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**Environmental Policy, Sustainable Development, Governance Mechanisms and Environmental
Performance**

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Environmental Policy, Sustainable Development, Governance Mechanisms and Environmental Performance

Abstract

We investigate the effects of environmental policy (Climate Change Act – CCA), sustainable development frameworks (Global Reporting Initiative – GRI; UN Global Compact - UNGC) and corporate governance (CG) mechanisms on environmental performance (Carbon Reduction Initiatives – CRIs and Actual Carbon Performance – GHG emissions) of UK listed firms. We use generalised method of moments (GMM) estimation technique to analyse data consisting of 2,245 UK firm-year observations over the 2002-2014 period. First, we find that the CCA has a positive effect on CRIs, and this effect is stronger in better-governed firms. Second, we find that the GRI-based framework is positively associated with CRIs. Third, we find that firms with poor CG structures have lower actual carbon performance compared with their better-governed counterparts. Overall, our evidence suggests that firms can symbolically conform to environmental policy (CCA) and sustainable development frameworks (GRI, UNGC) by engaging in CRIs without necessarily improving actual environmental performance (GHG emissions) substantively.

Keywords: Environmental policy, climate change act and GHG emissions, sustainable development and global reporting initiative, stakeholder engagement, corporate governance, institutional theory

1. Introduction

In this paper, we examine the effects of environmental policy, sustainable development and corporate governance (CG) mechanisms on environmental performance. We do this by distinctively examining the effects of the UK Climate Change Act (CCA), Global Reporting Initiative (GRI) and United Nations Global Compact (UNGC) on: (i) carbon reduction initiatives (CRIs); and (ii) actual carbon performance (greenhouse gas emissions – GHG emissions) of UK listed corporations. Additionally, we examine whether and how CG mechanisms (i.e., board independence, board size, CEO duality and managerial incentives) can impact on and interact with the CCA in influencing CRIs and actual GHG emissions of listed corporations. Our analysis is informed by theoretical insights drawn from neo-institutional theory.

Meanwhile the past two decades have witnessed policymakers, regulators, environmentalists, governments, supra national bodies and civil societies showing increasing concerns about the potential harmful effects of severe climate change on the environment. In this case, the 1997 Kyoto Protocol is considered to be one of the main pioneer global environmental policies that seeks to reinforce these concerns, and thus oblige the ratifying countries to limit GHG emissions, as well as enhance energy efficiency. As a consequence, different countries and firms around the world are gradually adopting various carbon-related strategies and actions, such as compliance with regulatory requirements and participation in emission trading schemes to reduce carbon footprints (Galbreath, 2010; Gallego-Alvarez et al., 2015).

Theoretically, neo-institutional theory suggests that institutional forces, such as political, economic and social institutions can drive and/or shape a firm's engagement with social and environmental performance (Ntim and Soobaroyen, 2013a). Specifically, neo-institutional theory predicts that a firm's response to coercive/regulative, cognitive/mimetic and normative institutional pressures is often driven by two motives: legitimisation (symbolic) and efficiency (substantive) (e.g., DiMaggio and Powell, 1983). From a legitimisation/moral perspective, firms may symbolically comply with regulative institutional pressures, such as environmental policies and regulations, by adopting corporate social strategies that can help them to gain (extend), maintain, and repair (defend) organisational legitimacy (e.g., Ntim, 2016; Oliver, 1991). On the other hand, the efficiency/instrumental view suggests that firms may substantively engage in social and environmental practices in order to protect shareholders' interests and enhance financial performance (Aguilera et al., 2007). This is likely to be particularly relevant in the context of climate-related commitments that require significant long-term investments without immediate financial benefits, and therefore might arguably discourage powerful executives from engaging in substantive environmental performance management. In this case, firms may symbolically implement a wide range of CRIs that are presumably inspired by the CCA, but such initiatives may have no substantive impact on actual carbon (GHG emissions) performance.

Consequently, a small, but gradually increasing number of studies have examined the determinants and effects of GHG emissions and disclosures (Eleftheriadis and Anagnostopoulou, 2015; Bernard et al., 2015; Freedman and Jaggi, 2005; Liao et al., 2015; Luo and Tang, 2014; Luo et al., 2012; Matsumura et al., 2014; Rankin et al., 2011; Tauringana and Chithambo, 2015; Ziegler et al., 2011), albeit with a number of observable weaknesses. First, little is known about the effect of carbon-specific legislation on carbon performance of firms, with the few existing studies focusing primarily on measuring the effect of environmental policies and regulations on carbon disclosures. For example, Tauringana and Chithambo (2015) examine the effect of the UK's Department for Environment, Food and Rural Affairs (DEFRA) guidance of GHG disclosures of FTSE350 companies, and find that the DEFRA guidance has a significant positive effect on GHG disclosures. Similar positive effect of environmental regulations on GHG disclosures has been reported by previous studies (e.g., Freedman and Jaggi, 2011; Rankin et al., 2011; Russo, 2009), although evidence by others (e.g., Alberto Gomez and Rodriguez, 2011; Arimura et al., 2016; Boiral and Henri, 2012; Busch and Hoffmann, 2011; Liao et al., 2015) has been inconclusive. Nonetheless, these studies have neither examined the effect of carbon-specific legislation, such as the CCA on carbon performance of listed firms nor investigated the long-term pre- and post-CCA enactment effects.

Second, a related literature (e.g., Perez-Batres et al., 2012) suggests that self-regulatory global sustainable development institutions and civil societies, such as the 1997 GRI, the 2000 UNGC and the 2015 UN Framework Convention on Climate Change (UNFCCC) act as an alternative and/or a complement to national laws and regulations that seek to encourage firms to engage in environmental sustainability and performance management. Whilst Perez-Batres et al. (2012, p.164) consider the adoption of the GRI as a reflection of a substantive demonstration of firms' commitment to sustainability, Milne and Gray (2013) argue that the triple bottom line² (TBL) and the GRI are insufficient frameworks to effectively measure firms' contribution to the sustainability of the Earth's ecology. Bernard et al., (2015) observe that the GRI framework does not provide a coherent, user-friendly and/or transparent account of a firm's sustainability performance. A number of studies (e.g., Clarkson et al., 2008; Al-Tuwairji et al., 2004) find that good environmental performers are likely to exhibit extensive environmental disclosures. However, little is known as to whether the GRI-type reporting framework has the ability to actually measure and differentiate superior carbon performance of firms in terms of reduced GHG emissions. Hence, this study further seeks to distinctively examine if the GRI framework and UNGC affiliations drive CRIs of a firm.

Third, despite the increasing evidence that corporate boards and executive management play critical roles in adopting these social and environmental practices (Ntim and Soobaroyen, 2013a, b; Ben-Amar and McIlkenny, 2015; Haque, 2017), existing studies investigating the extent to which

²TBL is commonly referred to as social, environmental and economic aspects of a firm.

CG mechanisms (e.g., board size, independence, CEO duality and managerial incentives) influence and/or moderate carbon performance are rare. As Sullivan and Gouldson (2017) argue, external governance pressures, internal governance conditions and corporate actions on climate change can interact with and influence each other. Fourth and as has been argued by Liao et al., (2015), carbon mitigation activities require substantial amount of financial, manpower and technological resources, as well as long-term strategic commitments with long-term implications. However, the existing literature (e.g., Liao et al., 2015; Freedman and Jaggi, 2011) has mainly employed cross-sectional data³ on GHG disclosures, and thereby arguably failed to provide insights relating to long-term trends in CRIs and their determinants. Finally, despite increasing calls for theoretical pluralism and development in social and environmental research (Ntim, 2016), existing studies are either largely descriptive or have relied mainly on the ubiquitous agency theoretical framework (Matsumura et al., 2014; Rankin et al., 2011; Tauringana and Chithambo, 2015; Ziegler et al., 2011). Observably, despite its theoretical appeal, past studies have not explicitly explored whether and how institutional theory can be employed to explain the effect of the CCA on carbon performance. Therefore, this study uses institutional theory as proposed by DiMaggio and Powell (1983) and Oliver (1991), and neo-institutional theory as proposed by Scott (2001) to explain how the CCA influences carbon performance of a firm, and whether a firm's response to the enactment of the CCA is influenced by powerful economic agents.

Consequently, this study intends to address these limitations within the literature by examining the effects of the CCA and its interactions with CG mechanisms on two aspects of carbon performance of a firm: (i) CRIs; and (ii) GHG emissions. It also examines if the adoption of GRI reporting and UNGC codes enhances carbon performance of listed firms, and thereby extending, as well as making a number of new and important contributions to the existing literature as follows.

First, to the best of our knowledge, this is the first study that addresses the effect of the CCA on both process-oriented (CRIs) and actual carbon performance (GHG emissions) of a firm by using a new dataset covering a longer time horizon (2002-2014). Our analysis also captures all categories of non-financial listed firms from a diverse range of industries instead of covering only the largest firms from polluting industries. Consistent with the predictions of the legitimation view of our neo-institutional theoretical framework, the evidence suggests that good carbon performance management (or process-oriented outcome) does not necessarily indicate good carbon operational performance, and that firms respond to institutional pressures, such as the CCA by demonstrating the former without improving actual outcome in the form of reduced GHG emissions.

³Tauringana and Chithambo (2015) use panel data (covering four years from 2008 to 2011) to examine the effect of the DEFRA guidance of GHG disclosures of FTSE350 companies.

Second, unlike other studies, we examine how the CCA interacts with CG mechanisms, including executive compensation, board size, board independence and CEO duality in shaping the climate-related initiatives of UK listed firms. Among others, Lee and Klassen (2016) highlight the significance of employing interaction and moderation variables in providing better understanding of environmental issues in an uncertain business environment, such as climate change. Our evidence suggests that executive management and independent boards tend to respond to the enactment of the CCA by symbolically undertaking climate protection initiatives, without demonstrating substantive improvement in actual carbon performance. Third and by contrast, we find that firms with poor CG structures, as captured by larger board size, have lower actual carbon emissions compared with their presumably better-governed/smaller board size counterparts. Fourth, we complement related studies to examine the effect of self-regulatory initiatives (such as GRI-reporting) on carbon performance, and find that GRI-based sustainable reporting framework represents superior process-oriented performance, rather than actual carbon performance of a firm. Overall, our evidence offers new insights into the ability of institutional theory to explain both individual and interactive effects of climate regulations, board independence and executive compensation on carbon initiatives and carbon emissions of firms.

The rest of the paper is structured as follows. Section 2 provides a background to the study. Section 3 reviews the theoretical literature. Section 4 reviews the empirical literature and develops hypotheses. Section 5 presents the data and research methodology. Section 6 reports the empirical results and discussion, whilst section 7 concludes the paper.

2. Environmental policy, sustainable development, environmental performance, corporate governance and UK corporate context

In the 1990s, there was a worldwide consensus that global temperatures were rising (global warming) and that it was caused primarily by human activities through the emission of GHGs, such as carbon dioxide, methane, nitrous oxide, ozone and water vapour, and thus there was an urgent need for this to be controlled. Consequently, a formal global environmental policy agreement was reached in Kyoto in 1997 known as the ‘Kyoto Protocol’ that required all countries that ratified the protocol to implement the necessary regulations and measures that can minimise GHGs.

In the UK, the government attempted to comply with the Kyoto Protocol by enacting the Climate Change Act (CCA) of 2008, which stipulated four legally binding ‘carbon budgets’ to cap on the amount of GHG emissions over five-year implementation periods, with the first budget running from 2008 to 2012, and to be followed by 2013-2017, 2018-2022, and 2023-2027 (DECC, 2011). Accordingly, the UK government implemented a number of climate change policies for firms and households in order to comply with the carbon emission reduction targets set out by the CCA. Consequently, the UK has reportedly met

the target of the first carbon budget (that ran from 2008 to 2012), and is well on track to meet the second one (Bassi et al., 2013). However, the Committee on Climate Change (CCC, 2014) has recently raised significant concerns about the slow progress in reducing GHG emissions.

Meanwhile the GRI is one of the most influential global sustainable development frameworks that has entered the fabric of firms' non-financial reporting, and become the intellectual framework through which the triple bottom line (TBL) and sustainability are articulated at the firm-level (Milne and Gray, 2013, p.19). Similar to the GRI, the UNGC is also a broad-based policy initiative for 'companies to align strategies and operations with universal principles on human rights, labour, environment, and anti-corruption issues'⁴. Based on a 2010 agreement, the UNGC and GRI have committed to maintaining collaborative relationship in order to advance corporate responsibility and transparency⁵. From the perspective of institutional theory, these self-regulatory institutions may enhance environmental legitimacy by influencing firms to demonstrate their commitment to sustainability (Perez-Batres et al., 2012; DiMaggio and Powell, 1991; Doh et al., 2010).

Noticeably and almost at the same time, the UK has been at the forefront of pursuing reforms aimed at strengthening good internal CG mechanisms through the publication of the Cadbury Report in 1992 that required publicly traded UK firms to appoint at least three outside board members and to restrict the CEO from becoming the chairman of the board. Subsequently, a number of similar CG codes were issued addressing specific issues, such as remuneration (Greenbury Report, 1995), Hampel Report (Combined Code, 1998), internal control and risk management (Turnbull Report, 1999), audit committee effectiveness (Smith, 2003) and independence of non-executive directors (Higgs Report, 2003) and the various consolidations to constitute 'The Combined Code' (2000, 2003, 2006, 2010, 2012, 2014 and 2016). In the main, the UK CG codes highlight the significance of having an appropriate balance of skills, experience, independence, checks and balances through CEO and chairperson role separation, and control over executive compensation through the introduction of 'say on pay'.

Consequently and with strong central government and institutional support and good governance at the firm-level, UK companies especially listed ones are expected to engage with the CRIs inspired by the CCA that are aimed at reducing the level of GHG emissions.

3. Theoretical literature review

⁴ <https://www.unglobalcompact.org/what-is-gc> (Accessed: 4 July 2016).

⁵ <https://www.globalreporting.org/information/about-gri/alliances-and-synergies/Pages/United-Nations-Global-Compact.aspx> (Accessed: 4 July 2016).

Despite increasing calls for theoretical pluralism and development, existing studies examining the relationship among environmental policy (CCA), sustainable development framework (GRI), environmental performance (CRI, GHG) and CG are either descriptive or have relied mainly on the ubiquitous agency theoretical framework (Liao et al., 2015; Luo and Tang, 2014; Luo et al., 2012; Matsumura et al., 2014), with studies drawing insights from other innovative and intuitively appealing theories, such as neo-institutional theory being rare (Ntim and Soobaroyen, 2013a). Dögl and Behnam (2015) use institutional theory to explain how regulatory, market and social stakeholders exert isomorphic influences on corporate environmental responsibility in developed and emerging economies. We, thus, employ institutional theory as proposed by DiMaggio and Powell (1983), and Oliver (1991), and neo-institutional theory as proposed by Scott (2001), to explain carbon performance of a firm.

According to institutional theory, firms conform to rules, norms and expectations of institutions and stakeholders in order to enhance and protect their legitimacy (Berrone and Gomez-Mejia, 2009). DiMaggio and Powell (1983) proposed three forms of institutional isomorphism that seek to explain the influence of institutional pressures on firms. They define *coercive/regulative isomorphism* as a process through which institutional forces exert both direct (such as government policy, laws and regulations) and indirect (such as cultural expectations of the broader society) influence on firms to adopt specific organisational structures and procedures, which in turn enhance organisational legitimacy. *Cognitive/mimetic isomorphism* is a process through which a firm responds to uncertainty by emulating the best practices adopted by other firms that are perceived to be more legitimate and successful (DiMaggio and Powell, 1983). Finally, *normative isomorphism* takes place when dominant professional networks of managers and specialised staff, as well as trade associations influence structures and processes of a firm.

Acknowledging the significant contributions of DiMaggio and Powell (1983), Oliver (1991) provides an important extension to institutional theory by offering a typology of strategic responses of a firm in response to pressures towards conformity with the institutional expectations. She highlights the role of organisational self-interests and active agency in organisational responses that include acquiescence, compromise, avoidance, defiance and manipulation.

Drawing upon the arguments of DiMaggio and Powell's (1983, 1991), Scott (2001) proposes neo-institutional theory by emphasising on three levels of analysis: (i) societal (global) institutions, (ii) governance structures of an organisation and its industry peers, and (iii) actors such as individuals and groups (Ntim and Soobaroyen, 2013a). For Scott (2001), these institutional pressures can affect (and are affected by) the forces of diffusion and/or imposition of institutional norms and practices, whilst developing new institutional norms and practices through innovations and/or negotiations in operational practices (see, Ntim and Soobaroyen, 2013a; Judge et al., 2010). Ntim and Soobaroyen (2013a) highlight the interplay

among these three levels, and argue that the actors not only compete for resources (efficiency), but also seek ultimate legitimacy and social acceptance (legitimation).

In terms of applicability to our current study, DiMaggio and Powell's 'institutional isomorphism' appears to provide a better theoretical framework in explaining the effects of environmental policy (CCA), sustainable development framework (GRI, UNGC) and CG mechanisms on environmental performance (CRI and GHG emissions). We contend that corporations are more likely to symbolically engage in sustainable business practices (such as pollution control, sustainable reporting) in order to legitimise their operations within society, and thereby demonstrating to their various powerful stakeholders (e.g., regulators, governments, employees, investors and consumers) that their social and environmental activities are consistent with the expectations of the broader society (Comyns and Figge, 2015).

4. Empirical literature and hypotheses development

4.1.1. Environmental policy (CCA), CG and environmental performance (CRI and GHG emissions)

According to 'coercive isomorphism' (DiMaggio and Powell, 1983), global and national governments' environmental policies, rules and regulations, such as the CCA, GRI, UNGC and UNFCCC are likely to exert pressures on firms to engage in CRIs in order to legitimise their operations within the broader society. Freedman and Jaggi (2005) argue that institutional pressures, such as the Kyoto Protocol tend to compel firms in polluting industries to pursue and disclose social and environmental activities in order to maintain their legitimacy (Comyns and Figge, 2015), as well as gain positive public image and goodwill (Hooghiemstra, 2000). Other studies (e.g., Ntim and Soobaroyen, 2013a) contend that firms engage in various environmental practices in order to enhance corporate *legitimacy* through symbolic measures and/or *economic efficiency* via substantive activities.

Noticeably, the existing empirical literature offers evidence on the impact of such institutional or regulatory pressures on environmental reporting/disclosure rather than actual environmental performance. For example, Tauringana and Chithambo (2015) find that the publication of DEFRA's guidance in 2009 has a significant positive effect on the level of GHG disclosures among FTSE350 companies over the 2008-2011 period. Similarly, Rankin et al., (2011) find that the adoption of ISO 14001-certified environmental management systems has a positive effect on the quality and level of environmental reporting in Australian firms. Similar findings have been reported by Freedman and Jaggi (2011), Chang et al., (2015), and Luo et al., (2012).

However, a related empirical literature suggests that firms can maintain or enhance environmental legitimacy without demonstrating actual environmental performance. For example, Cong and Freedman (2011) find that companies disclose pollution-related stories to meet society's expectations, so as to project

the image of being good corporate citizens with a view to enhancing their legitimacy, even though actual pollution performance appeared to be inconsistent with their environmental performance disclosures. D'Amico et al. (2016) also find that the introduction of voluntary legislation (e.g., legislative decree number 32/2007) on environmental disclosure in Italy resulted in an increase in quantity rather than quality of environmental disclosures. Similarly findings have been reported by Boiral (2014), Comyns and Figge (2015), Morhardt et al., (2002), Boiral and Henri (2012), Alberto-Gomez and Rodriguez (2011), and Arimura et al., (2016).

Against these theoretical predictions and empirical findings, we argue that firms might respond to the CCA strategically by demonstrating 'good process-oriented carbon management', such as carbon reduction planning, processes and disclosures, rather than 'actual carbon performance', such as the reduction of actual GHG emissions. Therefore, we would expect that the CCA is likely to have a greater impact on process-oriented carbon performance than actual carbon emissions. Thus, our first hypothesis is:

Hypothesis 1a. Ceteris paribus, the enactment of the CCA is likely to have a positive effect on carbon performance of a firm, and this effect is expected to be greater for CRIs than reductions in actual GHG emissions.

Even though a firm's investment in carbon pollution control or green technology is likely to enhance its economic value through energy savings and improved environmental image, powerful executives might be reluctant to pursue such projects, considering that this investment may only pay off in the longer term rather than shorter term (Liao et al., 2015). However, as Berrone and Gomez-Mejia (2009), and Mahoney and Thorn (2006) have argued, a firm's managerial incentive mechanisms can moderate the self-serving attitude of executive management and motivate them to design and implement appropriate environmental strategies and actions, which may enhance environmental legitimacy, and therefore generate direct and indirect economic benefits for the firm. Campbell et al., (2007) suggest, for example, that a properly designed sustainable executive compensation scheme can incentivise executives to engage in environmental activities that can substantively improve a firm's actual environmental performance.

Empirically, although the findings of a few related studies have shown inconclusive evidence regarding the relationship between executive compensation and social/environmental performance, little is known about their interactive effects. For example, Maas and Rosendaal (2016) find that firms operating predominantly in 'dirty' sectors/industries (e.g., utilities and the energy sector) in the US and Europe include sustainability targets in designing their executive compensation schemes, and that there is a strong focus on social, rather than environmental targets. Galbreath (2017) finds that the presence of inside directors' compensation scheme that is linked to environmental and social metrics positively moderates the negative relationship between insider directors and environmental/social performance. Berrone and

Gomez-Mejia (2009) find that CEO pay is positively related to pollution prevention strategies of US firms operating in pollution intensive-industries, although CEO pay is not related to ‘end-of-pipe’ pollution control. In a similar study of US firms, Cordeiro and Sarkis (2008) find a positive relationship between environmental performance and CEO compensation, but this relationship does not hold for all measures. Therefore, we would expect that the interaction between the CCA and executive compensation is likely to have a greater impact on process-oriented performance than actual carbon emissions. Thus, our next hypothesis is:

Hypothesis 1b: Ceteris paribus, the interaction between the CCA and executive compensation is likely to have a positive impact on carbon performance of a firm, and this effect is expected to be greater for CRIs than reductions in actual GHG emissions.

CG as represented by the board of directors of a firm plays a critical role in responding to institutional pressures and moderating the influence of powerful economic agents. Prior literature (Johnson and Greening, 1999; Michelon and Parbonetti, 2012) suggests that external directors, with diverse background, skills and strong stakeholder orientation, can enhance the ability of a board to develop policies that can accommodate conflicting needs and expectations of all stakeholders, including shareholders. Independent boards are in a better position to pursue executive management to undertake environmental performance management activities (Liao et al., 2015; de Villiers et al., 2011; Jizi, 2017), which can eventually enhance corporate legitimacy and financial performance. Empirically, de Villiers et al., (2011), and Mallin and Michelon (2011) report that board independence has a positive association with social and environmental performance of US firms. 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 activities.

Based on these arguments, an independent board might be able to persuade executive management to respond to the CCA to engage in CRIs so as to enhance organisational legitimacy. However, independent board members are less likely to have adequate power and remit to compel powerful executive management to pursue long-term financial and managerial commitments in CRIs, which can eventually enhance actual carbon performance in the form of reduced GHG emissions. Therefore, the interaction between the CCA and board independence is expected to have a greater influence on process-oriented aspects of carbon performance than actual GHG emissions. Hence, our next hypothesis is:

Hypothesis 1c: Ceteris paribus, the interaction between the CCA and board independence is likely to have a positive impact on carbon performance of a firm, and this effect is expected to be greater for CRIs than reductions in actual GHG emissions.

A related literature (e.g., de Villiers et al., 2011; Tauringana and Chithambo, 2015) suggests that larger boards can bring a diverse range of skills and experiences, as well as provide expert counsel and advice on environmental matters, which can eventually improve environmental performance of a firm. However, due to discernible increased free-rider, communication and co-ordination problems (Ntim, 2016), larger boards might be ineffective in responding to climate-related risks. Empirically, de Villiers et al., (2011), and Tauringana and Chithambo, (2015) find that board size has a positive relationship with environmental performance and GHG disclosures, even though Prado-Lorenzo and Garcia-Sanchez (2010) find opposite relationship between board size and GHG disclosures. Considering these contradictory theoretical predictions and empirical findings, our next hypothesis is:

Hypothesis 1d: Ceteris paribus, the interaction between the CCA and board size is likely to have a significant impact on carbon performance of a firm, and this effect is expected to be greater for CRIs than reductions in actual GHG emissions.

The CEO duality tends to reduce the independence of the board, since it can give the CEO too much power that might be used to maximise short-term monetary interests of the executives at the expense of long-term strategic investments, including those relating to environmental projects (de Villiers et al., 2011). This can eventually reduce carbon performance and carbon-related activities of a firm. Empirically, Prado-Lorenzo and Garcia-Sanchez (2010) find a positive relationship between CEO duality and GHG disclosures, although de Villiers et al., (2011) find statistically insignificant results. Therefore, we argue that CEO duality is likely to reduce the effectiveness of the board in devising long-term climate-related strategies of a firm, and instead direct firms' resources towards short-term investment projects. Thus, our next hypothesis is:

Hypothesis 1e: Ceteris paribus, the interaction between the CCA and CEO duality is likely to have a significant impact on carbon performance of a firm, and this effect is expected to be greater for CRIs than reductions in actual GHG emissions.

4.1.2. Sustainable development frameworks (GRI and UNGC) and environmental performance (CRI and GHG emissions)

Perez-Batres et al., (2012) consider the GRI framework as Scott's (1995) 'normative pillar' that establishes the moral base of organisational legitimacy. They also regard the adherence to the GRI framework as 'mimetic isomorphism' (DiMaggio and Powell, 1991) in that firms imitate the actions of 'legitimate' industry peers. Milne and Gray (2013, p.24) argue that the GRI and other TBL initiatives have been instrumental in expanding and shaping organisational practices, even though it has also often been

confused with advancing a just and sustainable world. Available empirical studies tend to support the notion that GRI reporting does not enhance actual environmental performance of a firm. Isaksson and Steimle (2009, p.168) find that GRI guidelines are not sufficient to determine how sustainable a firm is and how quickly it is approaching sustainability. Moneva et al., (2006) observe that firms adopt the GRI framework in order to legitimise management decisions and actions, without necessarily demonstrating improvements in critical sustainability indicators, such as GHG emissions, social equity and/or human rights. Morhardt et al., (2002) find that firms use the GRI framework to demonstrate greater sustainability scores without necessarily increasing actual environmental performance.

Considering these theoretical arguments and empirical evidence, we expect that the adoption of the GRI guidelines might influence firms to demonstrate superior process-oriented carbon performance, but this carbon activism may not be a reflection of actual carbon performance of a firm. Thus, our next hypothesis is:

Hypothesis 2a: Ceteris paribus, GRI-based reporting is positively associated with carbon performance of a firm, and this effect is expected to be greater for CRIs than reductions in actual GHG emissions.

Perez-Batres et al., (2012) also consider the adoption of the UNGC codes as DiMaggio and Powell's (1991) 'mimetic isomorphism' and Scott's (1995) 'normative pillar' that can enhance corporate legitimacy. For them, firms can exploit UNGC affiliations to gain corporate legitimacy through symbolic environmental commitments rather than substantive environmental actions. In the absence of monitoring and enforcement of compliance with the UNGC principles, there is a risk of 'bluewashing' in that opportunistic firms will try to use their affiliations with UNGC to improve their images, without necessarily improving actual environmental practices (Runhaar and Lafferty, 2009).

Empirically, Ortas et al., (2015) find that the adoption of UNGC codes is positively associated with environmental performance of firms in Spain, France and Japan. However, Runhaar and Lafferty (2009) find that firms can comply with the principles of UNGC at a reasonably lower cost, and that these principles do not seem to provide an effective impetus to undertake better environmental practices in the telecommunication industry.

Therefore, we expect that firms can comply with UNGC codes through demonstrating superior process-oriented carbon performance, without showing actual improvement in reducing GHG emissions. Thus, our next hypothesis is:

Hypothesis 2b: Ceteris paribus, UNGC affiliation is likely to have a positive association with carbon performance of a firm, and this effect is expected to be greater for CRIs than reductions in actual GHG emissions.

5. Research design

5.1. Data and sample

Our initial sample is based on 4,626 firm-year observations from 256 non-financial listed firms based on the FTSE all share index that were available. We collected CG and carbon initiatives data from the Thomson Reuters Asset4 database, whereas financial data were gathered from the Worldscope database. Among others, Qiu et al., (2014) and Trumpp et al., (2015) use Asset4 database, which is considered to be a comprehensive global database on environmental, social and governance (ESG) variables. We then eliminate 1,024 observations with missing yearly data relating to the independent variables. Finally, we remove 1,357 observations with missing firm-level ESG data in the Asset4 database. Our final sample is based on an unbalanced panel dataset of 2,245 firm-year observations, covering a period of 13 years (2002-2014). The study period also captures a longer time span before and after the enactment of the 2008 UK Climate Change Act, including the first carbon budget that ran from 2008 to 2012. Table 1 shows industry-wise distribution of the sample.

Insert Table 1 about here

5.2. Empirical model and variables

Whilst related literature (e.g., Tauringana and Chithambo, 2015; Liao et al., 2015; Berrone and Gomez-Mejia, 2009) use fixed-effects or ordinary least square regressions to examine carbon disclosures or environmental performance, these studies do not address the concerns about potential endogeneity and reverse causality problems (e.g., Al-Tuwairji et al., 2004; de Villiers et al., 2011). In order to address these problems, we use dynamic two-step GMM panel data estimator, as proposed by Arellano and Bond (1991) with Windmeijer (2000) bias-corrected robust standard errors. Among others, Martínez-Ferrero and Frías-Aceituno (2015) use GMM regressions to examine the relationship between sustainable corporate behaviour and financial performance of firms across various corporate governance systems.

We treat the lagged dependent variable as endogenous, so that ‘GMM-style’ instruments of deeper lags are created. The validity of the instruments is tested using Sargan test of over-identifying restrictions and Arellano-Bond test of the absence of serial autocorrelation. The null hypothesis of second-order autocorrelation [$AR(2)$] is rejected, and Sargan test results indicate that we cannot reject the null hypothesis

of over-identifying restrictions⁶. This suggests that the instruments are valid, since they are appropriately uncorrelated with the disturbance process.

Using carbon-reduction initiatives (*CRIs*) index and GHG emissions (*GHG*) as alternative dependent variables, we estimate the following empirical model to estimate the direct relationships between institutional variables and carbon performance:

$$Y_{it} = \beta_0 + \beta_1 \times Y_{it-1} + \beta_2 \times CCA_{it} + \beta_3 \times GRI_{it} + \beta_4 \times UNGC_{it} + \beta_5 \times C_{it} + u_{it} \quad (1)$$

In this model, Y of company i in the year t is a function of the first lag of the dependent variable Y , the Climate Change Act (*CCA*), the adoption of GRI-based sustainable reporting (*GRI*), the affiliation of UNGC (*UNGC*), company-specific control variables (C), and the error term u . We also add the first lag of *CRIs* in the specification of *GHG*, and vice-versa, as an additional control variable. Table 2 describes all the variables used in all our empirical models.

In order to examine the effects of the interactions between the *CCA* and executive compensation (*Exec_Comp*), ESG-based compensation (*ESG_Comp*), board independence (*Ind_Dir*), board size (*BoD size*), and CEO duality (*duality*), we estimate the following model by replacing *CCA* with the interaction variables.

$$Y_{it} = \beta_0 + \beta_1 \times Y_{it-1} + \beta_2 CCA_{it} + \beta_3 \times CCA * ExecComp_{it} + \beta_4 \times GRI_{it} + \beta_5 \times UNGC_{it} + \beta_6 \times C_{it} + u_{it} \quad (2a)$$

$$Y_{it} = \beta_0 + \beta_1 \times Y_{it-1} + \beta_2 CCA_{it} + \beta_3 \times CCA * ESG_Comp_{it} + \beta_4 \times GRI_{it} + \beta_5 \times UNGC_{it} + \beta_6 \times C_{it} + u_{it} \quad (2b)$$

$$Y_{it} = \beta_0 + \beta_1 \times Y_{it-1} + \beta_2 CCA_{it} + \beta_3 \times CCA * IndDir_{it} + \beta_4 \times GRI_{it} + \beta_5 \times UNGC_{it} + \beta_6 \times C_{it} + u_{it} \quad (2c)$$

$$Y_{it} = \beta_0 + \beta_1 \times Y_{it-1} + \beta_2 CCA_{it} + \beta_3 \times CCA * BoD_size_{it} + \beta_4 \times GRI_{it} + \beta_5 \times UNGC_{it} + \beta_6 \times C_{it} + u_{it} \quad (2d)$$

$$Y_{it} = \beta_0 + \beta_1 \times Y_{it-1} + \beta_2 CCA_{it} + \beta_3 \times CCA * Duality_{it} + \beta_4 \times GRI_{it} + \beta_5 \times UNGC_{it} + \beta_6 \times C_{it} + u_{it} \quad (2e)$$

We use a carbon reduction initiatives (*CRIs*) index representing a number of company-specific activities to reduce GHG emissions, with higher *CRIs* indicating greater climate-related activism of a firm. Table 2 describes the variables and outlines emission-related activities that are used to construct *CRIs* index.

⁶Since the Sargan test is based is on homoskedastic error term, it is computed without including VCE(robust) option in the specification.

Insert Table 2 about here

Our main explanatory variables are *CCA*, *GRI* and *UNGC* affiliation. In order to measure the effect of interaction between institutional pressure and internal corporate governance mechanisms, we use interactions between the *CCA* and board independence (*Ind_Dir*); board size (*BoD_size*); CEO duality (duality); executive compensation (*Exec_Comp*); and environmental-social-governance (ESG) based compensation policy (*ESG_Comp*).

Insert Table 3 about here

We follow among others, De Villiers et al., (2011), in using a number of firm characteristics as control variables. These include, firm size, employees, profitability (*ROA*), slack, leverage, capital intensity, capital expenditure, and market-to-book.

Insert Table 4 about here

6. Empirical results

6.1. Descriptive statistics and univariate analysis

Table 3 shows summary statistics of the main variables. It shows that the *CRIs* index is widespread, ranging from 0 to 8, with a mean value of 2.04 and a standard deviation of 1.86. In addition, the mean value of GHG is 12.30 with a standard deviation of 2.43, indicating that GHG emission data tends to be less spread (more clustered) around the mean. It is also evident that one-fifth of the sample firms adopt the GRI-guidelines to produce sustainable reports, and that 12 percent firms have UNGC affiliations. Table 3 also shows that the proportion of independent directors is around 54 percent, which is comparable with the findings of Liao et al., (2015). Moreover, the average board size is around nine, which is comparable with the findings of Tauringana and Chithambo (2015). In addition, only four percent of the sample firms have CEO duality and 35 percent firms have adopted ESG-based compensation policy.

Insert Table 5 about here

Table 4 shows bivariate correlations among the main variables. It is evident that the *CCA* is positively correlated with *CRIs* and negatively correlated with the GHG emissions, as expected. In addition, the GRI-based sustainable reporting and UNGC affiliation show positive correlations with both the *CRIs*

and GHG emissions. It is also shown that board independence and ESG-based compensation policy are positively correlated with *CRI*s, as expected, although they maintain similar relationships with the GHG emissions. Interestingly, firm size shows high degree of positive relationship with the GHG emissions and *CRI*s, indicating that large firms are associated with greater carbon emissions, and hence, they appear to undertake greater number of *CRI*s in an apparent attempt to avoid negative media publicity.

Table 5 shows *t*-test results of the difference in *CRI*s and GHG emissions between pre-and post-*CCA* periods. It is evident that firms demonstrate greater activism in *CRI*s and lower GHG emissions during the post-*CCA* period, as expected. This is broadly in line with arguments of Freedman and Jaggi (2011), who find that the Kyoto Protocol has a positive effect on GHG emissions of the sampled firms. Chang et al., (2015) also find that the enactment of environmental policy has a greater positive effect on environmental investment of Chinese firms in polluting industries. The table also shows the difference in *CRI*s and GHG emissions between polluting and non-polluting industries during the post-*CCA* period. It is shown that firms in polluting industries show higher GHG emissions and *CRI*s than those in non-polluting industries. This is in line with Luo and Tang (2014), who find that carbon intensive sectors have greater GHG emissions. Overall, our univariate and bivariate results tend to support our main hypothesis in relation to the potential effect of the *CCA* on *CRI*s. However, it is imperative to analyse multivariate regression results, before drawing firm statistical conclusions.

Insert Table 6 about here

6.2. Multivariate results and discussion

Table 6 shows two-step dynamic GMM results estimated with heteroskedasticity-adjusted robust standard errors. Columns 1 through to 5 show estimated results with the *CRI*s as the dependent variable, and columns 5 through to 10 show estimated results of GHG emissions, as the dependent variable. Column 1 shows estimated results for the three test variables, such as the *CCA*, *GRI*, *UNGC* affiliation, the CG variables, including board independence (*Ind_Dir*), board size, CEO duality, executive compensation (*Exec_Comp*), ESG-based compensation (*ESG_Comp*), and other control variables. Observably, the results show that *CCA*, *GRI* and *UNGC* are positively associated with *CRI* index, as expected. In addition, *Ind_Dir*, *Exec_Comp* and *ESG_Comp* show positive relationships with *CRI*, although board size, CEO duality and the control variables show statistically insignificant results. Column 2 shows similar estimated results with the first lag of GHG emissions (*Lag_GHG*) as an additional control variable. The estimated results for the *CCA*, *GRI*, *Exec_Comp* and *Ind_Dir* remain unchanged, although *ESG_Comp* shows weaker results (significant at 10% level), and *UNGC* shows statistically insignificant results.

In order to examine the effect of the interaction between *CCA* and the internal CG mechanisms, we also estimate Eqs. (2a) to 2(e) by including the interaction variables, together with the control variables. The estimated results shown in columns 3-5 suggest that the interactions of *CCA* with *Eexec_Comp*, *Ind_Dir* and *BoD_size* show statistically significant positive associations with *CRIs*, as expected. In addition, the regression coefficients of all the other variables remain unchanged. In particular, *GRI* maintains statistically significant and positive relationship with the *CRIs* in all specifications. We also find statistically insignificant results (not shown) of the interactions of *CCA* with *ESG_Comp* and CEO duality. Finally, column 6 shows estimation results of Eq.(1) by adding the interaction between *CCA* and pollution industry dummy (polluters), with this new variable having a statistically significant positive relationship with *CRIs*. This evidence is consistent with the *t*-test results, indicating that firms in polluting industries demonstrate greater *CRIs* in the post *CCA* period as part of their efforts to maintain or enhance corporate legitimacy. Columns 7-12 show results obtained by similarly replacing *CRIs* with actual *GHG* emissions, as the dependent variable. Surprisingly, the estimated results are statistically insignificant for most of the variables, including *CCA*, *GRI*, *UNGC*, and CG variables. Interestingly, only board size shows statistically significant positive association with actual *GHG* emissions, although the resulting interaction term with the *CCA* shows insignificant result. Whilst firm-specific control variables remain statistically insignificant, only capital expenditure (*Capex*) is found to have an inverse association with actual *GHG* emissions, as expected. This indicates that an increase in investment in long-term capital-intensive projects is likely to reduce actual *GHG* emissions.

Overall, our estimated results offer support for *Hypothesis 1a* in that the enactment of the Climate Change Act (*CCA*) has had a positive effect on carbon reduction initiatives (*CRIs*) of the sampled firms. By contrast, the relationship between the *CCA* and actual *GHG* emissions is statistically insignificant. This evidence suggests that firms appear to respond positively to the enactment of the *CCA* and other regulatory guidelines strategically (symbolically) by demonstrating ‘good process-oriented environmental performance’ activities, such as carbon reduction planning, processes and disclosures, but such *CRIs* do not necessarily result in substantive (significant) improvements in ‘actual carbon performance’, such as observable reductions in *GHG* emissions. This evidence is in line with the a growing body of related studies (such as, Cong and Freedman, 2011; Boiral, 2014; Boiral and Henri, 2012; Alberto-Gomez and Rodriguez, 2011; Morhardt et al., 2002) that show evidence of symbolic environmental commitments or ‘greenwashing’ or ‘impression management’ strategies of firms in the forms of an enhanced environmental disclosures or an adoption of environmental management standards (such as ISO 14001; GRI reporting framework; UNGC affiliation), even though these commitments are not reflected in actual environmental performance. Theoretically, this is consistent with the predictions of our neo-institutional theoretical framework that due to coercive/regulative, cognitive/mimetic and normative pressures, such as those posed

by the *CCA*, *GRI* and *UNGC*, firms are more likely to symbolically commit to implementing the environmental requirements contained in them by engaging in several *CRIs* in order to legitimise their operations without necessarily taking any substantive actions that can help to significantly reduce actual GHG emissions.

Our evidence further supports *Hypotheses 1b* and *1c* in that the interactions of *CCA* with executive compensation, and board independence have statistically significant positive associations with *CRIs*, whilst similarly insignificantly related to actual GHG emissions. Altogether, our evidence on executive compensation is broadly in line with the findings of Cordeiro and Sarkis (2008) and Haque (2017). However, this contradicts with the arguments of Berrone and Gomez-Mejia (2009), since an increased executive compensation does not necessarily moderate the self-serving attitude of the powerful executives, to the extent that it can motivate them to improve actual environmental performance of their firms. Whilst an independent board is likely to recognise the concerns of external institutions and various other stakeholders about the environment (Liao et al., 2015), it is also committed to improving firm financial performance and shareholder value. Therefore, an independent board might play a balancing act to demonstrate climate-related activism, whilst protecting the market-centric interests of shareholders. Our evidence suggests that board size has a positive association with GHG emissions, a finding that contradicts those of de Villiers et al., (2011) and Taurigana and Chithambo (2015), and suggests that a large board might have free-rider, communication and co-ordination problems that can result in greater conflicts in board decisions relating to environmental projects, and thus impact negatively on environmental performance. This evidence corroborates Prado-Lorenzo and Garcia-Sanchez (2010) in that corporate boards generally remain inactive in improving actual environmental performance of their firms. Altogether, this evidence suggests that corporate boards and executive management can demonstrate superior process-oriented carbon performance to gain (maintain) environmental legitimacy, without necessarily improving actual outcome in the form of reduced GHG emissions.

Our study results are in line with DiMaggio and Powell's 'institutional isomorphism' and Oliver's typology of 'strategic responses' in that firms partly conform to institutional isomorphism (such as the *CCA*) in order to legitimise their operations, whilst taking into consideration the interests of powerful economic agents, such as managers and shareholders. In other words, firms tend to follow Oliver's 'balancing the expectations of multiple constituents' tactic in complying with the *CCA* through *CRIs*, whilst protecting the short-term interests of managers, who are reluctant to undertake massive long-term investment in carbon abatement projects. Therefore, our evidence corroborates 'legitimation' rather than 'efficiency' aspect of our neo-institutional theoretical framework. Whilst firm-level CG structures may help in developing sustainable corporate strategies in response to pressures from social (and global) institutions (such as *CCA*, *GRI*, and interest groups), as well as industry peers, competition for monetary resources, and

an interplay among CG structures and powerful actors (such as managers) is likely to constrain implementation of those strategies. This eventually leads to a partial response to climate-related risks in the form of ‘symbolic’ *CRI*s, rather than ‘substantive’ ones that lead to significant reductions in actual GHG emissions and improvement in overall actual environmental performance.

Overall, our evidence corroborates the arguments of recent studies (such as, Cong and Freeman 2011; Boiral, 2014; Comyns and Figge, 2015) that find similar evidence in the contexts of GHG and biodiversity disclosures. This evidence is also in line with the observation of Bassi et al., (2013) in that the private sector in the UK is not making significant investment in green innovation and infrastructure due to the uncertainty in future returns from this investment. A lack of serious engagement and adequate investment in carbon abatement projects in the industrial sectors might be one of the reasons why the UK is currently not on track to meet the third and fourth carbon budgets.

In support of *Hypothesis 2a*, we find that GRI-based sustainable reporting shows a positive relationship with *CRI*s, but an insignificant relationship with actual GHG emissions. This evidence suggests that GRI-based reporting represents superior process-oriented carbon performance, rather than an improvement in actual carbon performance of a firm. This is broadly in line with the arguments and evidence of related studies (such as, Perez-Batres et al., 2012; Isaksson and Steimle, 2009; Moneva et al., 2006; Morhardt et al., 2002) in that firms adopt GRI-based reporting as part of their symbolic commitments to enhance corporate legitimacy, without improving substantive environmental performance. Lokuwaduge and Heenetigala (2017) observe that GRI-based reporting provides details about the quality of ESG disclosure, rather than the performance of the sustainability strategies of a firm.

Finally, we find that the interaction between *CCA* and polluting firms has a significant positive effect on *CRI*, although its relationship with actual GHG emissions is statistically insignificant. This evidence supports the arguments of related literature (such as Cong and Freedman, 2011), and suggests that firms in polluting industries seem to respond to the *CCA* by undertaking carbon reduction initiatives rather than reducing actual emissions, since the former can easily be communicated to gain positive public impression or to avoid negative media publicity.

7. Conclusions

The development and implementation of effective global environmental policies that can facilitate sustainable development by improving corporate governance (CG) and environmental performance arguably remains one of the most pressing global developmental challenges of the 21st century. Unsurprisingly, the past three decades in particular have witnessed a considerable amount of efforts by civil societies, supra-national bodies, national governments and public corporations towards designing, agreeing and implementing environmental measures that seek to reduce global warming by decreasing greenhouse

gas (GHG) emissions. In the UK, this objective has been pursued mainly through the 2008 Climate Change Act (CCA). Consequently, this study examined the effects of the CCA along with two other major global sustainable development initiatives (Global Reporting Initiative – GRI and UN Global Compact – UNGC), and the interactions of the CCA with CG mechanisms on environmental performance (i.e., carbon reduction initiatives – CRIs and actual carbon performance – actual GHG emissions) of UK listed corporations. We used two-step dynamic generalised method of moments (GMM) estimation technique to analyse an unbalanced panel dataset on 2,245 UK firm-year observations covering a period of 13 years (2002-2014), and thereby extending, as well as providing a number of new contributions to the extant literature as follows.

First, our results contribute to the literature by suggesting that the implementation of the CCA has had a positive effect on CRIs, and this effect is reinforced for firms with stronger CG mechanisms (i.e., greater board independence and higher executive compensation). Second, we find that the GRI-based sustainable reporting framework has impacted positively on CRIs. Third, we find that firms with poor CG structures, as captured by larger board size, have lower actual carbon performance (actual GHG emissions) compared with their better-governed counterparts. Overall, our evidence suggests that firms tend to symbolically conform to climate regulations or sustainable reporting guidelines by demonstrating superior process-oriented carbon performance, without necessarily improving actual carbon performance substantively. We interpret these findings within neo-institutional theoretical predictions, whereby regulative, mimetic and normative pressures, such as those posed by the CCA can compel firms to symbolically engage in CRIs in order to gain legitimacy for their operations, but are often not backed by substantive measures that can improve actual carbon performance by reducing actual carbon emissions. In this case, our evidence seems to offer more support for the legitimation (symbolic) predictions of our neo-institutional theoretical framework for engaging in CRIs compared with its efficiency (substantive) perspectives.

Our results have important implications for environmental policy, sustainable development, CG, environmental performance and business strategy. First and from a sustainable business strategy perspective, senior managers and their corporate boards may need to engage in both symbolic (legitimacy-oriented) and substantive (efficiency-oriented) environmental performance management initiatives if they are able to achieve intended sustainable competitive advantages in an uncertain world of climate change. However and in line with the predictions of our theoretical framework, our findings indicate that managers and boards of our sampled firms' environmental performance management efforts and strategies have focused mainly on symbolic ones and thereby delivering only symbolic (legitimation) outcomes. Consequently, we suggest that there is an urgency for firms, especially corporate boards and managers to commit to and implement comprehensive strategies that can improve not just process/management-oriented environmental performance outcomes, but also actual environmental performance by undertaking long-

term capital-intensive projects that can deliver sustainable development and energy efficiency. In this case and as a direct effort to align firms' sustainable targets with the interests of executive management, it seems imperative to redesign firms' executive compensation schemes by linking them with long-term verifiable sustainable targets (such as GHG emissions and energy-efficient products). In this case, a close collaboration among, and engagement with, critical internal stakeholders (such as shareholders, board members, managers and employees), and powerful external stakeholders (such as consumers, regulators, government, environmentalists, media, civil societies, such as the GRI and supra-national bodies, such as the UN) will seem to be appropriate to meeting the growing need to develop and implement effective environmental and sustainable development policies.

Second and with respect to regulatory and public policy implications of our findings, they suggest that the adoption of climate related environmental policies and regulations without explicit and verifiable sustainable targets, as well as monitoring and enforcement units for industries and firms is unlikely to be successful in reducing GHG emissions substantially. This also implies, therefore, that the ability for such environmental policies and efforts to have a positive impact on climate change by reducing global warming in the long-term is likely to be very limited. Therefore, we suggest that environmental regulations should have legally binding sustainable targets for industries and firms within those industries. Additionally and whilst self-regulatory global sustainability development institutions, such as the GRI and UNGC play critical role in enhancing corporate sustainability, they cannot eliminate the significance of having mandatory regulations, as well as establishing global and national environmental standards monitoring and enforcement units, on the successful development and implementation of global environmental and sustainable development policies.

Finally, our results suggest that good CG generally impacts positively on corporate environmental performance. In particular, the findings suggest that interaction between external environmental policies and regulations (e.g., CCA) and internal CG mechanisms (e.g., board size, independence and executive compensation schemes) can enhance environmental performance. This implies that efforts directed at improving environmental policy, sustainable development and corporate environmental performance should be pursued jointly along those aimed at improving internal CG practices. This can be done in the UK, for example, by DEFRA engaging directly with the Financial Reporting Council and London Stock Exchange towards incorporating the CCA requirements as part of the 'Combined Code' for listed firms to comply with. In this case, one critical aspect of CG that can be linked directly to corporate environmental policy and performance is executive compensation schemes. Such schemes should have variable and verifiable, but sustainable targets to be closely monitored by corporate boards in terms of matching targets against actual managerial environmental performance.

Although our findings are robust and important, it has some limitations that need to be explicitly acknowledged. First and like most archival studies of this nature, our proxies for CCA, CRIs, CG, compensation, GHG emissions, GRI and UNGC, among others, may or may not reflect actual corporate and management practices. In this case, future researchers may offer in-depth insights by conducting case studies and interviews with the various external and internal stakeholders, such as managers, directors, employees, regulators, civil societies, supra national bodies and governments to further explore these issues. Second, our empirical estimations could have been more robust with the inclusion of sustainable compensation policies with long-term emission targets. Future research can include these variables when examining the effectiveness of ESG-based policies in enhancing firms' actual carbon performance. Third, whilst informed by our findings, we argue that strategic responses of powerful economic agents (such as managers), inadequate climate-related policies and lax enforcement are some of the possible reasons that undermine the effectiveness of the CCA, it is therefore imperative to undertake further empirical studies in the future in order to ascertain the robustness of such a conclusion. Finally, future research can extend this empirical framework to include other countries around the world that have also ratified the Kyoto Protocol to conduct a cross-country study, which may enhance the generalisability of their findings.

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Tables

Table 1 Industry-wise distribution of the sample

Industry	No of Observations	Percent
Automobile, Aerospace and Defence	91	4.05
Construction materials	190	8.46
Food and beverages	107	4.77
Gas, Water and Utilities	83	3.70
Healthcare	112	4.99
IT and Electronics	151	6.73
Industrials	148	6.59
Mining	158	7.04
Oil and Gas	192	8.55
Retail	242	10.78
Services	771	34.34
Total	2245	100

Table 2 Variable definitions

<i>Variables</i>	<i>Symbols</i>	<i>Descriptions</i>
<u><i>Dependent Variables</i></u>		
Carbon reduction initiatives	CRI _s	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 CO ₂ 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 SF ₆ (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	Actual Carbon performance as measured by the natural log of total actual GHG emissions in tons.
<u><i>Independent Variables</i></u>		
Climate Change Act	CCA	A dummy variable that equals 1 if the data covers a period from 2008 to 2014 and 0 otherwise.
GRI reporting	GRI	A dummy variable that equals 1 if the firm's sustainability report is published in accordance with the GRI guidelines and 0 otherwise.
UNGC affiliation	UNGC	A dummy variable that equals 1 if the firm is a signatory of the UN Global Compact and 0 otherwise.
<u><i>Corporate Governance Variables</i></u>		
Board independence	Ind_Dir	Percentage of independent directors on board.
Executive compensation	Exec_Comp	The natural log of total compensation paid to all senior executives (in USD) as reported by the firm).
Board size	BoD_size	The natural log of the number of board members.
CEO duality	Duality	A dummy variable that equals 1 if the CEO is also the chair of the board and 0 otherwise.
ESG-based compensation	ESG_Comp	A dummy variable that equals 1 if firm has environmental-social-governance (ESG) related compensation policy, and 0 otherwise.
<u><i>Control Variables</i></u>		
Firm size	Size	The natural log of total assets of a firm.
Profitability	ROA	Return on assets.
Leverage	Leverage	The ratio of total debt to total assets.

Employees	Employees	The natural log of the number of employee of the firm.
Slack	Slack	The ratio of cash and equivalents to total assets.
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.
Polluting industries	Polluters	A dummy variable that equals 1 if the firm belongs to oil & gas, mining, industrials, utilities, construction, automobile and aerospace industries, and 0 otherwise.

Interaction Variables

CCA * Ind_Dir	Interaction between the CCA and the proportion of independent board members. We also use the interactions of the CCA with executive compensation (CCA*Exec_Comp), ESG-based compensation (CCA*ESG_Comp), board size (CCA*BoD_size), CEO duality (CCA*duality), and polluting industry dummies (CCA*Polluters).
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Table 3 Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
<i><u>Dependent Variables</u></i>					
CRI _s	2245	2.04	1.86	0	8.00
GHG	1372	12.30	2.43	4.38	18.53
<i><u>Independent Variables</u></i>					
CCA	2245	0.63	0.48	0	1.00
GRI	2245	0.19	0.40	0	1.00
UNGC	2245	0.12	0.33	0	1.00
<i><u>Corporate Governance Variables</u></i>					
Board Size (number)	2243	9.18	2.44	4	20
Duality	2245	0.04	0.20	0	1.00
Ind_Dir	2172	53.83	13.50	0	100.00
Exec_Comp	2108	15.26	1.03	6.83	19.62
ESG_Comp	2245	0.35	0.48	0.00	1.00
<i><u>Control Variables</u></i>					
Size	2235	14.86	1.47	11.08	19.78
ROA	2202	8.54	9.32	-66.99	100.83
Leverage	2235	23.29	17.98	0	133.09
Employees	2211	9.03	1.65	1.79	13.38
Slack	2235	0.11	0.10	0	0.68
Intensity	2213	0.52	0.37	0	2.05
Capex	2214	8.36	18.56	0	456.00
MTBV	2197	2.51	20.63	-568.78	238.68

Notes: Please see Table 2 for variable definitions.

Table 4 T-test results showing the difference in GHG emissions and carbon reduction initiatives (CRI) between (A) the pre- and post-CCA period, and (B) polluting and non-polluting industries in the post-CCA period

	GHG emissions	CRIs
Panel A:		
Post-CCA	12.128 (1074)	2.565 (1422)
Pre-CCA	12.881 (340)	1.130 (823)
Mean difference (Post-Pre)	-0.753***	1.435***
Panel B:		
Polluting industries (Post-CCA)	12.866 (437)	2.677 (541)
Non-Polluting industries (Post-CCA)	11.622 (637)	2.496 (881)
Mean difference (Polluting-Non-polluting)	1.243***	0.180*

Notes: ***, * indicate statistical significance at 1% and 10% levels, respectively. Figures in parentheses are sample size in each category.

Table 5 Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
CRIs (1)	1												
GHG (2)	0.46	1											
CCA (3)	0.37	-0.13	1										
GRI (4)	0.50	0.41	0.18	1									
UNGC (5)	0.34	0.32	0.10	0.41	1								
BoD_size (6)	0.34	0.38	-0.12	0.30	0.27	1							
Ind_Dir (7)	0.31	0.22	0.22	0.25	0.18	0.07	1						
Exec_Comp (8)	0.51	0.41	0.24	0.41	0.36	0.48	0.26	1					
ESG_Comp (9)	0.29	0.19	0.31	0.18	0.17	0.07	0.20	0.22	1				
Size (10)	0.58	0.74	-0.01	0.44	0.37	0.57	0.32	0.58	0.21	1			
ROA (11)	-0.05	-0.08	-0.07	-0.01	0.04	-0.03	-0.01	0.00	-0.09	-0.20	1		
Leverage (12)	0.09	0.16	-0.05	-0.02	-0.01	0.06	-0.03	0.00	-0.02	0.23	-0.11	1	
Intensity (13)	0.14	0.47	-0.01	0.12	0.15	0.02	0.04	0.01	0.09	0.14	-0.09	0.25	1
Capex (14)	-0.02	0.19	0.02	0.10	0.07	0.06	0.03	0.03	0.05	0.04	-0.01	0.04	0.29

Notes: Please see Table 2 for variable definitions.

Table 6 GMM regression results of Carbon Reduction Initiatives (CRIs) and GHG emissions

Variables	Carbon Reduction Initiatives (CRIs)						GHG emissions					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<i>First lag of the dependent variables</i>												
Lag_CRIs	0.105 (0.105)	0.0509 (0.0918)	0.0819 (0.0878)	0.0858 (0.0945)	0.0369 (0.0882)	0.201* (0.112)		0.0214 (0.0134)	0.0208 (0.0135)	0.0254** (0.0128)	0.0238 (0.0158)	0.0266** (0.0132)
Lag_GHG		0.0250 (0.0912)	0.0460 (0.0902)	0.0431 (0.0989)	-0.00801 (0.0670)	0.0554 (0.0916)	-0.0191 (0.150)	-0.0344 (0.169)	-0.0327 (0.169)	-0.0422 (0.174)	-0.0749 (0.178)	-0.0289 (0.175)
<i>Independent variables</i>												
CCA	0.445*** (0.115)	0.657*** (0.176)	- -	- -	- -	- -	0.0427 (0.0344)	0.0150 (0.0361)	- -	- -	- -	- -
GRI	0.333*** (0.117)	0.367** (0.151)	0.382** (0.156)	0.359** (0.145)	0.338** (0.148)	0.354** (0.142)	-0.0119 (0.0310)	-0.000723 (0.0321)	-0.00108 (0.0339)	0.00405 (0.0307)	0.0116 (0.0341)	0.00796 (0.0335)
UNGC	0.498** (0.217)	0.318 (0.251)	0.399 (0.310)	0.346 (0.260)	0.307 (0.228)	0.300 (0.345)	0.0290 (0.0602)	-0.00520 (0.0691)	-0.00807 (0.0694)	0.000906 (0.0614)	-0.00663 (0.0653)	-0.00357 (0.0705)
<i>Corporate governance variables</i>												
BoD_size	0.0357 (0.197)	-0.0186 (0.265)	0.0813 (0.224)	-0.0682 (0.270)	- -	-0.0482 (0.275)	0.214** (0.101)	0.228** (0.105)	0.224** (0.102)	0.209* (0.107)	- -	0.225** (0.106)
Duality	0.0136 (0.170)	-0.196 (0.159)	-0.0967 (0.154)	-0.249 (0.169)	-0.166 (0.155)	-0.213 (0.190)	-0.144 (0.129)	-0.132 (0.137)	-0.133 (0.135)	-0.106 (0.138)	-0.121 (0.179)	-0.127 (0.137)
Ind_Dir	0.00434** (0.0020)	0.00752** (0.0034)	0.00664** (0.0032)	- -	0.00736** (0.00336)	0.0057* (0.0033)	0.0009 (0.0015)	0.0008 (0.0015)	0.0008 (0.0015)	- -	0.000521 (0.00114)	0.00010 (0.0016)
Exec_Comp	0.218*** (0.0416)	0.240*** (0.0720)	- -	0.241*** (0.0648)	0.250*** (0.0748)	0.221*** (0.0755)	0.0048 (0.0314)	0.0040 (0.0314)	- -	0.00533 (0.0273)	0.0147 (0.0285)	0.00852 (0.0296)
ESG_Comp	0.260*** (0.0866)	0.199* (0.109)	0.197* (0.117)	0.197* (0.111)	0.222* (0.114)	0.201* (0.111)	-0.0339 (0.0759)	-0.0678 (0.0785)	-0.0738 (0.0785)	-0.0569 (0.0737)	-0.0966 (0.0589)	-0.0573 (0.0740)
<i>Control variables</i>												
Size	0.202* (0.113)	0.0505 (0.239)	0.0790 (0.283)	0.0819 (0.236)	0.0511 (0.234)	0.146 (0.231)	0.0159 (0.0807)	0.0452 (0.0866)	0.0470 (0.0858)	0.0647 (0.0974)	0.0988 (0.112)	0.0501 (0.0925)
ROA	0.0014 (0.0023)	0.0003 (0.0025)	0.0008 (0.0024)	-0.0003 (0.0027)	0.000480 (0.00268)	-0.0001 (0.0027)	-0.0022 (0.0016)	-0.0023* (0.0013)	-0.0023* (0.0014)	-0.0021 (0.0013)	-0.00240* (0.00132)	-0.0024* (0.0013)

Table 6 (continued) GMM regression results of Carbon Reduction Initiatives (CRIs) and GHG emissions

Variables	Carbon Reduction Initiatives (CRIs)						GHG emissions					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Leverage	0.0011 (0.0037)	-0.0038 (0.0052)	-0.0077 (0.0050)	-0.0038 (0.0049)	-0.00391 (0.00537)	-0.0025 (0.0050)	0.0010 (0.0019)	0.0007 (0.0020)	0.0006 (0.0019)	0.0006 (0.0020)	0.000658 (0.00225)	0.0008 (0.0021)
Employees	0.0271 (0.106)	-0.122** (0.0539)	-0.148** (0.0689)	-0.128** (0.0559)	-0.116** (0.0524)	-0.122** (0.0577)	0.0484 (0.0646)	0.0477 (0.0635)	0.0482 (0.0634)	0.0501 (0.0648)	0.0789 (0.0656)	0.0444 (0.0645)
Slack	-0.426 (0.315)	-0.592 (0.529)	-0.333 (0.557)	-0.739 (0.516)	-0.627 (0.512)	-0.585 (0.541)	-0.173 (0.190)	-0.118 (0.226)	-0.136 (0.248)	-0.111 (0.252)	-0.179 (0.265)	-0.141 (0.251)
Intensity	0.167 (0.347)	-0.296 (0.479)	-0.249 (0.465)	-0.279 (0.462)	-0.235 (0.460)	-0.337 (0.525)	-0.0483 (0.182)	0.0402 (0.168)	0.0381 (0.168)	0.0646 (0.166)	-0.00545 (0.188)	0.0302 (0.168)
Capex	0.0005 (0.0011)	0.0004 (0.0015)	-0.0003 (0.0016)	0.0002 (0.0016)	0.000472 (0.00165)	-0.0010 (0.0015)	- (0.0021)	- (0.0020)	- (0.0021)	- (0.0020)	- (0.00179)	- (0.0020)
MTBV	-0.0006 (0.0011)	-0.0006 (0.0010)	-0.0003 (0.0015)	-0.0007 (0.0010)	-0.000336 (0.00103)	-0.0008 (0.0012)	8.06e-05 (0.0002)	-3.10e-06 (0.0002)	4.07e-06 (0.0002)	-1.91e-05 (0.0002)	-6.95e-05 (0.000238)	-1.95e-05 (0.0002)
<i>Interaction variables</i>												
CCA*ExecComp	-	-	0.0442*** (0.0104)	-	-	-	-	-	0.0010 (0.0024)	-	-	-
CCA*IndDir	-	-	-	0.0093*** (0.0024)	-	-	-	-	-	-2.56e-05 (0.0007)	-	-
CCA*BoD_size	-	-	-	-	0.292*** (0.0786)	-	-	-	-	-	0.00124 (0.0161)	-
CCA*Polluters	-	-	-	-	-	0.590*** (0.218)	-	-	-	-	-	-0.0244 (0.0452)
Constant	-5.627*** (1.852)	-1.881 (3.420)	1.176 (4.391)	-1.963 (3.515)	-1.735 (3.326)	-3.270 (3.482)	11.24*** (2.083)	10.91*** (2.072)	10.96*** (2.127)	10.71*** (2.203)	10.68*** (2.599)	10.72*** (2.033)
Observations	1,520	846	846	846	846	846	852	828	828	828	828	828
Number of firms	231	170	170	170	170	170	168	164	164	164	164	164
AR(1) (p-value)	-2.64(0.001)	-2.21(0.03)	-2.43(0.02)	-2.31(0.02)	-2.17(0.03)	-2.41(0.02)	-0.31(0.75)	-0.21(0.83)	-0.22(0.83)	-0.16(0.87)	-0.02(0.98)	-0.24(0.81)
AR(2) (p-value)	1.62(0.11)	0.99(0.32)	0.95(0.34)	1.15(0.25)	0.90(0.37)	1.56(0.12)	0.84(0.40)	0.67(0.50)	0.67(0.50)	0.59(0.56)	0.50(0.62)	0.65(0.52)
Sargan (p-value)	79.88(0.11)	64.47(0.50)	56.48(0.77)	63.76(0.52)	64.35(0.50)	63.71(0.52)	71.27(0.28)	72.44(0.25)	72.91(0.23)	68.96(0.35)	70.51(0.30)	74.12(0.21)

Notes: This table presents results based on dynamic two-step system GMM panel data estimator, as proposed by Arellano and Bond (1991). We use the lagged dependent variables as endogenous, so that ‘GMM-style’ instruments of deeper lags are created. AR(1) and AR(2) are the first and second order Arellano-Bond tests for serial autocorrelation and Sargan is a test of over-identifying restrictions. The tests fail to reject the null hypotheses for ‘no second order serial autocorrelation’ and over-identifying restrictions. ***, ** and * indicate statistical significance at 1, 5 and 10% levels, respectively. The figures in parentheses are the heteroskedasticity-adjusted robust standard errors. Please see Table 2 for variable definitions.