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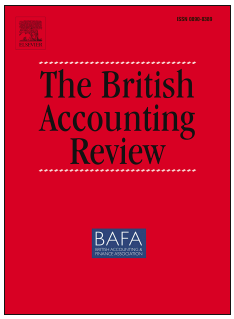

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Abstract

This study examines the effects of board characteristics and sustainable compensation policy on carbon reduction initiatives and greenhouse gas (GHG) emissions of a firm. We use firm fixed effect model to analyse data from 256 non-financial UK firms covering a period of 13 years (2002-2014). Our estimation results suggest that board independence and board gender diversity have positive associations with carbon reduction initiatives. In addition, environment-social-governance based compensation policy is found to be positively associated with carbon reduction initiatives. However, we do not find any relationship between corporate governance variables and GHG emissions of a firm. Overall, our evidence suggests that corporate boards and executive management tend to focus on a firm's process-oriented carbon performance, without improving actual carbon performance in the form of reduced GHG emissions. The findings have important implications for practitioners and policymakers with respect to the effectiveness of internal corporate governance mechanisms in addressing climate change risks, and possible linkage between corporate governance reform and carbon related policies.

Key words: Carbon reduction initiatives, GHG emissions, board independence, gender diversity, ESG-based compensation.

1. Introduction

There have been increasing concerns from the environmentalists, civil societies, policymakers, regulators, markets and shareholders about the consequence of greenhouse gas (GHG) emissions and climate change risks on the environment and on firm performance. The Kyoto Protocol is considered as the main driving force that influenced various stakeholder groups to put pressure on firms to disclose GHG emissions and to undertake emission reduction initiatives (Freedman and Jaggi, 2005). Luo, Lan, and Tang (2012) observe that the driving force for climate change initiatives comes from social, economic, regulatory pressures. Firms are gradually responding to these concerns by reducing GHG emissions and adopting various strategies relating to the consumption and use of water, energy and biodiversity (Gallego-Alvarez , Segura, and Martínez-Ferrero, 2015). Specific actions include complying with regulatory requirements, buying carbon credits (to offset own emissions), requiring supply chain partners to reduce their emissions, and applying technological solutions to reduce carbon footprint and other pollutions (Galbreath, 2010). Vesty, Telgenkamp, and Roscoe (2015) observe that the carbon emissions numbers become central to an organisation's accounts, which include the decision-making process and asset valuation for long-term investment projects. They also observe that carbon accounting has emerged as a part of a broader effort to make global sustainability issues visible and accountable.

Corporate governance (CG) mechanisms play critical roles in addressing a firm's environmental and climate-related risks, and monitoring a firm's engagement in carbon initiatives (see Peters and Romi, 2014). Matsumura, Prakash, and Vera-Mu˜noz (2014) observe that shareholders are exerting increasing pressure on managers to evaluate the risks and opportunities of a firm in relation to climate change, and to report the financial consequences of climate-related decisions of executive management. Available literature (for example, Liao, Luo, and Tang, 2015; Singh, Vinnicombe, and Johnson, 2001; Ibrahim and Angelidis, 1994) suggests that the implementation of climate-related programmes is more complex due to greater conflict of interests among various stakeholders, and that a diverse, independent and representative board is more likely to resolve these conflicts by making a balance between a firm's financial and non-financial goals. It is also observed that female directors show greater orientation towards corporate social and environmental responsibilities, and that independent directors offer effective monitoring of

management actions on environmental matters. However, Prado-Lorenzo and Garcia-Sanchez (2010) find that corporate boards generally remain inactive in monitoring the disclosure of a firm's environmental and carbon-related activisms.

Therefore, available literature shows inconclusive evidence of the effectiveness of the board in addressing environmental concerns. Moreover, these studies examine the impact of board characteristics on carbon disclosures, rather than carbon performance such as carbon protection initiatives and GHG emissions. Whilst carbon disclosure is a part of overall carbon mitigation activities, the latter require substantial amount of financial, personnel and technological resources, and long-term strategic commitments of the shareholders, boards and executive management (Luo, Lan, and Tang, 2013). Liao et al., (2015) argue that these decisions and potential outcomes have a far-reaching impact on a firm's future development. Among others, Matsumura et al., (2014) and Kim, An, and Kim (2015) examine the impact of carbon emissions on firm performance, whereas Luo and Tang (2014) examine the relationship between carbon performance and carbon disclosures. However, these studies do not consider the effects of corporate governance characteristics on carbon performance.

A notable exception is de Villiers, Naiker, and van Staden (2011), who examine the effects of board characteristics on environmental performance of US firms, and find evidence in support of monitoring and resource provisioning roles of the board. In a similar study, Mallin and Michelon (2011) examine the relationship between board characteristics and corporate social performance, and support the resource based view (RBV) of the board. A related literature addresses the incentivising role of the board in that the board can design an effective compensation structure to motivate self-serving executives to undertake environmental initiatives. For example, Mahoney and Thorn (2006) and Campbell, Johnston, Sefcik, and Soderstrom (2007) argue that executive compensation is likely to promote good social and environmental performance, which can enhance social and environmental legitimacy as well as organisational survival capabilities. Since carbon abatement projects require substantial long-term financial commitment without immediate financial gain (Liao et al., 2015), they are less likely to be materialised without active engagements of powerful executive management. Therefore, as Berrone and Gomez-Mejia (2009) suggest, firms can persuade powerful managers to undertake environmental initiatives

and extract the benefits of good environmental performance. Accordingly, Mahoney and Thorn (2006) find a positive relationship between executive compensation and corporate social performance of Canadian firms[1]. Using data from US firms, Berrone and Gomez-Mejia (2009) also show a positive relationship between executive compensation and environmental performance, even though Cordeiro and Sarkis, (2008) find mixed evidence.

Recognising the significance of executives' commitment in pursuing sustainable corporate strategies, there is a recent trend in the corporate sector to link executive compensation with sustainability issues. For example, the Newsweek Green Ranking 2015 shows that 53 percent of US firms and 69 percent of global firms link at least part of their executive bonus payout to green performance targets such as energy use and GHG emissions (Heaps, 2015)[2]. The significance of addressing the effect of executive compensation is more relevant in the context of the UK, where regulations were imposed on firms to disclose detailed reports on executive remunerations[3], following the latter's alleged role in the recent financial crisis. Interestingly, no studies to date address the effect of environment-social-governance (ESG)-based compensation on carbon performance of a firm[4].

Moreover, related literature considers social or environmental performance, rather than carbon performance of a firm. Considering the significance of climate-related risks, it is imperative to have a separate empirical framework on the determinants of carbon performance. Liao et al., (2015) and Lash and Wellington (2007) observe that GHG differs from water and air pollutions, hazardous waste and toxic chemical emissions, since GHG emission problem is global and its consequences are long-term and irreversible. Therefore, carbon management requires unique firm-specific capabilities and capital investment, and is guided by separate regulations and reporting requirements (Liao et al., 2015). Moreover, Luo and Tang (2014) argue that carbon

[1] Frye et al., (2006) examine the effect of CEO compensation on CEO turnover in socially responsible (SR) US firms, and find that SR firms are more likely to experience CEO turnover following poor performance.
[2] A Glass Lewis study of 2013 shows 44% of S&P 100 firms linking at least some executive compensation to at least one sustainability criteria, up from 42% in 2012 (Welsh, 2014).
[3] UK regulations require FTSE firms to present a directors' remuneration report covering information on directors' remuneration policy, service contract, characteristics of the pension schemes and share-based payments as well as details of the remuneration received by each director (in terms of salary, bonus, benefit and termination payment) (Melis, Gaia, and Carta, 2015).
[4] Cordeiro and Sarkis (2008) examine the relationship between environmental performance (EP) and CEO compensation in the US firms with explicit contractual linkage with EP, and find inconclusive evidence.

performance is a complex and multi-dimensional concept, and hence it is necessary to consider more than one aspect of carbon performance.

Based on the above discussions, it appears that there are inadequate empirical studies and inconclusive evidence on the effectiveness of corporate governance mechanisms in addressing the climate protection initiatives of a firm. Moreover, related literature (Liao et al., 2015; Luo et al., 2012, 2013) uses cross-sectional data that ignore variations in carbon emissions and its determinants over time. Given that a firm's carbon policy and response are in a constant state of change (see Liao et al., 2015), panel data appears more appropriate in capturing ongoing developments in carbon and climate related initiatives. In addition, scholars tend to have disproportionately relied on KLD Research & Analytics or Carbon Disclosure Project (CDP) databases (see Delmas, Etzion, and Nairn-Birch, 2013; Tauringana and Chithambo, 2015), and therefore, it might be useful to use alternative data sources to address the critical issue of climate change initiatives. Considering these gaps in the literature, this study examines the effects of board characteristics and sustainable compensation policy on carbon reduction initiatives and GHG emissions of a firm. Using ESG-data from the Thomson Reuters ASSET4 database, this empirical study is based on an unbalanced panel dataset on 256 non-financial firms from the FTSEALL share price index covering a period of 13 years (2002-2014). The analysis is carried out using firm fixed-effect model, which is selected based on the Hausman test results.

As one of the largest GHG emitters in the world, the United Kingdom (UK) represents an interesting case for this study. The UK government enacted The Climate Change Act 2008, to enforce a legally binding target of reducing GHG emissions by at least 80% below the 1990 baseline in 2050, with an interim target of at least 34% reduction by the year 2020. The UK has also met the target of the first carbon budget (that ran from 2008 to 2012), with emissions being 36 MtCO2e below the cap of 3,018 MtCO2e (The UK Department of Energy and Climate Change, 2013). Tauringana and Chithambo (2015) find that the GHG reporting guidelines of the Department for Environment, Food and Rural Affairs (DEFRA) issued in 2009 have a significant positive effect on the level of GHG disclosures of FTSE350 firms. According to Okereke (2007), major UK companies consider carbon management programmes to be good for their businesses, since they add long-term value to the stakeholders. Okereke (2007) also finds that a growing

number of FTSE100 companies pursue firm and market based actions to reduce GHG emissions, which include basic technological change, behavioural change, product and process-based innovations, emissions trading and public education. Considering these macro-level ambitious target and firm-level initiatives, it would be interesting to see whether and how firm-level governance indicators influence carbon initiatives and GHG emissions.

This paper makes a number of important contributions to the literature on corporate governance and carbon performance. *First*, we contribute to an emerging area of research on climate-related activism of a firm by combining board characteristics and executive compensation in a single empirical framework to explain both process-oriented (e.g., carbon reduction initiatives or CRI) and actual carbon performance (e.g., GHG emissions) of a firm. We complement existing literature (e.g., Delmas et al., 2013) that highlights the significance of addressing two distinct dimensions of environmental performance such as process and outcome in order to capture greater variations of the data and to provide comprehensive understanding of a firm's environmental commitments. Unlike other studies, we use a longer time horizon (e.g., 13 years) and alternative data source such as ASSET4 dataset (as opposed to KLD or CDP datasets) to extend limited available literature on this critical issue that has largely been US-centric. We also respond to the calls for further research (see, Liao et al., 2015; Tauringana and Chithambo, 2015), and include all categories of non-financial firms, rather than just large firms in polluting industry. *Second*, we add to the existing literature (e.g., de Villiers et al., 2011; Liao et al., 2015; Mallin and Michelon, 2011) to examine if available evidence on the effects of board independence and board gender diversity on carbon disclosures and environmental performance holds for two distinct dimensions of carbon performance of a firm. We find board independence and board gender diversity to have positive associations with CRI of a firm, although these board characteristics are not related to GHG emissions. Our evidence further indicates a positive effect of an increasing trend in female board representation in the FTSE companies, and validates recent government initiatives for FTSE250 companies to achieve a target of 23.1% female board representation by 2015 and 36.3% by 2020[5].

[5] A recent UK government report on Women on Boards shows that as of March 2013, women account for 17.3% of FTSE 100 and 13.2% of FTSE 250 board directors, an increase of roughly 40% from February 2011. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182602/bis-13-p135-women-on-boards-2013.pdf (Accessed: 08.09.2016)

Third, we extend the arguments of existing literature (such as, Luo et al., 2013) that considers financial resources as the main constrain of a firm's carbon performance, and argue that independent board and female board members can bring human and relational capital, and facilitate a firm's carbon reduction initiatives. With this, we support the notion of an integrated theoretical framework of agency theory and resource-dependence theory in relation to monitoring and resource-provisioning roles of the board. *Fourth*, to the best of our knowledge, this study is among the first to examine the effect of sustainability-based compensation policy on carbon performance a firm. Our evidence corroborates the agency theory based arguments in that ESG-based policy tends to incentivise executives to undertake carbon reduction initiatives, which can easily be communicated to the market and other stakeholders, leading to an improved financial performance. However, this mechanism seems ineffective in reducing actual GHG emissions of a firm. *Overall*, our evidence corroborates the arguments of related literature (e.g., Delmas et al., 2013; Cordeiro and Sarkis, 2008) in that corporate boards and executive management focus on a firm's process-oriented carbon performance, without improving actual carbon performance in the form of reduced GHG emissions. Our findings are likely to have important implications for managers and policymakers in relation to the role of internal CG mechanisms in addressing climate-change risks, together with the linkage between CG reform and industry- and firm-specific carbon policies.

The rest of the paper is structured as follows. Section 2 provides a critical review of theoretical and empirical literature, leading to the development of hypotheses. Section 3 outlines empirical specifications and data, and section 4 discusses empirical results. Finally, Section 5 concludes the paper.

2. Theoretical framework and hypotheses development

A growing body of recent literature addresses the significance of firms' environmental responsibilities and environmental performance on long-term survival capabilities of a firm. For example, Berrone and Gomez-Mejia (2009) argue that strong environmental performance

enhances corporate reputation, improves access to resources and reduces operating and litigation costs, leading to an improved financial performance. Moreover, a firm with improved environmental performance can take advantage of new market opportunities and reduced environment-related liabilities (de Villiers et al., 2011). Cong and Freedman (2011) and Kim et al., (2015) argue that effective firm-level carbon initiatives enhance a firm's reputation and mitigate carbon-related risks, which in turn reduce the cost of capital and improve the financial performance of a firm. Comyns and Figge (2015) explain a business case for sustainability practices by saying that 'there is an alignment between the social and environmental interests of stakeholders and increased shareholder value....businesses focused on increasing shareholder value will voluntarily develop and adopt the best sustainability reporting practices....This will result in a win-win situation for all parties' (p. 408).

Available empirical literature also finds a positive effect of environmental performance on firms' financial performance and shareholder value. For example, Al-Tuwaijri, Christensen, and Hughes (2004) and Clarkson, Li, Richardson, and Vasvari (2011) find a positive relationship between environmental performance and financial performance in US firms. Using a large sample of US firms, El Ghoul, Guedhami, Kwok, and Mishra (2011) find that firms' investment in improving social and environmental performance has an inverse effect on firms' cost of equity. Similarly, Kim et al., (2015) find carbon intensity being positively associated with the cost of equity capital in Korean firms. Cai and He (2014) find that environmentally responsible firms experience long-term abnormal return. Gallego-Alvarez et al., (2015) also find that a reduction in emissions has a positive effect on firm performance. In a study of S&P 500 companies, Matsumura et al., (2014) find that markets penalise firms with greater carbon emissions by lowering their valuations, and that a further penalty is imposed on firms with poor carbon disclosures.

Considering these strategic and financial benefits of environmental performance, in general, and carbon performance, in particular, shareholders are likely to influence their firms to pursue climate protection initiatives and green investment. The board of directors, being the representations of the shareholders, is likely to play a critical role in enhancing carbon performance of a firm. As de Villiers et al., (2011) argue, adherence to sound environmental

practices should be an important objective for the board of directors to increase shareholders' wealth and other nonfinancial benefits. For them, the board can play both monitoring and resource provisioning roles to achieve this objective.

Hillman and Dalziel (2003) provided an integrated theoretical framework of agency theory and resource based view (RBV) to explain the relationship between the board of directors and firm performance. For them, agency theory focuses on boards' monitoring role, whereas RBV addresses how boards' human and relational capital lead to the provision of resources (e.g., legitimacy, advice, access to resources, and inter-firm linkages) to a firm. de Villiers et al., (2011) use this theoretical framework to examine the effects of monitoring and resource-provisioning abilities of the board on a firm's environmental performance. They capture a comprehensive set of board characteristics that represent boards' monitoring role (board independence, board shareholding and CEO duality) and resource-provisioning role (i.e., board size, board tenure, and directors with multiple boards). Qiu, Shaukat, and Tharyan (2016) also use these two theories to explain social and environmental disclosures of FTSE350 companies. Mallin and Michelon (2011) use RBV to explain the relationship between boards' reputational attributes and corporate social performance. They refer to four types of resource provisioning roles of corporate boards that can enhance a firm's corporate social performance and organisational legitimacy: advice and counselling, organisational legitimacy, channels of communication between the firm and external institutions, and preferential access to resources and support from important stakeholders. Moreover, Ben-Amar, Chang, and McIlkenny (2015) use RBV to explain the effect of gender diversity on climate related disclosures.

Apart from monitoring and resource-provisioning roles, the board is also responsible for designing a compensation structure that incentivises executive management to work for shareholders' interests with far less monitoring costs (Ji, 2015; Mahoney and Thorn, 2006). Agency theory-based corporate governance model considers remuneration structure as an essential mechanism to mitigate agency problems and to improve firm performance. An explicit linkage between environmental performance and top executive compensation is also consistent with the agency theory (Cordeiro and Sarkis, 2008). As Mahoney and Thorn (2006: 149) argue, the structure of executive compensation can be an effective tool in aligning executives'

incentives with that of the 'common good', which represents a firm's socially responsible actions.

This study follows, among others, de Villiers et al., (2011), Mallin and Michelon (2011), and Berrone and Gomez-Mejia, (2009) in using agency theory and resource dependence theory (or resource based view) to explain how board characteristics and executive compensation are associated with two aspects of carbon performance of a firm: process oriented performance (e.g., carbon reduction initiatives) and actual carbon performance (e.g., GHG emissions).

2.1. Board independence

According to agency theory, independent boards perform effective monitoring role by objectively questioning and evaluating management, which in turn reduces agency costs and improves firm performance (de Villiers et al., 2011). Since independent directors are not involved in the day-to-day operations and have immaterial financial interests in the firm, they are less influenced by or dependent on executive management (Liao et al., 2015). As a result, they are more likely to contain opportunistic behaviour of managers, provide a more objective feedback on firms' operations, and provide a more effective monitoring of management (Liao et al., 2015; Coffey and Wang, 1998). In the context of climate-related activities of a firm, a board's monitoring role appears to be critical to resolving agency problems that might emerge from two possible sources: *long-term nature of carbon-related investments* and *opportunistic CSR engagements of poorly performing executives*.

Firstly, as carbon pollution control or green technology requires substantial long-term capital investment without immediate financial benefits, self-serving executives might be reluctant to undertake such projects (Liao et al., 2015), due to the short-term nature of their contracts (Tauringana and Chithambo, 2015). However, this carbon investment is likely to generate long-term value to shareholders via energy savings, improved environmental image and new market opportunities[6] (de Villiers et al., 2011; Liao et al., 2015; Matsumura et al., 2014). This can cause

[6] See also, Kim et al., (2015), and Cai and He (2014) for further arguments and evidence.

conflict of interests between managers and shareholders. Tauringana and Chithambo (2015) argue that this long-term nature of carbon investment is also an important reason for the divergence of interests between managers and stakeholders. Moreover, as Tauringana and Chithambo (2015) suggest, managers might not be properly rewarded for their efforts to develop green competencies and redesign internal processes that are often unobservable and non-verifiable, causing information asymmetry problems. This can aggravate the conflict of interests between inadequately motivated managers and shareholders.

Secondly, Cespa and Cestone (2007) explain another form of conflict of interests, when inefficient managers commit to socially responsible behaviour to maintain good relations with stakeholders and social activists, and use this relationship as a powerful entrenchment strategy to deprive shareholders. For them, this form of opportunistic corporate social responsibility (CSR) engagements is more prevalent, when stakeholder protection is left at the discretion of managers. This tendency is broadly similar to the impression management (IM) hypothesis explained by Merkl-Davies and Brennan (2007) in that self-serving managers use discretionary narrative disclosures opportunistically to obfuscate negative firm performance and to manipulate the perceptions and decisions of stakeholders (see also, Arena, Bozzolan, and Michelon, 2015). In the context of carbon management, poorly performing CEOs might engage in symbolic carbon initiatives or 'greenwashing' (such as environment-friendly pet projects, donations to environmental NGOs, relationships with environmental activists) to neutralise stakeholder pressures (see also, Cordeiro and Sarkis, 2008), whilst maintaining their job and rent-seeking behaviour. For Cespa and Cestone, when private benefits of control are large and stakeholder activism is effective, both shareholders and stakeholders are better-off under a tighter corporate governance regime with explicit stakeholder protection mechanisms.

In such a scenario, internal corporate governance mechanisms such as independent board members are likely to realise enormous potential value of costly emission-control projects, advocate long-term investment in environmental matters, and resist management pressures to overlook or delay such investments (de Villiers et al., 2011; Liao et al., 2015). Moreover, independent directors are in a better position to monitor managers' actions on carbon initiatives as well as ongoing progress of carbon projects (see also, Kock, Santalo, and Diestre, 2012),

which will eventually minimise climate-related risks and enhance long-term shareholder value of a firm.

Luo et al., (2013) use RBV to explain the influence of internal constraints on the propensity of carbon disclosures, and argue that financial resources are among the most important and prevalent constraints of carbon mitigation and disclosures. Qiu et al., (2016) also argue that firms with greater economic resources are likely to have more extensive engagements in corporate social activities. Apart from financial resources, human and relational capital is critical to a firm's carbon-related initiatives such as carbon management system, carbon innovations, adaptation to clean energy technologies, compliance with environmental legislation, etc. As Berrone and Gomez-Mejia, (2009) argue, carbon abatement projects require people-intensive structures and cross-functional coordination to design and implement green technologies and other emission reduction initiatives. For Gallego-Alvarez et al., (2015), firms need to be proactive in pursuing climate-related strategies, which will allow higher order learning and collaborative problem solving with stakeholders, and rethinking business models about products, technologies and processes.

Mallin and Michelon (2011) observe that independent directors provide a firm with human and relational capital in terms of unique skills, competencies, professional expertise and external links, which will attract critical resources, resolve environmental uncertainties, and manage external dependencies, leading to an improved corporate social performance. O'Neill, Saunders, and McCarthy (1989) argue that independent directors can use their expertise to create environmental opportunities. A related literature (for example, Liao et al., 2015; Johnson and Greening, 1999; Michelon and Parbonetti, 2012) suggests that independent directors, with diverse background and skills and strong stakeholder orientation, can enhance a board's ability to make a balance between financial and environmental accountability, as well as short-term and long-term objectives of a firm, and thus accommodate conflicting interests of managers, shareholders and various other stakeholders. Moreover, as the independent directors are sensitive to stakeholder demands, they have the incentives to pursue innovative environmental projects so as to improve firms' standing among their constituents and to enhance their own reputations to continue directorships (see, de Villiers et al., 2011).

Empirically, Mallin and Michelon (2011) and de Villiers et al., (2011) find a positive relationship between board independence and social and environmental performance in US firms. Liao et al., (2015) and Chau and Gray (2010) also find board independence having a positive association with social and environmental disclosures. Considering these theoretical arguments and empirical evidence, we argue that a board with a higher representation of independent directors is likely to realise the significance of climate-related challenges and opportunities, convince management to pursue long-term carbon projects, provide critical advice and support to implement these projects, and monitor ongoing progress and overall carbon performance of a firm. This discussion leads to the development of the following hypothesis:

> Hypothesis 1: *Ceteris paribus*, board independence is positively associated with carbon performance of a firm.

2.2. Board gender diversity

Gender diversity is considered to be one of the widely debated issues of the board of directors, especially in relation to social and environmental matters, with a number of related theories explaining the role of female board members from a variety of perspectives. Female board members are more committed, involved and diligent, and less self-oriented in the decision making process, leading to greater effectiveness of the board (Coffey and Wang, 1998; Huse and Solberg, 2006). Female directors can bring different sociological perceptions and understandings to broaden the scope of the board decision-making process (Swartz and Firer, 2005). These arguments are broadly in line with Hillman and Dalziel's (2003) explanation of RBV of the board. In particular, available literature highlights several aspects of human and relational capital that female board members can bring to promote carbon-related strategies and to enhance carbon performance of a firm.

Firstly, women are ascribed to *communal characteristics*, which make them more sensitive towards relationship building and multiple stakeholders' interests that are likely to be aligned with the promotion of socially responsible and environmentally sustainable initiatives (Mallin

and Michelon, 2011; Glass, Cook, and Ingersoll, 2015). Liao et al., (2015) and Braun (2010) argue that female directors and managers express greater concerns for the environment than their male counterparts, and that they are more likely to engage in pro-environmental activities, enabling them to make positive contribution to the society, environment and sustainable development. Khlif, Hussainey, and Achek (2015) argue that firms operating in cultural settings characterised by high femininity (low masculinity) tend to have greater engagement in social and environmental responsibilities, so as to meet stakeholders' expectations. *Secondly*, for Bear, Rahman, and Post (2010), female board members promote *participative decision-making and open discussion* to address CSR challenges, and facilitate board's monitoring of CSR activities. Nielsen and Huse (2010) argue that female directorship increases board effectiveness through reducing the level of conflict and ensuring high quality board development activities. As they mention, "women may be particularly sensitive to – and may exercise influence on – decisions pertaining to certain organisational practices, such as corporate social responsibility and environmental politics" (p.138).

Thirdly, firms with greater gender diversity of the board tend to promote *innovation in corporate social strategy*, with a focus on *longer-term outlook* and an acknowledgement of non-financial performance outcomes such as environmental performance (Glass et al., 2015; Mallin and Michelon, 2011). Female board members are likely to be assigned to and accept roles on firms' strategies and actions on environmental matters (Liao et al., 2015), and provide firms with high quality assistance to enhance capacity building, expertise, innovations to maintain sustainability (Braun, 2010). For, Siboni, Sangiorgi, Farneti, and de Villiers (2016), gender diversity promotes financial and social opportunities, and enhances organisational legitimacy and success. Taken together, female board members are likely to provide firms with critical advice and resources to get engaged in sustainable corporate initiatives such as carbon strategies and innovations, implementation and integration of carbon initiatives, compliance with sustainability-related regulations, and strengthening of stakeholder relations.

Available empirical studies show positive effects of board gender diversity on firms' social and environmental performance. Landry, Bernardi, and Bosco (2014) find that an increase in the percentage of women board members increases the likelihood of a firm's appearance on the

Fortune 500 lists of the most admired companies, the most ethical companies, the best companies to work for, and the best corporate citizens. Liao et al., (2015) and Ben-Amar et al., (2015) find that female board members enhance GHG disclosures. Willows and Van der Linde (2016) also find similar relationship between female directors and financial performance in South African firms. Glass et al., (2015) find that gender diversity advances innovative environmental policies and practices, leading to a superior environmental performance of a firm. Other related studies (such as, Bear et al., 2010; Mallin and Michelon, 2011; Arena et al., 2015; Rao and Tilt, 2016) also find board gender diversity having a significant positive effect on corporate social and environmental performance. Considering the arguments of resource-based view and related empirical evidence, the presence of female directors is expected to enhance emission reduction initiatives and reduce GHG emissions. Therefore, we intend to test the following hypothesis:

> Hypothesis 2: *Ceteris paribus*, board gender diversity is positively associated with carbon performance of a firm.

2.3. Multiple directorships

Multiple directorships can be considered as distinctive capabilities that can help a firm to gain competitive advantage, especially in relation to environmental management. According to RBV, multiple directorships help directors to accumulate valuable expertise from their external experiences on strategic and governance issues, including environmental management and performance (de Villiers et al., 2011). The inter-organisational linkages and knowledge-intensive services of the directors can facilitate interactions among firms, and help firms to manage external dependencies and uncertainties in getting access to critical resources such as green technologies (Ortiz-de-Mandojana, Aragón-Correa, Delgado-Ceballos, and Ferrón-Vílchez, 2012; Hillman, Cannella, and Paetzold, 2000). This eventually helps executive management to manage environmental crises and to exploit environmental opportunities related to green product stewardship strategies, pollution prevention and recycling (de Villiers et al., 2011).

However, 'busyness hypothesis' suggests that individuals with multiple directorships have limited capacity and time to monitor managers' actions and to provide useful advice on critical

strategic decisions, leaving managers to pursue their own private benefits at the expense of various stakeholders (Ahn, Jiraporn, and Kim, 2010; Jiraporn, Davidson, DaDalt, and Ning, 2009). As Mallin and Michelon (2011) argue, a busy director might be unable to provide adequate attention not only to monitor and evaluate management's behaviour, but also to advice and counsel the firm and attract critical environmental resources. This might be particularly true for carbon initiatives that require ongoing commitments and counselling on knowledge-intensive services such as the integration of environmental management into corporate strategy, implementation of pollution prevention technologies, and compliance with environmental regulation, etc.

The empirical evidence on the effect of multiple directorships appears inconclusive. Kassinis and Vafeas (2002) find that firms with multiple directorships experience fewer prosecutions for environmental violations. Glass et al., (2015) also find that interlinked directors exert a significant influence on environmental policy and practice. Rao and Tilt (2016) find multiple directorships having a positive association with CSR reporting in Australia. However, Jiraporn et al., (2009) find support for 'busyness hypothesis' in that individuals with multiple directorships are more likely to remain absent from board meetings. Ortiz-de-Mandojana et al., (2012) find mixed evidence between director interlocks and the adoption of proactive environmental strategies. Mallin and Michelon (2011) also find mixed evidence on the effect of multiple directorships on corporate social performance.

Considering these contradictory theoretical arguments and empirical evidence, we argue that 'busyness hypothesis' might be more relevant in the context of carbon management and performance. Given that a firm's carbon initiatives require expert advice on carbon management and innovations, capacity building, green competencies and mitigation of carbon-related risks, busy directors are less likely to offer personalised commitments and advice, and to oversee ongoing progress in carbon reduction initiatives. This discussion leads to the development of the following hypothesis:

> Hypothesis 3: *Ceteris paribus,* multiple directorships of board members are negatively associated with carbon performance of a firm.

2.4. Sustainable executive compensation

Agency theory predicts that incentive-based mechanisms align the interests of shareholders and managers, and motivate managers to work hard, which in turn mitigates agency costs, improves firms' cash flow and valuation, and reduces cost of capital (see Tran, 2014; Jensen and Meckling, 1976). Since carbon reduction initiatives involve long-term investment without having any immediate financial gain, corporate executives, with their self-serving attitudes, might be reluctant to pursue such massive investment (Liao et al., 2015). Moreover, as Berrone and Gomez-Mejia (2009) suggest, environmental activisms requires high performing employees with certain expertise and innovative mindsets, who can act promptly to reduce the risks of environmental mishaps and legal sanctions, design and implement pollution reduction strategies, or take part in developing green products and services. For this, it is imperative to recognise the critical role of executives through an executive pay structure that embraces long-term environmental perspectives, which in turn align the interests of shareholders and executives, and enhance long-term corporate social and environmental performance (Ji, 2015). Berrone and Gomez-Mejia (2009) argue that a firm's incentive mechanism should reward existing managers and attract talented workforce to enhance environmental performance, which will bring direct and indirect economic benefits for the firm.

Campbell et al., (2007) argue that the presence of environment-related compensation scheme provides executives with an opportunity to improve a firm's environmental performance. These arguments are supported by a recent trend in the corporate sector in linking part of executive compensations to sustainability issues or green performance targets (Heaps, 2015). Therefore, sustainable compensation policy seems necessary to motivate powerful executives to address environmental concerns such as carbon initiatives and GHG emissions. Moreover, firms can use ESG-based compensation policy to motivate high performing employees with distinctive competencies to develop energy efficient products and implement innovative carbon mitigation projects, leading to an improvement in carbon performance.

Available empirical studies find inconclusive evidence on the relationship between executive compensation and social or environmental performance, even though no studies directly consider sustainable compensation scheme. For example, Berrone and Gomez-Mejia (2009) find a positive association between CEO pay and pollution prevention strategies among the US firms in polluting industry, although CEO pay is not related to 'end-of-pipe' pollution control. Cordeiro and Sarkis (2008) shows a positive relationship between environmental performance and CEO compensation in US firms that links environmental performance with executive contracts, but this relationship does not hold for all environmental performance indicators. Mahoney and Thorn (2006) find that stock options and bonuses encourage executives to engage in socially responsible actions in large Canadian firms. Ji (2015) also finds that long-term pay structure for senior executives has a positive effect on corporate social performance of US firms. Based on agency-theory driven arguments and related empirical evidence, we develop the following hypotheses:

> Hypothesis 4: *Ceteris paribus*, ESG-based compensation policy is positively associated with carbon performance of a firm.

3. Research design

3.1. Data and sample

We use an unbalanced panel dataset covering 2315 observations from 256 non-financial firms based on the FTSE ALL share price index. Table 1 shows the sample selection process. We use firm-level data covering a period of 13 years (2002-2014), which will allow us to fully exploit the variations in carbon performance and corporate governance data. Moreover, as the theory of 'clean surplus' accounting suggests, analysing a longer series of accounting data may help us to alleviate the concern about the unreliability of accounting data (see Cornett, Guo, Khaksari, and Tehranian, 2010). Table 2 shows industry-wise distribution of the sample that comprises all categories of firms, rather than just large firms. Both corporate governance and carbon performance data are collected from the Thomson Reuters ASSET4 database, whereas financial

data are gathered from the Worldscope database. Among others, Qiu et al., (2016) and Trumpp, Endrikat, Zopf, and Guenther (2015) use ASSET4 database, which is regarded as one of the global leading databases on social, environmental and corporate governance information. ASSET4 data are collected from several sources (such as sustainability reports, company annual reports and websites, newspapers, and reports of non-governmental organisations), before going through a systematic and standardised screening process conducted by about 240 research analysts (see Ziegler, Busch, and Hoffmann, 2011 and Trumpp et al., 2015).

Insert Table 1 about here

3.2. Empirical model and variables

In order to examine the effects of board characteristics and sustainable compensation policy, we use both univariate and multivariate analyses. Univariate analysis is done through correlations, whereas firm fixed effect estimation method is employed to conduct multivariate analysis. Berrone and Gomez-Mejia (2009) also use fixed effect model to examine the relationship between environmental performance and CEO pay of US firms. We carry out the Hausman test, which suggests that fixed effect model is appropriate for our unbalanced panel dataset. Hsiao (2007), cited in Gallego-Alvarez et al., (2015), argues that panel data models provide greater efficiency and more accurate inferences through controlling omitted variable (missing or unobservable) problems, and capturing the unobserved heterogeneity among individual units or over time. Fixed effect model appears more appropriate, since it provides more consistent and less biased results (see Gallego-Alvarez et al., 2015). Using carbon performance (CP) as the dependent variable, we develop the following empirical model:

$$CP_{it} = \beta_0 + \beta_1 Ind\_Dir_{it} + \beta_2 Fem\_Dir_{it} + \beta_3 Affiliations_{it} + \beta_4 ESG\_Comp_{it} + \beta_5 Own_{it} + \beta_6 BoD\_size_{it} + \beta_7 Separation_{it} + \beta_8 Exec\_Comp_{it} + \beta_9 Dir\_Comp_{it} + \beta_{10} CSR\_com_{it} + \beta_{11} Size + \beta_{12} Employees_{it} + \beta_{13} ROA_{it} + \beta_{14} Slack_{it} + \beta_{15} Leverage_{it} + \beta_{16} Cap\_intensity_{it} + \beta_{17} Capex_{it} + \beta_{18} New\_tech_{it} + \beta_{19} MTBK_{it} + \beta_{20} Shareholders_{it} + u_{it} \quad (1)$$

In this model, carbon performance (CP) of firm i in the year t is a function board independence (Ind_Dir), board gender diversity (Fem_Dir), multiple directorships (Affiliations), ESG-based compensations (ESG_Comp), corporate-governance and other firm-specific control variables and the error term u. The variables in the regression model are defined as follows:

Insert Table 2 about here

3.2.1. Dependent variables

Trumpp et al., (2015) conceptualise two dimensions of corporate environmental performance such as environmental management performance (EMP) and environmental operational performance (EOP). For them, EMP focuses on strategic level of environmental performance that captures environmental policies, objectives, processes, monitoring and organisational structure, whereas EOP captures actual and quantifiable outcome of EMP. Similarly, Busch and Hoffmann (2011) use two distinct measures of carbon performance: carbon management strategies (e.g., strategies, policies, and processes) as process-based measurement and GHG emissions as outcome-based measurement. They define carbon management strategies as internal efforts and response options on ecological issues, as opposed to actual emission. Delmas et al., (2013, p. 263) argue that process-oriented aspects of environmental performance put in place to do 'good' and to reduce future environmental impacts, whereas outcome-oriented performance is actual negative releases or emissions that are 'bad' for the environment.

A related literature suggests that pollution prevention strategies are more valuable than end-of-pipe solutions, and therefore, agency theory-driven arguments are more inclined to reward managers for pollution prevention than end-of-pipe results (see, Berrone and Gomez-Mejia, 2009). Similarly, Delmas et al., (2013) observe that markets are more likely to respond to available information about process-oriented environmental performance, since this can easily be communicated to the investors and rating agencies. Accordingly, Delmas et al., (2013) find that process-oriented environmental performance, rather than outcome-oriented performance, is positively associated with the financial performance of US firms. However, Busch and

Hoffmann (2011) find actual carbon performance having a positive effect on financial performance.

Considering these contradictory findings, we examine whether and how corporate governance mechanisms influence these two alternative carbon performance (CP) indicators. We measure process-oriented carbon performance through a carbon reduction initiatives (CRI) index. CRI index represents a number of firm-specific activities to deal with climate change and GHG emissions, with higher CRI indicating greater climate-related activism of a firm. CRI captures firm-level policies, processes and disclosures in relation to renewable energy, energy efficiency and emission trading initiatives, evaluation of climate change risks and opportunities, and initiatives to reduce, reuse, recycle, substitute or phase out CO_2 and equivalents, fluorinated gases, ozone-depleting substances, and toxic chemicals and substances. Table 3 describes all variables including the details of emission-related activities that are used to construct CRI index. We also follow, among others, Luo et al., (2013) in using the natural logarithm of total GHG emissions (in tons) to measure outcome-oriented carbon performance, with higher GHG emissions indicating poor carbon performance.

Insert Table 3 about here

3.2.2. Independent variables

We use board independence, board gender diversity and multiple directorships as three board-related test variables in the regression model. We use a number of related studies (for example, Liao et al., 2015; Mallin and Michelon, 2011; de Villiers et al., 2011) to measure these board characteristics. *Firstly*, we use the percentage of independent board members, which is a widely used measure of board independence. In accordance with the monitoring and resource-provisioning roles of the board, board independence is predicted to have a positive association with carbon performance. *Secondly*, we use the percentage of female directors on the board (fem_dir) to measure board gender diversity. In consistent with the resource-provisioning role of the board, board gender diversity is expected to be positively associated with carbon performance measures. *Thirdly*, we use the natural logarithm of average corporate affiliations of

board members (affiliations) as a measure of multiple directorships, which is predicted to have an inverse association with carbon performance.

In measuring the effect of sustainable compensation, we use a dummy variable indicating a firm's adoption of environmental-social-governance (ESG) based compensation policy. Cordeiro and Sarkis (2008) use a dummy variable to measure if the CEO compensation is linked to environmental performance, although they do not directly measure the impact of sustainable compensation policy. In consistent with the agency theory-based arguments, this sustainability oriented compensation proxy is expected to have a positive association with carbon performance measures.

3.2.3. Control variables

In order to control for firm-specific determinants of carbon performance, we follow among others, de Villiers et al., (2011) in using a number of corporate governance indicators as control variables. We include ownership concentration (OWN), size of the board (BoD_size), CEO-Chair separation (separation), senior executives' compensation (Exec_Comp), compensation for non-executive directors (Dir_Comp), and the presence of CSR committee of the board (CSR_com) as control variables. Agency theory suggests that controlling shareholders, with higher cash-flow ownership, have the power and incentive to monitor executive management, which eventually reduces agency costs and improves firm performance (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 2002). Controlling shareholders are likely to promote sustainable environmental policies and practices that can minimise environmental risks and enhance long-term shareholder value. Moreover, as shareholders are concerned about the climate-related risks and responses of a firm, together with subsequent financial consequences (see Matsumura et al., 2014), they are more likely to monitor carbon initiatives of a firm. Therefore, ownership concentration is expected to have a positive effect on carbon performance of a firm.

Available literature (such as Prado-Lorenzo and Garcia-Sanchez, 2010) observes that larger boards tend to be inefficient due to free-rider problems and greater conflicts in the decision making process, implying a poor response to climate protection matters. However, resource

dependence theory suggests that larger boards, with more experienced and knowledgeable directors, can enhance environmental performance by providing expert advice on environmental uncertainties and outcomes, and facilitating access to critical financial and technological resources (see de Villiers et al., 2011). Therefore, board size is expected to have a positive association with carbon performance. The CEO-Chair duality causes agency problem, reduces the effectiveness of monitoring role of the board, and reduces the likelihood of approving long-term capital investment in environmental projects, leading to a decline in environmental performance (de Villiers et al., 2011). From this perspective, CEO-Chair separation is likely to have a positive effect on carbon performance of a firm.

We also follow Berrone and Gomez-Mejia (2009), Ji, (2015), and Campbell et al., (2007) in using senior executives' compensation (Exec_Comp) and non-executive directors' compensation (Dir_Comp) as additional governance-related control variables. The effect of executive compensation on environmental performance appears inconclusive. Whilst Berrone and Gomez-Mejia (2009) argue that powerful executives should be rewarded to design and implement environmental programmes, the short-term economic goals and self-serving phenomena of the executives might constrain climate-related performance of a firm. As Liao et al., (2015) argue, powerful executives might be reluctant to pursue such projects, considering that this investment will pay off only in the long run.

The presence of social and environmental committees of the board is likely to play a monitoring role, especially in relation to a firm's engagement in social and environmental practices. Peters and Romi (2014) argue that environmental committees are more likely to respond to stakeholder pressures and take a more proactive interest in corporate environmental risks and carbon disclosures. Accordingly, Peters and Romi (2014) and Lam and Li (2008) find the presence of environmental committee having a positive effect on carbon disclosures and environmental performance. Therefore, we expect a positive association between CSR committee and carbon performance of a firm.

Insert Figures 1 & 2 about here

We also follow de Villiers et al., (2011) and Luo et al., (2012) in using several firm-specific characteristics as control variables. These include, firm size (the natural logarithm of total assets), employees (the natural logarithm of the number of employees), profitability (return on assets), slack (the ratio of cash and equivalents to total assets), leverage (the ratio of total debt to total assets), capital intensity (the ratio of property, plant and equipment or PPE to total assets), capital expenditure (the ratio of capital expenditure to sales), new technology (the ratio of net PPE to gross PPE), market-to-book (the ratio of market to book value of equity), and shareholders (the natural log of the number of shareholders of the firm).

The effect of firm size on carbon performance seems inconclusive. Large firms are likely to experience increased social pressure to remain proactive on environmental matters, and manage environmental initiatives more effectively (see Liao et al., 2015; de Villiers et al., 2011). Accordingly, de Villiers et al., (2011) find positive association between firm size and environmental performance. However, large firms need to maintain their economic scale in terms of products, sales and employees, and thus cause greater GHG emissions unless these firms adopted advanced technology and achieved energy efficiency, which requires huge capital investment[7]. Likewise, firms with a higher number of employees are likely to cause greater GHG emissions. According to RBV, profitable firms with adequate economic resources are likely to be more proactive towards social and environmental concerns (see Qiu et al., 2014). Similarly, firms with adequate financial slack are more likely to divert resources towards carbon initiatives (see de Villiers et al., 2011).

Insert Table 4 about here

Firms with higher debt finance have greater obligation to pay interest, which in turn reduces free cash flows and financial resources, leading to a decline in climate related activism. In addition, debt holders are likely to influence managers to take a short-term view of a firm's operations and investment, thereby reducing a firm's commitment to climate protection activities. Firms with higher capital intensity, higher capital expenditure and new technologies are expected to employ clean and energy efficient technologies, leading to an improvement in energy efficiency and

[7] We are thankful to one of the reviewers for suggesting this.

carbon performance (see, de Villiers et al., 2011; Luo et al., 2012). Firms with higher market-to-book ratio are assumed to have greater investment opportunity, and hence, are likely to exhibit better environmental performance to gain competitive advantage in the long-term (de Villiers et al., 2011), Finally, firms with a higher number of shareholders are likely to be under intense scrutiny, which in turn forces them to maintain improved environmental standards (de Villiers et al., 2011).

Insert Table 5 about here

4. Empirical results

4.1. Descriptive statistics and univariate analysis

Figures 1 and 2 show year-wise distribution of mean values of carbon reduction initiatives (CRI) and GHG emissions, respectively. Figure 1 shows an increasing trend in carbon initiatives from 2007 onwards. Figure 2 shows a declining trend in carbon emissions from 2002 to 2007, followed by a stable pattern from 2009 to 2013, and a further reduction in 2014. Table 4 shows descriptive statistics of all variables used in the regression model. It is evident that the mean value of CRI is 2.04, although the level of carbon activism is higher (not shown) in certain sectors such as utility, food and beverage, healthcare, mining, and construction materials. The mean value of GHG emission is 12.31, even though the degree of emissions is higher (not shown) in the mining sector, followed by utility, food and beverage, oil and gas, and industrial sectors. Table 4 further shows that the average board size of the sample firms is around 10, with the proportions of independent and female directors being around 54% and 10%, respectively. In addition, around 35% of the sample firms adopt ESG-based compensation policy. Table 5 shows bivariate correlations among carbon performance, corporate governance and other firm-specific variables. It is evident that both carbon performance indicators are positively correlated with board independence, multiple directorships and three executive compensation measures, as expected. In addition, board gender diversity is positively correlated with CRI. However, it is imperative to analyse multivariate regression results, before drawing statistical inference in this regard.

4.2. Multivariate results and discussion

Table 6 shows firm fixed effect regression results of two carbon performance indicators: carbon reduction initiatives (CRI) and GHG emissions. Column 1 shows specification results of CRI against the test variables and other governance-specific control variables. It is shown that board independence, board gender diversity and ESG-based compensation policy have statistically significant positive associations with CRI, whereas board affiliations or multiple directorships are inversely related with CRI. Among the control variables, CSR committee, ownership concentration, total compensation for senior executives show statistically significant positive associations with CRI. Column 2 shows similar specification results with additional firm-specific control variables. It is evident that the explanatory powers of corporate governance variables remain unchanged. In addition, firm size, leverage and capital expenditure show positive associations with CRI, whereas the proxies for new technology and capital intensity show inverse relationships with CRI. Columns 3 and 4 show similar specification results with GHG emissions as the dependent variable. Surprisingly, all corporate governance variables show statistically insignificant results. Among the control variables, firm size and capital intensity show positive associations, whereas capital expenditure shows an inverse association with GHG emissions. Table 6 further shows that the variance inflation factor (VIF) values are within the acceptable limit, suggesting that the estimation results do not suffer from the multicollinearity bias.

Insert Table 6 about here

Overall, our estimation results show mixed evidence, depending on the type of carbon performance measure we use. Whilst our results are mostly in agreement with the hypothesised relationship between corporate governance variables and process-oriented measure of carbon performance, our test variables are largely insignificant in the specification results of actual carbon performance.

Our results confirm Hypotheses 1 and 2 in that board independence and board gender diversity are positively associated with carbon reduction initiatives (CRI) of a firm. The evidence on board independence supports the theoretical arguments on monitoring and resource-provisioning roles of the board. Several empirical studies also show board independence having a positive relationship with environmental performance (de Villiers et al., 2011), corporate social performance (Mallin and Michelon, 2011), and carbon disclosures (Liao et al., 2015). Our evidence on board gender diversity corroborates with a growing body of related literature (e.g., Glass et al., 2015; Bear et al., 2010; Mallin and Michelon, 2011) that shows gender diversity having a greater influence on board decisions to adopt environmentally responsible activities. Liao et al., (2015) also find female directors having a positive association with carbon disclosures of UK firms. This is also consistent with the resource-based view (RBV) in that female board members can bring human and relational capital as well as innovative mind-set and long-term outlook in the decision making process (see Glass et. al., 2015), which in turn helps firms to undertake innovative environmental initiatives and to enhance environmental performance. Our evidence on multiple directorships appears inconclusive as we find an inverse association between multiple directorships and CRI, but this relationship is turned out to be positive in our robustness test (*see later*) that is carried out using two-stage least square regressions.

Our estimation results show ESG-based compensation policy having a positive association with CRI, and thus confirm Hypothesis 4. Overall, our evidence suggests that sustainable compensation policy tends to motivate executive management to design and implement carbon reduction initiatives, which in turn can mitigate climate-related risks and improve long-term financial prospects of a firm. Berrone and Gomez-Mejia (2009) also find a positive association between environmental performance and total CEO pay among the US firms. This evidence is consistent with the broad-based assumption of the agency theory in that incentive-based mechanisms align interests of the powerful executives and shareholders towards sustainable corporate environmental strategies and actions, which in turn improve firms' financial performance and shareholder value in the long term.

Surprisingly, board characteristics and executive compensation variables are found to have statistically insignificant relationships with GHG emissions, indicating that corporate governance mechanisms do not influence actual carbon performance of a firm. Even though there is a growing industry trend in using sustainability oriented incentive policy to encourage corporate executives to get engaged in sustainable corporate actions, this policy does not seem to have the desired outcome in the form of reduced GHG emissions. In other words, firms might adopt ESG-based compensation policy to neutralise growing criticisms of excessive executive compensation, without forcing the powerful executives to achieve actual emission reduction targets. As Cordeiro and Sarkis (2008) suggest, corporate boards link environmental performance with top executives' compensation as a form of symbolic rather than substantive management to maintain their standing with stakeholders' concerns about environmental performance.

One likely reason for this evidence is the design of sustainable compensation policy, in which powerful executive management appears to influence firms to adopt ESG-based policy with a short-term focus, rather than mandating verifiable and long-term targets in environmental matters such as GHG emissions. As the principles for responsible investment (PRI, 2014) observes, 83 percent of the sample firms in the utilities and extractives industry in the developed economies adopt ESG-based compensation schemes, even though only 16 percent firms use long-term performance targets in their sustainable pay policies. In other words, ESG-based compensation policy without explicit climate related targets tends to motivate self-serving managers to show activisms in carbon reduction initiatives to gain environmental legitimacy, without engaging in long-term financial commitments in GHG emission reduction projects.

Overall, our evidence seems to be consistent with the agency theory-driven arguments (see Delmas et al., 2013; Berrone and Gomez-Mejia, 2009) in that firms concentrate more on process-oriented environmental performance, since this can easily be communicated to the investors, rating agencies and other stakeholders. Delmas et al., (2013) observe that firms might exhibit superior process-oriented environmental performance to enhance financial performance, but still emit substantial amount of pollution. Corroborating these arguments, our evidence suggests that good carbon management performance (or process-oriented outcome) does not necessarily

indicate a superior actual carbon performance, and hence, the board and executive management can demonstrate the former to improve financial performance, without improving actual outcome in the form of reduced GHG emissions. In other words, corporate governance mechanisms tend to have positive influence on 'good' aspects of carbon performance so as to reduce a firm's climate-related risks and improve financial performance, instead of reducing the 'negative' dimension of actual GHG emission that is causing the real environmental risk through climate change.

Among the control variables, both ownership concentration and senior executives' compensation show positive associations with CRI, a finding that is consistent with the prediction of agency theory. In addition, a positive relationship between CSR committee and CRI supports monitoring role of the board committees. The positive effect of firm size on both carbon measures suggests that large firms tend to cause greater GHG emissions, and therefore, exhibit good process-oriented performance to accommodate stakeholder pressures. Whilst capital expenditure shows positive association with both process-oriented and actual carbon performance, as expected, capital intensity shows opposite results.

4.3. Robustness tests

We perform a number of robustness tests. *First*, we follow Luo et al., (2012) to examine if the estimation results are sensitive to the winzorisation operation. We re-estimated Eq.(1) after winzorisation at 1% and 99% levels, and find no significant qualitative difference between the estimation results (not reported) and the reported findings. *Second*, we estimate Eq.(1) by replacing CRI with Environmental Protection Initiatives (EPI), which is a broad-based environmental performance measure covering firms' activisms in areas such as biodiversity, water efficiency, environmentally friendly buildings and land usage, and environmental supply chain management. The estimation results (not reported) are similar to the reported results. *Third*, we replace fem_dir with an alternative measure of board gender diversity (a dummy variable indicating the presence of female members on the board), and find similar evidence as reported for gender diversity. *Fourth*, we estimate Eq.(1) by replacing GHG emissions with two alternative measures of carbon intensity such as the ratio of total GHG emissions to total assets

and the ratio of total GHG emissions to net sales (see, Kim et al., 2015). The results (not shown) are similar to the reported evidence presented for GHG emissions.

Finally, we follow, among others, de Villiers et al., (2011) in addressing the concerns of endogeneous relationships between carbon performance and corporate governance mechanisms. Accordingly, we use two-stage least square regressions incorporating instrumental variables (IV). The IV regressions are performed first by regressing each endogeneous variable (e.g., our test variables) on CRI and other known determinants of board and executive compensation in order to obtain suitable instruments. These determinants include, firm size, sales growth, profitability, operating performance, leverage, slack, capital intensity, capital expenditures, market-to-book value of equity, free cash flow, intangible assets, liquidity, and numbers of shareholders and employees. In the second stage, the modified version of Eq.(1) has the right hand side endogenous variable replaced by the fitted value from the first-stage regression. The second-stage regression results (not reported) of the modified version of Eq.(1) indicate no qualitative difference with the reported results for board independence, board gender diversity, senior executives' compensation and ESG-based compensation. However, the coefficient of multiple directorships is turned out to be positive and significant in our robustness tests.

5. Conclusions

This study examined the effects of board independence, board gender diversity and sustainable executive compensation on two aspects of carbon performance of a firm: carbon reduction initiatives (CRI) and intensity of GHG emissions. It was based on both univariate and multivariate analyses using firm-level data from 256 non-financial firms in the UK covering a period of 13 years (2002-2014). We find board independence having a positive association with CRI, and thus support the arguments of monitoring and resource-provisioning roles of the board. Our evidence further suggests a positive relationship between board gender diversity and CRI, a finding that is consistent with the resource-provisioning role of the board. We also find ESG-based compensation policy having a positive association with CRI. This is broadly in line with the agency theory driven arguments that incentive-based mechanisms can persuade executive

management to undertake climate protection initiatives, which in turn enhance process-oriented carbon performance. Surprisingly, we find board characteristics and executive compensation variables having no relationships with GHG emissions, indicating that corporate governance mechanisms do not influence actual carbon performance of a firm. This evidence suggests that corporate boards and executive management tend to focus on a firm's process-oriented carbon performance to improve financial performance, without improving actual carbon performance in the form of reduced GHG emissions.

One potential policy implication of our evidence might be to consider industry- and firm-level emission reduction targets, and to encourage corporate boards and management to achieve those targets. The success of the DEFRA guidance (see, Tauringana and Chithambo, 2015) in improving GHG disclosures in the UK might be a step forward towards issuance of mandatory guidelines on CRI and GHG emissions for firms. Our evidence also validates recent initiatives of the UK government to increase female board representation in the FTSE companies by 2020. The policymakers should also consider issuing mandatory guidelines for firms to design sustainable compensation policy with verifiable and long-term targets in environmental matters such as GHG emissions. This is likely to align executives' incentives with long-term carbon commitments of a firm, leading to an improvement in actual carbon performance and environmental sustainability.

This study has some limitations as well as future research implications: *First*, one of the caveats of this study is that it does not consider ESG-based compensation with explicit long-term environmental targets, as well as long-term stock-based compensations. Future research can address their effects on carbon performance of a firm. *Second*, we did not address the relationship between process-oriented and actual carbon performance, together with their linkages with financial performance of a firm. This can be addressed in future research. *Third*, a potential area for further research is to examine the impact of the climate related legislation (such as the CCA) and related market-based mechanism (such as firms' participation in emission trading scheme) on actual carbon performance of a firm. *Fourth*, future research can extend this empirical framework to conduct a cross-country comparison between market-based economies such as the US and UK, and other major economies in Europe and Australasia.

References

Ahn, S., Jiraporn, P. & Kim, Y.S. (2010). Multiple Directorship and Acquirer Returns. *Journal of Banking and Finance, 34* (9), 2011-2026.

Al-Tuwaijri, S.A., Christensen, T.E., & Hughes, K.E. (2004). The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach. *Accounting Organizations and Society, 29*, 447–471.

Arena, C., Bozzolan, S. & Michelon, G. (2015). Environmental Reporting: Transparency to Stakeholder Manipulation? An Analysis of Disclosure Tone and the Role of the Board of Directors. *Corporate Social Responsibility and Environmental Management, 22*, 346-361.

Bear, S., Rahman, N., & Post, C. (2010). The impact of board diversity and gender composition on corporate social responsibility and firm reputation. *Journal of Business Ethics, 97*(2), 207–221.

Ben-Amar, W., Chang, M., & McIlkenny, P. (2015). Board Gender Diversity and Corporate Response to Sustainability Initiatives: Evidence from the Carbon Disclosure Project. *Journal of Business Ethics*, 1-15, DOI 10.1007/s10551-015-2759-1.

Berrone, P. & Gomez-Mejia, L. (2009). Environmental performance and executive compensation: an integrated agency-institutional perspective. *Academy of Management Journal 52*(1), 103–126.

Braun, P. (2010). Going green: Women entrepreneurs and the environment. *International Journal of Gender and Entrepreneurship, 2(3)*, 245–259.

Busch, T. & Hoffmann, V.H. (2011). How Hot Is Your Bottom Line? Linking Carbon and Financial Performance. *Business & Society, 50*(2), 233–265.

Cai, L. & He, C. (2014). Corporate Environmental Responsibility and Equity Prices. *Journal of Business Ethics*, *125*, 617–635.

Campbell, K., Johnston, D., Sefcik, S.E., & Soderstrom, N.S. (2007). Executive compensation and nonfinancial risk: An empirical examination. *Journal of Accounting and Public Policy, 26*, 436–462.

Cespa, G. & Cestone, G. (2007). Corporate Social Responsibility and Managerial Entrenchment. *Journal of Economics and Management Strategy, 16*, 741-771.

Chau, G., & Gray, S. J. (2010). Family ownership, board independence and voluntary disclosure: evidence from Hong Kong. *Journal of International Accounting, Auditing and Taxation, 19*(2), 93–109.

Clarkson, P.M., Li, Y., Richardson, G.D., & Vasvari, F.P. (2011). Does it really pay to be green? Determinants and consequences of proactive environmental strategies. *Journal of Accounting and Public Policy*, *30*, 122–144.

Coffey, B.S., & Wang, J. (1998). Board diversity and managerial control as predictors of corporate social performance. *Journal of Business Ethics*, *17*(14), 1595–1603.

Comyns, B. & Figge, F. (2015). Greenhouse gas reporting quality in the oil and gas industry. *Accounting, Auditing & Accountability Journal*, *28*(3), 403 – 433.

Cong, Y., & Freedman, M. (2011). Corporate governance and environmental performance and disclosures. *Advances in Accounting, Incorporating Advances in International Accounting*, *27*(2), 223–232.

Cordeiro, J. J. & Sarkis, J. (2008). Does explicit contracting effectively link CEO compensation to environmental performance? *Business Strategy and the Environment*, *17*(5), 304-317.

Cornett, M. M., Guo, L., Khaksari, S. & Tehranian, H. (2010). The impact of state ownership on performance differences in privately-owned versus state-owned banks: An international comparison. *Journal on Financial Intermediation*, *19*, 74-94.

de Villiers, C., Naiker, V., & van Staden, C.J. (2011). The effect of board characteristics on firm environmental performance. *Journal of Management*, *37*(6), 1636–1663.

Delmas, M.A., Etzion, D., & Nairn-Birch, N. (2013). Triangulating environmental performance: What do corporate social responsibility ratings really capture? *Academy of Management Perspectives*, *27*, 255-267.

El Ghoul, S. Guedhami, O., Kwok, C.C.Y. & Mishra, D.R. (2011). Does corporate social responsibility affect the cost of capital? *Journal of Banking & Finance, 35*, 2388–2406.

Freedman, M. & Jaggi, B. (2005). Global warming, commitment to the Kyoto protocol, and accounting disclosures by the largest global public firms from polluting industries. *The International Journal of Accounting*, *40*(3), 215-232.

Frye, M.B., Nelling, E. & Webb, E. (2006). Executive compensation in socially responsible firms. *Corporate Governance: An International Review*, *14*(5), 446-455.

Galbreath, J. (2010). Corporate Governance Practices that Address Climate Change: an Exploratory Study. *Business Strategy and the Environment, 19*, 335–350.

Gallego-Alvarez, I., Segura, L., & Martínez-Ferrero, J. (2015). Carbon emission reduction: the impact on the financial and operational performance of international companies. *Journal of Cleaner Production, 103*, 149-159.

Glass, C., Cook, A. & Ingersoll, A.R. (2015). Do Women Leaders Promote Sustainability? Analyzing the Effect of Corporate Governance Composition on Environmental Performance. *Business Strategy and the Environment, doi:* 10.1002/bse.1879.

Hart, S.L. (1995). A natural resource based view of the firm. *Academy of Management Review, 20*(4), 986-1014.

Heaps, T. A.A. (2015). *Corporations Are Going Green by Linking Executive Pay to Energy and Emissions Targets*. Newsweek, 4th June 2015. URL. http://www.newsweek.com/corporations-are-going-green-linking-executive-pay-energy-and-emissions-338708 Accessed: 15.09.2015.

Hillman, A.J., & Dalziel, T. (2003). Boards of directors and firm performance: integrating agency and resource dependence perspectives. *Academy of Management Review*, *28*(3), 383–396.

Hillman, A.J., Cannella, A.A., & Paetzold, R.L. (2000). The resource dependence role of corporate directors: Strategic adaptation of board composition in response to environmental change. *Journal of Management Studies, 37*, 235–256.

Hsiao, C. (2007). Panel data analysis - advantages and challenges. *Test 16*(1), 1-22.

Huse, M., & Solberg, A.G. (2006). Gender-related boardroom dynamics: how Scandinavian women make and can make contributions on corporate boards. *Women in Management Review*, *21*(2), 113–130.

Ibrahim, N. A., & Angelidis, J.P. (1994). Effect of board members' gender on corporate social responsiveness orientation. *Journal of Applied Business Research*, *10*(1), 35–41.

Jensen, M., & Meckling, W. (1976). Theory of the firm: management behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305-360.

Ji, Yong-Yeon (2015). Top management team pay structure and corporate social performance. *Journal o f General Management 40*, 3-20.

Jiraporn, P., Davidson, W., DaDalt, P., & Ning, Y. (2009). Too busy to show up? An analysis of directors' absences. *Quarterly Review of Economics and Finance, 49*, 1159–1171.

Johnson, R.A., & Greening, D.W. (1999). The effects of corporate governance and institutional ownership types on corporate social performance. *Academy of Management Journal 42*(5), 564–576.

Kassinis, G., & Vafeas, N. (2002). Corporate boards and outside stakeholders as determinants of environmental litigation. *Strategic Management Journal, 23*, 399-415.

Khlif, H., Hussainey, K., & Achek, I. (2015). The effect of national culture on the association between profitability and corporate social and environmental disclosure: a meta-analysis. Meditari Accountancy Research, 23(3), 296-321.

Kim, Yeon-Bok., An, H.T. & Kim, J.D. (2015). The effect of carbon risk on the cost of equity capital. *Journal of Cleaner Production 93*, 279-287

Kock, J., Santalo, J., & Diestre, L. (2012). Corporate governance and the environment: what type of governance creates greener companies? *Journal of Management Studies, 49*, 492-514.

La Porta, L., Lopez-de-Silanes, F., Shleifer, A. & Vishny, R. (2002). Investor protection and corporate valuation. *Journal of Finance 57*, 1147-1170.

Lam, K., & Li, Y. (2008). *Does corporate governance matter? The case of environmental and social responsibility committees on the board*. Working Paper. Toronto, ON: University of Toronto.

Landry, E.E., Bernardi, R.A. & Bosco, S.M. (2014). Recognition for Sustained Corporate Social Responsibility: Female Directors Make a Difference. *Corporate Social Responsibility and Environmental Management, 23*, 27–36.

Lash, J., & Wellington, F. (2007). Competitive advantage on a warming planet. *Harvard Business Review*, *85*(3), 94–102.

Liao, L., Luo, L. & Tang, Q. (2015). Gender diversity, board independence, environmental committee and greenhouse gas disclosure. *The British Accounting Review, 47*(4), 409-425.

Luo, I., & Tang, Q. (2014). Does voluntary carbon disclosure reflect underlying carbon performance? *Journal of Contemporary Accounting & Economics, 10*, 191–205.

Luo, L., Lan, Yi-Chen, & Tang, Q. (2012). Corporate incentives to disclose carbon information: Evidence from CDP Global 500 report. *Journal of International Financial Management and Accounting, 23*(2), 93-120.

Luo, L., Lan, Yi-Chen, & Tang, Q. (2013). Comparison of Propensity for Carbon Disclosure between Developing and Developed Countries: A Resource Constraint Perspective. *Accounting Research Journal, 26*(1), 6-34.

Mahoney, L.S. & Thorn, L. (2006). An examination of the structure of executive compensation and corporate social responsibility: A Canadian investigation. *Journal of Business Ethics, 69*(2), 149-162.

Mallin, C.A. & Michelon, G. (2011). Board reputation attributes and corporate social performance: an empirical investigation of US Best Corporate Citizens. *Accounting and Business Research, 41(2),* 119-144.

Matsumura, E.M., Prakash, R. & Vera-Mu˜noz, S.C. (2014). Firm-Value Effects of Carbon Emissions and Carbon Disclosures. *The Accounting Review, 89*(2), 695-724.

Melis, A., Gaia, S. & Carta, S. (2015). Directors' remuneration: A comparison of Italian and UK non-financial listed firms' disclosure. *The British Accounting Review, 47*, 66-84

Merkl-Davies D.M & Brennan N.M. (2007). Discretionary disclosure strategies in corporate narratives: Incremental information or impression management*? Journal of Accounting Literature, 26,* 116–194.

Michelon, G., & Parbonetti, A. (2012). The effect of corporate governance on sustainability disclosure. *Journal of Management and Governance 16*(3), 477–509.

Nielsen, S. & Huse, M. (2010). The contribution of women on boards of directors: going beyond the surface. *Corporate Governance: An International Review, 18,* 136–148.

O'Neill, H.M., Saunders, C.B., & McCarthy, A.D. (1989). Board members, corporate social responsiveness and profitability: are tradeoffs necessary? *Journal of Business Ethics 8*(5), 353–357.

Okereke, C. (2007). An Exploration of Motivations, Drivers and Barriers to Carbon Management: The UK FTSE 100. *European Management Journal, 25*(6), 475–486.

Ortiz-de-Mandojana, N., Aragón-Correa, J.A., Delgado-Ceballos, J. & Ferrón-Vílchez, V. (2012). The Effect of Director Interlocks on Firms' Adoption of Proactive Environmental Strategies. *Corporate Governance: An International Review, 20*(2): 164–178.

Peters, G.F. & Romi, A.M. (2014). Does the Voluntary Adoption of Corporate Governance Mechanisms Improve Environmental Risk Disclosures? Evidence from Greenhouse Gas Emission Accounting. *Journal of Business Ethics, 125,* 637–666.

Prado-Lorenzo, J.-M., & Garcia-Sanchez, I.-M. (2010). The role of the board of directors in disseminating relevant information on greenhouse gases. *Journal of Business Ethics, 97*(3), 391–424.

PRI (2014). Integrating ESG issues to executive pay: a review of global extractives and utilities companies. The Principles for Responsible Investment, United Nations Environment Programme Finance Initiative (UNEP FI).

Qiu, Y., Shaukat, A. & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. *The British Accounting Review, 48*(1), 102-116.

Rao, K., & Tilt, C. (2016). Board diversity and CSR reporting: an Australian study. *Meditari Accountancy Research, 24*(2), 182-210.

Siboni, B., Sangiorgi, D., Farneti, F., & de Villiers, C. (2016). Gender (in) accounting: insights, gaps and an agenda for future research. *Meditari Accountancy Research, 24*(2), 158-168.

Singh, V., Vinnicombe, S., & Johnson, P. (2001). Women directors on top UK boards. *Corporate Governance: An International Review, 9*(3), 206–216.

Swartz, N. P., & Firer, S. (2005). Board structure and intellectual capital performance in South Africa. *Meditari Accountancy Research, 13*(2), 145-166.

Tauringana, V. & Chithambo, L. (2015). The effect of DEFRA guidance on greenhouse gas disclosure. *The British Accounting Review, 47*(4), 425–444.

The UK Department of Energy and Climate Change (2013). *Annual Statement for Emissions 2013*. URL. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/417680/48439_Un-Act_DECC_Web_Accessible_v0.2.pdf Accessed: 09.09.2015.

Tran, D.H. (2014). Multiple corporate governance attributes and the cost of capital – Evidence from Germany. *The British Accounting Review, 46*, 179–197.

Trumpp C., Endrikat, J., Zopf, C. & Guenther, E. (2015). Definition, Conceptualization, and Measurement of Corporate Environmental Performance: A Critical Examination of a Multidimensional Construct. *Journal of Business Ethics, 126*, 185–204.

Vesty, G.M., Telgenkamp, A., & Roscoe, P.J. (2015). Creating numbers: carbon and capital investment. *Accounting, Auditing & Accountability Journal, 28*(3), 302 – 324.

Welsh, H. (2014). *An insider's view: why more companies should tie bonuses to sustainability.* The Guardian, Monday 11th August 2014. URL. http://www.theguardian.com/sustainable-

business/2014/aug/11/executive-compensation-bonuses-sustainability-goals-energy-water-carbon-dsm?CMP=share_btn_link Accessed: 15.09.2015

Willows, G., & van der Linde, M. (2016). Women representation on boards: a South African perspective. *Meditari Accountancy Research, 24*(2), 211-225.

Ziegler, A., Busch, T., & Hoffmann, V.H. (2011). Disclosed corporate responses to climate change and stock performance: An international empirical analysis. *Energy Economics, 33*(6), 1283–1294.

Figures and Tables

Figure 1: Year-wise distribution of Carbon Reduction Initiatives (CRI) Index

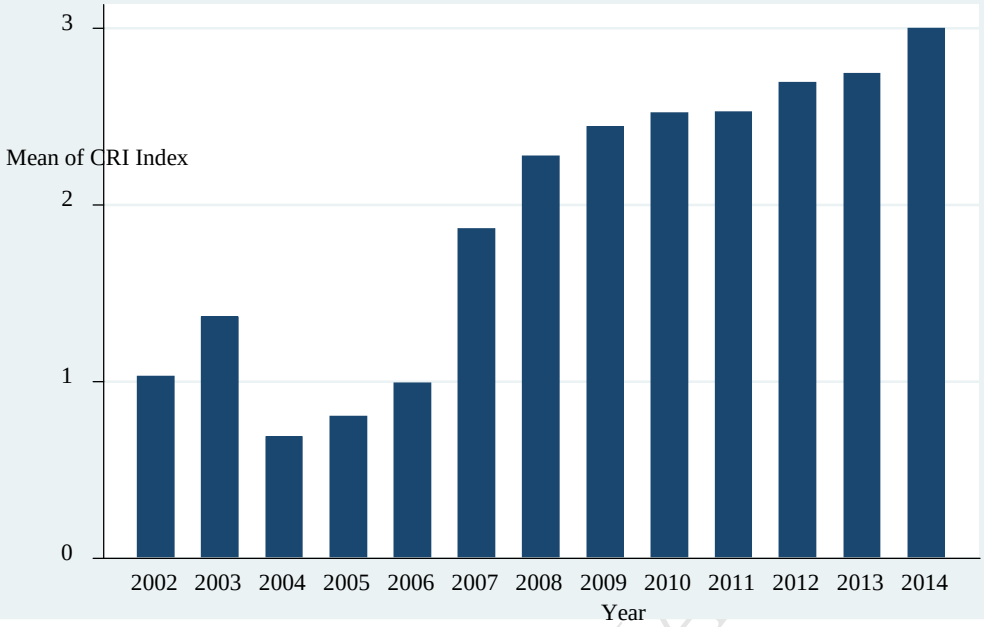

Figure 2: Year-wise didtribution of GHG emissions

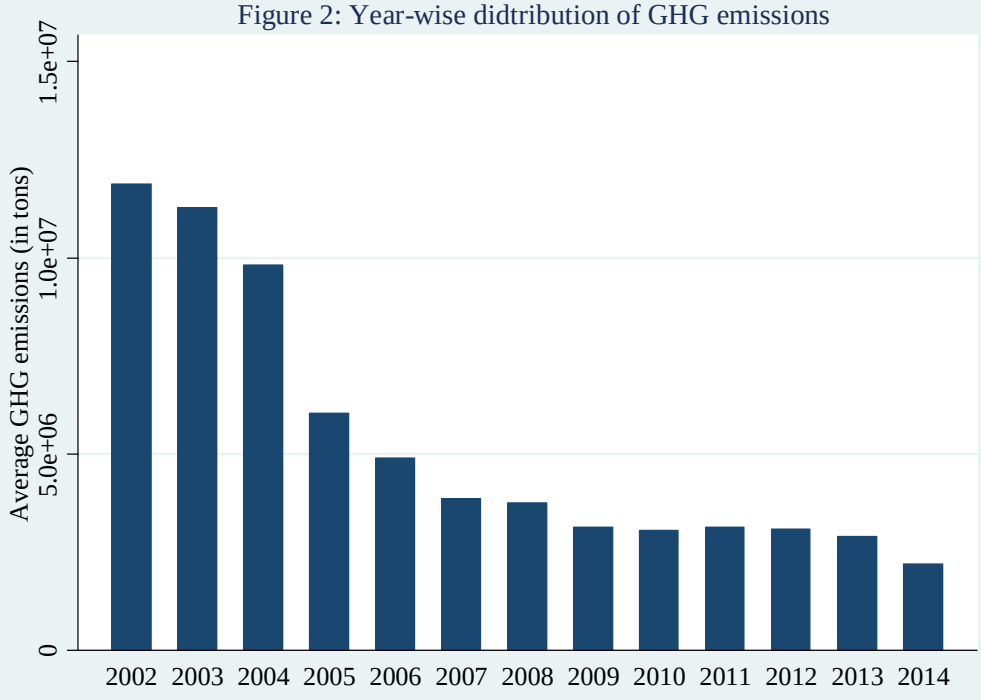

Table 1

Sample selection process

	Observations
Initial sample	4626
Less:	
Obs. with missing firm-level ESG data on ASSET4 database	(1287)
Obs. with missing yearly data	(1024)
Final sample	2315

Table 2

Industry-wise distribution of the sample

Industry	No of firms	No of Observations	Percent	Cum.
Automobile, Aerospace and Defence	9	91	3.93	3.93
Construction materials	18	190	8.21	12.14
Food and beverages	13	107	4.62	16.76
Gas, Water and Utilities	12	115	4.97	21.73
Healthcare	13	112	4.84	26.57
IT and Electronics	21	173	7.47	34.04
Industrials	18	156	6.74	40.78
Mining	23	158	6.83	47.6
Oil and Gas	25	192	8.29	55.9
Retail	27	242	10.45	66.35
Services	77	779	33.65	100
Total	256	2,315	100	

Table 3

Variable definitions

Variables	*Symbols*	*Descriptions*
Carbon reduction initiatives	CRI	This variable is calculated by adding 1 if the answer is yes to the questions 1–8 and 0 otherwise: (1) Does the company engage any emissions trading initiative? (2) Does the company show an initiative to reduce, reuse, recycle, substitute, phased out or compensate CO2 equivalents in the production process? (3) Does the company evaluate the commercial risks and/or opportunities in relation to climate change? (4) Does the company report on initiatives to recycle, reduce, reuse or phase out fluorinated gases such as HFCs (hydrofluorocarbons), PFCs (perfluorocarbons) or SF6 (sulfur hexafluoride)? (5) Does the company report on initiatives to reduce, substitute, or phase out ozone-depleting (CFC-11 equivalents, chlorofluorocarbon) substances? (6) Does the company make use of renewable energy? (7) Does the company have processes in place to improve its energy efficiency? (8) Does the company report on initiatives to reduce, reuse, substitute or phase out toxic chemicals or substances?
GHG emissions	GHG emissions	Natural log of total GHG emissions in tons
Board independence	Ind_Dir	Percentage of independent directors on board
Female directors	Fem_Dir	Percentage of female directors on board
Board diversity	Diversity	A dummy variable that equals 1 if there are female or foreign representation on board and 0 otherwise
Multiple directorships	Affiliation	Natural log of the average corporate affiliations of board members
ESG-based compensation	ESG_Comp	A dummy variable that equals 1 if the firm has a CSR committee, and 0 otherwise
Board size	BoD_size	Natural log of the number of board members
CEO-Chair separation	Separation	A dummy variable that equals 1 if the CEO and chair are two different individuals and 0 otherwise
Executive compensation	Exec_Comp	Natural log of total compensation paid to all senior executives (in USD) as reported by the firm)
Non-executive directors' compensation	Dir_Comp	Natural log of total compensation paid to non-executive directors (in USD) as reported by the firm
CSR committee	CSR_com	A dummy variable that equals 1 if firm has environmental-social-governance (ESG) related compensation policy, and 0 otherwise
Ownership	OWN	Percentage of shares held by all insiders and majority (5%) owners
Firm size	Size	Natural log of market capitalisation of the firm
Profitability	ROA	Return on Assets
Leverage	Leverage	The ratio of total debt to total assets
Shareholders	Shareholders	Natural log of the number of shareholders of the firm

Employees	Employees	Natural log of the number of employee of the firm
Slack	Slack	The ratio of cash and equivalents to total assets
New technology	New_tech	The ratio of net property, plant and equipment (PPE) to gross PPE.
Capital intensity	Cap_ intensity	The ratio of property, plant and equipment to total assets
Capital expenditure	Capex	The ratio of capital expenditure to sales
Market-to-book	MTBT	The ratio of market to book value of equity

Table 4

Descriptive statistics

Variables	Mean	Std. Dev.	Min	Max
CRI	2.04	1.86	0	8.00
GHG_em	12.31	2.42	4.38	18.53
BoD_size	9.21	2.45	4	20
Affiliation	1.49	0.97	0	12.75
Ind_Dir	53.93	13.48	0	90
Fem_dir	9.66	9.86	0	62.50
Diversity	0.86	0.34	0	1
ESG_comp	0.35	0.48	0	1
Separation	0.94	0.24	0	1
Exec_Comp	15.27	1.04	6.83	19.62
Dir_Comp	13.37	0.78	5.52	22.96
CSR_com	0.59	0.49	0	1
Ownership	17.09	18.99	0	90.61
Size	14.88	1.52	10.56	19.78
ROA	8.82	11.74	-66.99	234.42
Leverage	23.44	17.98	0	133.09
Shareholders	12.85	1.26	9.26	18.04
Employees	9.03	1.67	1.79	13.38
Slack	0.11	0.10	0	0.72
New_tech	0.56	0.17	0.03	1
Cap_intensity	0.53	0.39	0	2.12
Capex	8.45	18.35	0	456
MTBV	2.84	21.79	-568.78	238.68

* n = 2315 firm-year observations

Table 5

Correlation matrix

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	CRI	1.00																				
2	GHG_em	0.46	1.00																			
3	BoD_size	0.34	0.38	1.00																		
4	Affiliation	0.30	0.37	0.24	1.00																	
5	Fem_dir	0.35	-0.01	0.15	0.12	1.00																
6	Separation	-0.02	-0.07	0.03	-0.02	-0.02	1.00															
7	Ind_Dir	0.31	0.22	0.07	0.33	0.24	-0.04	1.00														
8	Exec_Comp	0.51	0.41	0.48	0.31	0.25	0.02	0.26	1.00													
9	Dir_Comp	0.44	0.51	0.46	0.35	0.27	-0.12	0.37	0.53	1.00												
10	ESG_comp	0.29	0.19	0.07	0.17	0.24	-0.08	0.20	0.22	0.18	1.00											
11	Ownership	0.16	-0.04	-0.07	-0.09	-0.12	0.16	-0.17	-0.12	-0.15	-0.10	1.00										
12	CSR_com	0.50	0.15	0.19	0.14	0.35	-0.03	0.24	0.40	0.35	0.33	-0.07	1.00									
13	Size	0.58	0.74	0.57	0.46	0.23	-0.07	0.32	0.58	0.63	0.21	-0.25	0.34	1.00								
14	ROA	-0.05	-0.08	-0.03	-0.01	-0.05	0.02	-0.01	0.00	-0.04	-0.09	0.07	-0.09	-0.20	1.00							
15	Leverage	0.09	0.16	0.06	0.09	0.03	-0.01	-0.03	0.00	0.10	-0.02	-0.10	0.00	0.23	-0.11	1.00						
16	Shareholders	0.43	0.50	0.46	0.41	0.21	-0.08	0.29	0.46	0.54	0.16	-0.11	0.23	0.73	-0.08	0.15	1.00					
17	Employees	0.41	0.56	0.40	0.33	0.16	-0.07	0.21	0.38	0.46	0.13	-0.23	0.25	0.68	-0.17	0.21	0.53	1.00				
18	Slack	-0.16	-0.08	-0.12	0.00	-0.08	0.00	-0.01	-0.11	-0.08	-0.01	0.24	-0.06	-0.26	0.22	-0.27	-0.11	-0.27	1.00			
19	New_tech	-0.01	0.30	0.06	-0.01	-0.03	0.07	-0.07	-0.01	0.02	-0.04	0.09	-0.02	0.18	-0.03	0.21	-0.05	-0.02	-0.14	1.00		
20	Cap_intensity	0.14	0.47	0.02	0.06	0.05	0.01	0.04	0.01	0.08	0.09	0.00	0.06	0.14	-0.09	0.25	0.09	0.12	-0.17	0.18	1.00	
21	Capex	0.01	0.19	-0.05	-0.05	0.01	0.00	-0.02	-0.01	-0.02	0.03	0.10	0.02	-0.04	-0.02	-0.03	0.00	-0.01	-0.02	0.06	-0.03	1.00
22	MTBV	-0.02	-0.03	-0.01	-0.03	-0.06	-0.01	-0.04	0.02	0.03	-0.02	0.06	0.02	-0.04	0.10	-0.04	0.04	-0.03	0.02	-0.01	-0.02	0.00

* n = 2315 firm-year observations

Table 6

Firm fixed effect regression results of Carbon Reduction Initiatives (CRI) and GHG emissions

	CRI		GHG emissions	
Variables	(1)	(2)	(3)	(4)
Independent directors	0.0181*** (0.00302)	0.0177*** (0.00305)	-0.000394 (0.00221)	-0.00125 (0.00221)
Female directors	0.0124** (0.00564)	0.0113** (0.00567)	0.00393 (0.00353)	0.000278 (0.00355)
Multiple directorships	-0.189*** (0.0677)	-0.214*** (0.0675)	0.0614 (0.0451)	0.050 (0.0445)
ESG-based compensation	0.629*** (0.0885)	0.538*** (0.0892)	0.0671 (0.0560)	-0.000648 (0.0568)
CEO-Chair separation	-0.0748 (0.228)	0.0924 (0.241)	-0.0187 (0.164)	0.0235 (0.182)
Board size	0.161 (0.231)	-0.0115 (0.243)	0.098 (0.168)	0.090 (0.177)
Executives' compensation	0.504*** (0.0494)	0.460*** (0.0511)	0.036 (0.0329)	0.00587 (0.0338)
Directors' compensations	0.0936 (0.0626)	0.0271 (0.0641)	0.0391 (0.0561)	-0.0464 (0.0577)
CSR Committee	0.800*** (0.0813)	0.739*** (0.0835)	-0.0281 (0.0556)	-0.0162 (0.0562)
Ownership concentration	0.00497* (0.00297)	0.00608** (0.00299)	-0.0037 (0.00236)	-0.00427* (0.00237)
Firm Size		0.399*** (0.114)		0.454*** (0.0919)
Return on Assets		-0.00576 (0.00384)		-0.00185 (0.00262)
Leverage		0.00742** (0.00377)		-0.00262 (0.00308)
Shareholders		-0.120 (0.0939)		0.0614 (0.0763)
Employees		0.0276 (0.0722)		0.0283 (0.0486)
Slack		-0.538 (0.533)		0.0678 (0.380)
New technology		-1.908*** (0.518)		0.134 (0.414)
Capital intensity		-0.831** (0.374)		0.576** (0.285)
Capital expenditure		0.00511* (0.00289)		-0.0072*** (0.0021)
Market-to-book		0.00012 (0.00028)		-0.00017 (0.000612)
Constant	-8.973***(1.097)	-10.40***(1.881)	11.15***(0.873)	4.542***(1.611)
VIF	1.584	1.669	1.021	1.090
F-statistics	65.15***	35.53***	1.28	2.67***
R-squared	0.381	0.401	0.162	0.588

Notes: n = 2315 firm-year observations ***, ** and * indicate statistical significance at 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroskedasticity-adjusted robust standard errors.