**Board sustainability committees, climate change initiatives, carbon performance, and market value**

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**Abstract**

We examine the interrelationships among board sustainability committees, process-based climate change initiatives, outcome-based carbon performance, and market value through the lens of economic- and social-based theoretical perspectives. Using a panel dataset of 8,408 observations from 35 countries between 2002 and 2019, we find that higher levels of actual greenhouse gas (GHG) emissions are negatively associated with market value. Further, we reveal a positive association between process-based climate change initiatives and market value. We then provide evidence that process-based climate change initiatives are positively related to increased levels of GHG emissions. We also observe that the presence of a board sustainability committee has a positive impact on market value, but does not seem to improve outcome-based carbon performance. Finally, we show that the predicted relationships vary across different country-groups, sector-groups, and periods. Our empirical findings are robust to alternative measures, endogeneities, and sample selection bias. Overall, our evidence supports the symbolic legitimation/greenwashing view in that firms are likely to employ process-based climate change initiatives under a symbolic approach to create positive impressions among stakeholders and protect their legitimacy.

**Keywords:** Board sustainability committees, climate change initiatives, carbon performance, market value, economic- and social-based theoretical perspectives

1. **Introduction**

Climate change has attracted a growing interest among academics, practitioners, policymakers, and regulators over the past few decades (Giannarakis *et al*., 2017; Jiang *et al.,* 2021), becoming a dominant issue on the economic, political, and business agenda. Caused by the excessive amount of greenhouse gas (GHG) emissions, global climate change is currently a major issue of concern to businesses, governments and other stakeholders (Bui *et al*., 2020; Downar *et al.,* 2021), adversely affecting the environment, socio-economic systems, and subsequently human lives (Goworek *et al.*, 2018; Sun *et al*., 2020). Hence, international organizations and national governments have introduced a number of initiatives, policies and practices to combat global warming and climate change (Baboukardos, 2018; Gaganis *et al.,* 2021). For example, the 1997 Kyoto Protocol and the 2015 Paris Agreement are among the most important international agreements that aim to mitigate GHG emissions and improve resilience to climate change (Luo and Tang, 2021). At the same time, business organizations are under tremendous pressure from stakeholders to respond to climate change by reporting their environmental impacts and engaging in relevant initiatives in order to reduce their actual GHG emissions (Backman *et al*., 2017).

Despite the steadily growing research within the climate change literature, limited attention has so far been paid to process-based corporate climate change initiatives (PCCIs) aimed at improving corporate carbon performance by actual emissions (CCPE) and financial outcomes (Dahlmann *et al.,* 2019; Wright and Nyberg, 2017). In particular, prior studies have largely focused on the impact of outcome-based CCPE (actual GHG emissions) on financial outcomes and yielded mixed results (e.g., Clarkson *et al*., 2015; Jacobs *et al.,* 2010; Lewandowski, 2017; Matsumura *et al.,* 2014). For example, Baboukardos (2017), and Choi and Luo (2021) find a negative association between GHG emissions and market value (MV), and argue that market participants react negatively to excessive emissions. By contrast, Lewandowski (2017) reports that lower GHG emissions are associated with lower MV, thus suggesting that corporate commitment to emissions reductions causes financial burdens. However, the above/prior studies have focused mostly on individual countries/regions, thereby failing to consider cross-country differences. Accordingly, the existing inconclusive findings cannot be generalized across diverse economies with different institutional and regulatory settings. As government responses to climate change vary substantially across countries and have different financial consequences for firms (Choi and Luo, 2021), there is a need to explore the relationships among PCCIs, outcome-based CCPE, and financial outcomes within diverse/multiple economies (Haque and Ntim, 2020; Jiang *et al*., 2021). In this case, a cross-country analysis with various country-level factors can help in explaining the mixed findings documented in prior literature.

Consequently, in this study, we employ a sample of global firms from 35 countries between 2002 and 2019 to examine the value relevance of both PCCIs and outcome-based CCPE. We also investigate whether the effects of PCCIs and CCPE on MV are moderated by the presence of a board sustainability committee (BSCOM). Past research has increasingly highlighted the role of corporate governance (CG) in formulating climate change initiatives/strategies that create shareholder value (Cumming *et al.,* 2021; Luo and Tang, 2021). For instance, effective board governance can increase accountability for environmental/social impacts by promoting environmentally responsible activities and engaging in corporate social responsibility (CSR) practices in order to manage environmental risks/concerns in an efficient and effective manner (Harjoto *et al*., 2015). In this regard, BSCOM plays a crucial role in designing environmental initiatives and introducing best sustainability management practices to promote stakeholder engagement, enhance accountability, address environmental issues, and improve corporate outcomes (Luo and Tang, 2021; Orazalin, 2020). Thus, BSCOM is becoming an increasingly prevalent/major governance mechanism to address climate change, promote sustainability, and create value for all stakeholders (Burke *et al.,* 2019). However, there is a dearth of research on the impact of BSCOM on PCCIs and performance outcomes (Helfaya and Moussa, 2017; Orazalin, 2020). We suggest that examining the moderating role of BSCOM in this context may provide useful insights into corporate climate change strategies/practices across countries with different institutional frameworks and regulatory systems. As argued by Sullivan and Gouldson (2017), CG practices, corporate responses to climate change, and performance outcomes are interrelated and interdependent, and therefore, it is important to assess them as a comprehensive, dynamic and interactive system rather than examining each of them individually. Therefore, we seek to address this dearth of research by distinctively examining the moderating effect of BSCOM on the relationships among PCCIs, outcome-based CCPE, and MV in a multi-country context.

To assess these relationships, we adopt legitimacy, resource-based view (RBV), and stakeholder perspectives to form a dynamic multi-dimensional economic- and social-based theoretical framework. According to the legitimacy perspective, firms exposed to greater stakeholder pressures may engage in process-oriented environmental initiatives, such as PCCIs and introduce CG mechanisms, such as BSCOM in order to protect/maintain/improve their legitimacy (Suchman, 1995). This can be achieved by symbolic legitimation/greenwashing/impression management strategies that might not necessarily improve outcome-based CCPE (Ashforth and Gibbs 1990). In contrast, substantive legitimation strategies that shape economically efficient actions may lead to improved CCPE and MV (Ashforth and Gibbs 1990). From the RBV perspective, firms may improve their environmental/carbon performance and sustain competitive advantage by engaging in environmental initiatives/strategies that require unique resources (e.g., finance, physical assets, human capital, and processes) and capabilities (e.g., adapting to climate change, developing eco-friendly products/processes/services, and implementing green projects/innovations to reduce emissions) ( Barney, 1991; Hart and Dowell, 2011). In this regard, the benefit aspect of RBV supports the adoption of PCCIs, which may improve outcome-based CCPE, and ultimately increase MV (Barney, 1991; Hart, 1995). However, the cost perspective of RBV suggests that the implementation of PCCIs that require significant resources, is associated with higher levels of risks and opportunity costs, and thus can be detrimental to MV (Andreou and Kellard, 2021; Oberndorfer *et al.,* 2013). The stakeholder perspective suggests that corporate commitment to environmental activities enhances a firm’s relationships with its stakeholders (Freeman 1984). In this context, firms with effective CG practices can strengthen stakeholder relationships by implementing sustainability practices and promoting environmental strategies (Michelon and Parbonetti 2012) and ultimately improve MV by balancing the conflicting interests of their stakeholders (Freeman 1984). Hence, the stakeholder aspect supports the implementation of PCCIs and the adoption of CG mechanisms, such as BSCOM to enhance corporate image, strengthen stakeholder relationships, and improve MV.

Our study makes several new contributions to the extant literature. First, our study is among the first to examine the effects of both PCCIs and outcome-based CCPE on MV. While prior literature has largely explored the relationship between outcome-based CCPE and MV, there has been limited research on the value relevance of PCCIs (He *et al.,* 2021). Our findings indicate that increased levels of GHG emissions are associated with lower MV, whereas PCCIs have a positive impact on MV. Second, extending the work of Bui *et al.* (2021) on assurance of CCPE (both Scope 1 and 2 emissions) and reporting integrity, we assess whether BSCOM can moderate the PCCIs/CCPE and MV relationships. While there is growing research on the link between carbon/environmental performance and MV, there is limited empirical evidence on whether CG characteristics affect the value relevance of PCCIs and outcome-based CCPE (Bui *et al.*, 2020). Our findings suggest that the presence of BSCOM improves MV, but does not seem to enhance outcome-based CCPE. Third, our study is among the first to examine the impact of PCCIs on outcome-based CCPE, and subsequently investigate the moderating role of BSCOM on this relationship. Despite the increasing calls for climate change research (Busch and Hoffmann, 2011; Wright and Nyberg, 2017), research relating to the relationship between PCCIs and outcome-based CCPE has received limited attention. Our finding reveals that firms that engage in PCCIs continue to emit high GHG emissions, thus supporting the symbolic legitimation view. Finally, extending the study of Bui *et al.* (2020) on climate governance (governance mechanisms/measures aimed at mitigating climate risks), CCPE, and carbon disclosure, we explore whether the predicted relationships differ between countries under the European Union Emission Trading System (EU ETS) and non-EU ETS countries. Our findings indicate that market participants react more negatively to increased emissions in EU ETS countries compared to non-EU ETS countries. Our results also reveal that the EU ETS leads to observable reductions in emissions and suggest that regulatory pressures might affect corporate engagement in climate mitigation activities/initiatives.

The rest of this paper is organized as follows. Section 2 provides the study’s background. Section 3 presents the theoretical framework, followed by the review of prior studies and hypotheses development in Section 4. Section 5 explains the research methodology. Section 6 presents the results and Section 7 concludes.

1. **Climate change initiatives around the world**

Growing concerns over the increasing levels of GHG emissions worldwide have led the global community to respond to global warming and climate change by undertaking various initiatives, deals, and reforms. The United Nations Framework Convention on Climate Change (UNFCCC), introduced in 1992 following the Rio Earth Summit and entered into force in 1994, was the first international effort to address global warming and climate change. However, the UNFCCC was unsuccessful in reducing GHG emissions worldwide, which has been confirmed by numerous reports/data (Gills and Morgan, 2020). For example, annual global emissions in terms of gigatonnes of carbon dioxide (GtCO2) increased from 23.7 GtCO2 in 1995 to more than 30 GtCO2 every year during 2006-2012 and well above 35 GtCO2 each year during 2012-2018 (Olivier and Peters, 2020). According to the United Nations Environmental Programme, total GHG emissions in GtCO2 reached a record high of 55.3 in 2018 (United Nations Environment Programme, 2019).

The Kyoto Protocol, adopted in 1997, was the first global treaty, which extended the UNFCCC. The Protocol provided a legally binding framework for participating countries to introduce standards, guidelines, and reforms to mitigate GHG emissions. As part of the Protocol, European countries implemented a number of climate change policies/legislations to introduce the EU ETS (European Commission, 2015). The Paris climate agreement was introduced in December 2015 to replace the Kyoto Protocol, effectively from 2016. The agreement requires each nation to prepare, submit, and maintain nationally determined contributions intended to reduce emissions and adapt to climate change.[[1]](#footnote-1) To date, a number of countries have adopted and implemented domestic laws/regulations to combat climate change. Nevertheless, and as demonstrated by the 2021 UN climate change conference of the parties (COP26) in Glasgow, there has been little progress in developing and implementing explicit guidelines/policies for businesses that could help regulators assess corporate commitments to climate change mitigation and control GHG emissions (Climate Change Committee 2021). Consequently, this study seeks to explore how global companies, operating in different jurisdictions with different environmental regulations and stakeholder pressures, respond to climate change risks/threats.

1. **Theoretical framework**

As we explore the associations among BSCOM, CCPE, PCCIs, and MV, we deem it appropriate to draw insights from RBV, legitimacy and stakeholder theoretical perspectives to form a dynamic multi-dimensional socio-economic-based theoretical framework to inform our analysis. In this case, the RBV suggests that a firm’s competitive advantage evolves from essential resources that are valuable, rare, inimitable, and difficult to substitute (Barney, 1991). These resources include physical assets, financial resources, human capital, and organizational processes that may develop unique capabilities and competencies that are instrumental to competitive advantage and increased MV (Backman, Verbeke and Schulz, 2017). The adapted RBV concept to climate change suggests that firms can improve environmental performance and sustain competitive advantage by adopting proactive environmental strategies that require unique resources and capabilities (Hart, 1995). In particular, the adoption of PCCIs can enhance economic efficiency, reduce operating and litigation costs, mitigate business risks, strengthen stakeholder relationships, and create sustainable advantage (Hart and Dowell, 2011). PCCIs may also develop resource combinations for green innovation, prevent GHG emissions and waste, and enhance internal resilience to climate change (Weber and Neuhoff, 2010). Hence, from the benefit aspect of RBV, firms with the advantages of valuable resources have a greater capacity to engage in PCCIs aimed at enhancing economic efficiency and gaining sustained competitive advantage, which in turn, can be positively valued by market participants (Haque and Ntim 2020; Hart 1995; He *et al.*, 2021).

However, improvements in outcome-based CCPE require substantial economic resources to implement PCCIs to have a positive effect on MV. In this regard, the cost perspective of RBV suggests that engaging in PCCIs imposes high costs on any organization, and economic efficiency may be achieved gradually over longer periods of time (He *et al.,* 2021; Oberndorfer *et al.,* 2013). Thus, the adoption of PCCIs that require significant time, effort, and financial resources that otherwise could be invested in other profitable projects is associated with higher levels of risks and opportunity costs, and thus can damage MV (Busch and Hoffmann, 2011).

The legitimacy view postulates that firms should align their business activities with the social values of society in which they operate (Deegan, 2002; Meyer and Rowan, 1977). Legitimacy, therefore, refers to the degree to which various stakeholders regard the actions of an organization as desirable, proper, and useful (Suchman, 1995). With strong legitimacy, firms can get good access to economic resources, attract and retain talented employees, improve relationships with stakeholders, and compete more effectively in the market (Oliver, 1991; Pfeffer and Salancik, 1978). In this regard, firms seeking legitimacy can be motivated by symbolic (‘greenwashing/impression management’) and/or substantive (‘economically efficient’) legitimation strategies. Symbolic strategies drive a firm’s engagement in superficial impressions to manage stakeholders concerns on sustainability-related issues rather than to bring meaningful improvements in environmental/social outcomes (Ashforth and Gibbs, 1990). In this case, firms with weak carbon/environmental performance are exposed to greater stakeholder pressures, and therefore, may undertake symbolic/greenwashing efforts in order to gain/maintain/repair legitimacy (Suchman, 1995), but such efforts might not improve carbon/environmental performance (Crossley *et al.,* 2021).

In contrast, substantive strategies involve fundamental changes in a firm’s goals, behavior, and practices to meet the expectations and needs of societal stakeholders (Ashforth and Gibbs 1990). In this regard, firms can undertake economically efficient actions to tackle climate change by adopting PCCIs that may lead to improved outcome-based CCPE and MV. However, as the adoption of comprehensive PCCIs requires significant investments and resources, it is more likely that firms employ symbolic PCCIs and promote governance mechanisms, such as BSCOM to create positive impressions (greenwashing) among stakeholders and protect MV (Berrone and Gomez-Mejia, 2009; Maas and Rosendaal, 2016), but such commitments do not improve outcome-based CCPE (Aguilera *et al*., 2007).

Finally, the stakeholder perspective suggests that corporate commitment to environmental/social activities enhances a firm’s relationships with all stakeholders (Freeman 1984; Rodgers *et al.,* 2013). Prior literature suggests that strong corporate environmental performance can reduce employee turnover, thus supporting the notion that potential employees prefer organizations with greater environmental accountability (Backhaus *et al.,* 2002; Berrone and Gomez-Mejia, 2009). Customers also respond positively to strong environmental performance by increasing their demand for environmentally sustainable products/services and paying premium prices (Berrone and Gomez-Mejia, 2009; Du *et al.,* 2007). In this context, firms with effective CG practices can strengthen stakeholder relationships by implementing sustainability practices and promoting environmental initiatives/strategies (Michelon and Parbonetti 2012), and ultimately improve MV by balancing the conflicting interests of all stakeholders (Freeman 1984). Hence, the stakeholder aspect supports the implementation of PCCIs, the promotion of CG mechanisms, such as BSCOM, and the implementation of sustainability-related practices to enhance corporate image, strengthen the relationships with stakeholders, and improve MV.

Put together, legitimacy, RBV, and stakeholder theoretical perspectives suggest that global companies exposed to different stakeholder pressures and environmental regulations can adopt PCCIs and establish BSCOM that may (i) enhance reputation and maintain legitimacy on a symbolic/greenwashing level (Burke *et al*., 2019; Busch and Hoffmann, 2011; Haque and Ntim, 2020; Walls *et al*., 2012) and/or (ii) substantively mitigate emissions through improved efficiency and reduced operating costs (Bui *et al.,* 2020, 2021; Dahlmann *et al.,* 2019).

1. **Literature review and hypotheses development**
	1. *Carbon performance, climate change initiatives, and market value*

According to the benefit aspect of RBV, proactive environmental strategies are likely to reduce carbon emissions and improve MV through enhanced operational efficiency, effective energy savings, and greater access to resources (Hart, 1995; Hart and Dowell, 2011). However, from the cost perspective, such environmental initiatives require substantive efforts, involve high risks and costs, and subsequently may damage MV (He *et al.,* 2021; Oberndorfer *et al.,* 2013). This argument also supports Porter's (1980) view of competitive strategy in that any managerial effort to improve process-based environmental performance is regarded as a waste of resources. At the same time, firms focus on improving outcome-based carbon/environmental performance in order to enhance stakeholder relationships, sustain competitive advantage, and ultimately improve MV (Busch and Hoffmann 2011), as capital markets penalize firms with higher levels of GHG emissions and reward firms with better outcome-based CCPE (Choi and Luo, 2021). In this circumstance, substantive environmental initiatives/practices/processes may lead to improved outcome-based CCPE. However, firms are less likely to undertake concrete actions in pursuing such complicated and costly initiatives, since they require significant economic resources and investments amid economic/financial benefits (Haque and Ntim, 2020). Hence, from the symbolic legitimation/greenwashing strategies perspective, firms may engage in symbolic PCCIs to gain legitimacy, impress stakeholders, and ultimately improve MV, without undertaking substantive/economically efficient efforts to improve outcome-based CCPE (Aguilera *et al.,* 2007).

Prior research argues that corporate environmental initiatives are significantly influenced/shaped by huge pressures and demands from stakeholders (Phan and Baird, 2015; Reid and Toffel, 2009). This is especially pertinent for long-term and complicated issues of climate change, where businesses face conflicting critiques and competing demands from stakeholders and shareholders (Wright and Nyberg, 2017). However, firms cannot easily integrate costly climate change challenges within the goal of profit maximization and value creation (Andreou and Kellard, 2021; Wright and Nyberg, 2017). Hence, when firms are forced to select between economic goals and environmental targets, they normally favour economic goals (Van der Byl and Slawinski, 2015). This is consistent with the argument that comprehensive PCCIs are generally aimed at achieving corporate economic/financial goals of cost reduction, profit maximization, and market expansion (Dauvergne and Lister, 2013). In other words, businesses may invest in environmental activities and green projects not only to ameliorate environmental problems, but also to improve corporate economic sustainability (Banerjee, 2003). Thus, firms have strong incentives in translating climate-related grand challenges away from practices that may constrain their profit generating abilities, while emphasizing more immediate responses that can be aligned with profit maximization and value creation (Wright and Nyberg, 2017). However, the adoption of process-based environmental management initiatives/practices is considered by stakeholders as a pure marketing/greenwashing tool used for impressions management purposes (Brammer and Millington, 2008). Thus, capital markets react more positively to improved outcome-based CCPE rather than to PCCIs (Busch and Hoffmann, 2011). Yet, although complex PCCIs may not be fully recognized by capital markets, especially in their early stages (Haque and Ntim, 2020), they might reflect a firm’s substantive intentions/incentives to assess, manage, and reduce emissions (Dahlmann *et al.*, 2019).

Prior empirical studies examining the effects of outcome-based CCPE on MV are limited and have provided mixed results (e.g., Busch and Hoffmann, 2011; Lewandowski, 2017; Matsumura *et al.*, 2014; Siddique *et al*., 2021). For example, Clarkson *et al*. (2015) and Tuesta *et al*.(2021) find a negative association between GHG emissions and MV and conclude that firms with excessive emissions suffer more from negative market valuations. By contrast, Jacobs *et al*. (2010) provide evidence that lower GHG emissions are significantly associated with lower MV, thus indicating that firms with higher emissions have greater MV. However, most of these studies have assessed outcome-based CCPE without ascertaining whether process-based environmental initiatives, such as PCCIs create shareholder value. The empirical findings by Busch and Hoffmann (2011) and Haque and Ntim (2020) are apparent exceptions. In particular, Busch and Hoffmann (2011) report that process-based carbon management strategies are negatively associated with MV and argue that market participants consider such initiatives less reliable than outcome-based CCPE with respect to estimating future MV. Further, Haque and Ntim (2020) conclude that firms pursue carbon mitigation initiatives in order to reduce legitimacy risks and improve MV, without making substantial improvements in outcome-based CCPE. Based on the RBV and symbolic legitimation perspectives, as well as the discussion above, we develop the following hypotheses:

***H1a:*** *Firms with better CCPE (lower GHG emissions) are more likely to have higher MV.*

***H1b:*** *Firms with greater PCCIs are less likely to have higher MV.*

* 1. *Carbon performance, climate change initiatives, and market value: The moderating effect of board sustainability committee*

The existence of BSCOM is an important CG arrangement, but has been less explored in recent research, especially in relation to climate change. Corporate boards establish BSCOM to address stakeholder needs (Burke *et al*., 2019), promote sustainability (García-Sánchez *et al*., 2019), and enhance the efficacy of board monitoring (Dixon-Fowler *et al*., 2017). Such committees play a crucial role in implementing environmental initiatives and introducing best sustainability management practices that might promote stakeholder engagement, address environmental issues, and improve corporate outcomes (Luo and Tang, 2021; Peters and Romi, 2014). Prior literature suggests that the establishment of BSCOM improves CG practices (Spira and Bender, 2004), promotes sustainability strategies (Orazalin 2020), enhances the effectiveness of carbon mitigation initiatives (Haque, 2017; Mackenzie, 2007), and increases corporate transparency (Michelon and Parbonetti, 2012). From a stakeholder perspective, BSCOM serves as an effective mechanism and substantive management practice that may satisfy the interests of relevant stakeholders (Kılıç *et al.*, 2021), improve sustainability performance (Al-Shaer and Zaman, 2019), and achieve sufficient financial outcomes (Burke *et al.* 2019). Thus, in the eyes of stakeholders, BSCOM has become an effective lever for carbon mitigation management to create shared values for both shareholders and stakeholders (Burke *et al.,* 2019). However, the symbolic legitimation approach argues that such committees serve as an impression management tool to protect legitimacy and enhance accountability toward stakeholder groups, and thus, do not necessarily mitigate sustainability-related risks (Burke *et al.*, 2019; Rodrigue *et al*., 2013). In other words, firms may establish BSCOM for achieving greenwashing purposes to create positive impressions among stakeholders and protect MV from sustainability risks (Walls *et al*., 2012).

Prior empirical studies have largely suggested that certain CG mechanisms may influence the link between environmental performance and financial outcomes (Choi and Luo, 2021), without considering the moderating role of BSCOM. For example, using data of South African firms, Ntim and Soobaroyen (2013) reveal that the interaction between CG and CSR is positively related to MV and conclude that effective CG mechanisms reinforce the positive nexus between CSR and MV. In the European context, Haque and Ntim (2020) report that incentive-based governance mechanisms enhance carbon reduction initiatives, which in turn lead to higher MV. Further, Choi and Luo (2021) find that good CG mechanisms attenuate the negative impacts of carbon emissions on MV. Observably, these studies do not assess whether BSCOM can moderate the PCCIs/CCPE and MV relationships. Given the importance of BSCOM in promoting environmental initiatives (Kassinis and Vafeas, 2002; Shaukat *et al*., 2016) and creating shareholder value (Singh *et al.,* 2018), we expect that BSCOM is likely to affect the CCPE–MV and the PCCIs–MV relationships. We thus propose the following hypotheses:

***H2a:*** *BSCOM moderates the relationship between CCPE and MV.*

***H2b:*** *BSCOM moderates the relationship between PCCIs and MV.*

* 1. *Carbon performance and climate change initiatives*

According to the legitimacy view, firms may engage in environmental management initiatives in order to achieve specific objectives, such as improving legitimacy, protecting reputation, gaining support from stakeholders, and facilitating access to critical resources (Ashforth and Gibbs, 1990; Suchman, 1995). In this regard, firms may seek to gain legitimacy for their business operations by implementing symbolic and/or substantive PCCIs. Symbolic PCCIs seek to demonstrate corporate commitment to carbon mitigation activities, but the design and implementation of such activities aim at gaining legitimacy and support from stakeholders rather than to make meaningful improvements in outcome-based CCPE (Crossley *et al.,* 2021). In contrast, substantive PCCIs seek to implement carbon mitigation activities, which may result in fundamental changes of carbon management behavior and improvement of outcome-based CCPE. In particular, a firm’s process-based environmental management initiatives/practices and climate change targets can be substantive in nature and reflect its real intentions/incentives to reduce GHG emissions (Dahlmann *et al.* 2019). However, long-term and comprehensive PCCIs (i.e., changes in production processes, the implementation of intricate projects, new technologies, and cross-functional employee training) are costly, time-consuming, and not easily observable by the market (Berrone *et al*., 2017). As climate change issues are perceived to be serious threats to corporate reputation/legitimacy, firms simply engage in symbolic/greenwashing activities with the aim of enhancing legitimacy, without undertaking substantial commitments to improve outcome-based CCPE (Aslam *et al*., 2021; Shevchenko, 2021). Accordingly, firms exposed to greater stakeholder pressures are more likely to engage symbolically rather than substantively in PCCIs with the aim of protecting corporate reputation and improving environmental legitimacy (Haque and Ntim 2020).

Empirically, Busch and Hoffmann (2011) report that process-based environmental management initiatives are unrelated to outcome-based CCPE. Similarly, Haque and Ntim (2020) conclude that firms symbolically adopt climate change activities to enhance legitimacy without undertaking substantive efforts to improve outcome-based CCPE. This is consistent with greenwashing/impression management arguments (Bansal and Clelland, 2004; Bansal and Kistruck, 2006) that firms exposed to greater pressures from stakeholders and the media are more likely to adopt symbolic environmental initiatives, such as PCCIs in order to protect their legitimacy and manage stakeholders’ impressions about environmental risks. However, these symbolic efforts do not bring meaningful improvements to environmental/carbon performance (Aslam *et al.*, 2021; Shevchenko, 2021). Nevertheless, given that firms seeking legitimacy may adopt symbolic and/or substantive legitimation strategies, we propose the following non-directional hypothesis:

***H3****: There is an association between PCCIs and CCPE.*

* 1. *Carbon performance and climate change initiatives: The moderating effect of board sustainability committee*

The stakeholder view suggests that the presence of BSCOM indicates a firm’s commitment to environmental and sustainability related issues to build stronger stakeholder relationships (Al-Shaer and Zaman, 2019; Amran *et al*., 2014). In particular, BSCOM plays a critical role in adopting effective sustainability strategies (Orazalin, 2020), managing CSR risks and environmental issues (Burke *et al*., 2019), and improving the quality of sustainability information (Al-Shaer and Zaman, 2018; Kılıç *et al.*, 2021). Such committees realize the importance of environmentally responsible activities and offer incentives to engage in carbon mitigation activities in response to stakeholder demands (Luo and Tang, 2021). Thus, from the stakeholder perspective, firms that have BSCOM are more likely to engage in PCCIs to address stakeholder needs and promote sustainability. Empirically, Haque (2017) reports a positive relationship between BSCOM and carbon mitigation initiatives of UK companies. Similarly, Dixon-Fowler *et al*. (2017) document that BSCOM has a positive impact on environmental performance by providing more effective monitoring function in the context of S&P 500 companies.

However, the symbolic legitimation view argues that firms adopt governance mechanisms and engage in environmental initiatives under a symbolic approach to protect legitimacy and manage stakeholders’ concerns on environmental issues (Haque and Ntim, 2020; Rodrigue *et al*., 2013). In this regard, BSCOM may serve as an impression management tool to manage stakeholders’ concerns on climate change, protect reputation, and enhance legitimacy (Ashforth and Gibbs, 1990). For example, Walls *et al*. (2012) report that BSCOM is positively related to environmental concerns and conclude that firms facing greater environmental risks use BSCOM as a risk management tool. Rodrigue *et al*. (2013) provide evidence that BSCOM is established symbolically to manage shareholder perceptions, and therefore, their role in improving environmental performance is limited. In a similar vein, Burke *et al*. (2019) argue that BSCOM is a symbolic mechanism to enhance accountability toward stakeholder groups and does not mitigate sustainability-related risks, thus supporting the notion that such committees are mainly established to protect MV from sustainability risks.

Together, it is argued that even though sustainability committees are a critical determinant of environmental initiatives/strategies (Mackenzie, 2007; Orazalin, 2020), the design of those committees and their impacts on climate change-related activities are mainly driven by economic motives of managers and shareholders (Burke *et al*., 2019; Rodrigue *et al*., 2013). Thus, based on the above discussion, which emphasizes the importance of BSCOM in promoting sustainability practices, addressing climate change issues, protecting legitimacy, and managing stakeholder impressions, we expect that the presence of BSCOM is likely to influence the impact of PCCIs on CCPE. Accordingly, we construct the following hypothesis:

***H4****: BSCOM moderates the relationship between PCCIs and CCPE.*

Figure 1 presents the conceptual framework, outlining the predicted relationships among CCPE, PCCIs, MV, and BSCOM. It shows the direct effects of CCPE and PCCIs on MV, the direct effect of PCCIs on CCPE, and the moderating effects of BSCOM on these relationships.

1. **Methodology**
	1. *Sample and data*

We focus on all companies in the world with the required data available from 2002 to 2019. Our initial sample consisted of all non-financial firms from 45 countries based on the availability of carbon data in the ASSET4 ESG database. We excluded financial institutions due to their specific accounting implications, different governance systems and regulatory environments (Luo and Tang, 2021; Orazalin, 2020). We then filtered the remaining firms, retaining those with the required data for at least five consecutive years.[[2]](#footnote-2) Table 1 outlines the sample selection process yielding 8,408 firm-year observations from 592 firms, representing 10 sectors and operating in 35 countries. Data on PCCIs, carbon emissions, and internal CG mechanisms were obtained from the Refinitiv’s ASSET4 ESG database, which provides comprehensive, objective, and systematic information on environmental, social, and governance performance indicators of publicly listed companies (Haque, 2017; Orazalin, 2020). The financial data were obtained from the Worldscope database. Further, to account for country specific effects, data on country governance indicators were collected from the Worldwide Governance Indicators developed by Kaufmann *et al*. (2011) and other country level variables, including GDP growth and inflation rates, were gathered from the World Bank database (World Bank, 2020). Table 2 presents the sample distributions and similar to most cross-country studies of this nature, it shows that Japan, with 1,760 observations (20.93%), is the most represented country, followed by the US with 1,613 observations (19.18%) and the UK with 1,105 observations (13.14%). Further, the sample shows that the industrials, materials, and consumer discretionary sectors have the most observations, accounting for 1,745 (20.75%), 1,564 (18.60%), and 944 (11.23%) of the sample, respectively.[[3]](#footnote-3)

* 1. *Models and variables*

In order to assess the direct effects of CCPE and PCCIs on MV and the moderating effect of BSCOM on the CCPE–MV and the PCCIs–MV relationships, we employ the following model:

MV*it*=α0+*β*1\*CCP*it*+*β*2\*BSCOM*it*+*β*3\*(CCP\*BSCOM*it*)+*β*4\*BSIZE*it*+*β*5\*INDIR*it*

+*β*6\*BGEN*it*+*β*7\*SIZE*it*+*β*8\*PROF*it*+*β*9\*DEBT*it*

+*β*10\*CASH*it*+*β*11\*CAPIN*it*+*β*12\*WGI*kt*+*β*13\*GDP*kt*

+*β*14\*INF*kt*+*εit*

(1)

where, CCP*it* is either PCCIs or CCPE of firm *i* at time *t;* CCP\*BSCOM is the interaction term between CCP and BSCOM. All other variables are defined/measured in Table 3.

Further, we employ the following model[[4]](#footnote-4) to estimate the direct effect of PCCIs on CCPE and the moderating effect of BSCOM on the PCCIs—CCPE link:

CCPE*it*=α0+*β*1\*PCCIs*i*[*t;t-1;t-2*]+*β*2\*BSCOM*i*[*t;t-1;t-2*]+*β*3\*(PCCIs\*BSCOM*i*[*t;t-1;t-2*])

+*β*4\*BSIZE*i*[*t;t-1;t-2*]+*β*5\*INDIR*i*[*t;t-1;t-2*]+*β*6\*BGEN*i*[*t;t-1;t-2*]+*β*7\*SIZE*i*[*t;t-1;t-2*]

+*β*8\*PROF*i*[*t;t-1;t-2*]+*β*9\*DEBT*i*[*t;t-1;t-2*]+*β*10\*CASH*i*[*t;t-1;t-2*]+*β*11\*CAPIN*i*[*t;t-1;t-2*]

+*β*12\*WGI*k*[*t;t-1;t-2*]+*β*13\*GDP*k*[*t;t-1;t-2*]+*β*14\*INF*k*[*t;t-1;t-2*]+*εi*[*t;t-1;t-2*]

 (2)

where, PCCIs\*BSCOM is the interaction term between PCCIs and BSCOM.

As shown in Figure 1, our conceptual framework contains four main variables, including PCCIs, CCPE, BSCOM, and MV. First, following prior studies (e.g., Eleftheriadis and Anagnostopoulou, 2015; Giannarakis *et al*., 2017), we develop the PCCIs index to measure PCCIs. The index is constructed based on 40 firm-specific activities that measure PCCIs.[[5]](#footnote-5) The Appendix 1 (supporting information) presents all 40 PCCIs and their measurements. To assess the validity and reliability of the index, the Cronbach’s alpha of individual dimensions of the PCCIs is estimated.[[6]](#footnote-6) The PCCIs index, which is a weighted average sector adjusted index, is then calculated based on these 40 firm-specific PCCIs.[[7]](#footnote-7) Second, consistent with related studies (Downar *et al.,* 2021; Moussa *et al*., 2020), we measure CCPE as the natural logarithm of total GHG emissions, including Scope 1 and Scope 2 emissions.[[8]](#footnote-8) Third, we measure BSCOM based on data obtained from the ASSET4 ESG, consistent with prior studies (Dixon-Fowler, Ellstrand and Johnson, 2017; Orazalin, 2020). Finally, following related studies (Rind *et al.,* 2021; Singh *et al.,* 2018), we measure MV using Tobin’s Q, which depends on various measures associated with the adoption of clean/green technologies, stockholder pressures for PCCIs, emissions mitigation efforts, and R&D costs (Faria *et al.* 2022) and, hence better reflects environmental stakeholders’ perceptions about corporate sustainability (Siddique *et al.,* 2021).[[9]](#footnote-9)

We also use several control variables to account for the confounding effects of firm and country specific characteristics that may affect MV and CCPE. Following prior studies (e.g., Berrone and Gomez-Mejia, 2009; Bui *et al*., 2020), we include several CG characteristics, such as board size, board independence, and board gender diversity. Further, consistent with prior studies (Haque, 2017; Siddique *et al*., 2021), we control several firm characteristics, including firm size, profitability, leverage, slack, and capital intensity. Finally, we use country governance indicators and macro-economic factors, such as GDP growth and inflation, following prior studies (Jiang *et al.,* 2021; Marin and Vona 2021; Siddique *et al.,* 2021).

1. **Empirical results**
	1. *Descriptive statistics and correlation analysis*

Figures 2 and 3 present year-wise distribution of carbon emissions and PCCIs, respectively, for the period 2002-2019. The yearly average of carbon emissions shows a declining trend from 2003 to 2005 and from 2007 to 2010, followed by a stable pattern between 2010 and 2014, and again a further reduction from 2015 onwards. Figure 3 shows that the average index of PCCIs remains relatively stable during the first three years and increases steadily from 2005 to 2012. Then, it slightly decreases from 2012 to 2015 and again rises steadily during the next four years. Overall, the pattern shows a steady improvement in PCCIs over time and this trend is generally comparable with the observations of Haque (2017).

Table 4 reports the descriptive statistics of the variables. The mean value of MV is 1.66 and varies between 0.33 and 15.99. The average PCCIs index stands at 50.00% and ranges from 0.47% to 99.97%. The CCPE values vary between 6.86 and 19.29, with a mean value of 13.72. The statistics for BSCOM display that approximately 80% of the firms have BSCOM. Further, the correlation coefficients in Table 5 show that CCPE is negatively correlated with MV and positively connected to PCCIs and BSCOM. Serious multicollinearity problems arise if correlation coefficients among predictors exceed a cutoff value of 0.80 (Gujarati, 2004). The matrix shows that none of the coefficients exceeds this value, thus indicating the absence of multicollinearity.[[10]](#footnote-10)

* 1. *Multivariate results and discussion*

*Carbon performance, board sustainability committees, climate change initiatives, and market value*

Table 6 reports the regression results of MV on CCPE, PCCIs, and BSCOM. Model (1) shows that CCPE is negatively related to MV (p < 0.01), indicating that firms with excessive GHG emissions suffer more from negative market valuation. This evidence supports *H1a* and corroborates the findings of Baboukardos (2017) and Choi and Luo (2021) that capital markets react negatively to increased levels of emissions. Model (2) displays a positive association between PCCIs and MV (p < 0.01), contrary to expectations of *H1b*. This finding suggests that firms facing increased climate-related risks/threats are more likely to adopt process-based environmental initiatives/strategies, such as PCCIs, which can be perceived positively by market participants, resulting in value enhancement (Haque and Ntim 2020). This evidence also supports the symbolic legitimation view in that firms are likely to engage in symbolic PCCIs to impress stakeholders, gain/maintain legitimacy, and ultimately improve MV (Berrone and Gomez-Mejia 2009; Suchman 1995). Further, Model (3) shows that BSCOM is positively associated with MV (p < 0.05). This evidence suggests that firms with BSCOM have higher MV and supports the view that CG practices, such as BSCOM improve organizational performance (Choi and Luo, 2021; Kılıç *et al.,* 2021). However, Models (4) and (5) show that the coefficients for the interaction terms (CCPE\*BSCOM and PCCIs\*BSCOM) are insignificant with MV (p > 0.10), thereby indicating that BSCOM has no moderating role on the CCPE–MV and the PCCIs–MV links. These findings are consistent with the view that BSCOM established under a symbolic approach can generate value, but it can be ineffective at mitigating sustainability-related risks and improving environmental performance (Burke *et al.* 2019; Rodrigue *et al.* 2013). Given that the formation of CSR/sustainability committees is purely voluntary and firms may establish such committees for greenwashing purposes (Dixon-Fowler *et al.,* 2017), our findings appear to indicate that executives can influence the formation of BSCOM, and hence may exert dominance over its decisions-making. This supports the view that environmentally sensitive firms tend to nominate their executives to BSCOM to pursue economic/financial motives, and hence the establishment of BSCOM serves as an impression management tool (Rodrigue *et al.,* 2013).

*Carbon performance, board sustainability committees, and climate change initiatives*

Table 7 reports the regression results of CCPE against, PCCIs and BSCOM. Models (1-6) show that PCCIs, PCCIs*t-1*, and PCCIs*t-2* are positively associated with CCPE (p < 0.01). These results indicate that firms that engage in PCCIs continue to emit high emissions. This is consistent with prior studies (Boiral, 2016; Talbot and Boiral, 2018) that provide evidence of symbolic process-based environmental initiatives in the form of active engagements in environmentally friendly activities and extensive environmental reporting, but these symbolic commitments do not necessarily improve outcome-based CCPE (Shevchenko, 2021). Theoretically, this finding supports the symbolic legitimation/greenwashing view in that firms are likely to engage in PCCIs under a symbolic approach to protect/maintain/improve legitimacy, but such initiatives do not result in observable emissions reductions (Haque and Ntim, 2020). Further, BSCOM, BSCOM*t-1*, and BSCOM*t-2* are positively related to CCPE, indicating that firms with BSCOM are likely to emit high emissions. These findings corroborate past studies (Burke *et al.* 2019; Walls *et al.* 2012), which reveal a positive association between BSCOM and environmental concerns and argue that firms exposed to greater environmental risks are more likely to use BSCOM as an impression management tool to protect/maintain/improve their legitimacy. Further, the interaction terms (PCCIs\*BSCOM, PCCIs*t-1*\*BSCOM*t-1*, and PCCIs*t-2*\*BSCOM*t-2*) are statistically insignificant, implying that BSCOM has no moderating impact on the PCCIs—CCPE link. This evidence suggests that despite greater commitment to PCCIs, GHG emissions continue to increase regardless of whether a firm has BSCOM or not. Collectively, Tables 6 and 7 suggest that firms that engage in PCCIs under a symbolic approach to enhance MV are more likely to establish BSCOM as an impression management tool for achieving greenwashing purposes to create positive impressions and gain/maintain/repair legitimacy. Nevertheless, PCCIs do not improve outcome-based CCPE, and BSCOM does not reduce excessive GHG emissions, which in turn are perceived negatively by market participants.

* 1. *Additional analyses*

Prior literature suggests that environmental management systems, CG practices, and organizational performance are greatly influenced by differing country- and sector- level environmental regulations, institutional systems, and regulatory frameworks (Andreou and Kellard 2021; Bianchini and Croce 2022; Gaganis *et al*., 2021). In this regard, it is important to focus on variations in regional and sectoral contexts when assessing the factors and outcomes of corporate environmental impacts and climate change initiatives/practices (Aslam *et al.*, 2021; Kolk *et al*., 2014; Liu *et al*., 2021). Hence, we perform a set of country- and sector-group analyses.

First, we estimate whether the predicted relationships differ across shareholder-based and stakeholder-based CG countries/systems. We introduce the dummy variable (SHARE) that equals one if firms belong to shareholder-based CG countries/systems, and zero otherwise. Panel A of Table 8 displays that the coefficient of CCPE\*BSCOM\*SHARE is positive, indicating that the negative impact of emissions on MV is weaker for firms with BSCOM in shareholder-based CG countries/systems. Further, SHARE is positively related to MV, indicating that firms operating in shareholder-based CG countries/systems have higher MV. Panel B displays that the positive relationship between BSCOM and CCPE is stronger for stakeholder-based countries/systems. Altogether, the results suggest that firms from shareholder-oriented markets are more concerned about the economic consequences of their environmental impacts. This is consistent with the view that firms in shareholder-based countries are compelled by investors’ pressures to pursue short-term financial goals and value-enhancing developments, while firms in stakeholder-based regimes are motivated to promote social values and stakeholder perspectives (Allen *et al*., 2021; Liu *et al*., 2021). Overall, the results conform with past research in suggesting that climate governance (Bui *et al.* 2020), institutional pressures (Benlemlih *et al.* 2022), and legal systems (Andreou and Kellard 2021) affect corporate responses to climate change and performance outcomes.

Second, we repeat the estimations for EU ETS and non-EU ETS countries. We employ the dummy variable (EUETS) that equals one if firms belong to EU ETS countries, and zero otherwise. Panel A of Table 9 shows that the negative impact of CCPE on MV is more prominent for EU ETS countries, indicating that high-polluting firms in EU ETS countries are penalized more by market participants than those in non-EU ETS countries. This evidence suggests that firms regulated under the EU ETS need to incur more costs to reduce emissions and increase energy efficiency according to the ‘cap and trade’ principle, and thus are more undervalued by markets for excessive emissions (Clarkson *et al*., 2015). By contrast, high-polluting firms in non-EU ETS jurisdictions are penalized less by market participants due to the absence of regulatory systems, such as the EU ETS (Choi and Luo, 2021). BSCOM\*EUETS is positively related to MV, which suggests that capital markets react more positively to the presence of BSCOM in EU ETS countries. Panel B shows that EU ETS is negatively related to CCPE, indicating that the EU ETS leads to observable reductions in corporate emissions. In this case, the nature of climate governance (Bui *et al.* 2020), as well as internal and external governance systems (Choi and Luo 2021) that vary across countries can explain the effect of stringent environmental regulations on corporate emissions.

Third, we estimate Equations (1) and (2) for three subsamples: Paris (2019-2016), Kyoto (2015-2005), and pre-reforms (2004-2002) to consider the effects of global climate change reforms/initiatives. Table 10 displays a significantly negative association between CCPE and MV in Paris and Kyoto subsamples, and no association in a pre-reforms subsample. These results highlight the importance of global reforms/initiatives in raising awareness among market participants about the negative consequences of GHG emissions. Finally, we estimate the hypothesized relationships for environmentally sensitive and non-sensitive sectors. The results reveal that the negative effect of CCPE on MV is more pronounced in sensitive sectors, indicating that firms in sensitive sectors suffer more from negative market effects due to their higher impacts on climate change (for brevity not reported, but available upon request).

* 1. *Robustness tests*

We perform a number of sensitivity tests to check the robustness of our findings. First, to ensure that our main results are not affected by possible endogeneity[[11]](#footnote-11), we perform two-stage least squares (2SLS). Second, to confirm the absence of endogeneity, we employ a dynamic two-step system GMM, developed by Arellano and Bond (1991) and Blundell and Bond (1998).[[12]](#footnote-12) Third, we run Heckman selection models using sector average values of the main independent variables as exclusion restrictions to address self-selection issues. The results from 2SLS (in Table 11) and GMM and Heckman models (in Table 12) are qualitatively similar to those reported in Tables 6 and 7, indicating the robustness of our main findings to endogeneity and sample selection bias. Fourth, we estimate Equations (1) and (2) using the relative changes in MV, CCPE, and PCCIs in year *t* (compared to year *t-1*), since it is possible that capital markets react positively to reductions in GHG emissions even if the level of CCPE is high. The un-tabulated results support the original findings regarding the relationships among MV, CCPE, and PCCIs. Fifth, we estimate Equations (1) and (2) using separate CCPE values of Scope 1 and Scope 2 emissions to assess their individual effects on MV. In addition, we replace CCPE with carbon intensity, measured as the ratio of GHG emissions to total assets. The un-tabulated results indicate that our findings are robust to the inclusion of these measures.

1. **Conclusion**

Due to the increasing levels of GHG emissions and particularly their adverse impacts on the environment, socio-economic systems, and subsequently human lives, climate change has attracted a growing interest among academics, practitioners, policymakers, and regulators over the past few decades, thus becoming a dominant issue on the economic, political, and business agenda. However, there is limited evidence on the role of CG mechanisms, such as BSCOM in addressing climate change issues and on the value relevance of PCCIs and CCPE. Our study aims to address this lacuna by empirically examining the interrelationships among BSCOM, PCCIs, CCPE, and MV based on a dataset of 592 global firms operating in 35 countries from 2002 to 2019. Drawing on the dynamic multi-dimensional socio-economic-based theoretical framework, our study offers several new contributions to the extant literature.

First, it extends the extant literature (Choi and Luo, 2021; Tuesta *et al*., 2021) by suggesting that higher levels of GHG emissions have a negative impact on MV, whereas PCCIs have a positive relationship with MV. Second, our results offer new evidence that PCCIs are positively related to increased levels of GHG emissions. Third, our results contribute to the CG and carbon literature (Benlemlih *et al.*, 2022; Bui *et al*., 2020) by showing that the presence of BSCOM is associated with higher GHG emissions. Our results support the symbolic legitimation view (Aslam *et al*., 2021; Shevchenko, 2021) in that firms that symbolically engage in PCCIs may use the governance mechanism of BSCOM as an impression management tool for achieving greenwashing purposes to create positive impressions among stakeholders and protect their legitimacy. However, PCCIs do not lead to emissions reductions, and the presence of BSCOM seems ineffective at improving outcome-based CCPE and mitigating climate-related risks. Our results also reveal that the predicted relationships vary across different county-groups, sector-groups, and periods.

Our study offers a number of important practical and policy implications. First, our findings suggest that managers and corporate boards should not neglect the deteriorating effects of excessive carbon emissions on the environment and society that may ultimately harm MV. Further, regulators and institutional investors should be proactive in raising awareness among all stakeholders about the negative consequences of GHG emissions. Second, regulators and policymakers need to develop enforceable policies/guidelines on PCCIs with mandatory carbon-mitigation targets at corporate, national, and global levels. In addition, they may consider introducing new legislation to motivate carbon-emitting firms to appoint BSCOM exclusively focused on climate change and sustainability. Finally, policymakers and standard-setters ought to develop and issue specific standards for reporting climate change and carbon-related information, especially in the absence of mandatory carbon reporting. For example, reporting firms should obtain external assurance of their climate change disclosures from independent assurance providers, who in turn, should examine and verify whether corporate reporting reflects a firm’s commitment to improve outcome-based CCPE. Such measures would prevent symbolic/greenwashing practices and help environmentally sensitive investors to select eco-friendly projects and make informed investment decisions (Al-Shaer and Zaman, 2018; Baboukardos *et al.*, 2021; Bui *et al.,* 2021; Reimsbach *et al.*, 2018).

Our study has some limitations that should be explicitly addressed by future research. First, our study is based on global companies whose shares are publicly traded in different stock markets. Consequently, the findings may not be generalizable to small and medium sized entities (SMEs). Hence, future research may provide new insights by examining whether these relationships hold in SMEs and non-publicly traded firms. Second, due to data limitations, we capture the existence of BSCOM rather than considering individual characteristics of committee members (e.g., age, culture, education, expertise, gender, independence, religion, and skills). Hence, future research may offer new insights by exploring these objective values of BSCOM that may also influence CCPE, PCCIs, and MV. Finally, we analyze data on climate change, carbon emissions, and financial results reported by the sampled firms and do not consider other information that might reflect actual practices and performance. In this regard, future studies might conduct comprehensive case studies and interviews with executives, board members, investors and other stakeholders to provide new insights on climate change. Furthermore, PCCIs may take time to influence actual GHG emissions, and therefore, our conclusion of PCCIs may be mere symbolic/greenwashing may not always hold, which as more data becomes available future research can revisit.

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Board sustainability committee (BSCOM)

 *H4*

 *H2a H2b*

Corporate carbon performance by emissions (CCPE)

Process-based climate change initiatives (PCCIs)

 *H3*

 *H1a H1b*

 Direct effects Moderating effects

**Figure 1. The conceptual framework**

**Figure 2. Year - wise distribution of carbon emissions in tonnes (in millions)**

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Source: authors’ own calculation based on data obtained from the Refinitiv database

**Figure 3. Year - wise distribution of climate change initiatives**

****

Source: authors’ own calculation based on data obtained from the Refinitiv database

*Table 1. Sample selection*

|  |  |
| --- | --- |
|  | **No. of observations** |
| All firm-year observations based on the availability of carbon data in the ASSET4 ESG | 20,591 |
| Less: observations with insufficient data on PCCIs  | 5,127 |
| Less: observations with insufficient data on CG | 3,688 |
| Less: observations with insufficient financial data | 3,368 |
| **Final sample**  | **8,408** |

*Table 2. Sample distribution by country and sector*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Firms** | **Obs.** | **Percent (%)** | **Cum. (%)** |
| *Panel A: Sample distribution by country* |  |
| Australia | 25 | 380 | 4.52 | 4.52 |
| Austria | 2 | 28 | 0.33 | 4.85 |
| Belgium | 6 | 98 | 1.17 | 6.02 |
| Brazil | 7 | 82 | 0.98 | 6.99 |
| Canada | 25 | 373 | 4.44 | 11.43 |
| China | 3 | 39 | 0.46 | 11.89 |
| Denmark | 10 | 151 | 1.80 | 13.69 |
| Finland | 9 | 132 | 1.57 | 15.26 |
| France | 26 | 392 | 4.66 | 19.92 |
| Germany | 26 | 309 | 3.68 | 23.60 |
| Greece | 3 | 44 | 0.52 | 24.12 |
| Hong Kong | 5 | 80 | 0.95 | 25.07 |
| Hungary | 1 | 12 | 0.14 | 25.21 |
| India | 5 | 59 | 0.70 | 25.92 |
| Ireland | 6 | 98 | 1.17 | 27.08 |
| Italy | 12 | 173 | 2.06 | 29.14 |
| Japan | 146 | 1760 | 20.93 | 50.07 |
| Luxembourg | 2 | 31 | 0.37 | 50.44 |
| Malaysia | 1 | 12 | 0.14 | 50.58 |
| Mexico | 4 | 53 | 0.63 | 51.21 |
| Netherlands | 13 | 211 | 2.51 | 53.72 |
| Norway | 6 | 88 | 1.05 | 54.77 |
| Portugal | 2 | 29 | 0.34 | 55.11 |
| Russia | 2 | 22 | 0.26 | 55.38 |
| Saudi Arabia | 1 | 10 | 0.12 | 55.49 |
| Singapore | 2 | 31 | 0.37 | 55.86 |
| South Africa | 7 | 83 | 0.99 | 56.85 |
| South Korea | 13 | 150 | 1.78 | 58.63 |
| Spain | 14 | 210 | 2.50 | 61.13 |
| Sweden | 20 | 272 | 3.24 | 64.37 |
| Switzerland | 15 | 234 | 2.78 | 67.15 |
| Thailand | 2 | 24 | 0.29 | 67.44 |
| Turkey | 2 | 20 | 0.24 | 67.67 |
| United Kingdom | 69 | 1105 | 13.14 | 80.82 |
| United States | 100 | 1613 | 19.18 | 100.00 |
| **Total** | **592** | **8408** | **100.00** |  |
|  |  |  |  |  |
| *Panel B: Sample distribution by sector* |  |  |
| Communication Services | 32 | 487 | 5.79 | 5.79 |
| Consumer Discretionary | 69 | 944 | 11.23 | 17.02 |
| Consumer Staples | 45 | 661 | 7.86 | 24.88 |
| Energy | 46 | 680 | 8.09 | 32.97 |
| Health Care | 40 | 622 | 7.40 | 40.37 |
| Industrials | 124 | 1745 | 20.75 | 61.12 |
| Information Technology | 52 | 731 | 8.69 | 69.81 |
| Materials | 115 | 1564 | 18.60 | 88.42 |
| Real Estate | 22 | 334 | 3.97 | 92.39 |
| Utilities | 47 | 640 | 7.61 | 100.00 |
| **Total** | **592** | **8408** | **100.00** |  |
| Notes: EU ETS countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, and United Kingdom. The remaining countries are non-EU ETS countries. |

*Table 3. Definition of variables*

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Symbols** | **Operationalization** | **Source** |
| *Substantive measures* |  |  |  |
| Market value | MV | Tobin’s Q calculated as total assets minus book value of equity plus market value of equity divided by total assets  | Datastream/ Worldscope |
| Corporate carbon performance by emissions | CCPE | The natural logarithm of total GHG emissions including Scope 1 (direct emissions from corporate activities) and Scope 2 (indirect emissions from the consumption of purchased electricity, cooling, heat, steam, etc.) emissions in tonnes. Higher CCPE values indicate greater levels of GHG emissions (i.e., weaker carbon performance).  | ASSET4-ESG |
|  |  |  |  |
| *Symbolic constructs/measures* |
| Process-based corporate climate change initiatives | PCCIs | The index is a weighted average sector adjusted index calculated based on 40 firm-specific items (see the Appendix 1 in supporting information) related to climate change initiatives and practices. It ranges between 0% (no climate change initiatives and practices) and 100% (fully instituted climate change initiatives and practices) | ASSET4-ESG |
| Board sustainability committee | BSCOM | A dummy value of 1 is assigned if the board has a sustainability committee, and 0 otherwise | ASSET4-ESG |
|  |  |  |  |
| *Corporate governance variables* |
| Board size | BSIZE | The natural logarithm of the number of board directors | ASSET4-ESG |
| Board independence  | INDIR | The percentage of independent directors on the board | ASSET4-ESG |
| Board gender diversity | BGEN | The percentage of female directors on the board  | ASSET4-ESG |
|  |  |  |  |
| *Firm-specific control variables* |
| Firm size | SIZE | The natural logarithm of total assets | Worldscope |
| Profitability  | PROF | Net income divided by total assets | Worldscope |
| Leverage | DEBT | Total debt divided by total assets | Worldscope |
| Slack | CASH | Cash and cash equivalents divided by total assets | Worldscope |
| Capital intensity  | CAPIN | Property, plant, and equipment divided by total assets | Worldscope |
|  |  |  |  |
| *Country-specific variables* |
| Country governance quality | WGI | Composite index of a country’s governance quality. Calculated based on the dimensions including government effectiveness, regulatory quality, and rule of law obtained from the Worldwide Governance Indicators developed by Kaufmann, Kraay and Mastruzzi, (2011). The score is expressed in percentages and ranges between 0% and 100% | Worldwide Governance Indicators |
| GDP growth  | GDP | The sum of gross value added by all resident producers plus product taxes and minus subsidies not included in the value of products | World Bank |
| Inflation rates | INF | Annual percentage change in retail prices of goods and services that may be fixed or changed during the year | World Bank |
|  |  |  |  |

*Table 4. Descriptive Statistics*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  **Variable** |  **Obs.** |  **Mean** |  **Std. Dev.** |  **Min** |  **Max** |
|  MV (ratio) | 8408 | 1.66 | 1.02 | 0.33 | 15.99 |
|  CCPE (ln) | 7778 | 13.72 | 2.19 | 6.86 | 19.29 |
|  PCCIs (%) | 8408 | 50.00 | 28.84 | 0.47 | 99.97 |
|  BSCOM | 8408 | 0.80 | 0.40 | 0.00 | 1.00 |
|  BSIZE (ln) | 8408 | 2.41 | 0.31 | 0.69 | 3.50 |
|  INDIR (%) | 8408 | 56.94 | 27.76 | 0.00 | 100.00 |
|  BGEN (%) | 8408 | 14.99 | 13.05 | 0.00 | 63.64 |
|  SIZE (ln) | 8408 | 23.36 | 1.29 | 18.99 | 27.41 |
|  PROF (%) | 8408 | 5.33 | 6.91 | -78.62 | 106.22 |
|  DEBT (%) | 8408 | 24.96 | 14.07 | 0.00 | 87.00 |
|  CASH (ratio) | 8408 | 0.07 | 0.08 | 0.00 | 0.60 |
|  CAPIN (ratio) | 8408 | 0.31 | 0.22 | 0.00 | 1.00 |
|  WGI (%) | 8408 | 89.47 | 9.83 | 34.29 | 99.83 |
|  GDP (%) | 8408 | 1.79 | 2.12 | -9.13 | 25.16 |
|  INF (%) | 8408 | 1.67 | 1.58 | -4.48 | 16.33 |
|  |

*Table 5. Correlation matrix*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **MV** | **CCPE** | **PCCIs** | **BSCOM** | **BSIZE** | **INDIR** | **BGEN** | **SIZE** | **PROF** | **DEBT** | **CASH** | **CAPIN** | **WGI** | **GDP** | **INF** |
| MV | 1.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CCPE | -0.23\*\* | 1.00 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PCCIs | -0.12\*\* | 0.27\*\* | 1.00 |  |  |  |  |  |  |  |  |  |  |  |  |
| BSCOM | -0.09\*\* | 0.11\*\* | 0.48\*\* | 1.00 |  |  |  |  |  |  |  |  |  |  |  |
| BSIZE | -0.10\*\* | 0.27\*\* | 0.24\*\* | 0.09\*\* | 1.00 |  |  |  |  |  |  |  |  |  |  |
| INDIR | -0.03\*\* | 0.14\*\* | 0.14\*\* | 0.12\*\* | -0.11\*\* | 1.00 |  |  |  |  |  |  |  |  |  |
| BGEN | 0.13\*\* | -0.02 | 0.19\*\* | 0.15\*\* | -0.01 | 0.16\*\* | 1.00 |  |  |  |  |  |  |  |  |
| SIZE | -0.18\*\* | 0.62\*\* | 0.44\*\* | 0.18\*\* | 0.41\*\* | 0.17\*\* | 0.12\*\* | 1.00 |  |  |  |  |  |  |  |
| PROF | 0.57\*\* | -0.12\*\* | -0.07\*\* | -0.08\*\* | -0.05\*\* | -0.03\*\* | 0.09\*\* | -0.07\*\* | 1.00 |  |  |  |  |  |  |
| DEBT | -0.22\*\* | 0.21\*\* | 0.03\*\* | 0.03\*\* | 0.10\*\* | 0.02 | 0.03\*\* | 0.18\*\* | -0.28\*\* | 1.00 |  |  |  |  |  |
| CASH | 0.14\*\* | -0.21\*\* | 0.00 | 0.01 | -0.05\*\* | 0.00 | -0.18\*\* | -0.15\*\* | 0.09\*\* | -0.27\*\* | 1.00 |  |  |  |  |
| CAPIN | -0.11\*\* | 0.44\*\* | -0.02 | 0.06\*\* | 0.03\*\* | 0.02 | -0.06\*\* | 0.07\*\* | -0.06\*\* | 0.11\*\* | -0.19\*\* | 1.00 |  |  |  |
| WGI | 0.04\*\* | -0.14\*\* | -0.14\*\* | -0.08\*\* | -0.21\*\* | 0.07\*\* | 0.14\*\* | -0.12\*\* | 0.01 | -0.05\*\* | 0.01 | -0.11\*\* | 1.00 |  |  |
| GDP | 0.15\*\* | 0.04\*\* | -0.13\*\* | -0.11\*\* | -0.03\*\* | 0.02\* | 0.06\*\* | 0.01 | 0.17\*\* | -0.06\*\* | -0.06\*\* | 0.03\*\* | -0.05\*\* | 1.00 |  |
| INF | 0.09\*\* | 0.09\*\* | -0.09\*\* | -0.06\*\* | -0.01 | 0.01 | 0.08\*\* | 0.02 | 0.15\*\* | 0.02 | -0.17\*\* | 0.11\*\* | -0.37\*\* | 0.17\*\* | 1.00 |
| \*\* Correlation is significant at the 0.01 level (2-tailed), \* correlation is significant at the 0.05 level (2-tailed).  |

*Table 6. Impacts of carbon performance, climate change initiatives, and board sustainability committees on market value*

This table reports the regression results of carbon performance, climate change initiatives, and sustainability committees on market value. All variables are defined and measured in Table 3. *t*-statistics estimated using robust standard errors are reported in parentheses.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) |
|  | MV | MV | MV | MV | MV |
| CCPE | -0.067\*\*\* |  |  | -0.069\*\*\* |  |
|  | (-9.79) |  |  | (-10.09) |  |
| PCCIs |  | 0.002\*\*\* |  |  | 0.001\*\*\* |
|  |  | (4.16) |  |  | (3.59) |
| BSCOM |  |  | 0.055\*\* | 0.107\*\*\* | 0.063\*\* |
|  |  |  | (2.14) | (4.15) | (2.21) |
| CCPE\*BSCOM |  |  |  | 0.010 |  |
|  |  |  |  | (0.90) |  |
| PCCIs\*BSCOM |  |  |  |  | 0.001 |
|  |  |  |  |  | (1.27) |
| BSIZE | 0.050 | 0.047 | 0.053\* | 0.048 | 0.048 |
|  | (1.63) | (1.56) | (1.75) | (1.57) | (1.57) |
| INDIR | -0.000 | -0.001\*\* | -0.001\*\* | -0.000 | -0.001\*\*\* |
|  | (-0.70) | (-2.55) | (-2.36) | (-0.92) | (-2.65) |
| BGEN | 0.004\*\*\* | 0.004\*\*\* | 0.004\*\*\* | 0.004\*\*\* | 0.004\*\*\* |
|  | (3.22) | (3.33) | (3.33) | (3.12) | (3.28) |
| SIZE | -0.049\*\*\* | -0.133\*\*\* | -0.120\*\*\* | -0.052\*\*\* | -0.134\*\*\* |
|  | (-4.49) | (-14.28) | (-14.47) | (-4.74) | (-14.34) |
| PROF | 0.059\*\*\* | 0.061\*\*\* | 0.062\*\*\* | 0.059\*\*\* | 0.061\*\*\* |
|  | (15.65) | (16.53) | (16.59) | (15.71) | (16.58) |
| DEBT | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
|  | (0.57) | (0.44) | (0.23) | (0.69) | (0.47) |
| CASH | 0.867\*\*\* | 0.995\*\*\* | 0.998\*\*\* | 0.853\*\*\* | 0.994\*\*\* |
|  | (4.99) | (5.89) | (5.90) | (4.90) | (5.87) |
| CAPIN | -0.001 | -0.155\*\*\* | -0.158\*\*\* | -0.009 | -0.159\*\*\* |
|  | (-0.03) | (-4.11) | (-4.17) | (-0.24) | (-4.20) |
| WGI | -0.005 | -0.006 | -0.006 | -0.005 | -0.006 |
|  | (-0.80) | (-1.08) | (-1.15) | (-0.95) | (-1.16) |
| GDP | 0.027\*\*\* | 0.027\*\*\* | 0.027\*\*\* | 0.027\*\*\* | 0.027\*\*\* |
|  | (3.74) | (3.88) | (3.81) | (3.80) | (3.89) |
| INF | 0.019\* | 0.020\* | 0.019\* | 0.019\* | 0.020\* |
|  | (1.71) | (1.90) | (1.82) | (1.78) | (1.91) |
| Constant | 2.609\*\*\* | 4.883\*\*\* | 4.588\*\*\* | 2.821\*\*\* | 4.949\*\*\* |
|  | (4.19) | (8.78) | (8.42) | (4.50) | (8.84) |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes |
| Sector fixed effects | Yes | Yes | Yes | Yes | Yes |
| Country fixed effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 7778 | 8408 | 8408 | 7778 | 8408 |
| R-squared | 0.525 | 0.521 | 0.520 | 0.526 | 0.521 |

\*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively

*Table 7. Impacts of climate change initiatives and board sustainability committees on carbon performance*

This table reports the regression results of climate change initiatives and sustainability committees on carbon performance. All variables are defined and measured in Table 3. *t*-statistics estimated using robust standard errors are reported in parentheses.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | CCPE | CCPE | CCPE | CCPE | CCPE | CCPE |
| PCCIs | 0.008\*\*\* |  |  | 0.008\*\*\* |  |  |
|  | (13.23) |  |  | (12.95) |  |  |
| BSCOM | 0.176\*\*\* |  |  | 0.159\*\*\* |  |  |
|  | (4.14) |  |  | (3.50) |  |  |
| PCCIs\*BSCOM |  |  |  | -0.001 |  |  |
|  |  |  |  | (-0.68) |  |  |
| PCCIs *t-1* |  | 0.007\*\*\* |  |  | 0.007\*\*\* |  |
|  |  | (11.66) |  |  | (11.35) |  |
| BSCOM *t-1* |  | 0.110\*\*\* |  |  | 0.104\*\* |  |
|  |  | (2.59) |  |  | (2.21) |  |
| PCCIs *t-1*\*BSCOM *t-1* |  |  |  |  | -0.000 |  |
|  |  |  |  |  | (-0.24) |  |
| PCCIs *t-2* |  |  | 0.007\*\*\* |  |  | 0.007\*\*\* |
|  |  |  | (10.48) |  |  | (10.30) |
| BSCOM *t-2* |  |  | 0.092\*\* |  |  | 0.082\* |
|  |  |  | (2.14) |  |  | (1.69) |
| PCCIs *t-2*\*BSCOM *t-2* |  |  |  |  |  | -0.001 |
|  |  |  |  |  |  | (-0.35) |
| BSIZE[*t;t-1;t-2*] | -0.055 | -0.046 | -0.076 | -0.056 | -0.046 | -0.077 |
|  | (-1.00) | (-0.80) | (-1.33) | (-1.01) | (-0.81) | (-1.34) |
| INDIR[*t;t-1;t-2*] | 0.003\*\*\* | 0.003\*\*\* | 0.002\*\*\* | 0.003\*\*\* | 0.003\*\*\* | 0.002\*\*\* |
|  | (5.29) | (5.32) | (4.73) | (5.29) | (5.32) | (4.73) |
| BGEN[*t;t-1;t-2*] | 0.002 | 0.003\* | 0.003\* | 0.002 | 0.003\* | 0.003\* |
|  | (1.60) | (1.85) | (1.73) | (1.60) | (1.85) | (1.73) |
| SIZE[*t;t-1;t-2*] | 0.868\*\*\* | 0.878\*\*\* | 0.885\*\*\* | 0.868\*\*\* | 0.878\*\*\* | 0.885\*\*\* |
|  | (65.83) | (64.50) | (63.98) | (65.80) | (64.50) | (64.00) |
| PROF[*t;t-1;t-2*] | -0.006\*\*\* | -0.005\*\* | -0.005\*\* | -0.006\*\*\* | -0.005\*\* | -0.005\*\* |
|  | (-2.99) | (-2.50) | (-2.33) | (-2.98) | (-2.50) | (-2.32) |
| DEBT[*t;t-1;t-2*] | 0.007\*\*\* | 0.006\*\*\* | 0.006\*\*\* | 0.007\*\*\* | 0.006\*\*\* | 0.006\*\*\* |
|  | (6.26) | (5.96) | (5.40) | (6.25) | (5.96) | (5.40) |
| CASH[*t;t-1;t-2*] | -0.659\*\*\* | -0.657\*\*\* | -0.664\*\*\* | -0.662\*\*\* | -0.658\*\*\* | -0.665\*\*\* |
|  | (-3.70) | (-3.56) | (-3.47) | (-3.71) | (-3.56) | (-3.48) |
| CAPIN[*t;t-1;t-2*] | 2.164\*\*\* | 2.143\*\*\* | 2.145\*\*\* | 2.164\*\*\* | 2.143\*\*\* | 2.145\*\*\* |
|  | (23.53) | (22.54) | (21.94) | (23.53) | (22.54) | (21.94) |
| WGI[*t;t-1;t-2*] | 0.018\*\* | 0.016\*\* | 0.013 | 0.018\*\* | 0.016\*\* | 0.013 |
|  | (2.38) | (1.97) | (1.40) | (2.38) | (1.97) | (1.40) |
| GDP[*t;t-1;t-2*] | 0.004 | 0.008 | 0.013 | 0.004 | 0.008 | 0.013 |
|  | (0.45) | (0.85) | (1.39) | (0.44) | (0.84) | (1.38) |
| INF[*t;t-1;t-2*] | 0.038\*\*\* | 0.042\*\*\* | 0.048\*\*\* | 0.038\*\*\* | 0.042\*\*\* | 0.048\*\*\* |
|  | (2.88) | (3.13) | (3.38) | (2.88) | (3.13) | (3.39) |
| Constant | -9.483\*\*\* | -9.619\*\*\* | -9.525\*\*\* | -9.464\*\*\* | -9.611\*\*\* | -9.515\*\*\* |
|  | (-11.66) | (-11.21) | (-10.09) | (-11.63) | (-11.20) | (-10.08) |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Country fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 7778 | 7212 | 6779 | 7778 | 7212 | 6779 |
| R-squared | 0.769 | 0.771 | 0.773 | 0.769 | 0.771 | 0.773 |

\*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively

*Table 8. Additional analysis: carbon performance, climate change initiatives, board sustainability committees, and market value in shareholder-based and stakeholder-based countries*

This table reports the regression results for the effects of carbon performance, sustainability committees, and climate change initiatives on market value and for the effects of climate change initiatives and sustainability committees on carbon performance for shareholder-based and stakeholder-based countries. The SHARE is a dummy variable that equals one if firms belong to shareholder-based countries, and zero if firms are operating in stakeholder-based countries. All variables are defined and measured in Table 3. *t*-statistics estimated using robust standard errors are reported in parentheses.

|  |
| --- |
| *Panel A: Impacts of CCPE, PCCIs, and BSCOM on MV* |
|  |  | (1) | (2) | (3) | (4) | (5) |
|  |  | MV | MV | MV | MV | MV |
| CCPE |  | -0.067\*\*\* |  |  | -0.070\*\*\* |  |
|  |  | (-9.56) |  |  | (-10.04) |  |
| CCPE\*SHARE |  | 0.009 |  |  | 0.007 |  |
|  |  | (1.07) |  |  | (0.87) |  |
| PCCIs |  |  | 0.002\*\*\* |  |  | 0.001\*\*\* |
|  |  |  | (4.15) |  |  | (3.48) |
| PCCIs\*SHARE |  |  | 0.000 |  |  | 0.000 |
|  |  |  | (0.33) |  |  | (0.27) |
| BSCOM |  |  |  | 0.055\*\* | 0.100\*\*\* | 0.070\*\* |
|  |  |  |  | (2.13) | (3.84) | (2.30) |
| BSCOM\*SHARE |  |  |  | -0.013 | -0.050 | 0.034 |
|  |  |  |  | (-0.30) | (-1.12) | (0.57) |
| CCPE\*BSCOM |  |  |  |  | 0.011 |  |
|  |  |  |  |  | (1.02) |  |
| CCPE\*BSCOM\*SHARE |  |  |  |  | 0.080\*\*\* |  |
|  |  |  |  |  | (3.68) |  |
| PCCIs\*BSCOM |  |  |  |  |  | 0.001 |
|  |  |  |  |  |  | (1.30) |
| PCCIs\*BSCOM\*SHARE |  |  |  |  |  | 0.002 |
|  |  |  |  |  |  | (0.91) |
| SHARE |  | 0.733\*\* | 0.791\*\*\* | 0.761\*\*\* | 0.847\*\*\* | 0.798\*\*\* |
|  |  | (2.48) | (2.75) | (2.66) | (2.83) | (2.76) |
| Controls |  | Yes | Yes | Yes | Yes | Yes |
| Year/Sector/Country FE |  | Yes | Yes | Yes | Yes | Yes |
| Observations |  | 7778 | 8408 | 8408 | 7778 | 8408 |
| R-squared |  | 0.525 | 0.521 | 0.520 | 0.527 | 0.521 |
| *Panel B: Impacts of PCCIs, and BSCOM on CCPE* |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | CCPE | CCPE | CCPE | CCPE | CCPE | CCPE |
| PCCIs *t-1* | 0.008\*\*\* |  | 0.007\*\*\* |  |  |  |
|  | (12.12) |  | (11.28) |  |  |  |
| PCCIs *t-1*\*SHARE *t-1* | -0.000 |  | 0.001 |  |  |  |
|  | (-0.15) |  | (1.38) |  |  |  |
| BSCOM *t-1* |  | 0.177\*\*\* | 0.094\* |  |  |  |
|  |  | (4.17) | (1.90) |  |  |  |
| BSCOM *t-1*\*SHARE *t-1* |  | -0.236\*\*\* | -0.239\*\* |  |  |  |
|  |  | (-3.33) | (-2.45) |  |  |  |
| PCCIs *t-1*\*BSCOM *t-1* |  |  | -0.001 |  |  |  |
|  |  |  | (-0.81) |  |  |  |
| PCCIs *t-1*\*BSCOM *t-1*\*SHARE *t-1* |  |  | 0.000 |  |  |  |
|  |  |  | (0.11) |  |  |  |
| SHARE *t-1* | 0.220 | 0.148 | 0.323 |  |  |  |
|  | (0.60) | (0.40) | (0.88) |  |  |  |
| PCCIs*t-2* |  |  |  | 0.007\*\*\* |  | 0.007\*\*\* |
|  |  |  |  | (10.88) |  | (10.21) |
| PCCIs *t-2*\*SHARE *t-2* |  |  |  | 0.000 |  | 0.002\* |
|  |  |  |  | (0.10) |  | (1.66) |
| BSCOM *t-2* |  |  |  |  | 0.154\*\*\* | 0.072 |
|  |  |  |  |  | (3.61) | (1.41) |
| BSCOM *t-2*\*SHARE *t-2* |  |  |  |  | -0.221\*\*\* | -0.244\*\* |
|  |  |  |  |  | (-3.16) | (-2.41) |
| PCCIs *t-2*\*BSCOM *t-2* |  |  |  |  |  | -0.002 |
|  |  |  |  |  |  | (-0.99) |
| PCCIs *t-2*\*BSCOM *t-2*\*SHARE *t-2* |  |  |  |  |  | 0.000 |
|  |  |  |  |  |  | (0.03) |
| SHARE *t-2* |  |  |  | 0.344 | 0.288 | 0.441 |
|  |  |  |  | (0.89) | (0.74) | (1.14) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Year/Sector/Country FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 7212 | 7212 | 7212 | 6779 | 6779 | 6779 |
| R-squared | 0.771 | 0.768 | 0.772 | 0.773 | 0.770 | 0.773 |

\*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively

*Table 9. Additional analysis: carbon performance, climate change initiatives, board sustainability committees, and market value in EU ETS and non-EU ETS countries*

This table reports the regression results for the effects of carbon performance, sustainability committees, and climate change initiatives on market value and for the effects of climate change initiatives and sustainability committees on carbon performance for EU ETS and non-EU ETS countries. The EUETS is a dummy that equals one if firms belong to EU ETS counties, and zero if firms are operating in non-EU ETS countries. All variables are defined and measured in Table 3. *t*-statistics estimated using robust standard errors are reported in parentheses.

|  |
| --- |
| *Panel A: Impacts of CCPE, PCCIs, and BSCOM on MV* |
|  |  | (1) | (2) | (3) | (4) | (5) |
|  |  | MV | MV | MV | MV | MV |
| CCPE |  | -0.066\*\*\* |  |  | -0.068\*\*\* |  |
|  |  | (-9.63) |  |  | (-9.88) |  |
| CCPE\*EUETS |  | -0.038\*\*\* |  |  | -0.040\*\*\* |  |
|  |  | (-4.63) |  |  | (-4.75) |  |
| PCCIs |  |  | 0.002\*\*\* |  |  | 0.001\*\*\* |
|  |  |  | (4.19) |  |  | (3.34) |
| PCCIs\*EUETS |  |  | 0.001 |  |  | -0.000 |
|  |  |  | (1.07) |  |  | (-0.64) |
| BSCOM |  |  |  | 0.049\* | 0.099\*\*\* | 0.062\*\* |
|  |  |  |  | (1.90) | (3.77) | (2.15) |
| BSCOM\*EUETS |  |  |  | 0.123\*\*\* | 0.116\*\*\* | 0.148\*\*\* |
|  |  |  |  | (2.79) | (2.60) | (2.60) |
| CCPE\*BSCOM |  |  |  |  | 0.015 |  |
|  |  |  |  |  | (1.42) |  |
| CCPE\*BSCOM\*EUETS |  |  |  |  | -0.014 |  |
|  |  |  |  |  | (-0.68) |  |
| PCCIs\*BSCOM |  |  |  |  |  | 0.001 |
|  |  |  |  |  |  | (1.46) |
| PCCIs\*BSCOM\*EUETS |  |  |  |  |  | 0.001 |
|  |  |  |  |  |  | (0.31) |
| EUETS |  | -0.066 | -0.034 | -0.044 | -0.077 | -0.048 |
|  |  | (-1.32) | (-0.71) | (-0.92) | (-1.54) | (-0.98) |
| Controls |  | Yes | Yes | Yes | Yes | Yes |
| Year/Sector/Country FE |  | Yes | Yes | Yes | Yes | Yes |
| Observations |  | 7778 | 8408 | 8408 | 7778 | 8408 |
| R-squared |  | 0.526 | 0.521 | 0.521 | 0.528 | 0.522 |
| *Panel B: Impacts of PCCIs, and BSCOM on CCPE* |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | CCPE | CCPE | CCPE | CCPE | CCPE | CCPE |
| PCCIs *t-1* | 0.008\*\*\* |  | 0.007\*\*\* |  |  |  |
|  | (12.09) |  | (11.25) |  |  |  |
| PCCIs *t-1*\*EUETS *t-1* | 0.001 |  | 0.001 |  |  |  |
|  | (0.64) |  | (0.73) |  |  |  |
| BSCOM *t-1* |  | 0.177\*\*\* | 0.102\*\* |  |  |  |
|  |  | (4.12) | (2.19) |  |  |  |
| BSCOM *t-1*\*EUETS *t-1* |  | 0.001 | -0.090 |  |  |  |
|  |  | (0.02) | (-1.02) |  |  |  |
| PCCIs *t-1*\*BSCOM *t-1* |  |  | -0.000 |  |  |  |
|  |  |  | (-0.24) |  |  |  |
| PCCIs *t-1*\*BSCOM *t-1*\*EUETS *t-1* |  |  | -0.002 |  |  |  |
|  |  |  | (-0.73) |  |  |  |
| EUETS *t-1* | -0.546\*\*\* | -0.570\*\*\* | -0.541\*\*\* |  |  |  |
|  | (-7.32) | (-7.54) | (-7.14) |  |  |  |
| PCCIs *t-2* |  |  |  | 0.007\*\*\* |  | 0.007\*\*\* |
|  |  |  |  | (10.86) |  | (10.12) |
| PCCIs *t-2*\*EUETS *t-2* |  |  |  | 0.001 |  | 0.000 |
|  |  |  |  | (0.56) |  | (0.36) |
| BSCOM *t-2* |  |  |  |  | 0.149\*\*\* | 0.080\* |
|  |  |  |  |  | (3.44) | (1.67) |
| BSCOM *t-2*\*EUETS *t-2* |  |  |  |  | 0.044 | -0.053 |
|  |  |  |  |  | (0.63) | (-0.57) |
| PCCIs *t-2*\*BSCOM *t-2* |  |  |  |  |  | -0.000 |
|  |  |  |  |  |  | (-0.30) |
| PCCIs *t-2*\*BSCOM *t-2*\*EUETS *t-2* |  |  |  |  |  | -0.003 |
|  |  |  |  |  |  | (-1.01) |
| EUETS *t-2* |  |  |  | -0.585\*\*\* | -0.604\*\*\* | -0.577\*\*\* |
|  |  |  |  | (-7.66) | (-7.83) | (-7.45) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Year/Sector/Country FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 7212 | 7212 | 7212 | 6779 | 6779 | 6779 |
| R-squared | 0.771 | 0.767 | 0.771 | 0.773 | 0.769 | 0.773 |

\*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively

*Table 10. Additional analysis: carbon performance, climate change initiatives, board sustainability committees, and market value in different periods*

This table presents the regression results for the effects of carbon performance, sustainability committees, and climate change initiatives on market value and for the effects of climate change initiatives and sustainability committees on carbon performance for three different periods: PARIS (2019-2016), KYOTO, (2015-2005), and PRE (2004-2002). All variables are defined and measured in Table 3. *t*-statistics estimated using robust standard errors are reported in parentheses.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **PARIS (2019-2016)** |  | **KYOTO (2015-2005)** |  | **PRE (2004-2002)** |
| *Panel A: Impacts of CCPE and BSCOM on MV* |  |  |  |  |
|  | (1) | (2) | (3) |  | (4) | (5) | (6) |  | (7) | (8) | (9) |
|  | MV | MV | MV |  | MV | MV | MV |  | MV | MV | MV |
| CCPE | -0.091\*\*\* |  | -0.091\*\*\* |  | -0.054\*\*\* |  | -0.056\*\*\* |  | -0.030 |  | 0.049 |
|  | (-6.39) |  | (-6.37) |  | (-6.79) |  | (-7.04) |  | (-0.62) |  | (0.76) |
| BSCOM |  | 0.055 | 0.074 |  |  | 0.082\*\*\* | 0.118\*\*\* |  |  | -0.095 | -0.105 |
|  |  | (0.82) | (1.41) |  |  | (2.75) | (3.99) |  |  | (-1.42) | (-0.83) |
| CCPE\*BSCOM |  |  | -0.012 |  |  |  | 0.011 |  |  |  | 0.134\*\* |
|  |  |  | (-0.44) |  |  |  | (0.82) |  |  |  | (2.40) |
| Controls | Yes | Yes | Yes |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Year/Sector/Country FE | Yes | Yes | Yes |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Observations | 2351 | 2351 | 2351 |  | 5211 | 5520 | 5211 |  | 216 | 537 | 216 |
| R-squared | 0.527 | 0.519 | 0.527 |  | 0.539 | 0.533 | 0.540 |  | 0.599 | 0.573 | 0.615 |
| *Panel B: Impacts of PCCIs and BSCOM on MV* |
|  | (1) | (2) | (3) |  | (4) | (5) | (6) |  | (7) | (8) | (9) |
|  | MV | MV | MV |  | MV | MV | MV |  | MV | MV | MV |
| PCCIs | 0.002\*\*\* |  | 0.002\*\* |  | 0.002\*\*\* |  | 0.002\*\*\* |  | -0.007\*\* |  | -0.001 |
|  | (2.76) |  | (2.49) |  | (3.96) |  | (3.49) |  | (-2.39) |  | (-0.31) |
| BSCOM |  | 0.055 | 0.037 |  |  | 0.082\*\*\* | 0.075\*\* |  |  | -0.095 | 0.401\* |
|  |  | (0.82) | (0.54) |  |  | (2.75) | (2.42) |  |  | (-1.42) | (1.87) |
| PCCIs\*BSCOM |  |  | 0.001 |  |  |  | 0.000 |  |  |  | 0.013\*\* |
|  |  |  | (0.50) |  |  |  | (0.38) |  |  |  | (2.31) |
| Controls | Yes | Yes | Yes |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Year/Sector/Country FE | Yes | Yes | Yes |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Observations | 2351 | 2351 | 2351 |  | 5520 | 5520 | 5520 |  | 537 | 537 | 537 |
| R-squared | 0.521 | 0.519 | 0.520 |  | 0.533 | 0.533 | 0.533 |  | 0.575 | 0.573 | 0.578 |
| *Panel C: Impacts of PCCIs and BSCOM on CCPE* |  |  |  |  |  |  |  |  |
|  | (1) | (2) | (3) |  | (4) | (5) | (6) |  | (7) | (8) | (9) |
|  | CCPE | CCPE | CCPE |  | CCPE | CCPE | CCPE |  | CCPE | CCPE | CCPE |
| PCCIs *t-2* | 0.007\*\*\* |  | 0.007\*\*\* |  | 0.007\*\*\* |  | 0.007\*\*\* |  | 0.024\* |  | 0.024\* |
|  | (7.16) |  | (5.94) |  | (7.89) |  | (7.61) |  | (1.73) |  | (1.86) |
| BSCOM *t-2* |  | 0.244\*\*\* | 0.180\*\* |  |  | 0.101\*\* | 0.040 |  |  | 0.152 | 0.191 |
|  |  | (2.67) | (2.04) |  |  | (2.04) | (0.65) |  |  | (0.37) | (0.32) |
| PCCIs *t-2*\*BSCOM *t-2* |  |  | 0.002 |  |  |  | -0.000 |  |  |  | -0.001 |
|  |  |  | (0.63) |  |  |  | (-0.23) |  |  |  | (-0.06) |
| Controls | Yes | Yes | Yes |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Year/Sector/Country FE | Yes | Yes | Yes |  | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Observations | 2345 | 2345 | 2345 |  | 4380 | 4380 | 4380 |  | 54 | 54 | 54.000 |
| R-squared | 0.761 | 0.757 | 0.761 |  | 0.781 | 0.778 | 0.781 |  | 0.845 | 0.830 | 0.832 |
| \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively |

*Table 11. Two-stage least squares*

This table reports the results of two-stage least squares (2SLS) estimates for the effects of climate change initiatives and carbon performance on market value and for the effects of climate change initiatives on carbon performance. All variables are defined and measured in Table 3. *t(z)*-statistics are reported in parentheses.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | First stage | Second stage |  | First stage | Second stage |  | First stage | Second stage |
|  | (1) | (2) |  | (3) | (4) |  | (5) | (3) |
|  | CCPE | MV |  | PCCIs | MV |  | PCCIs | CCPE |
| Lagged CCPE | 0.952\*\*\* |  |  |  |  |  |  |  |
|  | (33.46) |  |  |  |  |  |  |  |
| CCPE\_Industry | 0.071\*\* |  |  |  |  |  |  |  |
|  | (2.24) |  |  |  |  |  |  |  |
| CCPE |  | -0.075\*\*\* |  |  |  |  |  |  |
|  |  | (-9.36) |  |  |  |  |  |  |
| Lagged PCCIs |  |  |  | 0.876\*\*\* |  |  | 0.875\*\*\* |  |
|  |  |  |  | (54.49) |  |  | (51.24) |  |
| PCCIs\_Industry |  |  |  | 0.315\*\*\* |  |  | 0.311\*\*\* |  |
|  |  |  |  | (5.03) |  |  | (4.80) |  |
| PCCIs |  |  |  |  | 0.002\*\*\* |  |  | 0.009\*\*\* |
|  |  |  |  |  | (3.17) |  |  | (12.00) |
| BSCOM | 0.001 | 0.079\*\*\* |  | 2.414\*\*\* | 0.034 |  | 2.376\*\*\* | 0.134\*\*\* |
|  | (0.08) | (2.71) |  | (6.69) | (1.26) |  | (6.19) | (3.12) |
| BSIZE | -0.001 | 0.042 |  | 0.831\* | 0.033 |  | 0.782 | -0.030 |
|  | (-0.09) | (1.15) |  | (1.75) | (0.93) |  | (1.59) | (-0.55) |
| INDIR | 0.000 | -0.000 |  | 0.006 | -0.001\*\* |  | 0.007 | 0.003\*\*\* |
|  | (0.55) | (-0.82) |  | (1.41) | (-2.39) |  | (1.48) | (5.51) |
| BGEN | -0.001\*\* | 0.003\*\*\* |  | 0.017 | 0.004\*\*\* |  | 0.016 | 0.002 |
|  | (-2.35) | (3.31) |  | (1.35) | (3.71) |  | (1.21) | (1.56) |
| SIZE | 0.043\*\*\* | -0.042\*\*\* |  | 1.261\*\*\* | -0.132\*\*\* |  | 1.313\*\*\* | 0.856\*\*\* |
|  | (9.51) | (-3.71) |  | (10.48) | (-14.16) |  | (10.54) | (59.93) |
| PROF | 0.001 | 0.060\*\*\* |  | 0.023 | 0.062\*\*\* |  | 0.019 | -0.008\*\*\* |
|  | (0.81) | (44.78) |  | (1.36) | (47.12) |  | (1.06) | (-4.00) |
| DEBT | 0.000 | 0.001 |  | -0.022\*\* | 0.001 |  | -0.025\*\*\* | 0.007\*\*\* |
|  | (0.40) | (1.16) |  | (-2.53) | (1.33) |  | (-2.62) | (6.48) |
| CASH | -0.161\*\*\* | 0.882\*\*\* |  | -0.329 | 0.977\*\*\* |  | -0.557 | -0.646\*\*\* |
|  | (-2.99) | (6.71) |  | (-0.19) | (7.58) |  | (-0.31) | (-3.27) |
| CAPIN | 0.102\*\*\* | 0.012 |  | -0.265 | -0.170\*\*\* |  | -0.279 | 2.181\*\*\* |
|  | (4.90) | (0.23) |  | (-0.43) | (-3.63) |  | (-0.43) | (30.26) |
| WGI | 0.001 | -0.002 |  | 0.135\* | -0.003 |  | 0.165\*\* | 0.012 |
|  | (0.06) | (-0.40) |  | (1.81) | (-0.57) |  | (2.10) | (1.37) |
| GDP | 0.006\*\* | 0.023\*\*\* |  | 0.016 | 0.028\*\*\* |  | 0.054 | 0.006 |
|  | (2.46) | (3.52) |  | (0.18) | (4.31) |  | (0.62) | (0.65) |
| INF | 0.003 | 0.021\*\* |  | 0.020 | 0.025\*\* |  | 0.079 | 0.039\*\*\* |
|  | (0.62) | (2.13) |  | (0.16) | (2.50) |  | (0.59) | (2.63) |
| Year effects | Yes | Yes |  | Yes | Yes |  | Yes | Yes |
| Sector effects | Yes | Yes |  | Yes | Yes |  | Yes | Yes |
| Country effects | Yes | Yes |  | Yes | Yes |  | Yes | Yes |
| Observations | 7007 | 7007 |  | 7590 | 7590 |  | 7212 | 7212 |
| Cragg-Donald Wald F statistic | 3088.08\*\*\* |  |  | 3108.39\*\*\* |  |  | 2548.95\*\*\* |  |
| Anderson-Rubin Wald Chi-sq. | 14.46\*\*\* |  |  | 10.75\*\*\* |  |  | 15.02\*\*\* |  |
| Sargan (*p*-value) | 0.154 |  |  | 0.393 |  |  | 0.573 |  |

\*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively

*Table 12. GMM and Heckman selection model*

This table reports the results of generalized method of moments (GMM) regressions and Heckman selection for the effects of climate change initiatives and carbon performance on market value and for the effects of climate change initiatives on carbon performance. All variables are defined and measured in Table 3. *t*-statistics for GMM and *z*-statistics for Heckman are reported in parentheses.

|  |  |  |  |
| --- | --- | --- | --- |
|  | GMM |  | Heckman |
|  | (1) | (2) | (3) |  | (4) | (5) | (6) |
|  | MV | MV | CCPE |  | MV | MV | CCPE |
| L.MV | 0.512\*\*\* | 0.509\*\*\* |  |  |  |  |  |
|  | (10.05) | (12.09) |  |  |  |  |  |
| L.CCPE |  |  | 0.587\*\*\* |  |  |  |  |
|  |  |  | (17.46) |  |  |  |  |
| CCPE | -0.112\*\* |  |  |  | -0.050\*\*\* |  |  |
|  | (-2.34) |  |  |  | (-4.63) |  |  |
| PCCIs |  | 0.005\*\*\* | 0.002\*\* |  |  | 0.004\*\*\* | 0.026\*\*\* |
|  |  | (4.45) | (2.22) |  |  | (2.93) | (6.67) |
|  |  |  |  |  |  |  |  |
| BSCOM | 0.111\*\* | 0.052 | 0.031 |  | 0.117\*\*\* | 0.339\*\*\* | 0.940\*\*\* |
|  | (2.10) | (1.07) | (0.66) |  | (4.04) | (3.71) | (2.91) |
|  |  |  |  |  |  |  |  |
| Controls | Yes | Yes | Yes |  | Yes | Yes | Yes |
|  |  |  |  |  |  |  |  |
| Mills ratio |  |  |  |  | 0.063\* | 0.523\*\*\* | 2.177\*\*\* |
|  |  |  |  |  | (1.84) | (3.40) | (4.03) |
| Year effects | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Sector effects | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Country effects | Yes | Yes | Yes |  | Yes | Yes | Yes |
| Observations | 7212 | 7590 | 7007 |  | 7778 | 8408 | 8407 |
| Arellano‐Bond (AR‐1) | 0.000 | 0.000 | 0.000 |  |  |  |  |
| Arellano‐Bond (AR‐2) | 0.202 | 0.731 | 0.816 |  |  |  |  |
| Hansen test *(p-value)* | 0.100 | 0.129 | 0.315 |  |  |  |  |
| Wald chi2 |  |  |  |  | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |

\*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5%, and 10% levels, respectively

1. The agreement also requires developed countries to support financially with a joint investment of 100 billion US dollars annually for combating global warming and climate change and promoting sustainability in developing economies (United Nations, 2015). [↑](#footnote-ref-1)
2. This approach is consistent with prior research (Baboukardos *et al*., 2021) to capture changes in carbon performance, climate change initiatives, and market value over time. [↑](#footnote-ref-2)
3. The sample is distributed evenly over the 18-year period, with around 450 observations each year. [↑](#footnote-ref-3)
4. The effects of PCCIs on CCPE might be observed gradually over time (Haque and Ntim 2020). Hence, in addition to year *t*, we use the first and second lag values of PCCIs and other variables to ascertain whether PCCIs lead to emissions reduction in later years. [↑](#footnote-ref-4)
5. As climate change represents a global environmental threat, corporate impacts on the environment and ecosystems should be assessed at the planet level rather than at the national level (Atkins and Maroun 2018; Dumay *et al*., 2010). Therefore, we assess PCCIs based on a wide range of climate change activities/practices designed to address environmental and ecological issues that are common in any part of the world. [↑](#footnote-ref-5)
6. The obtained alpha coefficient of 0.889, which is sufficiently higher than the cut-off level of 0.700, suggests that the instrument is reliable and suggests that the dimensions of the PCCIs have high internal consistency. [↑](#footnote-ref-6)
7. ASSET4 ESG measures climate change initiatives/activities/ practices against all companies operating in the same sector. Hence, following the measurement approach used in prior research (Gupta *et al.,* 2020; Zaman *et al.,* 2021), we develop the PCCIs index for each firm by comparing its activities to those of other firms from the same sector. [↑](#footnote-ref-7)
8. Scope 1 includes direct GHG emissions in tonnes resulting from corporate activities, whereas Scope 2 represents indirect GHG emissions arising from the consumption of purchased energy resources, such as electricity, cooling, heat and steam. Scope 3, which includes other indirect emissions, is not included in the analysis due to missing data for the majority of firms and years. Higher CCPE values indicate greater levels of GHG emissions (i.e., weaker carbon performance). [↑](#footnote-ref-8)
9. Tobin’s q calculation includes market value of shares/stocks. In additional analysis, we have also checked the robustness of our findings by using other stock-based valuations measures, such as price-to-book and market-to-book ratios, which for brevity not reported here, but will be available upon request. [↑](#footnote-ref-9)
10. We also estimate the variation inflation factor (VIF) for each explanatory variable. As suggested by Chatterjee *et al*. (2000), a VIF value, exceeding a threshold value of 10, indicates the presence of multicollinearity. The results (not reported) reveal that the highest VIF is 2.33 and the mean VIF is 1.39, thus indicating that multicollinearity does not appear to be an issue in our study. [↑](#footnote-ref-10)
11. Consistent with prior studies (Martínez-García *et al.*, 2022; Ye *et al*., 2019), we utilize the first lag and sector average values of the main independent variables as instruments. Following these studies, we rely on these instruments, as they are unlikely to be correlated with the error term and may not directly affect the dependent variables. The Cragg-Donald Wald F, Anderson-Rubin Wald Chi-sq., and Sargan statistics, reported in Table 11, suggest that the selected instruments are suitable. [↑](#footnote-ref-11)
12. The first and second lags of explanatory variables are used as instruments, whereas year dummies and country-specific variables are classified as exogenous variables consistent with Wintoki *et al*. (2012). [↑](#footnote-ref-12)