Echoing practitioners' views, the existing literature highlights the informational benefits of accounting conservatism (Ahmed et al., 2002; Zhang, 2008; García Lara et al., 2011; Kim and Zhang, 2016b; Goh et al., 2017). For investors, the timelier recognition of economic losses relative to gains helps reduce uncertainty about future firm value, thereby lowering the cost of equity as well as the volatility and crash risk of future stock prices (García Lara et al., 2011; Francis et al., 2013; Kim and Zhang, 2016b; Goh et al., 2017). For lenders, conservative reporting enables more effective monitoring of a borrower's repayment capacity, reducing the cost of debt (Ahmed et al., 2002; Zhang, 2008). These findings suggest that contracting parties, including equity investors and lenders, value accounting conservatism as a mechanism to reduce information asymmetry and mitigate concerns about future uncertainty (Ahmed et al., 2002; Zhang, 2008; García Lara et al., 2011; Kim and Zhang, 2016b; Goh et al., 2017).

Despite the ongoing debate and extensive research on the informational role of accounting conservatism, much remains unknown—particularly regarding the determinants of conservative reporting. Only a limited number of studies have explored firm-level factors that influence managers' decisions to adopt conservative reporting practices. For instance, empirical evidence shows that firms with stronger corporate governance and higher institutional ownership tend to exhibit greater levels of conditional conservatism (García Lara et al., 2009; Ramalingegowda and Yu, 2012). Hsieh et al. (2019) further demonstrate that firms pursuing a "prospector" strategy—characterized by greater strategic ambiguity—are more likely to engage in conservative reporting compared to those following a "defender" strategy. They conclude that accounting conservatism can be interpreted as a relational managerial response to ambiguity.

Closely related to our research are recent studies that examine the association between CSR performance and accounting conservatism (Burke et al., 2020; Anagnostopoulou et al., 2021). Using a sample of U.S. listed firms from 1996 to 2013, Burke et al. (2020) find a negative relationship between CSR performance and conditional conservatism, suggesting that firms with better CSR performance face reduced concerns about managerial opportunism and information asymmetry, thereby lowering the demand for conservatism. Similarly, Anagnostopoulou et al. (2021), using a sample of North American firms from 2000 to 2014, report an overall negative association between CSR and accounting conservatism, although they observe a reversal in this trend following the global financial crisis. Our research differs from these prior studies by focusing specifically on carbon risk—proxied by GHG emissions—a more precise and verifiable dimension of environmental performance. This approach allows us to provide novel insights into the role of corporate carbon risk exposure in shaping accounting conservatism within an international context.

2.3. Carbon risk and conditional accounting conservatism

Drawing on both the carbon risk and accounting conservatism literature, we posit that firms facing higher carbon risk are more likely to adopt conditional accounting conservatism due to heightened contracting costs, investor scrutiny, and regulatory pressures. Carbon risk introduces substantial uncertainties regarding regulatory compliance, potential litigation, and reputational damage, making future cash flows more volatile and harder to predict (Matsumura et al., 2014; Clarkson et al., 2015; Bose et al., 2021). Given these risks, external capital providers—such as lenders, investors, and regulatory bodies—impose stricter monitoring and contracting requirements, leading to an increased demand for conservative financial reporting. This aligns with Watts's (2003a, 2003b) contracting demand theory, which posits that conservatism mitigates the risk of financial misstatements, earnings overstatements, and opportunistic managerial behaviour. Furthermore, following Chen et al. (2023), who document that litigation risk promotes conservatism by disciplining managerial incentives, we argue that carbon risk acts similarly by increasing firms' exposure to financial and regulatory uncertainty, thereby reinforcing the need for conservatism in financial reporting.

A critical driver of this relationship is the impact of carbon-related uncertainty on firms' debt financing costs and lending relationships. Empirical evidence suggests that firms with high carbon exposure face increased borrowing costs, stricter loan covenants, and greater difficulty in securing credit due to concerns about their long-term financial viability (Jung et al., 2018). Lenders perceive carbon-intensive firms as riskier borrowers, given the growing likelihood of carbon pricing regulations, environmental fines, and costly technological transitions required for decarbonization. As a result, creditors demand higher levels of accounting conservatism as a protective measure against potential earnings manipulation or overstatement of financial performance. Conditional conservatism, which ensures timely loss recognition, becomes an important tool in addressing lender concerns by enhancing transparency and verifiability of reported financial information. Firms with greater carbon exposure, therefore, adopt a more conservative reporting approach to align with creditor expectations and to signal financial discipline in the face of carbon-related risks.

Beyond debt financing, equity market participants also shape the relationship between carbon risk and conservatism. Investors, particularly institutional shareholders, increasingly recognize the material impact of carbon risks on firm value and financial stability (Matsumura et al., 2014; Clarkson et al., 2015; Bose et al., 2021). However, due to ongoing credibility and comparability issues in voluntary carbon disclosures, investors frequently struggle to assess firms' true exposure to climate-related financial risks (Kolk et al., 2008; Busch, 2010). This limitation creates information asymmetry, where managers have access to superior private information about the firm's carbon-related risks and future exposure, while external investors lack verifiable disclosures to evaluate these risks effectively (Healy and Palepu, 2001; Dai and Ngo, 2021). Prior literature demonstrates that information asymmetry increases managerial incentives for opportunistic behaviour, such as delaying the disclosure of bad news and inflating earnings figures (Lafond and Roychowdhury, 2008; Kim and Zhang, 2016a). In response, investors demand greater conservatism in financial reporting, particularly for firms with high carbon exposure, to ensure that financial statements provide a timely reflection of underlying risks and liabilities. Research has shown that firms facing higher information asymmetry tend to adopt more conservative accounting policies, reinforcing the role of conservatism as a mechanism to enhance investor confidence and mitigate concerns about hidden carbon-related risks (Hsieh et al., 2019; Burke et al., 2020).

In addition to investor and creditor pressures, regulatory and litigation risks arising from carbon exposure provide further incentives for conservative financial reporting. Carbon-intensive firms face growing regulatory scrutiny in the form of mandatory emissions disclosure requirements, carbon taxes, and environmental compliance obligations (AASB and AAUSB, 2019; IASB, 2020). Failure to properly disclose carbon-related risks and financial implications can result in substantial penalties, reputational damage, and even legal actions from regulators, shareholders, and environmental groups. Drawing on Chen et al. (2023), who argue that litigation risk alters managerial incentives toward greater conservatism to reduce the likelihood of adverse legal consequences, we propose that carbon-intensive firms face similar regulatory and litigation risks that make conservative reporting a rational choice to mitigate potential penalties and legal challenges. Given that the regulatory risks of overstating financial performance are typically higher than those of understating it, firms exposed to heightened carbon-related legal risks are more likely to recognize economic losses in a timely manner to comply with evolving regulatory expectations (Karpoff et al., 2008; Ettredge et al., 2016). This perspective is supported by prior findings showing that legal and regulatory pressures amplify the need for financial conservatism as firms attempt to reduce exposure to lawsuits and financial misstatements (Donelson et al., 2022).

Taken together, these considerations suggest that carbon risk serves as a disciplining force in financial reporting, influencing firms to adopt conditional conservatism as a strategic response to increased contracting costs, investor scepticism, and regulatory scrutiny. As Chen et al. (2023) document, firms modify their financial reporting behaviours when faced with heightened external pressures and asymmetric costs associated with regulatory penalties, and we extend this framework by demonstrating how carbon-intensive firms proactively use conservatism to mitigate these risks. Firms with high carbon exposure face stronger external monitoring and must proactively signal financial prudence to capital providers and regulators. Given the significant economic and reputational consequences of earnings misstatements or inadequate risk disclosures, accounting conservatism emerges as a credible mechanism to reassure stakeholders about the reliability and integrity of financial statements. Accordingly, we propose the following hypothesis:

H1: Carbon risk is positively associated with conditional accounting conservatism.

2.4. Carbon risk and conditional accounting conservatism: Moderating effect of corporate governance performance

Prior research suggests that internal and external monitoring mechanisms play a critical role in mitigating information asymmetry. We further examine two such mechanisms, namely, corporate governance and institutional investors' ownership as potential moderators of the relationship between carbon risk and conditional conservatism. Extensive literature documents the role of corporate governance as an internal monitoring mechanism that enhances corporate disclosure transparency and reduces information asymmetry (Kanagaretnam et al., 2007; Armstrong et al., 2012). We expect that stronger corporate governance facilitates greater transparency in carbon risk disclosure and improves carbon risk management. Effective governance can improve the quality of carbon risk disclosure. For example, Daradkeh et al. (2023) find that firms with more capable managers disclose higher levels of climate change information, but this effect is weakened under poor governance. Similarly, Dey et al. (2024) report that the negative relationship between climate change performance and information asymmetry is more pronounced in firms with stronger corporate governance. Improved transparency around carbon risk, driven by effective governance, enables investors to better evaluate carbon-related exposures and their financial implications, thereby reducing uncertainty and lessening the need for conservative financial reporting as a signalling mechanism. Furthermore, firms with strong corporate governance are better equipped to adapt to future changes in carbon regulations and to manage carbon-related risks effectively. Prior research shows that well-governed firms tend to exhibit superior environmental performance, as they are more capable of identifying and managing environmental risks (Walls et al., 2012; Hussain et al., 2018). In the context of carbon performance, studies have found that board independence and board gender diversity positively influence the adoption of carbon reduction initiatives (Haque, 2017), while larger board size is associated with lower carbon emissions (Shive and Forster, 2020). We expect that enhanced carbon management driven by strong corporate governance will alleviate investor concerns about the adverse consequences of carbon risk.

Taken together, this discussion suggests that firms with stronger corporate governance can ease investor concerns regarding the potential negative financial implications of carbon risk. As a result, managers in these firms may have less incentive to rely on conservative accounting as a signalling mechanism to convey the credibility of financial information. Therefore, we formulate the following hypothesis:

H2: The positive association between carbon risk and conditional accounting conservatism is less pronounced for firms with better corporate governance performance.

2.5. Carbon risk and conditional accounting conservatism: Moderating effect of institutional ownership

Institutional investors are widely recognized in the literature as important external monitors of management (Chen et al., 2007; Ferreira and Matos, 2008; Goh et al., 2017). Due to their sophistication and substantial shareholdings, institutional investors are both motivated and well-positioned to actively monitor corporate activities and enhance financial reporting quality (Koh, 2003; Sharma, 2004). We expect that institutional investors; by actively monitoring firms' carbon risk disclosure and management practices, help mitigate broader investor concerns related to carbon-related uncertainty. Institutional investors have strong incentives to improve information transparency through their monitoring efforts (Chen et al., 2007; Goh et al., 2017). Evidence shows that firms with higher institutional ownership are subject to greater scrutiny, which in turn improves financial reporting quality by reducing aggressive earnings management (Koh, 2003) and corporate fraud (Sharma, 2004). In the context of carbon risk, prior research reveals that firms respond to institutional demands for carbon-related information (Cotter and Najah, 2012), and that greater institutional ownership is positively associated with the level of carbon risk disclosure (Jaggi et al., 2018). Substantial institutional shareholdings provide a strong incentive for firms to disclose more comprehensive carbon-related information, thereby enabling investors to more accurately assess carbon risk in their investment decisions and alleviating concerns over carbon-related uncertainty (Bose et al., 2024a,b).

Moreover, institutional investors play a vital role in pressuring firms to mitigate carbon risk. They increasingly consider the financial implications of carbon exposure in their portfolio firms and view effective carbon risk management as a key priority (Krueger et al., 2020; Bose et al., 2024a,b). To manage this risk, institutional investors often divest from firms in high-emission industries (Bolton and Kacperczyk, 2021). Shive and Forster (2020) find that firms with higher mutual fund ownership tend to have lower carbon emissions, suggesting that institutional investors actively influence firms to improve their carbon management practices. As a result, firms with greater institutional ownership are generally more effective at managing carbon risk. For these firms, investors are likely to be less concerned about carbon-related uncertainty.

The above discussion suggests that firms with higher institutional ownership are better positioned to alleviate investors' concerns about carbon risk. This, in turn, reduces managers' incentives to rely on accounting conservatism as a signalling mechanism to convey the quality of financial reporting. This leads to the following hypothesis:

H3: The positive association between carbon risk and conditional accounting conservatism is less pronounced for firms with a higher level of institutional ownership.

3. Research design

3.1. Sample and data

Our initial sample consists of all firms that responded to the CDP (previously Carbon Disclosure Project) questionnaire from 2007 to 2019. Our sample period begins with 2007, as the carbon risk data are only available from 2007, and conclude in 2019, the final year of data collection prior to the onset of the COVID-19 pandemic.[4] We collect carbon risk data from the CDP database. We obtain financial and stock market data from Worldscope and DataStream databases, respectively. We also collect financial analysts' data from the Institutional Brokers' Exchange System (I/B/E/S) database, institutional investors' ownership data from the FactSet LionShare database, and non-financial data from Refinitiv ESG database. Country-level data on gross domestic product (GDP) and governance are obtained from the World Bank database, while information on emissions trading schemes (ETS) is sourced from the International Carbon Action Partnership (ICAP).[5] After merging data from these databases and excluding incomplete observations, our initial final sample size is 7,636 firm-year observations with 1,654 unique firms across 29 countries from 2007 to 2019. The sample selection procedure is reported in Panel A of Table 1.

Table 1, Panel B shows the industry-wise distribution of firms in the sample. This table shows that firms in the transportation industry (10.16 %) dominate our sample, followed by firms in the computer industry (8.70 %), while the category of 'other' industries has the fewest observations. Table 1, Panel C also reports the year-wise distribution of firms in our sample. This shows that 2016 has the highest number of observations (11.63 %), followed by 2015 (10.27 %), while 2008 has the fewest observations (2.15 %).

3.2. Measures of conditional accounting conservatism

In the accounting literature, Basu's (1997) measure is the most widely used for measuring accounting conservatism. The measure, however, is calculated either at the industry-year level using a cross-section of firms or at the firm level using time-series data (Francis et al., 2013; Kong et al., 2017). Given that carbon risk is both firm- and time-specific, we believe that a firm-year measure of accounting conservatism is more appropriate for this study. Therefore, following prior studies (Kong et al., 2017; Burke et al., 2020), we measure conditional accounting conservatism using the conservatism score *(CSCORE)*, a firm-year measure of conditional accounting conservatism, developed by Khan and Watts (2009). More specifically, we first estimate the following equation for each country and

[4] We intentionally exclude the post-2019 period to avoid the confounding effects of the COVID-19 crisis, which introduced unprecedented economic uncertainty and firm-level shocks that could distort the relationship between carbon risk and financial reporting conservatism.

[5] We obtain other country-level data from prior studies (Djankov et al., 2008; Bose et al., 2021).

Table 1
Sample description.

Panel A: Sample selection

	Observations
CDP carbon emissions data coverage from 2007 to 2019	16,305
Less: Firm-year observations with missing data due to merging with Worldscope, DataStream, FactSet, IBES and ESG databases	(7,270)
Less: Firm-year observations dropped to keep a minimum of 20 observations per country	(324)
Less: Firm-year observations dropped due to insufficient control variables	(1,075)
Final Test Sample	**7,636**

Panel B: Industry-wise distribution of sample firms

Name of industry	Number of firms	% of sample
Mining/Construction	556	7.28
Food	505	6.61
Textiles/Printing/Publishing	292	3.82
Chemicals	447	5.85
Pharmaceuticals	337	4.41
Extractive	376	4.92
Manufacturing: Rubber/glass/etc.	177	2.32
Manufacturing: Metal	194	2.54
Manufacturing: Machinery	339	4.44
Manufacturing: Electrical Equipment	290	3.80
Manufacturing: Transport Equipment	391	5.12
Manufacturing: Instruments	335	4.39
Manufacturing: Miscellaneous	63	0.83
Computers	664	8.70
Transportation	776	10.16
Utilities	461	6.04
Retail: Wholesale	160	2.10
Retail: Miscellaneous	473	6.19
Retail: Restaurant	61	0.80
Financial	53	0.69
Insurance/Real Estate	45	0.59
Services	599	7.84
Others	42	0.55
Total sample	**7,636**	**100**

Panel C: Year-wise distribution of sample firms

	Number of firms	% of sample
2007	181	2.37
2008	159	2.08
2009	492	6.44
2010	467	6.12
2011	408	5.34
2012	635	8.32
2013	699	9.15
2014	726	9.51
2015	784	10.27
2016	888	11.63
2017	731	9.57
2018	737	9.65
2019	729	9.55
Total	**7,636**	**100**

each year separately using all firms in the Refinitiv ESG database:

$$NI_{i,t} = \beta_0 + \beta_1 NEG_{i,t} + \beta_2 RET_{i,t}(\gamma_1 + \gamma_2 SIZE_{i,t} + \gamma_3 MB_{i,t} + \gamma_4 LEV_{i,t}) + NEG_{i,t} \times RET_{i,t}(\alpha_1 + \alpha_2 SIZE_{i,t} + \alpha_3 MB_{i,t} + \alpha_4 LEV_{i,t}) + (\mu_1 SIZE_{i,t} + \mu_2 MB_{i,t} + \mu_3 LEV_{i,t}) + NEG_{i,t}(\delta_1 SIZE_{i,t} + \delta_2 MB_{i,t} + \delta_3 LEV_{i,t}) + \varepsilon_{i,t} \tag{1}$$

where *NI* is the reported earnings, scaled by the market value of equity at the beginning of the fiscal year; *RET* is the 12-month buy-and-hold returns, computed using monthly returns beginning at the fourth month after the end of fiscal year; *NEG* is an indicator variable which equals 1 if *RET* is negative and 0 otherwise. *SIZE* is the natural logarithm of a firm's total assets; *MB* is the ratio of the market value of equity to the book value of equity; and *LEV* is the ratio of total debt to total equity. We follow Kong et al. (2017) to measure the variables used in Equation (1). Then, we compute the firm specific *CSCORE* using the coefficient estimates $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$ from Equation (1) as follows:

$$CSCORE_{i,t} = \alpha_{1,t} + \alpha_2 SIZE_{i,t} + \alpha_3 MB_{i,t} + \alpha_4 LEV_{i,t} \tag{2}$$

where the higher the level of *CSCORE,* the greater the degree of conditional conservatism. Furthermore, following Zhang (2008) and Francis et al. (2013), we also employ the following Basu (1997) model to compute accounting conservatism as an alternative proxy for conditional accounting conservatism:

$$NI_{i,t} = \beta_0 + \beta_1 NEG_{i,t} + \beta_2 RET_{i,t} + \beta_3 NEG_{i,t} \times RET_{i,t} + \varepsilon_{i,t} \tag{3}$$

where β_2 is the sensitivity of earnings to positive news and $\beta_2 + \beta_3$ is the sensitivity of earnings to negative news, respectively. Therefore, the sensitivity of earnings to negative news over the sensitivity of earnings to positive news is measured by *Coeff_Basu* = $(\beta_2 + \beta_3)/\beta_2$. The higher level of the value for *Coeff_Basu* indicates a more conservative firm.

3.3. Measures of carbon risk

In this study, carbon risk is measured using firm-level carbon emissions. Carbon emissions expose firms to various risks, including regulatory and tax burdens, compliance and litigation costs, and reputational damage (Eccles et al., 2011; Matsumura et al., 2014; Clarkson et al., 2015; Griffin et al., 2017; Bose et al., 2021). Unlike other environmental risks, carbon risk is global, long-term, and potentially irreversible, making it a distinct and critical form of business risk (Lash and Wellington, 2007). These characteristics add complexity to forecasting future cash flows and can adversely affect a firm's equity price and market value (Lash and Wellington, 2007; Eccles et al., 2011; Matsumura et al., 2014). Accordingly, a higher level of carbon emissions reflects a higher level of carbon risk. Firms report their carbon emissions data in CO_2-equivalent (CO_2-e) metric tons, categorized into Scope 1, Scope 2, and Scope 3 emissions (World Business Council for Sustainable Development [WBCSD] and World Resources Institute [WRI], 2004). Scope 1 emissions are direct emissions from sources owned or controlled by the firm. Scope 2 emissions arise from purchased electricity, heating, cooling, or steam generated offsite. Scope 3 emissions represent all other indirect emissions related to a firm's operations but occurring from sources not owned or directly controlled by the firm (WBCSD and WRI, 2004). In our main analyses, we measure carbon risk *(CRISK)* as the natural logarithm of the sum of Scope 1 and Scope 2 carbon emissions. We exclude Scope 3 emissions from our primary measure due to the complexity and challenges firms face in accurately quantifying these emissions. To ensure the robustness of our findings, we also use carbon emissions intensity *(CRISK_INT)*, calculated as the sum of Scope 1 and Scope 2 emissions scaled by total revenue. Additionally, to provide a more granular assessment of firms' exposure to carbon-related financial and regulatory risks, we separately use the natural logarithm of Scope 1, Scope 2, and Scope 3 emissions as alternative proxies for carbon risk in our robustness tests.

3.4. Empirical model

We estimate the following model to test our first hypothesis (H1) which predicts a positive association between carbon risk and accounting conservatism:

$$\begin{aligned} CSCORE_{i,t+1} = {} & \beta_0 + \beta_1 CRISK_{i,t} + \beta_2 LNMCAP_{i,t} + \beta_3 MB_{i,t} + \beta_4 LEV_{i,t} + \beta_5 RDINT_{i,t} \\ & + \beta_6 SGROWTH_{i,t} + \beta_7 CSRPERF_{i,t} + \beta_8 ZSCORE_{i,t} + \beta_9 FAGE_{i,t} + \beta_{10} CFO_{i,t} \\ & + \beta_{11} CAPEX_{i,t} + \beta_{12} INTANG_{i,t} + \beta_{13} VOLAT_{i,t} + \beta_{14} LITG_{i,t} + \beta_{15} CROSS_{i,t} \\ & + \beta_{16} LNGDP_{j,t} + \beta_{17} STAKE_j + \beta_{18} LEGAL_j + \beta_{19} GCRI_{j,t} + \sum YEAR_t \\ & + \sum INDUSTRY_k + \sum COUNTRY_j + \varepsilon_{i,t+1} \end{aligned} \tag{4}$$

where subscript *i* denotes the individual firm, *j* denotes the country, and *t* denotes the time period. In the above models, *CSCORE* is conditional accounting conservatism, while *CRISK* is the natural logarithm of carbon emissions. To test H2, we include the interaction between carbon risk *(CRISK)* and corporate governance performance *(HIGH_CGOV)* in Equation (4). To test H3, we incorporate the interaction between *CRISK* and institutional ownership *(HIGH_INSTOWN)* in the same specification. We measure corporate governance performance as an indicator variable, *HIGH_CGOV*, that is coded 1 if the corporate governance performance score of a firm is greater than the sample's yearly median of corporate governance performance, and 0 otherwise. Similarly, we measure institutional investors' ownership as an indicator variable, *HIGH_INSTOWN*, that is coded 1 if the institutional investors' ownership of a firm is greater than the sample's yearly median of institutional investors' ownership, and 0 otherwise. Appendix A defines all variables.

3.5. Control variables

Following prior studies (e.g., Kong et al., 2017; Burke et al., 2020), we include several control variables that are likely to affect accounting conservatism. We control for firm size *(LNMCAP)* as larger firms tend to exhibit lower asymmetric timeliness of earnings (Watts and Zimmerman, 1978; Givoly et al., 2007; Burke et al., 2020). The Market-to-book ratio *(MB)* is included to account for unconditional accounting conservatism (Burke et al., 2020), as it may influence the extent of conservative accounting practices unrelated to the timeliness of earnings recognition (Beaver and Ryan, 2005). Furthermore, we control for leverage *(LEV)* as firms with higher leverage are likely to have greater bondholder–shareholder conflict, and thus potentially increasing a higher demand for conditional conservatism (Burke et al., 2020). Moreover, we include research and development (R&D) expenditures intensity *(RDINT)* and sales growth *(SGROWTH)* to capture growth opportunities as firms with higher growth opportunities have lower asymmetric timelines for recognizing gains and losses (Kong et al., 2017; Burke et al., 2020). We also control for the CSR performance (*CSRPERF*) of a firm that may have an impact on conditional accounting conservatism (Burke et al., 2020).

Furthermore, Burke et al. (2020) argue that creditor–shareholder conflict is exacerbated when firms face financial distress, thus potentially increasing the demand for conditional conservatism. Thus, we control for financial difficulty using Altman (1968) Z-score *(ZSCORE)*. Khan and Watts (2009) argue that younger firms face a higher level of uncertainty making them more conservative in financial reporting. Thus, we include firm age *(FAGE)*. We control for cash flow from operations (*CFO*) as firms with a higher level of operating cash flows have been shown to have a lower level of conservatism (Bjornsen et al., 2018; Burke et al., 2020). We include capital expenditures *(CAPEX)* and intangible assets *(INTANG)* as firms with higher levels of capital expenditures and intangible assets have been shown to have a lower level of conditional conservatism (Bjornsen et al., 2018). We control for firm-specific uncertainty using stock return volatility *(VOLAT)*, following Kong et al. (2017) and Khan and Watts (2009). Following Kong et al. (2017) and Bjornsen et al. (2018), a firm's litigation exposure *(LITG)* is controlled, which is measured as an indicator variable equal to 1 if the firm operates in a high litigation industry (Standard Industrial Classification [SIC] codes 2833–2836, 3570–3577, 3600–3674, 5200–5961 and 7370–7374), and 0 otherwise. We control for a firm's cross-listing status *(CROSS)*, as these firms are generally more visible to international investors and tend to adopt more conservative reporting practices (Kong et al., 2017). Furthermore, as our study's focus is the cross-country context, we control for several country-level variables, comprising country-level gross domestic product *(GDP)*, stakeholder-oriented business cultures *(STAKE)*, legal environment *(LEGAL)* and country-level global climate risk *(GCRI)*. We include industry based on the industry classifications of Dhaliwal et al. (2012) to control for possible changes in accounting conservatism across industries. We also include year and country fixed effects to control for their effects on accounting conservatism.

3.6. Estimation method

We apply the ordinary least squares (OLS) regression method to estimate all regression models. We employ robust standard errors clustered by firm in all regression models for addressing the heteroskedasticity and serial correlation issues.[6] Furthermore, we analyse variance inflation factor (VIF) values for assessing the potential multicollinearity issues. All firm-level continuous variables are winsorised at the 1st and 99th percentiles to minimize the influence of extreme values.

4. Empirical results

4.1. Descriptive statistics and correlation analysis

Table 2, Panel A presents the descriptive statistics. The mean (median) value of conditional conservatism *(CSCORE)* is 0.091 (0.069), consistent with Jayaraman (2012).[7] Furthermore, the mean (median) value of carbon emissions *(EMISSION)* is 3.256 (0.359) million CO_2-e metric tons. The mean (median) value of carbon risk *(CRISK)* is 0.666 (0.307). The average corporate governance performance *(CGOV)* is 0.494, while the average institutional investors' ownership is 49.60 %. The mean (median) value of the natural logarithm of market capitalization *(LNMCAP)* is 8.978 (8.960), indicating an average total market capitalization of US$7,940 million. The mean market-to-book ratio *(MB)* is 3.046, indicating that the stocks of firms in our sample trade at prices well above their book value. The average leverage ratio *(LEV)* is 40.60 %, while the average research and development (R&D) expenditure intensity *(RDINT)* is 2.90 %, average sales growth *(SGROWTH)* is 3.40 % and average relative CSR performance *(CSRPERF)* is 0.590. The average value of Altman's (1968) Z-score is 1.235. The natural logarithm of the average firm age *(FAGE)* is 3.122, implying an average age of 23.99 years. On average, the operating cash flow (*CFO*), capital expenditures (*CAPEX*) and intangible assets *(INTANG)* are about 10.40 %, 5.10 % and 23.30 % of total assets, respectively. The average value of stock price volatility *(VOLAT)* is 0.055.

About 22.20 % of firms in our sample operate in litigated industries *(LITG)*, while approximately 19 % of firms in our sample are cross listed *(CROSS)*. The average of natural logarithm of gross domestic product *(LNGDP)* per capita is 10.624, implying an average value of US$40,296 per capita. About 44 % of firms in our sample are domiciled in countries with stakeholder-oriented business cultures *(STAKE)*. The average legal environment score *(LEGAL)* is 2.520, while the average natural logarithm of the global climate risk score *(GCRI)* is 4.151, implying an average Global Climate Risk Index (GCRI) score of 63.816.

Table 2, Panel B presents the country-level descriptive statistics. Our sample is dominated by firms in the United States (US) (27.12 %), followed by Japan (12.39 %) and the United Kingdom (UK) (12.15 %), while Hong Kong (0.26 %) has the lowest number of firm observations. Regarding carbon emissions, firms in Hong Kong (11.836 million CO_2-e metric tons) followed by firms in Italy (8.303 million CO_2-e metric tons) and Thailand (6.484 million CO_2-e million tons) emit more carbon, while firms in New Zealand (0.477 million CO_2-e metric tons) emit less carbon. Regarding the legal environment, Singapore has the highest level while India has the lowest. Interestingly, Thailand has the highest global climate risk score *(GCRI)* followed by India, while the Singapore has the lowest.

Table 3 reports Pearson's correlation matrix. The correlation between *CRISK* and *CSCORE* is positive and statistically significant in Table 3, indicating that carbon risk is positively correlated with conditional accounting conservatism. Further, the multicollinearity problem is very unlikely in our regression models, given that correlation coefficients among other variables are less than 0.60 (Gujarati and Porter, 2009). The average value of the VIF of the variables used in the model is 1.68, with VIF values ranging from 1.07 to 4.6.

[6] We also apply robust standard errors clustered by country, and we find similar results.

[7] The mean of value of conditional conservatism *(CSCORE)* for US firms is 0.070, as shown in Panel B of Table 2, which is consistent with Burke et al. (2020).

Table 2
Descriptive statistics.

Panel A: Full sample descriptive statistics

	Observations	Mean	Std. Dev.	Median	1st Quartile	3rd Quartile
CSCORE	7,636	0.091	0.831	0.069	−0.091	0.252
EMISSION (in million metric tons)	7,636	3.256	13.958	0.359	0.087	1.376
CRISK	7,636	0.666	0.879	0.307	0.083	0.865
CGOV	7,636	0.494	0.500	0.000	0.000	1.000
INSTOWN	7,636	0.496	0.500	0.000	0.000	1.000
LNMCAP	7,636	8.978	1.355	8.960	8.025	9.887
MB	7,636	3.046	3.887	2.156	1.275	3.786
LEV	7,636	0.406	0.173	0.400	0.275	0.532
RDINT	7,636	0.029	0.052	0.003	0.000	0.032
SGROWTH	7,636	0.034	0.161	0.030	−0.047	0.102
CSRPERF	7,636	0.590	0.203	0.615	0.453	0.746
ZSCORE	7,636	1.235	0.712	1.149	0.750	1.621
FAGE	7,636	3.122	0.482	3.296	2.833	3.497
CFO	7,636	0.104	0.061	0.095	0.063	0.136
CAPEX	7,636	0.051	0.043	0.040	0.022	0.067
INTANG	7,636	0.233	0.220	0.168	0.045	0.373
VOLAT	7,636	0.055	0.242	0.034	0.020	0.059
LITG	7,636	0.222	0.415	0.000	0.000	0.000
CROSS	7,636	0.190	0.392	0.000	0.000	0.000
LNGDP	7,636	10.624	0.567	10.754	10.582	10.883
STAKE	7,636	0.440	0.496	0.000	0.000	1.000
LEGAL	7,636	2.520	0.870	2.601	2.422	3.115
GCRI	7,636	4.151	0.384	4.136	3.832	4.483

Panel B: Country descriptive statistics

Country	N	%	CSCORE	*EMISSION* (in million Co2-e metric tons)	GDP (US$ in Thousand)	STAKE	LEGAL	GCRI
Australia	290	3.80	0.049	2.321	56.410	0	7.088	53.696
Austria	27	0.35	−0.155	3.636	48.531	1	4.636	59.277
Belgium	41	0.54	−1.015	1.586	45.263	1	4.241	69.133
Brazil	143	1.87	0.627	0.872	10.345	1	−0.683	84.600
Canada	477	6.25	0.236	2.274	47.024	0	7.219	97.136
Chile	20	0.26	0.131	2.525	14.654	1	5.117	95.692
Denmark	116	1.52	−0.126	2.640	58.984	1	7.742	112.835
Finland	151	1.98	−0.488	1.703	47.743	1	7.022	154.191
France	403	5.28	0.320	4.982	40.644	1	5.073	40.171
Germany	312	4.09	−0.041	6.613	44.080	1	5.893	42.391
Hong Kong	20	0.26	0.064	11.836	35.719	0	8.192	170.378
India	67	0.88	−0.160	2.075	1.728	0	−0.133	38.086
Ireland	70	0.92	0.069	0.941	60.614	0	8.236	115.113
Italy	112	1.47	0.229	8.303	34.957	1	0.728	41.757
Japan	946	12.39	0.147	2.391	40.389	1	6.502	85.452
Mexico	30	0.39	−0.587	4.432	10.046	1	−1.615	57.600
Netherlands	120	1.57	0.202	1.665	50.532	1	4.641	72.124
Norway	86	1.13	−0.486	1.175	85.181	1	6.911	136.139
New Zealand	47	0.62	0.201	0.477	38.707	0	7.678	82.743
Singapore	46	0.60	0.158	1.354	56.826	0	8.943	170.418
South Africa	236	3.09	−0.032	2.259	6.412	0	0.444	82.544
South Korea	238	3.12	0.065	2.615	26.259	1	4.621	69.240
Spain	146	1.91	0.357	4.879	29.274	1	5.217	48.107
Sweden	200	2.62	0.251	0.612	54.663	1	6.857	127.051
Switzerland	246	3.22	0.115	4.075	79.951	1	5.614	49.457
Thailand	24	0.31	0.077	6.484	6.045	0	−0.297	35.425
Turkey	23	0.30	0.025	1.023	10.724	1	−0.487	109.307
United Kingdom	928	12.15	0.075	1.219	43.069	0	8.659	66.402
United States	2,071	27.12	0.070	4.672	54.288	0	4.782	44.316
Total/Average	**7,636**	**100**	**0.091**	**3.256**	**45.660**		**5.647**	**67.681**

4.2. *Regression results*

Table 4 reports the regression results for Hypotheses 1 through 3 (H1-H3). Model (1) reports the regression results excluding the variable of interest, carbon risk *(CRISK),* while Model (2) reports the regression results including the variable of interest, carbon risk *(CRISK)*. The coefficient of *CRISK* is positive and statistically significant ($\beta = 0.027p < 0.05$) in Model (2), suggesting that carbon risk is

Table 3
Correlation matrix.

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]
CSCORE	[1]	1.000																			
CRISK	[2]	0.046***	1.000																		
LNMCAP	[3]	-0.060***	0.329***	1.000																	
MB	[4]	-0.192***	-0.129***	0.215***	1.000																
LEV	[5]	0.111***	-0.140***	-0.024**	-0.104***	1.000															
RDINT	[6]	-0.023**	-0.168***	0.222***	0.107***	0.237***	1.000														
SGROWTH	[7]	-0.072***	-0.025**	0.101***	0.072***	0.061***	0.040***	1.000													
CSRPERF	[8]	-0.030***	0.178***	0.435***	0.055***	-0.090***	0.088***	-0.067***	1.000												
ZSCORE	[9]	-0.010	-0.164***	0.047**	0.271***	0.086***	-0.058***	0.071***	0.061***	1.000											
FAGE	[10]	0.052***	0.174***	0.242***	-0.018	-0.049***	0.055***	-0.100***	0.221***	0.051***	1.000										
CFO	[11]	-0.046***	-0.102***	0.288***	0.364***	0.228***	0.104***	0.150***	0.040***	0.455***	-0.073***	1.000									
CAPEX	[12]	-0.058***	0.214***	0.002	-0.025**	0.099***	-0.178***	0.147***	-0.091***	-0.045***	-0.123***	0.310***	1.000								
INTANG	[13]	-0.026**	-0.233***	0.153***	0.132***	-0.069***	0.144***	0.154***	0.042***	-0.087***	-0.037***	0.012	-0.309***	1.000							
VOLAT	[14]	0.016	0.038***	-0.084***	-0.055***	-0.022*	-0.014	-0.038***	-0.021*	-0.055***	-0.061***	-0.044***	0.028**	-0.055***	1.000						
LITG	[15]	-0.028**	-0.136***	0.172***	0.089***	0.101***	0.466***	0.045***	0.130***	0.194***	0.011	0.128***	-0.087***	0.087***	-0.006	1.000					
CROSS	[16]	0.014	0.079***	0.066***	-0.035***	0.042***	-0.027**	-0.013	0.074***	-0.082***	-0.022***	-0.042***	0.065***	-0.073***	0.007	-0.021*	1.000				
LNGDP	[17]	0.032***	-0.005	0.187***	0.089***	-0.004	0.150***	0.077***	0.014	0.035***	0.093***	0.081***	-0.066***	0.172***	-0.037***	0.031***	0.100***	1.000			
STAKE	[18]	0.002	-0.010	-0.020*	-0.139***	0.008	-0.001	-0.061***	0.174***	-0.025**	0.016	-0.163***	-0.056***	-0.128***	-0.005	-0.048***	0.089***	-0.122***	1.000		
LEGAL	[19]	0.043***	-0.095***	-0.110***	-0.057***	0.073***	0.003	-0.001	-0.133***	-0.024**	0.018	-0.064***	-0.023***	0.025***	0.009	-0.039***	0.152***	0.458***	-0.108***	1.000	
GCRI	[20]	0.036***	-0.127***	-0.299***	-0.106***	0.133***	-0.132***	-0.068***	-0.128***	0.005	-0.068***	-0.061***	0.080***	-0.187***	0.024**	-0.117***	0.138***	-0.092***	0.249***	0.318***	1.000

Notes: Superscript asterisks***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Appendix A provides the definitions of all variables.

Table 4
Regression results between carbon risk and accounting conservatism.

	Dependent Variable = *CSCORE*			
	Model (1)	Model (2)	Model (3)	Model (4)
CRISK	—	0.027**	0.055***	0.058***
		(2.178)	(2.925)	(3.703)
CRISK × *HIGH_CGOV*	—	—	−0.046**	—
			(−2.525)	
HIGH_CGOV	—	—	0.013	—
			(0.540)	
CRISK × *HIGH_INSTOWN*	—	—	—	−0.071***
				(−4.315)
HIGH_INSTOWN	—	—	—	0.037
				(1.272)
LNMCAP	−0.068***	−0.076***	−0.074***	−0.075***
	(−7.623)	(−7.760)	(−7.556)	(−7.724)
MB	−0.015***	−0.014***	−0.014***	−0.014***
	(−4.681)	(−4.499)	(−4.476)	(−4.438)
LEV	−0.129**	−0.122*	−0.118*	−0.117*
	(−1.985)	(−1.878)	(−1.818)	(−1.802)
RDINT	0.200	0.246	0.233	0.204
	(1.008)	(1.232)	(1.166)	(1.012)
SGROWTH	0.131*	0.133*	0.133*	0.135*
	(1.850)	(1.879)	(1.872)	(1.904)
CSRPERF	0.000	0.000	0.000	0.000
	(0.719)	(0.609)	(0.705)	(0.675)
ZSCORE	−0.040***	−0.040***	−0.040**	−0.042***
	(−2.625)	(−2.592)	(−2.554)	(−2.726)
FAGE	−0.027	−0.031	−0.031	−0.028
	(−1.346)	(−1.495)	(−1.523)	(−1.378)
CFO	0.195	0.265	0.255	0.245
	(0.855)	(1.153)	(1.107)	(1.064)
CAPEX	−0.674**	−0.742**	−0.744**	−0.697**
	(−2.216)	(−2.397)	(−2.406)	(−2.245)
INTANG	−0.082	−0.066	−0.066	−0.077
	(−1.612)	(−1.282)	(−1.286)	(−1.507)
VOLAT	0.010	0.005	0.008	−0.000
	(0.734)	(0.362)	(0.587)	(−0.010)
LITG	0.079	0.082	0.081	0.081
	(1.158)	(1.194)	(1.187)	(1.158)
CROSS	0.006	0.001	0.002	−0.002
	(0.179)	(0.039)	(0.067)	(−0.048)
LNGDP	−0.540***	−0.537***	−0.536***	−0.536***
	(−4.720)	(−4.698)	(−4.686)	(−4.676)
STAKE	−1.467***	−1.489***	−1.464***	−1.528***
	(−4.745)	(−4.802)	(−4.721)	(−4.936)
LEGAL	−0.111***	−0.112***	−0.111***	−0.110***
	(−2.758)	(−2.765)	(−2.745)	(−2.733)
GCRI	−0.085	−0.081	−0.081	−0.078
	(−0.561)	(−0.535)	(−0.529)	(−0.514)
Intercept	4.732***	4.744***	4.696***	4.695***
	(4.804)	(4.815)	(4.760)	(4.756)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes
Observations	7,636	7,636	7,636	7,636
R-squared	0.102	0.103	0.103	0.104
Gujarati and Porter (2009) ΔR^2-*F*-statistic		3.53*		

Notes: Superscript asterisks***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Coefficient values (robust t-statistics) are shown with standard errors clustered at the firm level. Appendix A provides the definitions of all variables.

positively associated with conditional accounting conservatism.[8] This finding is interpreted to mean that firms with a higher level of carbon risk have a higher level of conditional accounting conservatism. In terms of the finding's economic significance, the estimated coefficient in Model (1) suggests that a one-unit increase in the natural log of carbon emissions *(CRISK)* increases *CSCORE* by 0.027, which corresponds to a 29.67 % increase relative to the sample's mean *CSCORE* of 0.091 (0.027/0.091). This translates to a 0.021 rise in *CSCORE* or approximately a 23.08 % increase (0.021/0.091), when comparing firms at the 1st quartile of carbon risk with those at the 3rd quartile. The results are economically significant.

The explanatory power (R-squared) of Table 4's Model (2) with *CRISK* is 10.30 %. Following Gujarati and Porter (2009), we next assess the incremental contribution of *CRISK* to our research model's explanatory power. More specifically, we re-run Equation (4) after excluding *CRISK*, the main research variable. We report these regression results in Table 4, Model (1), showing that the regression model's explanatory power decreased to 10.20 %. Using the R-squared values from Models (1) and (2), we then test the null hypothesis that the addition of *CRISK* as an explanatory variable does not affect the model's explanatory power (R-squared), with results shown in Table 4, Model (2). We report Gujarati and Porter's (2009) F-statistic in Model (2) with its value of 3.53 being statistically significant ($p < 0.10$), thus suggesting that *CRISK* significantly increases the explanatory power of the regression model. Overall, the results suggest that firm-level carbon risk is incrementally informative information.

The results presented in Table 4, Model (3) show our examination of the moderating role of corporate governance on the association between carbon risk and conditional accounting conservatism. To test the moderation hypothesis, our variable of interest is the interaction between carbon risk and a higher level of corporate governance *(CRISK × HIGH_CGOV)*, as shown in Model (3). The interaction term captures differences in the effects of carbon risk on conditional accounting conservatism between firms with higher and lower levels of corporate governance. On the other hand, the coefficient of *CRISK* captures the effect of carbon risk for firms with a lower level of corporate governance. The coefficient of *CRISK* is positive and statistically significant ($\beta = 0.055p < 0.01$). On the other hand, the coefficient of *CRISK × HIGH_CGOV* is negative and statistically significant ($\beta = –0.046p < 0.05$) in Model (3), indicating that controlling for other factors, the average increase of conditional accounting conservatism due to carbon risk is lower for firms with a higher level of corporate governance. In terms of the economic significance, the estimated coefficient suggests that, on average, a one standard deviation increase in the carbon risk leads to a 4.83 % (0.055×0.879) increase in the value of conditional accounting conservatism for firms with a lower level of corporate governance performance, while a one standard deviation increase in the carbon risk leads to a 1.03 % ($–0.046 \times 0.879 + 0.055 \times 0.879$) increase in the value of conditional accounting conservatism for firms with a higher level of corporate governance. Our results suggest that better corporate governance attenuates the positive impact of carbon risk on conditional accounting conservatism.

Furthermore, we examine the moderating role of institutional investors' ownership on the association between carbon risk and conditional accounting conservatism. To test the moderation hypothesis, our variable of interest is the interaction between carbon risk and a higher level of institutional investors' ownership *(CRISK × HIGH_INSTOWN)*, with results shown in Model (4). The coefficient on *CRISK* is positive and statistically significant ($\beta = 0.058\text{p} < 0.01$). On the other hand, the coefficient on *CRISK × HIGH_INSTOWN* is negative and statistically significant ($\beta = –0.071\text{p} < 0.01$) in Model (4), indicating that controlling for other factors, the average increase of conditional accounting conservatism due to carbon risk is lower for firms with a higher level of institutional investors' ownership. In terms of the finding's economic significance, the estimated coefficient suggests that, on average, a one standard deviation increase in the carbon risk leads to a 5.10 % (0.058×0.879) increase in the value of conditional accounting conservatism for firms with a lower level of institutional investors' ownership, while a one standard deviation increase in the carbon risk leads to a 1.14 % ($–0.071 \times 0.879 + 0.058 \times 0.879$) decrease in the value of conditional accounting conservatism for firms with a higher level of institutional investors' ownership. Our results suggest that a higher level of institutional investors' ownership attenuates the positive relationship between carbon risk and conditional accounting conservatism.

Regarding control variables from Model (2) to (4), we find that the coefficients on *LNMCAP*, *MB, LEV, ZSCORE,* and *CAPEX* are negative and statistically significant. This suggests that firms that are larger, with a higher level of unconditional accounting conservatism, have higher leverage ratio, Altman Z-score and higher capital expenditure have lower conditional accounting conservatism. In contrast, the coefficients of *SGROWTH* are positive and statistically significant, suggesting that firms with a higher sales growth have a greater level of conditional accounting conservatism. Regarding the country-level variables, the coefficients of *LNGDP* are negative and statistically significant, suggesting that firms in countries with a higher GDP have a lower level of conditional accounting conservatism. Further, the coefficient of *STAKE* and *LEGAL* are negative and statistically significant, suggesting that firms in countries with stakeholder-oriented business cultures and stronger legal environments tend to exhibit lower levels of conditional accounting conservatism.

[8] To empirically validate the information asymmetry mechanism underpinning our theoretical framework, we conduct additional analysis to test whether the relationship between carbon risk and conditional accounting conservatism is moderated by firm-level information asymmetry. Following Dey et al. (2024), we proxy information asymmetry using the average of the daily closing bid–ask spread as a percentage of the closing price, calculated annually at the firm level. We construct an indicator variable, *HIGH_INFOASYM*, which equals 1 if a firm's bid–ask spread is above the country-year median, and 0 otherwise, thereby adjusting for cross-country and temporal variation in market structure. While we do not report the regression results for brevity, the unreported findings show that the positive association between carbon risk and conservatism is significantly stronger for firms with high information asymmetry. This supports our argument that firms facing both heightened carbon uncertainty and greater information asymmetry are more likely to adopt conservative reporting, reinforcing the contracting demand explanation of conservatism.

4.3. Endogeneity analysis

While our results show that firms with higher carbon risk tend to exhibit greater conditional accounting conservatism, this relationship does not necessarily imply causation. To ensure a causal interpretation of the observed relationship between carbon risk and conditional accounting conservatism, we implement several strategies to address potential endogeneity concerns, including reverse causality and omitted variable bias, which are discussed below.

4.3.1. Heckman (1979) two-stage model

Our findings may be affected by self-selection bias as we draw firms in our sample from the CDP database which only reports carbon emissions information for firms that voluntarily respond to the CDP questionnaire. We apply Heckman's (1979) two-stage model for

Table 5
Regression results between carbon risk and accounting conservatism using Heckman's (1979) two-stage model.

Panel A: First-stage probit regression results using Heckman's (1979) model			
	Dependent variable = *EMI_DISC*		
	Coefficient	**z-statistic**	**p-value**
PROPDISC	2.964	24.778	0.000
EMI_DISC_LAG	3.205	64.001	0.000
LNMCAP	0.172	6.930	0.000
ROA	−0.027	−0.078	0.938
MB	−0.005	−0.723	0.470
LEV	−0.012	−0.095	0.924
FAGE	−0.003	−0.065	0.948
FOREIGN	0.144	2.892	0.004
CAPEX	1.443	3.155	0.002
VOLAT	−0.034	−1.104	0.270
INSTOWN	0.144	1.796	0.072
ANALYST	0.008	0.226	0.821
CSRPERF	0.006	7.463	0.000
LNGDP	−0.718	−3.007	0.003
STAKE	0.010	0.031	0.975
LEGAL	0.029	0.086	0.931
GCRI	0.398	2.172	0.030
Intercept	1.727	0.753	0.451
Year Fixed Effects		Yes	
Industry Fixed Effects		Yes	
Country Fixed Effects		Yes	
Pseudo *R*-squared		0.800	
Observations		17,829	
Log pseudolikelihood		−2407.32	

Panel B: Second-stage regression results between carbon risk and accounting conservatism			
	Dependent Variable = *CSCORE*		
	Model (1)	**Model (2)**	**Model (3)**
CRISK	0.021*	0.040**	0.042***
	(1.740)	(2.094)	(2.744)
CRISK × *HIGH_CGOV*	——	−0.035**	——
		(−1.973)	
HIGH_CGOV	——	0.009	——
		(0.365)	
CRISK × *HIGH_INSTOWN*	——	——	−0.054***
			(−3.425)
HIGH_INSTOWN	——	——	0.043
			(1.466)
IMR	0.021	0.023	0.022
	(0.739)	(0.809)	(0.790)
Intercept	4.691***	4.593***	4.606***
	(5.018)	(4.854)	(4.843)
Control variables	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes
Observations	7516	7516	7516
R-squared	0.101	0.101	0.102

Notes: Superscript asterisks***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively; coefficient values (robust t-statistics) are shown with standard errors clustered at the firm level. Appendix A provides the definitions of all variables.

addressing the potential self-selection bias. In the first stage, we develop a probit regression model with the firm's decision to respond to the CDP questionnaire and disclosures of carbon risk information by augmenting the sample with firms to whom CDP sent the questionnaire but that did not respond. More specifically, we employ the following model:

Table 6
PSM, change-specific regression results and two-stage Instrumental variable analysis results between carbon risk and accounting conservatism.

Panel A: Regression results between carbon risk and accounting conservatism based on PSM-matched sample			
	Dependent Variable = Δ*CSCORE*		
	Model (1)	**Model (2)**	**Model (3)**
CRISK_DUM	0.033*	0.067**	0.055**
	(1.738)	(2.412)	(2.184)
CRISK_DUM × *HIGH_CGOV*	—	−0.052*	—
		(−1.721)	
HIGH_CGOV	—	0.007	—
		(0.237)	
CRISK_DUM × *HIGH_INSTOWN*	—	—	−0.067**
			(−2.511)
HIGH_INSTOWN	—	—	0.056
			(1.418)
Intercept	7.863***	8.289***	7.644***
	(4.050)	(5.670)	(3.920)
Control Variables	Yes	Yes	Yes
Year, Industry and Country Fixed Effects	Yes	Yes	Yes
Observations	3,952	3,952	3,952
R-squared	0.123	0.113	0.124
Panel B: Change-specific regression results between carbon risk and accounting conservatism			
	Dependent Variable = Δ*CSCORE*		
	Model (1)	**Model (1)**	**Model (1)**
ΔCRISK	0.172**	0.167**	0.164**
	(2.317)	(2.227)	(2.182)
ΔCRISK × *ΔHIGH_CGOV*	—	−0.165*	—
		(−1.899)	
ΔHIGH_CGOV	—	0.014	—
		(0.423)	
ΔCRISK × *ΔHIGH_INSTOWN*	—	—	−0.165**
			(−2.010)
ΔHIGH_INSTOWN	—	—	−0.001
			(−0.019)
Intercept	0.372**	0.375**	0.330*
	(2.310)	(2.322)	(1.955)
ΔControl Variables	Yes	Yes	Yes
Year, Industry and Country Fixed Effects	Yes	Yes	Yes
Observations	5,982	5,982	5,982
R-squared	0.036	0.037	0.037

Panel C: Two-stage Instrumental variable analysis results between carbon risk and accounting conservatism		
	Dependent Variable = *CSCORE*	
	Model (1)	**Model (2)**
CRISK_PREDICTED	—	0.085**
		(2.570)
CO2EMISSION_COUNTRY	0.031***	—
	(27.850)	
Intercept	−0.651	4.899***
	(−0.820)	(4.860)
Control Variables	Yes	Yes
Year, Industry and Country Fixed Effects	Yes	Yes
Observations	7,636	7,636
R-squared	0.527	0.106
Instrument diagnostics tests:		
Shea's partial R^2	0.065	
Partial *F*-statistic	776..76	

Notes: Superscript asterisks***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Coefficient values (robust t-statistics) are shown with standard errors clustered at the firm level. Appendix A provides the definitions of all variables.

$$
\begin{aligned}
Pr(EMI\_DISC = 1)_{i,t} = {} & \beta_0 + \beta_1 PROPDISC_{i,t} + \beta_2 EMI\_DISC\_LAG_{i,t} + \beta_3 LNMCAP_{i,t} + \beta_4 ROA_{i,t} \\
& + \beta_5 MB_{i,t} + \beta_6 LEV_{i,t} + \beta_7 FAGE_{i,t} + \beta_8 FOREIGN_{i,t} + \beta_9 CAPEX_{i,t} \\
& + \beta_{10} VOLAT_{i,t} + \beta_{11} INSTOWN_{i,t} + \beta_{12} ANALYST_{i,t} + \beta_{13} CSRPERF_{i,t} \\
& + \beta_{14} LNGDP_{j,t} + \beta_{15} STAKE_j + \beta_{16} LEGAL_j + \beta_{17} GCRI_{j,t} + \sum YEAR_t \\
& + \sum INDUSTRY_k + \sum COUNTRY_j + \varepsilon_{i,t+1}
\end{aligned} \tag{5}
$$

In Eq. (5), *EMI_DISC* is measured as an indicator variable that takes a value of 1 if the firm responds to the CDP questionnaire by disclosing carbon emissions information, and 0 otherwise. We include several variables in Eq. (5) based on prior studies (e.g., Matsumura et al., 2014; Bose et al., 2025a,b) and two exclusion restrictions in the first-stage model as shown in Eq. (5): *PROPDISC* and *EMI_DISC_LAG*. We include *PROPDISC* to capture industry pressure. If more firms in a given industry disclose their carbon risk information through the CDP, non-disclosing firms face increased pressure to do so to avoid negative perceptions from external capital providers (Matsumura et al., 2014). *PROPDISC* is measured as the proportion of firms in an industry that respond to the CDP questionnaire by disclosing carbon risk information. Furthermore, we control for *EMI_DISC_LAG* to capture a firm's response to the CDP questionnaire by providing carbon emissions information in the previous year as the firm's decision to respond to the CDP questionnaire tends to be sticky. A positive coefficient on *PROPDISC* and *EMI_DISC_LAG* is expected. Appendix A provides the definitions of all variables. We generate inverse Mills ratio *(IMR)* from Eq. (5) and use it as a control variable in Eq. (4) that accounts for self-selection bias.

Table 5, Panel A presents the first-stage regression results. The coefficients of *PROPDISC* and *EMI_DISC_LAG* are positive and statistically significant ($\beta = 2.964 p < 0.01; \beta = 3.205, p < 0.01$), which is in line with our expectation. The model has a pseudo-R^2 value of 80 %. Furthermore, we assess the strengths of the exclusion restrictions using the partial R^2 values (untabulated), which are 11.17 % ($p < 0.01$) and 30.93 % ($p < 0.01$) for *PROPDISC* and *EMI_DISC_LAG*, respectively, suggesting that the two exclusion restrictions are reasonable exogenous variables. The second-stage regression results are reported in Panel B of Table 5. The results suggest that our findings are similar as shown in Table 4. Further, the coefficient on *IMR* is positive and statistically insignificant across all models, indicating that the findings are robust after controlling for self-selection bias that corroborates our main findings.

4.3.2. Propensity score matching (PSM) analysis

The relationship between carbon risk and conditional accounting conservatism may be affected by observable heterogeneity bias (Tucker, 2010; Lennox et al., 2012) and functional misspecification bias (Shipman et al., 2017). To address these concerns, we apply a PSM analysis. We create a dummy variable equal to 1 if a firm's carbon risk is above the year–industry-adjusted median (*CRISK_DUM = 1*) and 0 otherwise. To implement PSM, we follow two stages. First, we estimate a logistic regression of *CRISK_DUM* using the same set of control variables as in Eq. (4), consistent with the principle of applying identical covariates in both stages to ensure proper balance (Shipman et al., 2017). We do not report the first-stage regression results and the matching comparison for brevity. However, the unreported results show no statistically significant differences between the two groups.

In the second stage, we perform caliper matching within a 3 % range and match without replacement each treated firm-year *(CRISK_DUM = 1)* to a control firm-year *(CRISK_DUM = 0)* based on the estimated propensity scores. Panel A of Table 6 reports regression results based on PSM-matched samples. Consistent with our main findings in Table 4, the coefficient on *CRISK_DUM* is positive and statistically significant in Model (1), while the interaction terms *CRISK* × *HIGH_CGOV* in Model (2) and *CRISK* × *HIGH_INSTOWN* in Model (3) are negative and statistically significant, reinforcing the robustness of our results.

4.3.3. Change-specific analysis

Potential omitted variable bias may raise endogeneity concerns in our models. Although we control for key firm- and country-level factors and include industry, country, and year fixed effects, unobserved heterogeneity may persist. To address this, we use change regressions to control for time-invariant firm characteristics. Table 6, Panel B, reports the estimates from Models (1)–(3). The coefficient on *ΔCRISK* is positive and significant in Model (1), indicating that increases in carbon risk are associated with increases in accounting conservatism. The interaction terms *ΔCRISK* × *ΔHIGH_CGOV* and *ΔCRISK* × *ΔHIGH_INSTOWN* are negative and significant in Models (2) and (3), respectively, suggesting that strong governance and institutional ownership moderate this relationship. These results help mitigate concerns over omitted variable bias and reinforce the robustness of our findings.

4.3.4. Instrumental variable analysis

Our findings may be influenced by reverse causality, as the relationship between carbon risk and accounting conservatism can be bidirectional. We argue that regulatory and market-driven carbon reduction commitments are typically imposed by external institutions (e.g., governments or industry bodies) rather than firm-level accounting choices. This institutional context makes it less likely that conditional accounting conservatism drives a firm's carbon abatement activities. Accordingly, the causal direction is more plausibly from carbon risk to accounting conservatism. Nevertheless, we acknowledge the possibility of reverse causality, whereby inherently conservative firms may appear to have higher carbon risk due to their more cautious recognition of carbon-related liabilities, reduced investment in mitigation technologies, or increased visibility to regulators, which may subject them to greater scrutiny. To address potential endogeneity from reverse causality, we employ an instrumental variable (IV) approach, which requires identifying an exogenous instrument that is correlated with carbon risk *(CRISK)* but does not directly affect accounting conservatism *(CSCORE)*. Following Bose et al. (2025a,b), we select carbon emissions at the country level *(CO2EMISSION_COUNTRY)* as our instrumental variable. The rationale is that firms operating in high-emission countries face greater regulatory pressures and climate-related risks, which can shape their carbon risk profile. However, country-level carbon emissions are unlikely to directly influence accounting conservatism, making this a valid instrument for our analysis.

The first-stage regression estimates are shown in Model (1) of Table 6, Panel C, where *CO2EMISSION_COUNTRY* is significantly associated with carbon risk (β = 0.031, $p < 0.01$). The Shea's partial R^2 is 0.065, and the partial *F*-statistic is 776.76, which exceeds the critical threshold suggested by Stock et al. (2002), confirming that our instruments are not weak. Table 8, Model (2) reports the second-stage regression results, where *CRISK_PREDICTED* is positively and significantly associated with *CSCORE* (β = 0.085, $p < 0.05$), supporting our main findings. The positive and significant coefficient suggests that higher carbon risk leads to greater accounting conservatism, even after addressing endogeneity concerns. These results confirm the robustness of our findings, suggesting that the observed relationship between carbon risk and accounting conservatism is unlikely to be driven by endogeneity arises from the reverse causality.

4.3.5. Other endogeneity analyses

A potential concern in our analysis is that carbon risk and accounting conservatism may be jointly determined by unobservable firm characteristics—such as corporate culture or managerial risk preferences—leading to simultaneity bias. To mitigate this issue, we incorporate key governance and leadership variables into our empirical model, including board size *(BSIZE)*, board independence *(BIND)*, and CEO duality *(DUAL)*, which are well-established determinants of both environmental performance and financial reporting. Their inclusion helps to account for corporate governance structures and managerial styles that may simultaneously affect both outcomes, reducing omitted variable bias and addressing endogeneity concerns. We do not report the regression results for brevity; however, the inclusion of these additional governance and leadership variables does not qualitatively alter our main findings, suggesting robustness to simultaneity and omitted variable bias.

4.4. Robustness checks and sensitivity analyses

4.4.1. Alternative proxy for carbon risk

In our main analysis, we measure carbon risk as the natural logarithm of carbon emissions. To assess the robustness of our findings, we use a relative measure of carbon risk, that is, the sum of Scope 1 and Scope 2 carbon emissions, scaled by total revenues *(CRISK_INT)*. Table 7, Panel A reports the regression results. The coefficient of *CRISK_INT* is positive and statistically significant in Model (1), while the coefficients of *CRISK_INT* × *HIGH_GOV* and *CRISK_INT* × *HIGH_INSTOWN* are negative and statistically significant in Models (2) and (3). These findings are qualitatively similar to those in Table 4, thus corroborating our main findings.

We measure carbon risk *(CRISK)* as the natural logarithm of the sum of Scope 1 and Scope 2 emissions, excluding Scope 3 due to the challenges firms face in accurately quantifying these data. To provide a more comprehensive assessment, we also examine Scope 1, Scope 2, and Scope 3 emissions separately as alternative proxies. Table 7, Panels B, C, and D present these results. In Model (1) of each panel, the coefficient on *CRISK* remains positive and significant, indicating that higher carbon risk is associated with greater accounting conservatism. In Models (2) and (3), the interaction terms *CRISK* × *HIGH_CGOV* and *CRISK* × *HIGH_INSTOWN* are consistently negative and significant, suggesting that strong corporate governance and institutional ownership attenuate this relationship. These findings align with those in Table 4 and demonstrate robustness across alternative carbon risk measures, reinforcing the reliability of our conclusions.

4.4.2. Alternative measure of accounting conservatism

We use *CSCORE* as a measure of conditional accounting conservatism. We also employ Basu's (1997) measure of accounting conservatism as an alternative proxy for measuring accounting conservatism. Table 7, Panel E reports the regression results. The coefficient of *CRISK* is positive and statistically significant in Model (1), while the coefficients of *CRISK* × *HIGH_GOV* and *CRISK* ×

Table 7
Regression results between carbon risk and accounting conservatism: Robustness analysis.

Panel Title	Model (1)	Model (2)	Model (3)	Model (4)	Observations
	CRISK	CRISK× HIGH_CGOV	CRISK× HIGH_INSTOWN	CRISK × *PARIS_AGREE*	
Panel A: Alternative measure of Carbon Risk	0.028**(2.227)	−0.054***(−2.889)	−0.052**(−2.195)		7,598
Panel B: Scope 1 Emissions	0.042***(8.191)	−0.049***(−7.712)	−0.054*** (−6.117)		7,636
Panel C: Scope 2 Emissions	0.005*(1.773)	−0.023***(−3.819)	−0.020**(−2.280)		7,636
Panel D: Scope 3 Emissions	0.008***(3.262)	−0.026***(−7.321)	−0.017***(−5.526)		6,498
Panel E: Basu's (1997) measure of accounting conservatism	0.248***(3.065)	−0.469***(−3.643)	−0.240**(−2.010)		7,562
Panel F: Role of 2015 Paris Agreement				0.110** (2.319)	4,406
Control Variables	Yes	Yes	Yes	Yes	
Year Fixed Effects	Yes	Yes	Yes	Yes	
Industry Fixed Effects	Yes	Yes	Yes	Yes	
Country Fixed Effects	Yes	Yes	Yes	Yes	

Notes: Superscript asterisks ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. Coefficient values (robust t-statistics) are shown with standard errors clustered at the firm level. Appendix A provides the definitions of all variables.

HIGH_INSTOWN are negative and statistically significant in Models (2) and (3). These findings are qualitatively similar to those presented in Table 4, thus corroborating our main findings.

4.4.3. Other tests

Panel B of Table 2 shows that U.S. firms account for the largest portion of the sample (27.12 %). Prior cross-country studies have raised concerns that such results may be disproportionately driven by U.S. firms. To address this, we re-estimate all regressions excluding U.S. firms. For brevity, results are not reported, but the untabulated findings remain qualitatively similar. As additional country-level sensitivity checks, we repeat the analyses excluding, one at a time: (1) U.S. firms, (2) U.K. firms, (3) Japanese firms, and (4) countries with fewer than 30, 50, and 100 observations. In all cases, the unreported results are consistent with our main findings, confirming their robustness.

5. Additional analyses

5.1. Role of Paris agreement analysis

To further assess the plausibility of our findings, we conduct a post-event analysis using the 2015 Paris Climate Agreement as a contextual policy shock. The agreement marked a major shift in global climate governance, increasing regulatory attention and expectations around carbon disclosures. Following Bolton and Kacperczyk (2023), we treat the agreement as an exogenous shift in the global climate policy landscape and test whether firms with higher carbon risk responded by adopting more conservative financial reporting practices in its aftermath.

We define *PARIS_AGREE* as a dummy variable equal to 1 for 2016–2018 (post-agreement) and 0 for 2012–2014 (pre-agreement), and interact it with firm-level carbon risk *(CRISK* × *PARIS_AGREE)*. Panel F in Table 7 shows a positive and significant coefficient, indicating that carbon-intensive firms increased conditional conservatism following the agreement. While not establishing causality, this result supports the view that global climate policy developments influence firms' financial reporting behaviour through heightened stakeholder and regulatory pressure.

5.2. Do country-level characteristics affect the relationship between carbon risk and conditional accounting conservatism?

Prior studies suggest that firms in countries with emissions trading schemes (ETSs) face greater economic pressures to reduce carbon emissions, prompting investment in carbon mitigation (Kolk et al., 2008). An ETS is a government-mandated, market-based mechanism requiring firms to limit emissions, often resulting in substantial compliance costs (Clarkson et al., 2015; Bose et al., 2024a, b). These regulatory pressures heighten firms' exposure to carbon-related risks and liabilities, incentivizing more conservative financial reporting to manage earnings volatility and reassure investors. Clarkson et al. (2015) empirically show that firms under the EU ETS face greater market value penalties than those in non-ETS regions, reflecting increased investor demand for financial prudence in such environments. Accordingly, firms in ETS-participating countries are likely subject to stricter investor scrutiny and reporting expectations, leading to greater adoption of conditional conservatism. To test this, we define ETS as a binary variable equal to 1 if a firm operates in a country with an active ETS, and 0 otherwise. Consistent with our expectations, we hypothesize that the positive association between carbon risk and conditional conservatism is stronger in ETS-participating countries, highlighting the disciplining effect of carbon regulation on financial reporting behaviour.

Table 8, Panel A shows that the positive association between carbon risk and conditional conservatism is significant in ETS-participating countries (Model 1: $\beta = 0.024$, $p < 0.10$), but not in non-ETS jurisdictions (Model 2). The interaction terms *CRISK* × *HIGH_CGOV* and *CRISK* × *HIGH_INSTOWN* are negative and significant in ETS countries (Models 3 and 5), but not elsewhere, suggesting that strong governance and institutional ownership weaken the conservatism response to carbon risk in regulated settings.

Beyond regulatory compliance, country-level governance quality plays a key role in shaping firms' financial reporting responses to carbon risk. Strong governance environments impose greater legal scrutiny, investor protection, and reporting expectations, increasing the contracting costs associated with carbon-related uncertainty and reinforcing the demand for conditional conservatism (Leuz et al., 2003). We construct a governance index *(COUNTRY_GOV)* using the World Bank's six Worldwide Governance Indicators and classify countries as high governance *(HIGH_COUNTRY_GOV = 1)* if their score is above the yearly median. Panel B of Table 8 reports the sub-sample results. The coefficient on *CRISK* is positive and significant in high-governance countries (Model 1: $\beta = 0.068$, $p < 0.01$), confirming that the effect of carbon risk on conservatism is stronger in these settings. Furthermore, the interaction terms *CRISK* × *HIGH_CGOV* and *CRISK* × *HIGH_INSTOWN* are negative and significant ($\beta = -0.102$, $p < 0.01$; $\beta = -0.141$, $p < 0.01$) in Models (3) and (5), but not in Models (4) and (6), suggesting that firm-level governance and institutional ownership weaken the degree of conditional conservatism adopted in response to carbon risk, particularly in high-governance countries.

In addition to regulatory and governance factors, national business culture significantly influences firms' sustainability-related financial reporting. Prior studies suggest that firms in stakeholder-oriented cultures (e.g., code law countries) emphasize long-term value creation, CSR, and sustainability integration, facing greater public and regulatory pressure around environmental responsibility (Ball et al., 2000; Simnett et al., 2009). This elevates the contracting costs of carbon risk, thereby increasing the demand for conditional conservatism. In contrast, firms in shareholder-oriented cultures (e.g., common law countries) prioritize short-term financial performance, reducing the incentive for conservative reporting in response to carbon risk. Following Ball et al. (2000), we define *STAKE* as an indicator variable equal to 1 for firms in stakeholder-oriented countries and 0 otherwise. We expect a stronger positive association between carbon risk and conservatism in stakeholder-oriented settings. Panel C of Table 8 presents the sub-sample

Table 8
Regression results between carbon risk and accounting conservatism using country-level moderators.

Panel A: Regression results between carbon risk and accounting conservatism using country-level Emissions Trading Scheme (ETS)

	Dependent Variable = *CSCORE*					
	ETS	**NON_ETS**	**ETS**	**NON_ETS**	**ETS**	**NON_ETS**
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**
CRISK	0.024*	0.014	0.059***	0.012	0.058***	0.011
	(1.758)	(0.553)	(2.786)	(0.281)	(3.199)	(0.340)
CRISK × *HIGH_CGOV*	—	—	−0.061***	0.002	—	—
			(−2.959)	(0.055)		
HIGH_CGOV	—	—	0.008	0.034	—	—
			(0.304)	(0.601)		
CRISK × *HIGH_INSTOWN*	—	—	—	—	−0.078***	0.004
					(−4.266)	(0.110)
HIGH_INSTOWN	—	—	—	—	0.054*	−0.035
					(1.760)	(−0.511)
Intercept	10.529***	3.235	10.295***	3.212	10.265***	3.285
	(6.061)	(0.843)	(5.958)	(0.838)	(5.916)	(0.855)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,007	1,629	6,007	1,629	6,007	1,629
R-squared	0.128	0.181	0.129	0.181	0.130	0.181

Panel B: Regression results between carbon risk and accounting conservatism using country-level governance quality

	Dependent Variable = *CSCORE*					
	HIGH_COUNTRY _GOV	**LOW_COUNTRY _GOV**	**HIGH_COUNTRY _GOV**	**LOW_COUNTRY _GOV**	**HIGH_COUNTRY _GOV**	**LOW_COUNTRY _GOV**
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**
CRISK	0.068***	−0.003	0.123***	−0.011	0.107***	−0.004
	(3.114)	(−0.225)	(3.955)	(−0.531)	(4.261)	(−0.202)
CRISK × *HIGH_CGOV*	—	—	−0.102***	0.013	—	—
			(−3.134)	(0.678)		
HIGH_CGOV	—	—	0.059	−0.021	—	—
			(1.420)	(−0.780)		
CRISK × *HIGH_INSTOWN*	—	—	—	—	−0.141***	0.002
					(−4.677)	(0.102)
HIGH_INSTOWN	—	—	—	—	0.047	0.007
					(0.983)	(0.197)
Intercept	8.134***	6.857***	8.103***	6.853***	8.213***	6.875***
	(3.190)	(2.929)	(3.173)	(2.933)	(3.224)	(2.934)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3176	4460	3176	4460	3176	4460
R-squared	0.158	0.138	0.160	0.138	0.161	0.138

Panel C: Regression results between carbon risk and accounting conservatism using country-level stakeholder-orientation

	Dependent Variable = *CSCORE*					
	STAKE	**SHARE**	**STAKE**	**SHARE**	**STAKE**	**SHARE**
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**
CRISK	0.041*	−0.005	0.063*	0.003	0.059**	0.009
	(1.717)	(−0.470)	(1.847)	(0.220)	(2.349)	(0.600)
CRISK × *HIGH_CGOV*	—	—	−0.062*	−0.015	—	—
			(−1.663)	(−1.121)		
HIGH_CGOV	—	—	0.016	0.043**	—	—
			(0.340)	(2.127)		
CRISK × *HIGH_INSTOWN*	—	—	—	—	−0.105**	−0.021
					(−2.030)	(−1.364)
HIGH_INSTOWN	—	—	—	—	0.100	0.023
					(1.439)	(0.917)
Intercept	14.270***	2.593***	6.657***	2.644***	14.037***	2.574***
	(3.721)	(3.238)	(2.907)	(3.324)	(3.648)	(3.201)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes

(*continued on next page*)

Table 8 (*continued*)

Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,140	4,496	3,140	4,496	3,140	4,496
R-squared	0.153	0.214	0.134	0.215	0.154	0.214

Notes: Superscript asterisks***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively; coefficient values (robust t-statistics) are shown with standard errors clustered at the firm level. Appendix A provides the definitions of all variables.

results. The coefficient on *CRISK* is positive and significant ($\beta = 0.041$, $p < 0.10$) in stakeholder-oriented countries (Model 1), but not significant in shareholder-oriented ones (Model 2). The interaction terms *CRISK* × *HIGH_CGOV* and *CRISK* × *HIGH_INSTOWN* are negative and significant ($\beta = -0.062$, $p < 0.10$; $\beta = -0.105$, $p < 0.05$) in Models (3) and (5), indicating that firms in stakeholder-oriented cultures adopt stronger conservatism in response to carbon risk, while firm-level governance and institutional ownership mitigate this effect.

6. Conclusions

In this study, we examine the association between corporate carbon risk and a prevailing feature of financial reporting, conditional accounting conservatism. Using 7,636 firm-year observations from 29 countries over the period 2007–2019, we find a significant positive relationship between firms' carbon risk exposure and conditional accounting conservatism. The results are robust to alternative measures of both carbon risk and conditional accounting conservatism, and to various tests addressing endogeneity and self-selection bias. Our findings suggest that managers incorporate carbon risk into financial reporting decisions, adopting conditional conservatism to reduce information asymmetry and facilitate investor assessment of firm value. We further find that this positive association is weaker among firms with stronger institutional ownership and corporate governance, indicating the moderating role of internal and external monitoring. Additionally, the relationship is more pronounced for firms operating in countries with emissions trading schemes (ETS), stronger country-level governance, and stakeholder-oriented business cultures. These results highlight the importance of institutional heterogeneity in shaping the financial reporting implications of carbon risk.

This study contributes to the growing literature on carbon risk and conditional accounting conservatism by highlighting the role of carbon risk in shaping financial reporting practices. While prior research has documented the effects of carbon risk on capital markets (Matsumura et al., 2014; Griffin et al., 2017; Bose et al., 2021), its implications for financial reporting remain underexplored. Historically, the disclosure of carbon risk has been largely voluntary and not mandated by major accounting frameworks. However, the recent introduction of IFRS S2 by the ISSB marks a significant regulatory shift, requiring climate-related disclosures aligned with the Task Force on Climate-related Financial Disclosures (TCFD). Despite this progress, many jurisdictions—particularly those applying U.S. GAAP—still do not require firms to report carbon risk in financial statements, leaving investors reliant on voluntary non-financial disclosures. Our findings, which show a positive association between carbon risk and conditional accounting conservatism, suggest that firms are already responding to investor demands by incorporating carbon risk into financial reporting. This evidence is particularly relevant for accounting standard-setters, regulators, and policymakers seeking to operationalize IFRS S2 and related frameworks. By demonstrating how carbon risk influences core reporting behaviours, this study offers valuable insights for enhancing transparency, improving capital market efficiency, and supporting more informed investment decisions in an increasingly carbon-constrained global economy.

We acknowledge the limitations of the study and offer directions for future research. First, our analysis relies on carbon emissions data voluntarily disclosed by firms through the CDP questionnaire. As a result, firms that do not respond to CDP are excluded from our sample, which may introduce selection bias. Although we employ multiple techniques to address self-selection and endogeneity concerns, future research could incorporate carbon risk information obtained through alternative disclosure channels or mandatory reporting frameworks to broaden coverage and improve generalizability. Second, while this study focuses on conservative financial reporting, it does not examine a closely related and specific element—carbon risk provisions. The recognition of provisions for future carbon-related obligations is a tangible mechanism of conservatism in financial reporting. We encourage future research to investigate how carbon risk provisions are reported in financial statements, whether they accelerate the recognition of carbon-related liabilities, and how such practices influence firm valuation and investor decision-making.

7. Research support

This research received no external financial or non-financial support.

8. Relationships

There are no additional relationships to disclose.

9. Patents and intellectual property

There are no patents to disclose.

10. Other activities

There are no additional activities to disclose.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors thank the anonymous reviewers and the Editor for their constructive and helpful comments. We also appreciate the valuable feedback and suggestions received from participants at the 2021 Accounting and Finance Association of Australia and New Zealand (AFAANZ) Conference, the 2024 Journal of Contemporary Accounting and Economics (JCAE) Mid-Year Symposium in Auckland, and seminar participants at the Discipline of Accounting and Finance, The University of Newcastle, Australia.

Appendix. Definition of variables

Variables		Definition
Panel A: Dependent variable(s)		
CSCORE	Conditional conservatism	Firm-year measure of conditional accounting conservatism, estimated following Khan and Watts (2009).
Coeff_Basu	Conditional conservatism	Firm-year measure of conditional accounting conservatism, estimated following Basu (1997).
Panel B: Variables of interest		
CRISK	Carbon risk	The natural logarithm of the total amount of carbon emissions in CO2-e metric tons.
CRISK_INT	Carbon risk	Total amount of carbon emissions in CO2-e metric tons, scaled by total revenues.
Panel C: Firm-level variables		
SIZE	Firm size	The natural logarithm of total assets.
LNMCAP	Firm size	The natural logarithm of market capitalization.
MB	Market-to-book	The ratio of market value of equity to book value of equity.
LEV	Leverage	The ratio of total debt scaled by total equity.
RDINT	Research and development	The ratio of research and development expenses to total sales.
INSTOWN	Institutional investors' ownership	The percentage of ownership held by institutional investors.
CGOV	Corporate governance	The corporate governance performance score from the Refinitiv ESG database.
SGROWTH	Revenue growth	The percentage of annual change in total revenue.
CSRPERF	CSR performance	The average of environmental and social performance pillar score from the Refinitiv ESG database.
ZSCORE	Financial distress	Altman's (1968) Z-score.
FAGE	Firm age	The natural logarithm of the total number of years since the firm first appears in the World scope database.
CFO	Cash flow	The ratio of cash flow from operations to total assets.
CAPEX	Capital expenditures	Capital expenditures scaled by total assets.
INTANG	Intangible assets	The ratio of intangible assets to total assets.
VOLAT	Stock price volatility	The standard deviation of daily stock returns over the years.
LITG	Litigation	An indicator variable equals 1 if the firm is in a high litigation industry and 0 otherwise. High-litigation industries include those with SIC codes 2833–2838, 3570–3577, 3600–3674, 5200–5961, 7370–7374, and 8731–8734.
CROSS	Cross-listing	An indicator variable that takes a value of 1 if the firm is listed in foreign stock exchanges and 0 otherwise.

(*continued on next page*)

(*continued*)

Variables		Definition
EMI_DISC	Disclosure of carbon emissions	An indicator variable that takes a value of 1 if the firm responds to the CDP questionnaire by disclosing carbon emissions information, and 0 otherwise.
PROPDISC	Industry pressure	The proportion of firms releasing carbon emission information to the total number of firms in the industry (using the two-digit SIC code).
ROA	Profitability	The ratio of net income scaled by total assets.
ANALYST	Analyst's coverage	The natural logarithm of total number of analysts coverage.
FOREIGN	Foreign exposure	An indicator variable that takes a value of 1 if the firm has foreign operations, and 0 otherwise.
INFOASYM	Information asymmetry	The average of the daily closing bid–ask spreads as a percentage of the daily closing price over the years. We compute *HIGH_INFOASYM* as an indicator variable if the firm-level information asymmetry is greater than the country-year adjusted median value of information asymmetry and 0 otherwise.
Panel D: Country-level variables		
LNGDP	Gross domestic product (GDP)	The natural logarithm of gross domestic product (GDP) per capita.
STAKE	Stakeholder orientation	An indicator variable that takes a value of 1 if the firm is domiciled in a code-law country, and 0 otherwise.
LEGAL	Legal environment	The multiplication of anti-director rights by the rule of law index following Ferreira and Matos (2008).
GCRI	Global climate risk	The country-level Global Climate Risk Index (GCRI) score from Germanwatch and Climate Action Network. We multiply the CRI by minus one to interpret high value indicates higher risks.
CO2EMISSION_COUNTRY	Country-level carbon emissions	The natural logarithm of total carbon emissions at the country level.
ETS	Emissions trading scheme	An indicator variable that takes a value of 1 if the firm operates in a country participating in an emissions trading scheme (ETS), and 0 otherwise.
COUNTRY_GOV	Country-level governance	They are the six worldwide governance indices rated by the World bank including Voice and Accountability Index, Political Stability and Absence of Violence Index, Government Effectiveness Index, Regulatory Quality Index, Rule of Law Index, and Control of Corruption Index.

Data availability

Data will be made available on request.

References

Ahmed, A.S., Billings, B.K., Morton, R.M., Stanford-Harris, M., 2002. The role of accounting conservatism in mitigating bondholder-shareholder conflicts over dividend policy and in reducing debt costs. Account. Rev. 77, 867–890.

Altman, E.I., 1968. Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. J. Finance 23, 589–609.

Anagnostopoulou, S.C., Tsekrekos, A.E., Voulgaris, G., 2021. Accounting conservatism and corporate social responsibility. Br. Account. Rev. 53, 100942.

Armstrong, C.S., Balakrishnan, K., Cohen, D., 2012. Corporate governance and the information environment: evidence from state antitakeover laws. J. Account. Econ. 53, 185–204.

Australian Accounting Standards Board [AASB] & Auditing and Assurance Standards Board [AAUSB] 2019. Climate-related and other emerging risks disclosures: Assessing financial statement materiality using AASB/IASB Practice Statement 2. 2019. Available at: https://www.aasb.gov.au/admin/file/content102/c3/AASB_AUASB_Joint_Bulletin_Finished.pdf (accessed on 25 July 2022).

Balachandran, B., Nguyen, J.H., 2018. Does carbon risk matter in firm dividend policy? Evidence from a quasi-natural experiment in an imputation environment. J. Bank. Financ. 96, 249–267.

Ball, R., Kothari, S.P., Robin, A., 2000. The effect of international institutional factors on properties of accounting earnings. J. Acc. Econ. 29, 1–51.

Basu, S., 1997. The conservatism principle and the asymmetric timeliness of earnings. J. Acc. Econ. 24, 3–37.

Basu, S., 2005. Discussion of "Conditional and Unconditional Conservatism: Concepts and modeling". Rev. Acc. Stud. 10, 311–321.

Beaver, W.H., Ryan, S.G., 2005. Conditional and unconditional conservatism: Concepts and modeling. Rev. Account. Stud. 10, 269–309.

Bebbington, J., Larrinaga-Gonzalez, C., 2008. Carbon trading: Accounting and reporting issues. European Accounting Review 17, 697–717.

Bjornsen, M., Do, C., Omer, T.C., 2018. The influence of country-level religiosity on accounting conservatism. J. Account. Res. 18, 1–26.

Bolton, P., Kacperczyk, M., 2021. Do investors care about carbon risk? J. Finan. Econ. 142 (2), 517–549.

Bolton, P., Kacperczyk, M., 2023. Global pricing of carbon-transition risk. J. Finance 78, 3677–3754.

Bose, S., Cahan, S.F., Dhole, S., Mishra, S., 2024a. Does a customer focus influence firms' climate-change reporting decisions? The role of market-driven corporate culture. J. Bus. Finan. Acct. https://doi.org/10.1111/jbfa.12841.

Bose, S., Lim, E.K., Minnick, K., Schorno, P.J., Shams, S., 2025a. Does carbon risk influence stock price crash risk? International evidence. J. Bus. Financ. Acc. https://doi.org/10.1111/jbfa.12851.

Bose, S., Boubaker, S., Daradkeh, H., Shams, S., 2025b. From the executive suite to the environment: how does CEO power affect climate change disclosures? J. Int. Finan. Markets, Inst. Money 100, 102140.

Bose, S., Lim, E.K., Minnick, K., Shams, S., 2024b. Do foreign institutional investors influence corporate climate change disclosure quality? International evidence. Corp. Gov. An. Int. Rev. 32, 322–347.

Bose, S., Minnick, K., Shams, S., 2021. Does carbon risk matter for corporate acquisition decisions? J. Corp. Finance 70, 1–24.

Burke, Q.L., Chen, P.-C., Lobo, G.J., 2020. Is corporate social responsibility performance related to conditional accounting conservatism? Account. Horiz. 34, 19–40.

Busch, T., 2010. Corporate carbon performance indicators revisited. J. Ind. Ecol. 14, 374–377.

Chapple, L., Clarkson, P.M., Gold, D.L., 2013. The cost of carbon: Capital market effects of the proposed emission trading scheme (ETS). Abacus 49, 1–33.

Chen, X., Harford, J., Li, K., 2007. Monitoring: which institutions matter? J. Financ. Econ. 86, 279–305.

Chen, X., Lu, M., Shan, Y., Zhang, Y., 2023. Securities class actions and conditional conservatism: evidence from two legal events. Account. Finance 63, 2441–2471.

Choi, B., Luo, L., 2021. Does the market value greenhouse gas emissions? evidence from multi-country firm data. Br. Account. Rev. 53, 1–24.

Clarkson, P.M., Li, Y., Pinnuck, M., Richardson, G., 2015. The value relevance of greenhouse gas emissions under the European Union carbon emissions trading scheme. Eur. Account. Rev. 24, 551–580.

Cohen, S., Kadach, I., Ormazabal, G., 2023. Institutional investors, climate disclosure, and carbon emissions. J. Acc. Econ. https://doi.org/10.1016/j.jacceco.2023.101640.
Cooper, S.A., Raman, K., Yin, J., 2018. Halo effect or fallen angel effect? firm value consequences of greenhouse gas emissions and reputation for corporate social responsibility. J. Account. Public Policy 37, 226–240.
Cotter, J., Najah, M.M., 2012. Institutional investor influence on global climate change disclosure practices. Aust. J. Manag. 37, 169–187.
Dai, L., Ngo, P., 2021. Political uncertainty and accounting conservatism. Eur. Account. Rev. 30, 277–307.
Daradkeh, H., Shams, S., Bose, S., Gunasekarage, A., 2023. Does managerial ability matter for corporate climate change disclosures? Corp. Gov. an. Int. Rev. 31, 83–104.
Dey, S.K., Bose, S., Luo, L., Shams, S., 2024. Impact of corporate climate change performance on information asymmetry: International evidence. J. Account. Res. 1–33. https://doi.org/10.2308/jiar-2022-057.
Dhaliwal, D.S., Radhakrishnan, S., Tsang, A., Yang, Y.G., 2012. Nonfinancial disclosure and analyst forecast accuracy: International evidence on corporate social responsibility disclosure. Account. Rev. 87, 723–759.
Djankov, S., La Porta, R., Lopez-de-Silanes, F., Shleifer, A., 2008. The law and economics of self-dealing. J. Finan. Econ. 88, 430–465.
Donelson, D.C., Kettell, L., McInnis, J., Toynbee, S., 2022. The need to validate exogenous shocks: Shareholder derivative litigation, universal demand laws and firm behavior. J. Acc. Econ. 73, 101427.
Downar, B., Ernstberger, J., Reichelstein, S., Schwenen, S., Zaklan, A., 2021. The impact of carbon disclosure mandates on emissions and financial operating performance. Rev. Acc. Stud. 26, 1137–1175.
Eccles, R.G., Serafeim, G., Krzus, M.P., 2011. Market interest in nonfinancial information. J. App. Corp. Finance 23, 113–127.
Ettredge, M.L., Huang, Y., Zhang, W., 2016. Conservative reporting and securities class action lawsuits. Account. Horiz. 30, 93–118.
Ferreira, M.A., Matos, P., 2008. The colors of investors' money: the role of institutional investors around the world. J. Financ. Econ. 88, 499–533.
Francis, B., Hasan, I., Qiang, W., 2013. The benefits of conservative accounting to shareholders: evidence from the financial crisis. Account. Horiz. 27, 319–346.
García Lara, J.M., García Osma, B., Penalva, F., 2009. Accounting conservatism and corporate governance. Rev. Acc. Stud. 14, 161–201.
García Lara, J.M., Osma, B.G., Penalva, F., 2011. Conditional conservatism and cost of capital. Rev. Acc. Stud. 16, 247–271.
Givoly, D., Hayn, C.K., Natarajan, A., 2007. Measuring reporting conservatism. Account. Rev. 82, 65–106.
Goh, B.W., Lim, C.Y., Lobo, G.J., Tong, Y.H., 2017. Conditional conservatism and debt versus equity financing. Contemp. Account. Res. 34, 216–251.
Griffin, P.A., David, H.L., Pomare, C., 2020. The curious case of Canadian corporate emissions valuation. Br. Account. Rev. 100922.
Griffin, P.A., Jaffe, A.M., 2018. Are fossil fuel firms informing investors well enough about the risks of climate change? J. Energy Nat. Resour. Law 36, 381–410.
Griffin, P.A., Lont, D.H., Sun, Y., 2017. The relevance to investors of greenhouse gas emission disclosures. Contemp. Account. Res. 34, 1265–1297.
Gujarati, D.N., Porter, D.C., 2009. Basic Econometrics. McGraw-Hill Irwin, New York, NY.
Haque, F., 2017. The effects of board characteristics and sustainable compensation policy on carbon performance of UK firms. Br. Account. Rev. 49, 347–364.
Healy, P.M., Palepu, K.G., 2001. Information asymmetry, corporate disclosure, and the capital markets: a review of the empirical disclosure literature. J. Acc. Econ. 31, 405–440.
Heckman, J.J., 1979. Sample selection bias as a specification error. Econometrica 47, 153–161.
Herbohn, K., Gao, R., Clarkson, P., 2019. Evidence on whether banks consider carbon risk in their lending decisions. J. Bus. Ethics 158, 155–175.
Hsieh, C.-C., Ma, Z., Novoselov, K.E., 2019. Accounting conservatism, business strategy, and ambiguity. Acc. Organ. Soc. 74, 41–55.
Huang, H.H., Kerstein, J., Wang, C., 2018. The impact of climate risk on firm performance and financing choices: an international comparison. J. Int. Bus. Stud. 49, 633–656.
Hussain, N., Rigoni, U., Orij, R.P., 2018. Corporate governance and sustainability performance: Analysis of triple bottom line performance. J. Bus. Ethics 149, 411–432.
Intergovernmental Panel on Climate Change [IPCC]. (2019). Global warming of 1.5°C. Retrieved from https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf (accessed on 10 February 2024).
International Accounting Standards Board [IASB]. (2020). Effects of climate-related matters on financial statements. Retrieved from https://www.ifrs.org/content/dam/ifrs/supporting-implementation/documents/effects-of-climate-related-matters-on-financial-statements.pdf (accessed 30 January 2022).
Jaggi, B., Allini, A., Macchioni, R., Zagaria, C., 2018. The factors motivating voluntary disclosure of carbon information: evidence based on italian listed companies. Organ. Environ. 31, 178–202.
Jayaraman, S., 2012. The effect of enforcement on timely loss recognition: evidence from insider trading laws. J. Acc. Econ. 53, 77–97.
Jung, J., Herbohn, K., Clarkson, P., 2018. Carbon risk, carbon risk awareness and the cost of debt financing. J. Bus. Ethics 150, 1151–1171.
Kanagaretnam, K., Lobo, G.J., Whalen, D.J., 2007. Does good corporate governance reduce information asymmetry around quarterly earnings announcements? J. Acc. Public Policy 26, 497–522.
Karpoff, J.M., Scott Lee, D., Martin, G.S., 2008. The consequences to managers for financial misrepresentation. J. Finan. Econ. 88, 193–215.
Khan, M., Watts, R.L., 2009. Estimation and empirical properties of a firm-year measure of accounting conservatism. J. Acc. Econ. 48, 132–150.
Kim, J.-B., Zhang, L., 2016a. Accounting conservatism and stock price crash risk: Firm-level evidence. Contemp. Account. Res. 33, 412–441.
Kim, J.B., Zhang, L., 2016b. Accounting conservatism and stock price crash risk: Firm-level evidence. Contemp. Account. Res. 33, 412–441.
Koh, P.-S., 2003. On the association between institutional ownership and aggressive corporate earnings management in Australia. Br. Account. Rev. 35, 105–128.
Kolk, A., Levy, D., Pinkse, J., 2008. Corporate responses in an emerging climate regime: the institutionalization and commensuration of carbon disclosure. Eur. Account. Rev. 17, 719–745.
Kong, X., Radhakrishnan, S., Tsang, A., 2017. Corporate lobbying, visibility and accounting conservatism. J. Bus. Financ. Acc. 44, 527–557.
Kpmg, 2015. Currents of change: the KPMG survey of corporate responsibility reporting 2015. Haymarket Network Ltd, Netherlands, p. 2015.
Krueger, P., Sautner, Z., Starks, L.T., 2020. The importance of climate risks for institutional investors. Rev. Financ. Stud. 33, 1067–1111.
Lafond, R., Roychowdhury, S., 2008. Managerial Ownership and Accounting Conservatism. J. Account. Res. 46, 101–135.
Lash, J., Wellington, F., 2007. Competitive advantage on a warming planet. Harv. Bus. Rev. 85, 1–11.
Lennox, C.S., Francis, J.R., Wang, Z., 2012. Selection models in accounting research. Account. Rev. 87, 589–616.
Leuz, C., Nanda, D., Wysocki, P.D., 2003. Earnings management and investor protection: an international comparison. J. Finan. Econ. 69, 505–527.
Luo, H.A., Balvers, R.J., 2017. Social screens and systematic investor boycott risk. J. Financ. Quant. Anal. 52, 365–399.
Matsumura, E.M., Prakash, R., Vera-Muñoz, S.C., 2014. Firm-value effects of carbon emissions and carbon disclosures. Account. Rev. 89, 695–724.
Perrault, E., Quinn, M.A., 2018. What have firms been doing? Exploring what KLD data report about firms' corporate social performance in the period 2000-2010. Bus. Soc. 57, 890–928.
Ramalingegowda, S., Yu, Y., 2012. Institutional ownership and conservatism. J. Account. Econ. 53, 98–114.
Sharma, V.D., 2004. Board of director characteristics, institutional ownership, and fraud: evidence from Australia. Auditing: a. J. Pract. Theory 23, 105–117.
Shipman, J.E., Swanquist, Q.T., Whited, R.L., 2017. Propensity score matching in accounting research. Account. Rev. 92, 213–244.
Shive, S.A., Forster, M.M., 2020. Corporate governance and pollution externalities of public and private firms. Rev. Financ. Stud. 33, 1296–1330.
Stern, N., Taylor, C., 2007. Climate change: risk, ethics, and the Stern review. Science 317, 203–204.
Stock, J.H., Wright, J.H., Yogo, M., 2002. A survey of weak instruments and weak identification in generalized method of moments. J. Bus. Econ. Stat. 20, 518–529.
Task Force on Climate-Related Financial Disclosures [TCFD]. (2017). Recommendations of the Task Force on Climate-related Financial Disclosures. Retrieved from https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf (accessed on 05 March 2025).
Tucker, J.W., 2010. Selection bias and econometric remedies in accounting and finance research. J. Account. Lit. 29, 31–57.
United Nations Environment Programme Finance Initiative [UNEP FI]. (2021). Net-zero banking alliance. Retrieved from https://www.unepfi.org/net-zero-banking/ (accessed on 31 January 2025).

United Nations Framework Convention on Climate Change [UNFCCC]. (2015). COP 21: Report of the Conference of the Parties on its Twenty-first Session, held in Paris from 30 November to 13 December 2015. Retrieved from http://unfccc.int/resource/docs/2015/cop21/eng/10.pdf (accessed on 30 January 2025).
Walls, J.L., Berrone, P., Phan, P.H., 2012. Corporate governance and environmental performance: is there really a link? Strateg. Manag. J. 33, 885–913.
Watts, R.L., 2003a. Conservatism in Accounting Part I: Explanations and Implications. Account. Horiz. 17, 207–221.
Watts, R.L., 2003b. Conservatism in Accounting Part II: evidence and Research Opportunities. Account. Horiz. 17, 287–301.
Watts, R.L., Zimmerman, J.L., 1978. Towards a positive theory of the determination of accounting standards. Account. Rev. 53, 112–134.
World Business Council for Sustainable Development [WBCSD], World Resources Institute [WRI]. (2004). The greenhouse gas protocol - A corporate accounting and reporting standard. Retrieved from http://www.ghgprotocol.org/files/ghgp/public/ghg-protocol-revised.pdf (accessed on 10 March 2025).
Zhang, J., 2008. The contracting benefits of accounting conservatism to lenders and borrowers. J. Acc. Econ. 45, 27–54.