

Discussion Paper

Corporate Carbon Emission and Financial Performance: Does Carbon Disclosure Mediate the Relationship in the UK?

June 2016

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Abstract

Academic debate relating to the link between corporate environmental disclosures, environmental performance and financial performance is persistent and controversial. In this paper, we investigate whether and if so, how, carbon emission performance is related to corporate financial performance and how disclosures of carbon emission in the annual and standalone reports mediate such relationship. Specifically, we construct a 42-item disclosure index to quantify the quality of corporate carbon emission information of 62 FTSE 100 companies from the period of 2010 to 2012. We find that while carbon emission is negatively associated with financial performance, it is positively related to the level of carbon disclosures which is significantly and positively related to financial performance. The findings show that market responses to excessive carbon emission; however, companies with poor carbon performance tend to use disclosure strategically to manage the legitimacy threat and to reduce the information asymmetry.

Keywords

carbon emission, carbon disclosure, financial performance, firm value, mediation analysis

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1 Introduction

A substantial body of literature examines the question ‘Does it pay to be green?’ using either environmental performance or environmental disclosure as proxy for corporate engagement with corporate social responsibility (CSR). The studies are designed to investigate the association between CSR disclosure and financial performance (Al-Tuwaijri, Christensen, & Hughes li, 2004; Freedman & Jaggi, 1982; Konar & Cohen, 2001; Li, Richardson, & Thornton, 1997; Qiu, Shaukat, & Tharyan, 2016; Saka & Oshika, 2014; Ullmann, 1985) and between CSR performance and financial performance (Dowell, Hart, & Yeung, 2000; Dye, 1985; Flammer, 2015; King & Lenox, 2001; Li et al., 1997; Liao, Luo, & Tang, 2014; Saka & Oshika, 2014), while the results are greatly controversial. Furthermore, the association between CSR performance and CSR disclosure is yet clear (Al-Tuwaijri et al., 2004; Cho & Patten, 2007; Clarkson, Li, Richardson, & Vasvari, 2008; Li et al., 1997; Patten, 2002; Saka & Oshika, 2014; Ullmann, 1985; Wiseman, 1982). Nevertheless, these studies collectively emphasise the importance of understanding the impact of corporate CSR engagement on corporate financial performance and the mechanisms behind the association.

There are two main streams of explanations for the controversial outcomes of the above association. From an economic perspective, engaging in CSR is a cost burden to companies and provides few financial benefits, as companies incurring costs for environmentally responsible engagement put themselves at an economic disadvantage compared to other companies without such expenditures. This view has been challenged as more countries mandate regulations for corporate CSR behaviours and also as the legitimate interests of the stakeholder is emerging, which has created renewed scepticism about the objectives of business. On one hand, engaging in CSR protects companies from potential legal fines and regulatory costs. On the other hand, the socio-political view suggests that companies can gain benefit from satisfying diverse groups of stakeholders and can gain competitive advantage by engaging in CSR activities (Dye, 1985; Hart & Ahuja, 1996). In addition, it is recognised that CSR engagement is a multidimensional construct that encompasses a variety of corporate actions in relation to its resources, processes and outputs (Brammer & Millington, 2008; Carroll, 1979; Waddock & Graves, 1997). Fundamentally different parts of CSR engagement would be differently motivated and would accordingly have different implications for corporate financial performance. This study therefore addresses this issue by emphasizing one particular element of CSR – carbon emission issues.

It is also argued in the current study that environmental disclosure or environmental performance alone does not provide the full picture of corporate environmental engagement; the association between environmental performance and corporate financial performance could be mediated by environmental disclosure in annual reports and CSR reports, which are used by the market to assess corporate environmental performance. Al-Tuwaijri et al. (2004) claim that the prior empirical research of the relations between environmental performance, environmental disclosure and corporate financial performance mainly focus on the strength of paired-wise association between two of these three variables. In the current study, environmental disclosure and environmental performance are separated into two variables as they measure different things. This study extends Al-Tuwaijri et al. (2004) holistic approach to investigate the interrelationship among corporate carbon emission, carbon disclosures and corporate financial performance simultaneously.

To achieve the aim of this research and answer the research questions, the study employs annual reports and stand-alone CSR reports of 62 environmentally sensitive FTSE 100 companies in the United Kingdom (UK). Mediation path analysis is used to explain how carbon emission performance and financial performance are related. Based on our longitudinal data, we employ a two-level mediation model to test the direct effect of carbon emission performance on corporate financial performance, and the indirect effect of carbon emission, mediated by annual carbon emission disclosure, if any.

The structural equation modelling analysis shows that in the UK context, corporate carbon emissions impact on corporate financial performance through both direct and indirect mechanisms. For the direct impact, it is found that corporate carbon emission is negatively associated with corporate financial performance, which indicates that the market does respond to corporate carbon emission performance. For the indirect impact, the results show that corporate carbon emission is positively related to the level of corporate carbon disclosures (companies with more carbon emissions make more extensive disclosures), and also show that a significant positive relation exists between corporate carbon disclosure and corporate financial performance (more carbon disclosures lead to higher subsequent share return for the company). Thus, the higher levels of corporate carbon disclosures appear to mediate the potential negative effects of the company's high carbon emissions. The direct and indirect mechanisms are in line with the prediction of socio-political and economic disclosure theories, which suggest that the market does respond to corporate environmental performance (Clarkson, Li, Richardson, & Vasvari, 2011; Matsumura, Prakash, & Vera-Muñoz, 2013; Saka & Oshika, 2014), and companies with poor environmental performance tend to disclose more

information to manage the legitimacy threat that is subsequently created by the poor performance (Chauvey, Giordano-Spring, Cho, & Patten, 2014; Cho & Patten, 2007; Patten, 2002) and to reduce the information asymmetry (Al-Tuwaijri et al., 2004; Healy & Palepu, 2001; G. F. Peters & Romi, 2014).

This study contributes to the understanding of how social concerns for climate change affect corporate financial performance and provides in-depth understanding of the mechanisms of the association. To our best knowledge, this is the first study investigating the simultaneous association among corporate carbon emission, carbon disclosures and corporate financial performance. The use of the two-level mediation model allows us to evaluate direct, indirect and total effects between our interests' variables. The mediating impact of carbon disclosure on the negative association between carbon emission and corporate financial performance sheds light on the motivation of corporate voluntary carbon disclosures. This study also contributes to corporate carbon accounting and reporting literature by providing an overview of expected disclosures from government, lobby groups and other climate change related institutions through building up a comprehensive carbon disclosure index. The findings also have important implications for corporate top management and government who are interested in improving corporate carbon emission reduction and reporting strategy. Extending previous literature, this study contributes by providing new conceptual and methodological advancements.

The paper is organised as follows. Section 2 reviews the relevant literature and presents the main hypotheses. In Section 3, the research methods are discussed. Section 4 presents the results and discussion, followed by the summary and conclusions in Section 5.

2 Literature review and hypothesis development

2.1 Carbon emission and corporate financial performance

In terms of carbon emission management, there is a direct financial impact from both the regulatory perspective and investment perspective in the UK. From the regulatory perspective, if companies cannot fulfil their responsibilities to reduce their emissions to the targets under mandatory carbon management schemes, they should either pay for the fines or buy emission allowance from the carbon trading market, both of which cause financial burden for the company. To achieve the carbon emission targets and avoid the fines, companies could invest in their carbon reduction management system by using low emission energy, equipment, and/or by developing low carbon technology. When their carbon emission is below their emission target, companies could have some surplus of their carbon emission allowances and they could

sell their surplus in the carbon trading market for financial benefits.¹ Better performance in carbon management will therefore lessen the financial burden and even bring profit for the company that does well. In addition to the tangible financial impact, better carbon emission performance may, according to stakeholder theory prediction (Freeman, 2010), have other intangible impacts on the company, such as good reputation and better relationships with government, suppliers and customers (Brammer & Pavelin, 2005; Brown & Dacin, 1997; Sen & Bhattacharya, 2001). Given all of the above, this study attempts to test if in fact a company with better carbon emission performance will benefit from improved financial performance.

There is limited empirical evidence of the link between carbon emission and financial performance. The studies of environmental performance and corporate financial performance should shed light on the association between carbon emission and corporate financial performance. Clarkson et al. (2011) seek insights into the question 'Does it pay to be green?' They employ a sample of 242 companies from the four most polluting industries in the US, across the time period 1990–2003. Toxic release inventory in pounds per cost of goods sold is used as a measure of corporate environmental performance. Their results show that companies with improvement in their environmental performance benefit from increased Tobin's Q s, profitability, liquidity and sales growth in the subsequent periods.

Studies with a focus on corporate carbon emission performance find similar results. Using carbon emission data of a sample of S&P 500 companies, Matsumura et al. (2013) find significantly negative association between carbon emission and firm value. The authors hand-collect carbon emissions data of S&P firms from carbon disclosure project (CDP) questionnaires and use market value of common equity as the measure of firm value. They find that on average, for every additional thousand metric tons of carbon emissions, firm value decreases by \$212,000. Saka and Oshika (2014) examine the association between corporate carbon emission and firm value in the Japanese context. Instead of using the voluntarily reported volume of carbon emissions, they use mandatorily reported carbon emissions data, which is claimed to solve the endogeneity problems in previous studies. Consistent with previous studies, they use market value of equity to measure corporate value. They evidence that carbon emissions and firm value are negatively related. Clarkson, Li, Pinnuck, and Richardson (2015) further look into how corporate carbon emissions affect firm valuation under the European Union Emissions Trading Scheme (EU ETS). They explicitly consider the impact of carbon emission allowances and a company's ability to pass carbon compliance cost on to the end users and consumers in their

¹ European Climate Exchange, the world's largest carbon exchange, has proved to be a mature market for carbon trading over the period of 2008 and 2011. (Ibikunle, Gregoriou, Hoepner and Rhodes, 2015)

valuation model. For the firm value, the authors use the Ohlson valuation model as a measure. Their results show that a company's carbon allowances are not associated with firm value but that the shortfalls are negatively associated. Accordingly, the first hypothesis relates to the association between corporate carbon emission and financial performance. These above arguments lead to the following hypothesis:

Hypothesis 1. There is a negative relationship between corporate carbon emission and corporate financial performance.

2.2 Carbon emission and carbon disclosure

Previous studies examining the relationship between environmental disclosure and environmental performance are motivated by the voluntary nature of disclosures related to corporate environmental affairs. For the disclosures to be useful to stakeholders, there should be some correspondence between the disclosures and actual performance. Patten (2002) uses a Toxics Release Inventory (TRI) related sample of 131 US companies and controls for size and industry in the model. Content analysis of annual reports is used to assess the content of environmental disclosure. The results document a significant negative relationship between disclosure and actual performance and the association is stronger for companies from non-environmentally sensitive industries. Cho and Patten (2007) later provide additional support for the argument that companies with poorer environmental performance provide more environmental disclosures as a legitimate tool for addressing the increased threats to their legitimacy. Instead of using absolute pollution, they subcategorise the 100 KLD-related sample in terms of worse performers and better performers, using the corporate social and environmental performance ratings compiled by KLD Research and Analytics. Environmental disclosures in companies' 10K reports are measured using an eight-item content analysis classification developed by Patten (2002), further distinguishing monetary and non-monetary items. Consistent with previous studies, they find that generally poorer performers disclose more than better performers and the use of monetary and non-monetary components of disclosure varies across groups. Cho and Roberts (2010) provide more evidence of the environmental performance–disclosure link in a more recent study. The authors employ a comprehensive disclosure evaluation metric to assess both the content and the presentation of corporate website environmental disclosures and utilise a company's Toxic 100 toxic score to proxy for corporate environmental performance. The disclosures of Toxic 100 companies are compared with the disclosures of non-Toxic 100 companies. It is concluded that corporate environmental disclosures on websites are often de-coupled from corporate actual

environmental performance and companies use Internet reporting to project a more socially acceptable environmental management approach to public stakeholders.

There is very limited literature on the environmental performance–disclosure link focusing on corporate carbon emission issues. Hassan and Kouhy (2014) examine the environmental disclosure–performance link of the Nigerian oil and gas industry. They content analyse corporate annual reports, press releases and fact sheets to measure the substance of disclosure and also the volume of disclosure. The data envelopment analysis model, which is based on the mathematical technique of linear programming, is used for measuring carbon emission performance. The results document a significant negative association between the substance of disclosure and performance.

In line with the previous studies, this study concentrates on the legitimising function of voluntary disclosures. Legitimacy theory recognises the fact that companies are bound by a social contract in which they agree to perform within the norms of their respective societies, and posits that organizations employ environmental disclosures as a legitimacy tool to meet the expectations of the society and thus to gain or maintain their legitimacy (Deegan, 2002; Deegan, Rankin, & Tobin, 2002; Dowling & Pfeffer, 1975; Lindblom, 1994; Patten, 1992). Legitimacy theory posits a negative association between corporate environmental performance and environmental disclosure, which indicates that companies with poor environmental performance tend to make more environmental disclosures to meet the expectation from the stakeholder to maintain their social contract to operate within the society. Given all of the above discussion, this study hypothesises that:

Hypothesis 2. There is a positive relationship between corporate carbon emission and corporate carbon disclosures.

2.3 Carbon disclosure and corporate financial performance

In contrast to examinations of the environmental performance–disclosure link and environmental performance–financial performance link, explorations of the financial impact of environmental disclosures are more limited. E.-H. Kim and T. Lyon (2011) study the circumstances under which share prices are increased for the Financial Times Global 500 companies due to participation in the CDP. They use participation of CDP as proxy for corporate carbon disclosure and fail to find evidence that CDP participation itself could lead to increased shareholder value. However, CDP participants do benefit from increased stock prices in a significant and sustained fashion when there is likelihood of climate change regulation risk when

Russia ratified the Kyoto Protocol. The participant companies are perceived as being more prepared for exogenous shocks. In addition to the positive impact of carbon disclosure on firm value during carbon sensitive periods, Saka and Oshika (2014) investigate, in the context of Japan, the association between carbon disclosure and firm value during 'normal days' when there is no specific carbon agenda. Similar to E.-H. Kim and T. Lyon (2011) study, they use companies' responses to CDP as proxy for carbon disclosures. Market value is measured as the market value of equity. They document a positive effect of carbon disclosures on corporate value. And the positive impact is more significant for companies with high volume of carbon emissions. Instead of examining the firm-value impact of carbon disclosure directly, Matsumura et al. (2013) compare the firm value for the companies that choose to disclose their carbon emission to CDP with a propensity score matched sample of companies that choose to not disclose this information. They find that the median firm value of companies that disclose their carbon emission information is about \$2.3 billion higher than that of their non-disclosing counterparts.

Revealing information about a company's environmental technologies, environmental practices and performance satisfies the needs of a company's stakeholders, including regulators, employees and customers. In general, disclosures provide benefits through reduced information asymmetry between the company and outsiders, consequently facilitating efficient allocation of scarce resources (Healy & Palepu, 2001) and leading to the company's adaptation to external demands (Orlitzky, Schmidt, & Rynes, 2003). A company that makes more extensive and objective voluntary carbon emission disclosures is therefore more likely to benefit from higher share prices. The market is likely to treat non-disclosure behaviour as an adverse signal and to penalise non-disclosing companies. Based on this discussion, the hypothesis is stated as follows:

Hypothesis 3. There is a positive association between corporate carbon disclosures and corporate financial performance.

Together with the discussion in the above three sub-sections (2.1, 2.2 and 2.3), if all the three correlations are confirmed – that more carbon emissions have a negative impact on corporate financial performance and a positive impact on carbon disclosures, and that carbon disclosures positively impact on corporate financial performance – it is reasonable to confirm that companies choose to disclose their carbon emissions, likely knowing that capital markets penalise them for their carbon emissions. In this relationship, carbon disclosures should be considered as a mediator variable. Matsumura et al. (2013) find that the market penalises all companies for their carbon emissions, but a further penalty is imposed on companies that do not disclose their emission information.

3 Methods

3.1 Sample selection

To achieve the aim of this research and answer the research questions, the study employs annual reports and stand-alone CSR reports of 62 carbon sensitive FTSE 100 companies in the UK. The majority of the existing literature on environmental disclosure focused on disclosure by environmentally intensive industries (Berthelot & Robert, 2012; Dragomir, 2012; Eleftheriadis & Anagnostopoulou, 2014; E.-H. Kim & T. P. Lyon, 2011; Matisoff, 2012; Pizer, Morgenstern, & Shih, 2011). This study extends previous studies by identifying carbon sensitive industries. Carbon-sensitive industries are identified by investigating the industries with companies that are Carbon Trading Account Holders (AH). Carbon Operator Holding Accounts are recorded by the European Commission in the European Union Transaction Log at: <http://ec.europa.eu/environment/ets/welcome.do?languageCode=en>. The database records the ownership of carbon allowances in both the EU Emission Trading System (EU ETS) and the United Nations system, based on countries that have ratified the Kyoto Protocol. The Operator Holding Accounts in the database is employed in the current research. In the case of carbon emissions, carbon sensitive industries are more concerned with carbon emission and carbon information and are consequently expected to be more willing to release carbon disclosure data to the public, to demonstrate the legitimacy of their operations (Dowling & Pfeffer, 1975). There are a number of reasons for using UK data. Firstly, UK ETS was introduced in 2002, thus the UK has a relatively well developed system on carbon emission. The UK is also the country that ratified the Kyoto Protocol in the very early stages; companies from countries ratifying the Protocol are more forthcoming to make greenhouse gas (GHG) disclosures (Freedman & Jaggi, 2005). Climate change issues are more salient in the UK. The selection of FTSE 100 is justified from both the theoretical and empirical perspectives. Legitimacy theory suggests that large companies are facing more legitimacy concerns and are more exposed to social scrutiny (Dowling & Pfeffer, 1975), and a number of prior studies document that the extent of corporate CSR disclosures are positively associated with company size (Chauvey et al., 2014; Elsayed, 2006; Patten, 1992, 2002; Qiu et al., 2016). The FTSE companies are also argued to have heterogeneous stakeholders with different vested interests (Liao et al., 2014; Qiu et al., 2016; Salama, 2005).

Deegan (2002) indicates that financial report disclosures are used by the management of companies as a legitimizing tool and the annual report is the most important media for companies to communication to their stakeholders and the public (Adams, Hill, & Roberts,

1998). Information disclosed in annual reports are widely used in previous research (Cho & Patten, 2007; Mahadeo, Oogarah-Hanuman, & Soobaroyen, 2011; Patten, 1992, 2002; Roberts, 1992; Wiseman, 1982). In addition to annual reports, we also use CSR reports and/or standalone reports to examine the quality of corporate carbon disclosures, based on the following reasons. Firstly, carbon issues are more technical than other social and environmental issues; companies prefer to provide more detailed carbon information in their standalone reports rather than annual reports. Secondly, while the social and environmental information in annual reports is not usually audited, the fact that more and more standalone reports are would enhance the credibility and quality of the information disclosed.

3.2 Variable measurements

3.2.1 Carbon disclosure

To measure corporate carbon disclosure, existing literature mainly uses the CDP data either as the proxy for the existence of carbon disclosure of companies and/or as proxy for the quality of carbon disclosure (Ben-Amar & McIlkenny, 2014; Freedman & Jaggi, 2005; Kolk, Levy, & Pinkse, 2008; Liao et al., 2014; Luo, Lan, & Tang, 2012; Saka & Oshika, 2014; Stanny, 2013). CDP changed their questionnaire over time and company responses are also in constant flux (Kolk et al., 2008; Liao et al., 2014).² Using CDP data is therefore not suitable for this longitudinal analysis and comparison. Another data source of existing carbon disclosure literature is content analysis of annual reports and/or CSR reports, which is more discretionary than corporate response to CDP's questionnaire (Dwyer et al., 2009; Eleftheriadis & Anagnostopoulou, 2014; Freedman & Jaggi, 2005; Ieng Chu, Chatterjee, & Brown, 2012; JM Ferreira, Anastasia Mariussen, Kuo, & Yi-Ju Chen, 2013; Lee, Park, & Klassen, 2015; Peng, Sun, & Luo, 2014). This discretionary nature of content analysis is of particular importance, since Liesen et al. (2015) document quantitative corporate carbon disclosures to suffer from incompleteness, as less than a quarter of European firms in their sample report greenhouse gas emissions of scope 1 and 2 for more than 90% of their operations. For the purpose of this study, qualitative content analysis is hence more appropriate to assess the quality of corporate carbon disclosure rather than the quantity of disclosure (Chelli, Durocher, & Richard, 2014; Cormier, Magnan, & Van Velthoven, 2005; Wiseman, 1982).

This paper extends prior study by using a 42-item disclosure index, as provided in the Appendix. Besides the extant environmental disclosure and carbon emission studies, the index design

² It is also noteworthy that company responses to the CDP questionnaire do not always equal the same company's carbon disclosure in its sustainability report.

closely follows certain carbon accounting and reporting guidelines, which include GRI (2013), WBCSD and WRI (2004), DEFRA (2013), CDP (2012), carbon accounting and reporting literature (Andrew & Cortese, 2011; Bebbington & Larrinaga-Gonzalez, 2008; Burritt, Schaltegger, & Zvezdov, 2011; Cook, 2009; Haque & Deegan, 2010; Hopwood, 2009; Kolk et al., 2008; Lohmann, 2009), and also makes reference to research associations of corporate carbon emission accounting and reporting issues. It is believed that those documents present the mainstream requirements or expectations of corporate carbon disclosures from society and stakeholders and represents the best practice of carbon emission disclosures. A score of "1" is awarded for each item in the index when the information is disclosed in either annual or standalone reports; otherwise a score of "0" is given. The total score thus ranges from 0 to 42.

3.2.2 Financial performance

There are two categories of financial performance: accounting based performance and market based performance. Accounting performance indicators mainly include return on equity, return on asset, which are based on the information from corporate financial statements. The argument for the positive association between CSR and accounting performance is mainly based on stakeholder theory (Preston and O'Bannon, 1997, Salama, 2005, Hatch and Cunliffe, 2012) The argument for the negative association between CSR and accounting performance is based on agency theory (Barnea & Rubin, 2010; M. Friedman, 1970) However, the impact of CSR is not only on the accounting performance; CSR is recognised as a kind of corporate investment that creates opportunities to enhance organizational financial performance in the future (Jones, 1995), so socially, environmentally responsible companies are likely to be viewed more favourably by investors (Friedman & Miles, 2001; Hoepner, Oikonomou, Scholtens, & Schröder, 2016; Majoch, Hoepner, & Hebb, 2016). Consistent with the prediction of the resource based view (stakeholder theory) one can argue that companies with more engagement in CSR are likely to benefit from higher share prices. In recent studies, market based financial performance is widely used in CSR studies ((Balabanis, Phillips, & Lyall, 1998; Cho & Roberts, 2010; Clarkson, Li, Pinnuck, & Richardson, 2014; Ingram, 1978; Jacobs, Singhal, & Subramanian, 2010; Lee et al., 2015; Matsumura et al., 2013; Murray, Sinclair, Power, & Gray, 2006; Patten & Nance, 1999; Qiu et al., 2016; Saka & Oshika, 2014; Salama, 2005; Shane & Spicer, 1983). In this study, market based financial performance is employed to fully reflect the impact of corporate carbon reduction engagement through carbon emission performance and also carbon emission disclosure. Monthly total return index from 2011 to 2013 is first collected from Thomson Reuters Datastream and annual returns are calculated for full firm year observation. Sector

average return is then subtracted to obtain the sector adjusted return (Kang & Shivdasani, 1995).

3.2.3 Carbon emission

While we are aware of the weaknesses of quantitative carbon emissions data (Liesen, Hoepner, Patten, & Figge, 2015; Yu, Hoepner, & Adamsson, 2016), these quantitative data points albeit insufficient are still used frequently in the literature (Clarkson et al., 2015; Saka & Oshika, 2014). Yearly total carbon emission from 2010 to 2012 is downloaded from environmental, social and governance (ESG) data powered by Thomson Reuters ASSET4 on Datastream, is also used by extant literature (Ioannou & Serafeim, 2012; Ziegler, Busch, & Hoffmann, 2011). The ASSET4 database provides objective, relevant, and systematic corporate Environmental, Social and Governance performance information, and it contains more than 750 data points including all exclusion (ethical screening) criteria and all aspects of sustainability performance. There are more than 280 key performance indicators (KPI) integrated and structured into 18 categories. Emission related KPIs include CO₂ Equivalent Emission Total, CO₂ Equivalent Emission Direct (i.e. Scope 1), CO₂ Equivalent Emission Indirect (Scope 2) and CO₂ Equivalent Indirect Emissions (Scope 3). However, data availability on the individual scopes is, unfortunately, limited, since a significant proportion of companies only reports aggregated emissions instead of emissions by scope.³ Hence, due to this data in availability, we use only at corporate total carbon emissions (i.e. CO₂ Equivalent Emission Total).

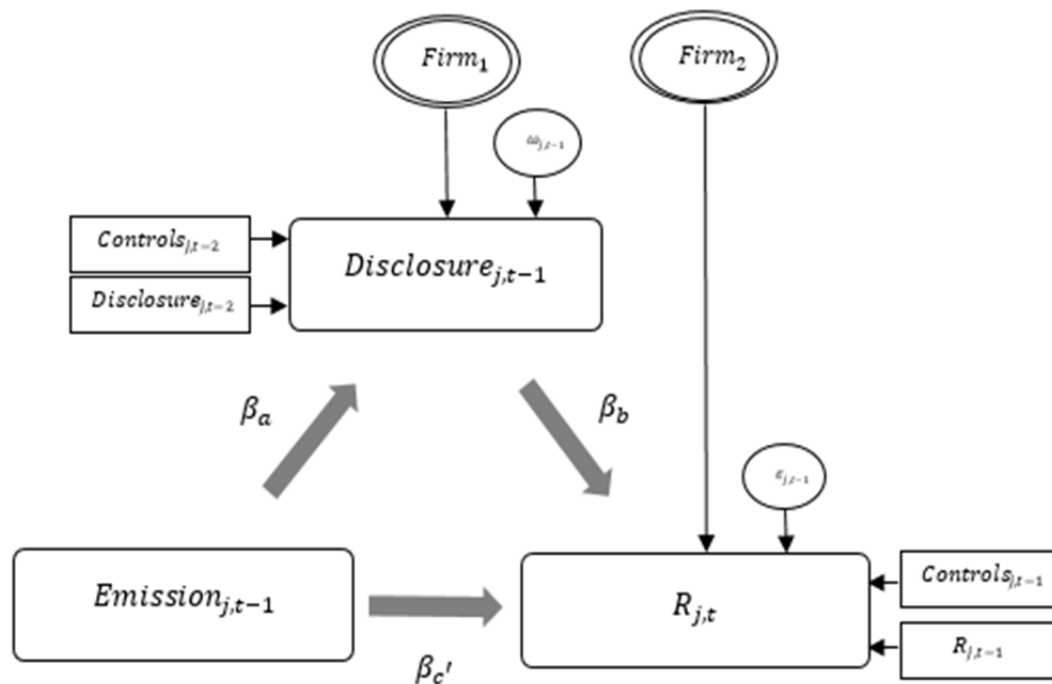
3.3 Empirical model and tests

Two-level meditational modelling is designed to test mediated effects in clustered datasets and it is appropriate to accommodate independent and mediator variables measured in the longitudinal data. *Figure 1* indicates the hypothesised meditational relationship in a longitudinal dataset in which year observations are nested within the firm. The three interest variables – independent variable ($Emission_{j,t-1}$), mediator or mediation variable ($Disclosure_{j,t-1}$) and dependent variable ($R_{j,t}$) – are all measured at firm (year observation) level. It illustrates that carbon emission performance in previous years relates to carbon disclosure during that same year which in turn relates to the firm financial performance in the current year. It is also noted that there is a direct relation of $Emission_{j,t-1}$ to $R_{i,t}$ that is the direct effect of carbon emission on return. Another reason to lag the variables is to account for the potential existence of a contemporaneous, bidirectional association between carbon emission, carbon disclosure and

³ This is confirmed by ASSET 4 through email.

firm return. Control variables ($Controls_{j,t-1}$) are firm characteristics in year $t - 1$ that could affect firm return in year t . The reason to lag these firm characteristics in the model is based on the notion that resources available at the beginning of a fiscal period dictate spending for the period (Clarkson et al., 2011). Control variables ($Controls_{j,t-2}$) are firm characteristics in year $t - 2$ that could affect carbon disclosure in year $t - 1$. One year lagged return ($R_{j,t-1}$) and one year lagged disclosure ($Disclosure_{j,t-2}$) is also considered as a control variable. The symbols aside each arrow corresponding to the relation of carbon emission performance to carbon disclosure, β_a , the relation of carbon disclosure to return, β_b , the relation of carbon emission to return, β_c . The relation of carbon emission to return has a prime, $\beta_{c'}$, to reflect adjustment for the mediating variable.

Figure 1 Path diagram of two-level mediation model.



Variables in square boxes indicate observed variables. Variables in circles are error terms. $Emission_{j,t-1}$ indicates carbon emission performance for firm j in year $t - 1$. $Disclosure_{j,t-1}$ indicates carbon disclosure and is the mediator observed for firm j in year $t - 1$ and $R_{j,t}$ indicates firm sector-adjusted annual return and is the dependent variable observed for firm j in year t . $Controls_{j,t-1}$ are control variables observed in year $t - 1$ for firm j .

A two-level model is considered in which the subscript, t , refers to within firm level (level 1), and the subscript, j , refers to across firm level (level 2). The variables with j and t subscript shows that they can take on a unique value for each year observation t within firm j . According to

stakeholder theory, it is hypothesized that previous year ($t - 1$) carbon emission and carbon disclosure affect the current year (t) firm financial performance. Following this hypotheses and the notation of Kenny, Korchmaros, and Bolger (2003) and Krull and MacKinnon (2001) a two-level mediation model is depicted with the following two equations. Two-level mediation estimation include (1) a regression equation predicating firm financial performance from the previous year carbon emission and carbon disclosure variable; and (2) a regression equation predicting carbon disclosure from carbon emission performance.

$$1) \quad \text{Level 1: } R_{j,t} = \beta_{0j} + \beta_{c'} Emission_{j,t-1} + \beta_b Disclosure_{j,t-1} + \beta_3 R_{j,t-1} + \beta_2 Controls_{j,t-1} + \epsilon_{j,t-1}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \mu_{0j}$$

$$2) \quad \text{Level 1: } Disclosure_{j,t-1} = \beta_{0j} + \beta_a Emission_{j,t-1} + \beta_4 Disclosure_{j,t-2} + \beta_5 Controls_{j,t-2} + \omega_{j,t-1}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \mu_{0j}$$

Where $Emission_{j,t-1}$ is the independent variables observed for firm j in year $t - 1$, $Disclosure_{j,t-1}$ indicates carbon disclosure and is the mediator observed at for firm j in year $t - 1$ and $R_{j,t}$ indicates firm financial performance and is the dependent/outcome variable observed at year t for firm j . $Controls_{j,t-2}$ is the control variables observed in year $t - 2$ for regression equations predicting the carbon disclosure and $Controls_{j,t-1}$ is the control variables observed in year $t - 1$ for regression equations predicting the firm financial performance respectively. One year lagged return ($R_{j,t-1}$) and one year lagged disclosure ($Disclosure_{j,t-2}$) are considered as control variables in regression (1) and (2) respectively. This set of equation includes a within firm level (Level 1) equation and an across firm level equation (level 2).

The intercept term (β_{0j}) has been indexed by the subscript j , which suggest that it is treated as a random intercept and varies across firm level units. It equals an overall mean of the intercept (γ_{00}) and a deviation from the mean for each across firm level unity (μ_{0j}). It is this second level error term (μ_{0j}) that allows the two - level model to address within firm homogeneity of errors in the longitudinal data.

The slops in level 1 of all three regressions $\beta_{c'}, \beta_a, \beta_b$ are path coefficients. The direct effect carbon emission on firm financial performance controlling the mediator (carbon disclosure) is designated, $\beta_{c'}$, the effect of carbon disclosure on the dependent variable is designated, β_b , and the effect of carbon emission on carbon disclosure is designated, β_a . The product $\widehat{\beta}_a \widehat{\beta}_b$ is a

second point estimate of the mediated effect, which evaluates the extent to which carbon emission affects carbon disclosure and the extent to which the carbon disclosure, in turn, affects firm financial performance. The path coefficient is measured by the standardized regression coefficient. It represents the change in the dependent variable for a 1 standard deviation change in the independent variable. The error term $\epsilon_{ij,t-1}$ represents the part of return that is not explained by its relation with carbon emission and carbon disclosure in regression (1). The error term $\omega_{ij,t-1}$ indicates the part of carbon disclosure that is not explained by its relation with carbon emission in regression (2).

In equation regression (2), the dependent variable is carbon disclosure and it is scored using the criteria described previously for the firm-year observation. It is non-negative and discrete and roughly following Poisson distribution. Thus, regression (2) is considered as Poisson regression equation.

4 Empirical results

4.1 Descriptive statistics

Table 1 Panel A reports summary statistics of the above variables including mean, standard deviation, minimum and maximum values. The main interest variables are carbon disclosure, carbon emission and sector-adjusted return. The mean and the standard deviation of carbon disclosure is 16.741 and 7.989 respectively, which suggests that the overall carbon emission is quite spread out over the range from 0 to 35. The mean and standard deviation of carbon emission are about 6 and 1 respectively with minimum value of 3.883 and maximum value of 7.929. And these summary statistics indicate that the overall variation of carbon emission is moderate. The summary statistics of firm sector-adjusted return suggest that the distribution is not dispersed and the data points are very close to the mean. However, as the data are longitudinal, details with decomposition are investigated within and between firm observations in *Table 1* Panel B.

The control variables descriptive statistics indicate that the most dispersed distribution is dividend yield. The distributions of return on equity, leverage and profit margin are also very dispersed. However, the size does not vary greatly with standard deviation of 0.595. A similar distribution pattern applies to capital expenditure with standard deviation of 0.813, minimum value of 3.791 and maximum value of 7.310.

Table 1**Panel A: summary statistics of variables.**

Variable	Obs	Mean	St.d	Min	Max
Carbon disclosure	185	16.741	7.989	0	35
Log carbon emission	173	6.051	1.011	3.883	7.929
Sector adjusted return	185	0.001	0.027	-0.097	0.064
Log (MV)	182	4.113	0.595	1.269	5.149
MTBV	179	2.949	4.061	-43.438	12.078
Profit margin	184	19.702	13.325	-0.02	61.79
Leverage	184	35.762	20.161	0	99.245
Dividend yield	182	21.484	157.310	0	1725.605
Current ratio	184	1.505	0.997	0.213	6.53
Capital expenditure	184	5.604	0.813	3.791	7.310
Return on equity	181	23.801	30.009	-29.92	338.268

Panel B: Within and between firm summary statistics of interest variables.

Variable	Mean	St.d	Min	Max	Observation
Carbon disclosure					
Overall	16.741	7.989	0	35	N=185
Between		7.653	0	33.667	N=62
Within		2.361	6.407	25.074	T-bar=2.98
Sector adjusted return					
Overall	0.001	0.027	-0.097	0.064	N=185
Between		0.015	-0.046	0.045	N=62
Within		0.023	-0.071	0.068	T-bar=2.98
Log(Carbon emission)					
Overall	6.051	1.011	3.889	7.929	N=173
Between		0.997	3.916	7.920	N=60
Within		0.164	4.470	6.845	T-bar=2.88

Table 1 panel B decomposes the standard deviation, minimum and maximum values into 'between' and 'within' components for the independent variables (carbon emission), mediation variable (carbon disclosure in annual report) and outcome variable (firm sector adjusted return).

The mean of firm sector adjusted return is close to 0 with minimum value of -0.097 and maximum value of 0.064 . The standard deviations of sector adjusted return between firm and within firm are 0.015 and 0.023 (close to overall St.d of 0.027) respectively. These summary statistics indicate that sector-adjusted return changes more over the sample time than across firm dispersion. The overall mean of carbon disclosure is 16.7 with minimum value of 0 and maximum value of 35 . And the standard deviation of carbon disclosure between firm is 7.653 suggests that carbon disclosure is quite dispersed between firm. However, within firm standard deviation is only 2.361 indicate that the carbon disclosure does not change much during the sample period 2010–2012. The mean of log carbon emission is about 6.051 with minimum value of 3.889 and maximum value of 7.929 . The standard deviations across firm and within firm are 0.997 and 0.164 respectively, which indicates that carbon emission is more spread out between firm compared with within firm variation. This is a very interesting finding: carbon disclosure variance between and within firms follows the same pattern as carbon emission.

4.2 Analysing the interrelationship

The standardised regression coefficient is reported in the results in *Table 2*. It is rescaled regression coefficient to measure the effect size in the mediated effect. The direct effect of carbon emission on firm sector-adjusted return is measured by $\beta_{c'}$ and estimated to be -0.004 . This negative effect is small but statistically significant. It indicates that one standard deviation increase of carbon emission decreases firm sector-adjusted return by 0.004 standard deviation. The path coefficient β_a indicates the effect of carbon emission on carbon disclosure and is estimated to be 0.18 . It is a moderate effect and highly statistically significant. This result suggests that one standard deviation increase in carbon emission increases carbon disclosure by 0.18 standard deviation. The effect of carbon disclosure on sector-adjusted return is measured by β_b . This effect is very small (0.0004) and marginally statistically significant. It indicates that carbon disclosure in year $t - 1$ positively associated with sector-adjusted return in year t , however, the influence is very small. The result of β_a and β_b together suggest that carbon emission performance affects carbon disclosure in firm annual report and which in turn, affects the firm return. Thus we could argue that carbon disclosure in the previous year annual report is a mediator of the effect of carbon emission on the firm's financial performance. The indirect effect of carbon emission on firm return is the effect of carbon emission on carbon disclosure (β_a) multiplied by the effect of carbon disclosure on return (β_b), and it is almost negligible. The total effect of carbon emission on sector-adjusted return equals the direct effect ($\beta_{c'}$) plus the indirect effect $\beta_a * \beta_b$, and the result is -0.0037 . It is argued that carbon emission in previous years is negatively associated with firm sector-adjusted return, however this effect is small.

Table 2 Parameter and standard error estimates for two-level mediation model.

Parameters	Estimates	Standard Error	95% confidence interval	
			Lower	Upper
Direct Effects on firm sector-adjusted return (regression equation 1)				
Carbon emission ($\beta_{c'}$)	-0.0038**	0.0019	-0.0075	-0.0001
Carbon disclosure(β_b)	0.0004*	0.0002	-0.0000	0.0008
Industry control	Yes			
Firm characteristics control	Yes			
Lagged return control	Yes			
M1 [firm id]	Constrained to 1			
Carbon emission effects on carbon disclosure (regression equation 2)				
Carbon emission (β_a)	0.1788***	0.0578	0.0654	0.2922
Lagged carbon disclosure	0.0346***	0.0051	0.0246	0.0445
MV	0.0518	0.0923	-0.1290	0.2327
MTBV	-0.0070	0.0044	-0.0157	0.0017
Capital expenditure	-0.1467*	0.0824	-0.3083	0.0148
Leverage	-0.0018	0.0016	-0.0048	0.0014
Profit margin	0.0039	0.0025	-0.0009	0.0088
Industry control	Yes			
M2 [firm id]	Constrained to 1			
Variances				
Variance (M1)	2.15e-35	1.80e-20		
Variance (M2)	0.0178	0.0125	0.0037	0.0733
Variance (e. return)	0.0002	0.0000	0.0002	0.0003
Observation	113			

Notes: *, **, and *** denote statistical significant at 10%, 5% and 1% levels respectively.

Looking at the factors that affect carbon disclosure, it is reported that, as expected, previous year carbon disclosure is a significant predictor of the current year carbon disclosure. It is also found that capital expenditure is negatively related to carbon disclosure. Other firm characteristics, such as size, profit margin, current ratio, return on equity and leverage do not seem to exert influence on carbon disclosure in annual reports. One explanation is that those firm characteristics are likely being captured by carbon disclosure in the annual report in the same year.

The variance of M1 and M2 indicates the extent to which the strength of the across-firm difference explains the dependent variables in regression (1) and regression (2). The estimated variance of M1 in regression equation (1) is almost negligible. The variance of M2 in regression (2) is estimated to be 0.018 – a small size. This indicates that across-firm difference is more influential in explaining carbon disclosure in annual report than in explaining sector-adjusted return.

5 Discussion

The results are in support of H1, H2 and H3 and are also consistent with prior studies (Cho & Patten, 2007; Clarkson et al., 2011; Hassan & Kouhy, 2014; E.-H. Kim & T. Lyon, 2011; Matsumura et al., 2013; Patten, 2002; Saka & Oshika, 2014). Overall, the simultaneous association among the three variables indicates a mechanism of the underlying relationship between corporate carbon emission and financial performance – carbon emission has a direct negative effect on corporate financial performance and an indirect or mediated effect through carbon disclosures. The results confirm the mediating effect of carbon disclosures.

The direct effect of carbon emission on corporate subsequent share return implies that the capital market does respond to corporate carbon emission. The results are consistent with prior studies suggesting that market analysts increasingly gather corporate environmental information as an indicator of corporate future capital market returns (Kiernan, 1998). Since the launch of the Kyoto Protocol in 1997, climate change and corporate carbon emissions have become a central aspect of the corporate environmental issue, but scholars have only started to pay more attention to the association between corporate carbon emission and corporate financial performance over the last couple of years. The results for the link between carbon emission and financial performance is more consistent than that between holistic environmental performance and financial performance. The earlier environmental performance–financial performance link studies show evidence that corporate environmental engagement is negatively linked with financial performance; the capital market takes such activities more as a financial burden (Jaggi & Freedman, 1992). In the more recent views of corporate environmental performance, the intangible and reputational impact has been recognised to explain the financial benefit of improving corporate environmental performance (Salama, 2005). With regards to the negative impact of corporate carbon emission on the subsequent financial performance, it provides evidence that lower carbon emission can increase shareholders' wealth and earn profits above the return on its tangible assets. Tackling carbon emissions allows companies to lower the costs of complying with further environmental

regulations (e.g., more carbon reduction regulations would be expected following the Paris Climate Summit in 2015 as a result of the first global agreement in carbon reduction), drive down corporate operating costs, improve their corporate reputation, enhance the loyalty of key stakeholders who equate companies with their environmentally friendly side, and enhance corporate financial performance. This result is consistent with prior studies showing that the market does negatively respond to corporate carbon emission (Busch & Hoffmann, 2011; Clarkson et al., 2015; Matsumura et al., 2013; Saka & Oshika, 2014).

The indirect effect of corporate carbon emission on subsequent share return works through the mediating impact of carbon disclosure. There is no known studies examining the links between corporate carbon disclosure in annual or standalone CSR reports, corporate carbon emission and financial performance. Prior studies use corporate response to CDP as proxy for corporate carbon disclosure – 0 score for no response and 1 score for response – without consideration of the extent of disclosure (Lee et al., 2015; Matsumura et al., 2013; Saka & Oshika, 2014). Still, those studies could shed light on the results of the current study and the results found in this study are consistent with those prior studies, indicting the mediating influence of carbon disclosures. On one hand, carbon disclosure is found to be positively associated with subsequent corporate financial performance. In general, disclosures provide benefits through reduced information asymmetry between the company and outsiders, including its investors, customers, lobby institutions, and subsequently facilitates efficient allocation of scarce resources (Healy & Palepu, 2001). Companies making truthful voluntary carbon disclosures deliver transparent nonfinancial information to investors. If companies do not disclose their carbon emission information, investors will not be able to impute the company's carbon emissions, but will also likely treat non-disclosure as an adverse signal and may penalise non-disclosing companies (Oikonomou, Brooks, & Pavelin, 2012, 2014). Voluntary disclosure is also used by companies to reduce further regulatory intervention (Blacconiere & Patten, 1994). On the other hand, carbon disclosure is found to be positively associated with concurrent carbon emission. A legitimacy gap is created when a company's carbon emission does not meet the expectation of the stakeholders. If a company suspects its social legitimacy is or might be threatened, it has the incentive to actively participate in policy process and to communicate its legitimacy repairing strategy to the stakeholders (Liesen et al., 2015). Subsequently, companies with more carbon emissions intend to disclose more extensive carbon emission information in an attempt to address the increased threats to their poor carbon emission performance. The above two aspects together explain why companies choose to make carbon emission disclosures even if the capital markets penalise companies for their carbon emissions. However, the carbon disclosure–financial performance link is inconsistent with some other studies. Lee et al. (2015)

investigate the association with a sample of companies from the CDP in Korea. Their results suggest that the market is likely to respond negatively to company's carbon disclosure, implying that investors tend to perceive carbon disclosure as bad news. One plausible explanation is that carbon related costs and benefits are more recognised in more developed countries, which have more experience in carbon emission issues and are more pronounced in promoting carbon reduction activities.

Another interest of this study is to investigate factors that could impact on corporate carbon disclosure. Looking at the factors that affect carbon disclosure, it is shown in *Table 2* that, as expected, previous year carbon disclosure is a significant predictor of the current year carbon disclosure; this result is highly consistent with the conclusion of the previous chapter, that corporate carbon disclosures become institutionalised and normative within and between companies. It is also found that capital expenditure is negatively related with carbon disclosure. This result is consistent with previous studies that indicate capital expenditure is found to be highly related with the level of corporate environmental disclosures and is usually controlled in environmental disclosure research (C. de Villiers & C. van Staden, 2011; C. de Villiers & C. J. van Staden, 2011; G. F. Peters & Romi, 2014; Tauringana & Chithambo, 2014). Companies with less capital expenditures are less likely to invest in carbon reduction innovative technologies and other carbon management investment; according to legitimacy theory, those companies would be more likely to disclose more information to maintain their operating legitimacy in society. Interestingly, other firm characteristics, such as size, profit margin, current ratio, return on equity and leverage, which are found to be determinant factors of corporate social and environmental disclosures in extant studies (Bewley & Li, 2000; Branco & Rodrigues, 2008; Liao et al., 2014), do not seem to exert influence on carbon disclosure in annual and standalone reports. One plausible explanation is that those firm characteristics are likely being captured by carbon disclosure in the same year.

6 Summary and conclusion

This study investigates the simultaneous relationship between corporate carbon emission performance, financial performance and corporate carbon disclosures, for an extensive panel data sample of 62 FTSE 100 companies between the years 2010 and 2012. In addition, the study is also interested in the determinant factors of the extent to which companies disclose their carbon emission information. The corporate carbon disclosure data was collected from hand review of reports using a self-constructed disclosure index that represents the best practice and stakeholders' expectations of corporate carbon emission information. The rest of the data was

downloaded from Datastream. The structural equation modelling analysis shows that corporate carbon emission impacts on corporate financial performance through both direct and indirect mechanisms. For the direct impact, it is found that corporate carbon emission is negatively associated with corporate financial performance, which indicates that the UK market does respond to corporate carbon emission performance. For the indirect impact, the results show that corporate carbon emission is positively related to the level of corporate carbon disclosures (companies with more carbon emissions make more extensive disclosures), and also show a significant positive relation between corporate carbon disclosure and corporate financial performance (more carbon disclosures lead to higher subsequent share return for the company). Thus, the higher levels of corporate carbon disclosures appear to mediate the potential negative effects of more carbon emissions of the company. The results are consistent with prior studies investigating the three links respectively.

The findings are also consistent with the predictions of socio-political theories and economic disclosure theories. The study provides evidence that the market does value corporate carbon emission issues, including both actual carbon emissions and the carbon emission related information published in annual and standalone reports. Consistent with both socio-political and economic disclosure theories, companies with higher carbon emissions would try to keep their legitimacy to operate in society by increasing their carbon disclosure to address the legitimacy threat. The increased disclosures therefore reduce information asymmetry and investors can gauge how well the companies are managing their carbon emission risks and how well they are equipped to tackle the risks in the future.

This study also evidences that previous year carbon disclosure is a significant predictor of the current year carbon disclosure. Corporate carbon disclosures become institutionalised and normative within and between companies. It is also found that capital expenditure is negatively related with carbon disclosure. Companies with less effort in their investment are more motivated to communicate with their stakeholders through increased level of disclosures. Other firm characteristics, such as size, profit margin, current ratio, return on equity and leverage do not seem to exert influence on carbon disclosure in annual reports. One plausible explanation is that those firm characteristics are likely being captured by the control of last year carbon disclosures.

Like all research, ours is subject to limitations. The first limitation lies in the subjectivity of building a disclosure score rating index to arrive at an aggregate disclosure quality score. It is also the inherent limitation of qualitative content analysis. The selection of index units and categories could be arbitrary. The author managed to reduce the subjectivity by referring to

extant environmental disclosure, carbon reporting literature, and also carbon reporting guidance and regulations. Secondly, our sample is restricted to the largest UK carbon-sensitive companies – the sample size is therefore relatively small. Based on our results, the quality of carbon disclosures among those companies remains low and there is still companies making no carbon disclosures at all. Therefore, including more companies in the sample would not improve the quality of the study. Due to data availability, this study only employs corporate total carbon emission as measurement of corporate carbon emission performance. The enacted 2013 carbon disclosure regulation in the Companies Act 2006 requires companies to disclose their direct (scope 1 and 2) and indirect (scope 3) emissions. Further research could be done when the data is available to investigate if the financial market reacts differently to different types of carbon emissions and if different types of carbon emissions have a different determinant impact on carbon emission related disclosures.

Appendix

Extending the methodology used by Haque and Deegan (2010) the selection criteria for these items is the key issue and is addressed in at least two of the literature sources and in corporate reports. The index also focuses on the usefulness of the information disclosed by companies. For example, if the organization discloses that it funds other organization's carbon reduction research, it is useful for users of the reports to know the amount of the funding, in order to assess the impact of this activity. Consequently, such complementary items are included in the index to ensure organizations that disclose useful information receive higher scores than organizations that only disclose information that is superficial and/or intended to improve their image.

Specific issues	Description	Literature background	Examples
1. Whether the CEO/chairperson articulates the organisation's views on the issue of climate change through publicly available documents such as annual reports, sustainability reports.	Whether carbon emission issues are in the chairman's and executive's letters.	Haque and Deegan (2010), CDP (2012), DEFRA (2013)	'We apply a carbon price to some of our new projects, and require existing operations to consider and implement cost-effective efficiency measures.' (BP, SA2012 CEO Letter, P4)
2. Whether any quantitative carbon emission performance information is included in CEO/chairman's reports.	The context of the quantitative information.	DEFRA (2013)	'Sadly, greater transparency of North American activities has caused an apparent increase from 2.3 to 3.8 tonnes of carbon per employee...' (Amec, AR2012, CEO Letter, p9)
3. Whether carbon emission issues are under the supervision of the Board or executive management team.	Whether carbon emission issues are in the statement of responsibility of Board, individual position statements, or board committee or whether a specific	Haque and Deegan (2010), CDP (2012)	'Following this, the Sustainability Committee has overseen the introduction of a new target for the next five years, which aims to reduce the overall intensity of the Group's GHG emissions by 10%'.(BG, AR 2012, P56)

	board committee exists to deal with carbon issues, from the name of committee and risk management system.		
4. Whether the organization has a general knowledge of carbon emission reduction but no target or result is stated (qualitative policy).	General strategy /policy.	CDP (2012), DEFRA (2013)	'While energy is available to meet growing demand, action is needed to limit carbon dioxide.' (CO ₂)(BP, AR2012,P13)
5. Whether the organization implements or plans to implement any specific carbon management schemes or strategies.	Whether carbon reduction initiatives are implemented or planned within the organizations.	WBCSD and WRI (2004), DEFRA (2013)	'Introduction of new carbon software allowed far greater transparency of data, resulting in a significant increase in the number of offices reporting utility usage, particularly in the Americas'. (Amec, SA 2012, P39)
6. Whether the organization has a future quantitative target for carbon emission reduction.	Quantitative targets.	Haque and Deegan (2010), CDP (2012), DEFRA (2013), Ratnatunga and Balachandran (2009)	Our long term targets form part of our strategy and remain at: 15 per cent reduction in CO ₂ by 2013, 40 per cent reduction in CO ₂ by 2020, 60 per cent reduction in CO ₂ by 2030, 80 per cent reduction in CO ₂ by 2050. (AMEC, SA2012, P38)
7. Whether the organization discloses the methodology or methodologies used to measure or calculate carbon emissions.	Methodology disclosed or reference or link provided.	GRI (2011), GRI (2013), WBCSD and WRI (2004), DEFRA (2013)	'We have reported for more than a decade using the global World Resources Institute/World Business Council on Sustainable Development (WRI/WBCSD) GHG protocol which sets out how to measure and account for emissions.' (BG, SA 2012, P8)
8. Whether the organization conducts its carbon measurement in accordance with any carbon footprint measurement	High quality of information and data if the	GRI (2011), GRI (2013), CDP (2012), DEFRA (2013)	'We have reported for more than a decade using the global World Resources Institute/World Business Council on Sustainable Development (WRI/WBCSD) GHG protocol which

standard, e.g. GHG Protocol, ISO 14064-1, BS 8901, UK Government's Environmental Reporting Guidance WRI/WBCSD, Climate Change Agreements, EU ETS, The Carbon Reduction Commitment Energy Efficiency Scheme (CRC Energy Efficiency), and reporting standards in other countries.	organization complies with any measurement standard.		sets out how to measure and account for emissions.' (BG, SA 2012, P8)
9. Whether the organization discloses the consolidation approach for carbon emissions and/ or any changes during the reporting period.	Boundary of the organization, e.g., Equity shares, financial control or operational control approach.	GRI (2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	'We report GHG emissions on a CO ₂ -equivalent basis, including CO ₂ and methane. This represents all consolidated entities and BP's share of equity accounted entities except TNK-BP'. (BP,SA2011, P38)
10. Whether the organization defines and reviews the operational boundary.	Operational /inventory boundary, e.g., direct emissions and indirect emissions; scope 1, scope 2, scope 3 emissions.	Haque and Deegan (2010), GRI (2011), GRI (2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	'Our only significant source of Scope 2 emissions (indirect emissions that arise from the consumption of purchased electricity, heat or steam) is electricity.'(BG, SA 2012, P9)
11. Whether the organization sets up a base or baseline year to measure and/or compare its carbon emissions.	Baseline or benchmark.	DEFRA (2013), WBCSD and WRI (2004), CDP (2012), DEFRA (2013)	'We are therefore treating 2012 as our baseline year for CO ₂ emissions.' (Tullow, SA 2012, P42)
12. Whether the organization adopts absolute quantitative disclosures of its direct carbon emission (scope 1).	Gross direct carbon emission quantities.	GRI (2011), GRI (2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	'Our direct GHG emissions were 59.8 million tonnes (Mte) in 2012, compared with 61.8Mte in 2011, a decrease of 2.0Mte versus 2011.(BP,AR2012, P52)
13. Whether the organization adopts	Performance	GRI (2011), (GRI,	Our direct GHG emissions were 59.8 million tonnes (Mte) in

quantitative comparison of direct carbon emission (scope 1), with either previous year/years, or with the baseline year.	compared with historical data.	2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	2012, compared with 61.8Mte in 2011, a decrease of 2.0Mte versus 2011.(BP,AR2012, P52)
14. Whether the organization adopts absolute quantitative disclosures of its indirect carbon emission from purchasing energy (scope 2).	Gross indirect carbon emission quantities.	GRI (2011), GRI (2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	Indirect carbon dioxide (CO ₂)h (Mte), 9.2 (2008), 9.6 (2009), 10 (2010), 9 (2011), 8.4 (2012) (BP,SA2012, P48)
15. Whether the organization adopts quantitative comparison of its indirect carbon emission (scope 2), with either previous year/years, or with the baseline year.	Performance compared with historical data and/or targets.	GRI (2011), GRI (2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	Indirect carbon dioxide (CO ₂)h (Mte), 9.2 (2008), 9.6 (2009), 10 (2010), 9 (2011), 8.4 (2012) (BP,SA2012, P48)
16. Whether the organization uses intensity ratios to disclose its scope 1 and scope 2 carbon emission information.	Ratios that compare scope 1 and 2 emissions data with relevant business metrics or financial indicators.	DEFRA (2013), WBCSD and WRI (2004), GRI (2013)	Sadly, greater transparency of North American activities has caused an apparent increase from 2.3 to 3.8 tonnes of carbon per employee, despite many good initiatives in other areas.(Amec, AR 2012, P9)
17. Whether the organization makes any quantitative disclosures of other indirect carbon emission (scope 3).	Gross scope 3 carbon emission quantities.	GRI (2011), GRI (2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	'Customer emissions (MteCO ₂): 530 (2008), 554 (2009), 573 (2010), 539 (2011), 517 (2012)'.(BP,SA2012, P48)
18. Whether the organization makes quantitative comparison of its other indirect carbon emission (scope 3), with either previous year/years, or with baseline year.	Performance compared with historical data and/or targets.	GRI (2011), GRI (2013), CDP (2012),WBCSD and WRI (2004)	'Customer emissions (MteCO ₂): 530 (2008), 554 (2009), 573 (2010), 539 (2011), 517 (2012)'.(BP,SA2012, P48)

19. Whether the organization uses intensity ratios to disclose its scope 3 carbon emissions.	Ratios that compare scope 3 emissions data with relevant business metric or financial indicators.	DEFRA (2013), GRI (2013), WBCSD and WRI (2004)	'Tonnes carbon per £million turnover, total scope ('000 tonnes carbon), 22.6 (2012)...'(Amec, SA 2012, P71)
20. Whether the organization breaks down the carbon emissions, e.g., by the organization's activities, products or services, combustion of fuel, operation of facilities, electricity, heat etc.	Emission sources.	GRI (2011), GRI (2013), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	'Around 55% of our GHG emissions came from the refineries and chemical plants in our downstream business. The production of oil and gas in our Upstream business accounted for around 40% of our GHG emissions, and our shipping activities for the remaining 5%.'(SHELL,SA 2011,P28)
21. Whether the organization explains its carbon performance and/ or any significant changes of its carbon performance.	Reasons that caused significant increase or reduction of carbon emissions.	DEFRA (2013), WBCSD and WRI (2004)	'Our absolute emissions rose significantly in 2012, due to better inclusion of more complete data from our Americas business. We will be reviewing this in 2013 and looking at re-base lining our 2008 data following numerous acquisitions.' (AMEC, SA, 2012, P8)
22. Whether the organization has any disclosures of financial implications of carbon emission.	Implications of carbon emission issues on financial statements/financial performance.	CDP (2012), Burritt et al. (2011)	'Approval of the project will allow EVRAZ NTMK to exercise its right to sell Emission Reduction Units (ERUs). The Group expects that total revenues from the sale of ERUs under the EVRAZ NTMK project could be in the region of US\$28 million.'(Evraz, AR,2010, P57)
23. Whether the carbon emission data disclosed by the organization is independently verified by a third party.	Whether the data disclosed is verified independently.	Haque and Deegan (2010), CDP (2012), WBCSD and WRI (2004), DEFRA (2013)	'Independent assurance statement to Tullow Group Services Limited on the Tullow Oil plc 2012 Corporate Responsibility Report.' (Tullow, SA 2012, P71)
24. Whether the third party gives unqualified opinion of organization's carbon disclosures.	Unqualified opinion indicates high quality of disclosures.	Haque and Deegan (2010), CDP (2012), WBCSD and WRI (2004), DEFRA	'Based on the scope of our work and the assurance procedures we performed, nothing has come to our attention that causes us to believe that the selected CR performance indicators compiled as described in Tullow Oil's basis of reporting and presented on pages 72-76 are materially misstated.'(Tullow,

		(2013)	SA 2012, P71)
25. Whether the organization makes any disclosures of its carbon allowance recognition policy (net position method or donated asset method).	Accounting policies.	Bebbington and Larrinaga-Gonzalez (2008), Cook (2009), Hopwood (2009), Lohmann (2009)	'Allowances, whether issued by government or purchased, are accounted for as intangible assets in accordance with IAS 38 'Intangible Assets'. Allowances that are issued for less than fair value are measured initially at their fair value.' (EVRAZ, AR, 2010,P131)
26. Whether the organization makes any disclosures of its valuation basis to measure its carbon items in financial statements.	Accounting policies.	Bebbington and Larrinaga-Gonzalez (2008), Hopwood (2009), Lohmann (2009)	'When allowances are issued for less than fair value, the difference between the amount paid and fair value is recognised as a government grant. Initially the grant is recognised as deferred income in the statement of financial position and subsequently recognised as income on a systematic basis over the compliance period for which the allowances were issued, regardless of whether the allowances are held or sold.'(EVRAZ, AR, 2010,P131)
27. Whether the organization has a policy of compliance with any guidance to report its carbon emissions e.g., GRI, DEFRA Guidance, Climate Change Reporting Framework (CCRF).	Compliance with reporting standards implies high quality of disclosures.	Haque and Deegan (2010), CDP (2012), DEFRA (2013)	'This report applies the Global Initiative G3.1 Guidelines and Oil and Gas Sector Supplement, which are designed to help organisations measure and report on their economic, environmental and social performance over time'. (Tullow, SA 2012, P70)
28. Whether the organization discloses or plans to disclose its carbon information to CDP.	Voluntary response to CDP represents the organization's carbon emission disclosure strategy.	Kolk et al. (2008), G. Peters and Romi (2009)	'We have been disclosing to the Carbon Disclosure Project since 2007'.(Amec, SA 2012, P42)
29. Whether the organization recognizes its regulatory and compliance risks.	Risk arising from the changing of carbon measurement, trading or reporting standards.	Haque and Deegan (2010), CDP (2012), WBCSD and WRI (2004)	'In the future, we expect that additional regulation of GHG emissions aimed at addressing climate change will have an increasing impact on our businesses.'(BP,AR2012, P52)

<p>30. Whether the organization recognizes the risk of the carbon price.</p>	<p>Risk arising from the changing of the carbon price.</p>	<p>Ratnatunga and Balachandran (2009), Lohmann (2009)</p>	<p>'Climate change and carbon pricing policies could result in higher costs and reduction in future revenue and strategic growth opportunities.'(BP,AR2012, P38)</p>
<p>31. Whether the organization pursues strategies to minimise exposure to potential regulatory or compliance risks.</p>	<p>E.g., the organization pursues a policy to work closely with government or policy makers, or advances its practice according to government documents.</p>	<p>CDP (2012), Ratnatunga and Balachandran (2009)</p>	<p>'During 2012, we prepared for the implementation of new government carbon pricing and trading legislation in key markets and collaborated with industry partners on important issues such as fugitive emissions.' (BG, SA 2012, P4)</p>
<p>32. Whether the organization recognizes any other carbon-related risks.</p>	<p>Disclosures of relevant or potential implications of carbon risks.</p>	<p>CDP (2012), Burritt et al. (2011), Ratnatunga and Balachandran (2009)</p>	<p>'Compliance with changes in laws, regulations and obligations relating to climate change could result in substantial capital expenditure, taxes, reduced profitability from changes in operating costs, and revenue generation and strategic growth opportunities being impacted.' (BP, AR2012, P38)</p>
<p>33. Whether the organization endeavours to achieve energy efficiency and/or renewable energy to reduce carbon emissions.</p>	<p>Whether the organization purchases or develops renewable energy, or improves its utilization of energy.</p>	<p>Haque and Deegan (2010), WBCSD and WRI (2004), Ratnatunga and Balachandran (2009)</p>	<p>'policies that emphasize efficiency in production and energy use as reducing the amount of energy used can have a material impact on GHG emissions'.(BP,SA2012, P16)</p>
<p>34. Whether the organization discloses its investment in energy efficiency and/or renewable energy.</p>	<p>Quantitative disclosure of investment or cost in energy efficiency or renewable</p>	<p>Burritt et al. (2011), Ratnatunga and Balachandran (2009)</p>	<p>'During 2011, we invested a further \$1.6 billion in our Alternative Energy business, which takes total investment since 2005 to \$6.6 billion.'(BP,AR2011, P17)</p>

	energy.		
35. Whether the organization endeavours to develop lower-carbon technology.	Lower-carbon technology other than energy efficiency or renewable energy.	Haque and Deegan (2010), Burritt et al. (2011)	'BP is continuing to take a number of practical steps, including investing in lower-carbon energy products...'(BP,AR2012, P52)
36. Whether the organization discloses the amount of its investment in lower-carbon technology.	Disclosure of the amount of cost or investment.	CDP (2012), Burritt et al. (2011)	'Since 2005 we have invested \$7.6 billion in lower-carbon businesses.'(BP, AR2012, P27)
37. Whether the organization endeavours to improve its business process to reduce carbon emissions.	Improvement of business processes other than energy efficiency or renewable energy.	Burritt et al. (2011), Ratnatunga and Balachandran (2009)	'During 2012 we encouraged the use of electronic communication tools instead of physical travel to meetings.'(Amec, SA 2012, P41)
38. Whether the organization trains its employees and/ or its value chain organizations and/ or its customers in carbon emission issues or encourages its suppliers to reduce carbon emissions.	Employee training and/ or customer carbon reduction service.	Haque and Deegan (2010), Ratnatunga and Balachandran (2009)	'In addition, we work to help our customers conserve energy and reduce their CO ₂ emissions, including through the development and sale of advanced fuels and lubricants...'(Shell, AR2012, P47)
39. Whether the organization works with any other organizations to identify carbon reduction issues.	Co-operation with other organizations or participation in any carbon reduction projects or schemes.	Haque and Deegan (2010)	'BP is a founding member of the UK's Energy Technologies Institute-a public/private partnership established in 2008 to accelerate lower-carbon technology development.' (BP, AR2012, P58)
40. Whether the organization funds any organizations involved in carbon emission issues.	Provision of funding to other organizations in carbon reduction	Haque and Deegan (2010)	'BP is funding the Energy Sustainability Challenge, a consortium of academics that is analysing the complex relationships between energy and natural resources.'(BP, SA2012, P5)

	research or projects.		
41. Whether the organization discloses the amount of funding of professional organizations.	Quantitative disclosure of funding.	CDP (2012)	'Developed under the direction of scientists at the University of Miami's Rosenstiel School of Marine and Atmospheric Science, the devices gather a wide range of data to aid in assessing ocean pollution and researching global climate change and cyclic weather patterns. ... In addition to providing ships as platforms for the required equipment, Carnival has also supported the organization with annual contributions of \$50,000 since 2008.'(Carnival, SA 2011, P57)
42. Whether the organization recognizes any other carbon-related opportunities.	Disclosures of any other carbon-related opportunities recognized by the organization.	CDP (2012), Burritt et al. (2011), Ratnatunga and Balachandran (2009)	'We ran workshops in partnership with the Carbon Trust this year to help 80 UK SMEs improve their understanding of climate change and develop action plans to reduce their impact.' (BT, AR 2011, P38)

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