

PERFORM TO DISCLOSE OR DISCLOSE TO PERFORM: WHICH DRIVES WHICH?

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ABSTRACT

With corporate disclosure of carbon emissions rapidly increasing, there is a long standing question as to how carbon disclosure is associated with the development of carbon performance. Using a sample of Global 500 companies and their carbon emission and disclosure data released during 2008 and 2011, this study finds that from performance to disclosure, companies with poorer carbon performance (reflected as higher carbon intensity) in preceding years consistently achieve better carbon disclosure scores in subsequent years. However, from disclosure to performance, companies having better carbon disclosure in preceding years consistently improve their carbon performance subsequently. Putting these findings together, there may be a continuum between carbon disclosure and performance. The pattern may be that at first, poorer carbon performers try to achieve higher levels of carbon disclosure to legitimise and compensate their poor performance. Then once their disclosure is improved, they are motivated to use disclosure as an “outside-in” opportunity to create change and improve their carbon performance. This implies carbon disclosure is used as a “legitimacy” as well as a “management” tool.

Key words: Carbon disclosure, Carbon performance, Carbon emissions, Environmental disclosure, Environmental performance

1. INTRODUCTION

This paper investigates the underlying relationship between carbon disclosure and performance. The aim is to investigate whether the rapidly increased disclosure of carbon emissions drives the actual carbon performance and efficiency improvement of companies or whether it is the other way around.

Managing and reporting carbon emissions have become increasingly popular among large corporations. Ernst & Young's latest survey (Ernst & Young, 2012) found that over 75% of world large companies have set carbon emission reduction targets and disclosed carbon emission information, with another 16% indicating that they planned to do so within the next five years. The recent Carbon Disclosure Project (CDP) survey (CDP, 2011) reported similar results. 74% of Global Fortune 500 (GF500) companies have formulated and reported absolute or relative carbon emission reduction targets. 68% have integrated climate change initiatives into their overall business strategy and 93% have assigned board or senior executive responsibilities to oversee the company's climate change program. KPMG's (2011) recent survey reveals that 95% of the world's largest 250 companies report publically about their social and environmental responsibility activities, increasing from 80% in 2008 (KPMG, 2008; 2011).

With the increasing acceptance of climate change as one of the most discussed political, societal and business issue globally, and the introduction of regulations such as the Emission Trading Scheme (ETS) in the European Union and carbon pricing in several further countries (e.g. Australia, Japan, Norway, South Korea, Switzerland) to tackle the challenge of global warming, we would expect the increasing popularity of carbon disclosure to continue. However, despite the promising reporting developments described in recent studies, it remains unclear how the disclosure of carbon emissions is related to the development of corporate carbon performance.

This paper investigates the dual relationship between the increasing carbon disclosure and actual carbon performance improvement of companies. While corporate carbon disclosure is becoming a *de facto* standard for businesses, the debate continues over whether carbon disclosure has been used as a legitimacy tool that helps manage external stakeholder relationships (Deegan, 2002; Cho and Patten, 2007) or as a management tool that supports managers to deal with different decision situations (Burritt and Schaltegger, 2010; Schaltegger and Burritt, 2010). Clearly, the legitimacy view and the management view of corporate disclosure present different arguments on the relationship between carbon disclosure and carbon performance.

The *legitimacy approach* considers business activities as reactions to external pressures and incentives, thus positioning businesses as adaptive entities reacting to environmental challenges. The rationale of this view is that poorer environmental performers are more likely to have a higher level of disclosure to legitimise and compensate their poor performance while, on the other side, companies with a low disclosure level are more likely to face higher stakeholder pressures and thus perform better (Patten, 2002; Clarkson et al., 2011). The *management approach*, however, emphasizes that companies and their management can act proactively with regard to environmental challenges and climate change. From this perspective, good environmental performers are keen to improve their environmental performance and to create business cases for sustainability (e.g. Schaltegger et al. 2012). This

includes reputational business cases using disclosure as an “inside-out” opportunity to distinguish themselves and receive acclamation for their superior performance relative to their peers. Improved disclosure, in turn, will then be used as an “outside-in” motivation to create change and improve performance (Dawkins and Fraas, 2011; Burritt and Schaltegger, 2010).

Both perspectives and arguments have their merits and are supported by prior literature, however, no previous study has so far examined the two competing and co-existing views on how disclosure and performance affect each other. It remains unanswered for core questions such as: do companies focus on performance for operational excellence and then disclose their carbon reduction achievements, or do companies just seek legitimacy and perform where necessary to create a well-received carbon report and company image? Depending on what drives corporations to manage carbon issues, different policy recommendations are suitable. If the legitimacy logic prevailed in practice, policies should be directed to reinforce stakeholder power, corporate transparency and accountability. Public policies which standardize, audit and verify carbon disclosure would be recommended to make reports and disclosed information comparable. Similarly, prizes for best carbon disclosures and reporting would be in line with this rationale of supporting the improvement of corporate carbon performance. If, however, corporations are mainly driven by the management-oriented logic, public policies should focus more on helping companies develop their carbon reduction management strategies and to implement performance measurement and management tools. Further measures which support the management-oriented rationale are guidelines for material flow cost accounting, carbon management systems, eco-efficiency measures and illustrative case studies serving as good practice examples, would be advised. Given the relevance of these two different rationales linking carbon disclosure and carbon performance for the design of effective policies supporting corporate sustainability this paper conducts a detailed empirical examination of the relationship between carbon disclosure and performance. This research uses a sample of Global 500 firms for the time period between 2008 and 2011 to investigate the two competing perspectives on carbon disclosure and performance.

The remainder of this paper is organised as follows. Section 2 reviews existing literature regarding the relationship between environmental disclosure and environmental performance, which assist in generating hypotheses for this study. Section 3 discusses the research method used for data collection and measurement of variables, followed by the analysis of the findings in Section 4. The paper concludes in Section 5 with a discussion of the results and limitations of the presented study.

2. LITERATURE REVIEW

2.1 Perform to disclose

From the legitimacy perspective, business corporations are part of the social system in which they operate and thus corporate activities need to be, or should appear to be, congruent with social values (Dowling and Pfeffer 1975; Deegan 2002). Companies increase their disclosure of social and environmental information in order to reply to social expectations and various stakeholder pressures (Deegan, 2002; AlTuwaijri et al., 2004; Branco and Rodrigues, 2008; Clarkson et al., 2008, Cormier et al., 2004). KPMG’s recent survey (2008) highlighted that over 50% of the 250 largest companies identified improving stakeholder relationships as a

reason for reporting. This suggests disclosure has been used as a legitimacy instrument to demonstrate corporate conformance to social norms and stakeholder expectations, and thus guaranteeing the societal survival and success of the company (Deegan, 2002; Zimmerman and Zeitz, 2002).

As the legitimacy theory posits that social and environmental disclosure is a function of pressure by external stakeholders, disclosure is just a tool used by firms to obtain, maintain and repair their legitimacy status (O'Donovan, 2002; Deegan 2002; Patten, 2002). Companies may disclose information to manipulate or educate stakeholders in order to obtain their support and approval because it is often easier to manage image than to make actual commitments and changes to sustainability performance (Dowling and Pfeffer, 1975; Neu et al., 1998; Lyon and Maxwell, 2011).

Empirical evidence seems to be in favour of the legitimacy theory approach to environmental disclosure. Patten (2002) and Cho and Patten (2007) found significant negative relationships between voluntary environmental disclosure and environmental performance, which means corporate disclosure is not used by leading companies to communicate achievements and improvements, but rather, it is a legitimacy instrument for laggards. Hughes et al. (2001) revealed that companies with higher levels of disclosure have poorer environmental performance rankings, which, they argued, is attributed to increased regulatory scrutiny forcing poor performers to make more disclosures as they are subject to remediation activities. In a recent comparison of the environmental reporting quality of Australian firms between 2002 and 2006, Clarkson et al. (2011) found that despite modest improvements in disclosure between 2002 and 2006, firms with a higher pollution propensity consistently disclosed more environmental information in both of the two compared years. Cho et al. (2012) reconfirm the negative relationship between environmental performance and disclosure, claiming that worse performers make more extensive disclosures to maintain their environmental reputation. Our first hypothesis, presented from the legitimacy perspective, is thus:

H1a: Poorer carbon performance leads to better carbon disclosure.

In contrast, the management-orientated approach regards social and environmental disclosure as a key tool assisting in communicating corporate performance and achievements. In management literature, this view is supported by both voluntary disclosure theory and signalling theory. Voluntary disclosure theory posits that firms with “good news” have incentives to disclose more and better so that poorer performers face difficulties to copy, i.e. mimicry is made difficult and competitive advantages can be secured (Li et al., 1997; Bewley and Li, 2000; Clarkson et al., 2011). Therefore, there is a positive relationship between environmental performance and disclosure (Clarkson et al., 2008). Signally theory posits that companies tend to engage in disclosure practices to signal their improved social and environmental performance to stakeholders (Branco and Rodrigues, 2006). Instead of being “responsive actors”, companies would actively use corporate disclosure as a “communication instrument” to create, protect, or enhance their images and reputation (Hooghiemstra, 2000; Hasseldine et al., 2005). From these strategic management-orientated views, corporate sustainability accounting and reporting are driven by competitive market forces. Burritt and Schaltegger (2010, p. 832) argue that sustainability reporting represents “the result of the demand from managers to position the company in society and the market and to communicate achievements”. Schaltegger and Wagner (2006) define this approach as an “inside-out” approach to corporate sustainability. This approach suggests that

companies which invest resources to improve their environmental and social performance are more willing to disclose what they are doing and improving (Clarkson et al., 2008). Therefore, it is logical to argue that the increase of corporate environmental disclosure is likely to be driven by companies' increasing commitments to sustainability and their improvement of environmental performance (Burritt and Schaltegger, 2010). Al-Tuwaijri et al. (2004) provide empirical evidence showing that environmental performance is significantly positively associated with economic performance and disclosure of environmental information. Clarkson et al. (2008) echo that companies that have achieved better environmental performance are more likely to inform stakeholders of their strategies and achievements through disclosing additional environmental information. So the second competing hypothesis can be generated as:

H1b: Better carbon performance leads to better carbon disclosure.

2.2 Disclose to perform

There are much fewer studies focusing on how disclosure drives performance. This is perhaps because legitimacy theory supporters do not believe disclosure actually affects performance, or if it affects, the effect is negative. For example, Cowan and Deegan (2011) find that with the establishment of National Pollutant Inventory (NPI) and the National Greenhouse and Energy Reporting Act 2007 in Australia, the legitimacy gap between the community and governmental expectations of carbon emission levels and corporate carbon performance becomes more visible and sensitive. Companies with poorer disclosures and larger legitimacy gap are more likely to close the legitimacy gap by improving carbon performance and thus making their norms and values regarding carbon emissions "more closely aligned with the norms and value, and expectations of environmental performance of the community" (Cowan and Deegan, 2011, p.415). Critical theorists even contend that as the definition of sustainability remains contested there is little hope for sustainability accounting and reporting to drive the real change in reality (Gray and Milne, 2002; Gray, 2010). Therefore, the growing voluntary social and environmental disclosures are merely viewed as greenwash or suspicion of conspiracy to mislead (Lyon and Maxwell, 2011). Worse performers tend to disclose more to legitimise their poor performance and worse disclosing companies tend to improve their performance to repair their adverse images.

Mobus (2005) supports the legitimacy view on performance and finds that when a mandatory disclosure program is in place to make noncompliant companies subject to higher public scrutiny and legitimacy threat, subsequent environmental regulatory performance and compliance levels increase. The study of Liu et al. (2010) also find that companies with lower ratings in the mandatory government-orientated environmental disclosure program in China are more likely to improve their environmental performance in subsequent years. This may reflect the shame and fear theory where companies fear that to be listed as low ranking performers attracts negative political attention; therefore, lower rating companies because of lower levels of disclosure (i.e. poorer disclosure) are more likely to improve environmental performance (Stephan 2002). Therefore, the following hypothesis is proposed:

H2a: Poorer carbon disclosure leads to better carbon performance.

The management view of environmental performance improvement is that stakeholder dialogues and reporting in response to public demands help companies define their

measurement and management activities and thus drive the improvement of corporate sustainability performance. Schaltegger and Wagner (2006) defined this approach as an “outside-in” approach to corporate sustainability. From the outside-in view, stakeholders’ pressures will force companies to actively communicate with stakeholders, scan their expectations and by this means derive performance measures and accounting approaches from there (Schaltegger and Wagner, 2006). The outside-in approach supports the role of environmental disclosure in representing stakeholders’ norms and expectations and helping these norms and expectations infiltrating into companies to drive change and performance improvement (Boons and Strannegard, 2000). Although companies may act as “passive actors” in response to public pressures and information demands, Burritt and Schaltegger (2010) argued that corporate sustainability reporting provides a good basis for internal decision making and a motivation to perform better (Schaltegger and Burritt, 2005). In this regard, better environmental disclosure is likely to be associated with more corporate commitment to sustainability and the actual improvement of corporate environmental performance and eco-efficiency (economic-ecological efficiency) (Burritt and Schaltegger, 2010). In Salo’s (2008) empirical analysis of environmental performance, a significant positive relationship between disclosure and performance was found, affirming that more disclosure of non-financial information motivates firms to become more concerned with managing those revealed areas and improve their environmental performance. Therefore, we hypothesize that:

H2b: Better carbon disclosure leads to improved carbon performance.

Adams and Whelan (2009) conceptualise future change in corporate sustainability reporting by highlighting that debate about sustainability reporting should move away from a simple focus on maintenance of legitimacy to potential “cognitive dissonance” and “a felt need for change” (p. 135). Several recent surveys provided evidence that more changes are taking place in business practice than what research indicates. For example, Ernst & Young’s (2012) study found that where corporate sustainability once focused on meeting external pressures, it has now become strategic inside many companies. Likewise, KPMG’s (2008) survey found that companies have realised that they need to play a key role in contributing to healthy societies, eco-systems and economics and it is in their best interest to maintain and improve in these areas. These studies may suggest corporate sustainability is being integrated more into core business, and the focus is moving from obtaining organisational legitimacy to obtaining and providing information for problem solving and decision-making by business managers. Therefore, there may be a tendency for corporations moving from seeking legitimacy and compensation to creating (reputational) business cases and improving performance.

3. RESEARCH METHOD

Sample

We collected carbon emission information from the Carbon Disclosure Project (CDP) during the years 2008 to 2011. Panel data were used to control for unobservable firm heterogeneities so that the hypotheses can be better tested. CDP has created the largest registry of corporate greenhouse gas emission data for the world’s largest publically listed corporations since 2000. Despite the limited attention at the beginning, CDP has now engaged with hundreds of large institutional investors globally to urge corporations to extensively disclose carbon related

information (CDP 2012). CDP data has been increasingly used in environmental and sustainability research in recent years, for example, Weinhofer and Hoffmann (2010), Dawkins and Fraas (2011), Kim and Lyon (2011), Luo et al. (2012) and among the others.

We selected Global Fortune 500 companies in the CDP to conduct the analysis. The focus on the largest companies is justified by their visibility in the public, their (perceived) leading role to respond to climate change and their importance for the global economy. However, data before 2008 were excluded because carbon emission information prior to 2008 was limited in its scope and for the number of companies, which could constrain the comparability of data between years. To maintain consistency and obtain as much information as possible, we used CDP data from 2008 to 2011. During this time period, the urgency to manage climate change has been gradually realised by business managers and regulations such as Emission Trading Scheme (ETS) have a significant impact on corporate carbon management activities.

Companies were selected if (1) they did not experience merger & acquisition which led to changes of name or industry during the study periods, (2) they were included as top 500 companies in both CDP Global 500 and the OSIRIS financial database during the study period, and (3) they have carbon emission and financial information for at least two consecutive years. This gave us an unbalanced panel sample of 324 companies totalled 1296 observations across four years.

Models and Measurements

Based on the relationship between carbon performance and disclosure discussed previously, we estimate the following two models:

$$CDisc_{i,t} = \alpha_i + \alpha_1 CPerf_{i,t-1} + \alpha_2 Controls + \varepsilon_{i,t} \quad (1)$$

$$CPerf_{i,t} = \beta_i + \beta_1 CDisc_{i,t-1} + \beta_2 Controls + \varepsilon_{i,t} \quad (2)$$

Eq. (1) examines the effect of carbon performance on carbon disclosure levels, where $CDisc_{i,t}$ is the carbon disclosure level of company i in year t and $CPerf_{i,t-1}$ represents the carbon performance of company i in year $t-1$. Carbon performance is one year lagged so that we can observe how a company's carbon emission performance in the period $t-1$ affects its disclosure level at time t . Eq. (2) examines the effect of carbon disclosure on corporate carbon performance, where $CPerf_{i,t}$ represents the carbon performance of company i in year t , and $CDisc_{i,t-1}$ is the carbon disclosure level of company i in year $t-1$. Likewise, we lagged carbon disclosure by one year to observe how the disclosure level in a preceding year drives the change of carbon performance in a later year. *Controls* represent control variables that are commonly included in previous literature (e.g. company size, financial performance and industry effects). α_i and β_i are scalar constants representing the effects of omitted variables that are specific to the i th company. $\varepsilon_{i,t}$ and $\varepsilon_{i,t}$ are error terms.

We use the carbon disclosure score reported by CDP as the primary measure of carbon disclosure ($CDisc_{i,t}$) for this study. The quality of carbon disclosure is scored from 0 to 100, based on the comprehensiveness of reporting on (1) general risks and opportunities of climate change, (2) impact of existing and future carbon emission regulations, (3) physical risk of climate change, (4) innovations developed in response to climate change, (5) responsible management group or personnel for climate change, (6) quantitative emission levels, (7) emissions associated with products, services and supply chains, (8) emission reduction

strategy and investment, (9) strategies for emission trading; and (10) energy consumption and costs. These criteria of disclosure scores are consistently used for all study periods.

Carbon performance ($CPerf_{i,t}$) is measured as total carbon emission intensity. This study focuses on the totals of corporate carbon emissions, i.e. including both Scope 1 CO₂ emissions¹ and Scope 2 CO₂ emissions². The reason for using both types of emissions is that both emissions are part of corporate carbon responsibility, although we understand only Scope 1 emissions are regulated and included in current emission trading systems (ETS). We scaled total carbon emissions by sales revenue at the end of the year to obtain carbon emission intensity, i.e. each measure reflects a firm's carbon emissions per dollar of sales. This is consistent with a number of previous studies (e.g. Patten 2002; Cho and Patten 2007; Clarkson et al. 2011). Since carbon emission intensity reflects a firm's pollution level, the actual carbon performance should be read as the inverse of emission intensity.

Firm size has been used as a control variable in many previous studies of environmental disclosures (e.g. Patten, 2002, Deegan and Gordon, 1996; Clarkson et al., 2011). It has been argued that larger companies are subject to higher political and regulatory pressures and thus higher political costs (Gamerschlag, et al., 2010). To reduce political cost, larger companies may have more incentives to perform better and disclose more. In this study, size is measured as the logarithm of the companies' market capitalisation.

Carbon emission intensity reflects the environmental sensitivity of a company, which could influence a company's environmental performance as well as its environmental strategy and disclosure level. As heavy polluters are more likely to be threatened by breach of social legitimacy, in the public eye they should bear most costs and take more responsibility to improve their environmental performance. Deegan and Gordon (1996) note that the focus of environmental issues is more heavily on those industries identified as more environmentally sensitive, e.g. mining, chemicals, coal, transport and oil/gas explorers, etc. These industries are in the public arena, subject to greater public scrutiny. Frost and Wilmshurst (2000) find that environmentally sensitive industries, defined as mining and resources, chemical and petroleum (gas/oil) businesses, report more environmental information and are more aware of environmental-related costs, although their environmental-related management accounting procedures are not significantly different from those in non-environmentally sensitive industries, such as retailing. Cho and Patten (2007) also reveal that firms operating in environmentally sensitive industries such as oil exploration, paper manufacturing, chemical and allied products, petroleum refining and metals, disclose more non-litigation-related environmental information in order to achieve social legitimacy. Therefore, carbon emission intensity is controlled and measured as a dichotomous variable where "1" representing environmentally sensitive firms in materials, energy and utilities, and "0" for others.

¹ Scope 1 emissions are the release of greenhouse gases into the atmosphere as a direct result of an activity or series of activities that constitute the facility. An example of this would be gases emitted by burning coal to generate electricity at an electricity production facility (i.e. a power station).

² Scope 2 emissions are the release of greenhouse gases emitted at a second facility because of the electricity, heating, cooling or steam that is consumed at the facility. An example would be scope 2 emissions in a car factory because of its use of electricity for lighting, as greenhouse gas is emitted in generating such electricity.

The economic benefits of managing social and environmental performance may include reducing cost and business risk, increasing reputation and developing new markets such as for green products. Previous empirical studies often report a positive relationship between financial performance and environmental performance (Wahba, 2008), social performance (Spicer, 1978; Waddock and Graves, 1997), corporate social responsibility (Schnietz and Epstein, 2005), or corporate sustainability (Lo and Sheu, 2007). The positive link is favoured by the business community and practitioners as it suggests both interests of shareholders and other stakeholders could be mutually satisfied if sustainability is managed well. Consistent with prior studies (e.g. Russo and Fouts; 1997, King and Lenox, 2002 and Nakao et al., 2007), financial performance is measured as return on assets (ROA). Return in this study is defined as profit before interest and tax (i.e. EBIT).

4. RESULTS

Descriptive statistics

Tables 1 and 2 report descriptive statistics of variables during the study period and in each individual year. Table 1 shows that the average carbon disclosure score is 67.856 out of 100. If 100 represents perfect disclosure and any score below 50 represents poor disclosure, an average score of nearly 68 seems to suggest a generally moderate level of carbon disclosure by the world's largest companies. For 2008, the disclosure score is nearly 65 and then slightly declines to 63.585 in 2009. There is an improvement afterwards as in 2010 the score reaches 69.463 and in 2011, 73.067. The carbon emission intensity seems to follow the same pattern. The average intensity level is 0.441 tonne of carbon emission per dollar of sales. Carbon emissions reach the highest level in 2009 and decrease strongly in 2010, although emissions slightly bounce back in 2011. The change in firm size is considered minimal with some marginal increase over the four years studied. The falloff of financial performance is obvious during 2008 and 2009 when a global financial crisis hit the market. However, Table 2 shows that financial returns recover soon in 2010 for the world's largest firms and their financial performance remains steady in 2011.

Table 1: Descriptive statistics for firms during 2008-2011

Variable	Mean	Std.Dev.	Min	Max
Carbon disclosure	67.856	16.798	2	99
Carbon emission intensity	0.441	1.164	0.000	11.077
Firm size	17.383	0.898	14.284	25.863
Financial performance	0.084	0.085	-0.569	0.446

Table 2: Descriptive statistics for firms in each year

Variable	2008	2009	2010	2011
Carbon disclosure	64.836	63.585	69.463	73.067
Carbon emission intensity	0.461	0.538	0.378	0.394
Firm size	17.130	17.440	17.513	17.457
Financial performance	0.085	0.074	0.088	0.087

Table 3 presents the correlation results between the investigated variables. The table shows that the correlation between carbon intensity and environmental sensitivity is relatively high

(0.511), indicating carbon intensity is largely influenced by industry. However, the correlation between industry and disclosure is minor.

Table 3: Correlation results for firms during 2008-2011

Variable	Carbon disclosure	Carbon intensity	Firm size	Financial performance	Industry sensitivity
Carbon disclosure	1.000				
Carbon intensity	-0.063	1.000			
Firm size	0.075	-0.168	1.000		
Financial performance	-0.056	-0.069	0.249	1.000	
Environmental sensitivity	-0.090	0.511	-0.009	0.051	1.000

Empirical tests

Table 4 presents the association between carbon disclosure and performance based on panel data tests. We undertook both fix and random effect estimations although in many cases the results of the Hausman test are significant at the 0.01 level. The Hausman test has been criticised for its problematic assumptions in comparing fixed and random effects (Wooldridge, 2002). Taking this into consideration, we applied both effects to minimise biased selection.

Table 4 Association between carbon disclosure and performance

Variables	Subsequent carbon disclosure	Subsequent carbon disclosure	Subsequent carbon emission intensity	Subsequent carbon emission intensity
Intercept	0.035** (35.538)	0.566 (26.588)	0.413 (0.506)	0.386 (-0.632)
Carbon emission intensity	0.005 *** (21.872)	0.009*** (70.863)		
Carbon disclosure level			0.035** (-0.002)	0.044** (-0.002)
Firm size	0.229 (1.058)	0.705 (-0.872)	0.649 (-0.016)	0.098* (0.070)
Firm performance	0.610 (4.620)	0.003*** (40.262)	0.004*** (-0.685)	0.002*** (-0.762)
Env. Sensitivity	0.048** (-4.710)	fixed effect	0.000*** (1.315)	fixed effect
Wald λ^2	0.024** (11.18)	0.001*** (5.22)	0.001*** (6.634)	0.003*** (4.71)
R ²	0.026	0.039	0.279	0.032
N	691	691	745	745

*p<0.10; **p<0.05; ***p<0.01

The results of “perform to disclose” (Table 4) show that carbon emission intensity (carbon performance) is significantly positively (negatively) associated with the carbon disclosure level of the subsequent year under both random ($\alpha=21.872$; $p=0.005$) and fixed ($\alpha=70.836$;

$p=0.009$) effect estimations. This result confirms the legitimacy approach to carbon disclosure where poorer carbon performers in preceding years disclose higher levels of carbon related information in subsequent years. Therefore, H1a is supported while H1b is rejected. Firm size is not found to be associated with the disclosure level. Financial performance is positively associated with the disclosure level under the fixed effect ($\alpha=40.262$; $p=0.003$) but under the random effect. Environmental sensitivity is negatively ($\alpha=-4.710$; $p=0.048$) associated with the disclosure level indicating that environmental sensitive industries disclose a significantly lower level of carbon information. This seems to suggest the opposite to the legitimacy approach.

In terms of “disclose to perform”, the results seem reversed. The carbon disclosure level is significantly negatively (positively) associated with the subsequent year carbon emission intensity (carbon performance) under both random ($\beta=-0.002$; $p=0.035$) and fixed ($\beta=-0.002$; $p=0.044$) effect estimations, indicating better carbon disclosure leads to higher carbon performance in subsequent years. This suggests that carbon disclosure has been actively used by large corporations as a mechanism to drive internal performance change, a win-win solution from an outside-in perspective. Therefore, H2a is rejected and H2b is supported. Firm size again plays only a minor role and is weakly significant under the fixed effect estimation ($\beta=0.070$; $p=0.098$). Financial performance is found to be negatively (positively) associated with carbon emission intensity (carbon performance), consistent with prior studies suggesting green activities pay off financially. With no surprise, environmental sensitivity is positively (negatively) associated carbon intensity (carbon performance), which means heavy polluters tend to have higher emission intensity and lower carbon performance.

Sensitivity test

Since carbon risk may be largely associated with industry environments, we further limit the investigation to companies with greater environmental exposures and sensitivity. This is consistent with a number of previous studies related to environmental performance and disclosure, for example Clarkson et al. (2008), Cho et al. (2012). Before the test, we analysed the mean differences between high sensitive and low sensitive firms. The t-test results are reported below.

Table 5 Mean comparison between high and low environmentally sensitive firms

<i>Variables</i>	<i>High sensitivity</i>	<i>Low sensitivity</i>	<i>t-stat</i>	<i>P value</i>
Carbon disclosure	65.748	68.662	2.654	0.008***
Carbon intensity	0.632	0.041	-14.155	0.000***
Firm size	17.388	17.381	-0.108	0.914
Financial performance	0.089	0.081	-1.489	0.137

The industries classified as high sensitivity are materials, energy and utilities while others are considered low sensitivity, such as commercials, retailing, etc. Table 5 clearly shows that there are significant differences of both carbon disclosure and performance between high and low sensitive industries. High sensitive industries have significantly higher carbon intensity but lower carbon disclosure levels than their low sensitive counterparts. As per firm size and financial returns there is not much difference between these two groups of firms.

Table 6 presents the results of association between disclosure and performance in environmentally (i.e. carbon) sensitive industries.

Table 6 Association between carbon disclosure and performance in environmentally sensitive industries

<i>Variables</i>	<i>Subsequent carbon disclosure</i>	<i>Subsequent carbon emission intensity</i>
<i>Intercept</i>	0.193 (49.910)	0.101 (3.332)
<i>Carbon emission intensity</i>	0.028 ** (48.111)	
<i>Carbon disclosure level</i>		0.060* (-0.005)
<i>Firm size</i>	0.258 (-1.657)	0.443 (-0.088)
<i>Firm performance</i>	0.001 *** (48.421)	0.062* (-1.216)
<i>Wald λ^2</i>	0.000 *** (17.36)	0.022 ** (9.54)
<i>R²</i>	0.101	0.047
<i>N</i>	200	213

*p<0.10; **p<0.05; ***p<0.01

The results are consistent with the previous findings, confirming low carbon performance (high carbon emission intensity) drives better carbon disclosure in subsequent years and better carbon disclosure leads to improved carbon performance (lower carbon emission intensity) for carbon emission sensitive industries. However, the significance levels are not as strong as previous findings. Firm size is insignificant in either model while firm performance is significantly positively associated with firms' carbon disclosure levels but negatively associated with firms' carbon emission intensity.

5. CONCLUSION

With corporate disclosure of carbon emissions rapidly increasing, there is a long standing question as to how carbon disclosure is associated with the development of carbon performance. From the legitimacy perspective, businesses are regarded as adaptive entities reacting to environmental challenges and climate change. The relationship between disclosure and performance is posited as negative. That is, poorer carbon performance is likely to drive better carbon disclosure and poorer carbon disclosure is likely to motivate better carbon performance. From the management perspective, businesses can act proactively when facing environmental and climate challenges. The management view posits a positive relationship between disclosure and performance. That is, better carbon performance will drive better carbon disclosure and better carbon disclosure will drive better carbon performance. Although both perspectives and arguments have been supported by prior literature with different sets of evidence, no previous study has so far examined the two competing views on how disclosure and performance may drive each other.

Using a sample of Global 500 companies and their carbon emission and disclosure data released during 2008 and 2011, this study finds that the two perspectives are each partially supported. From performance to disclosure, the legitimacy view dominates. Companies with poorer carbon performance (reflected as higher carbon intensity) in preceding years consistently achieve better carbon disclosure scores in subsequent years. However, from disclosure to performance, the management view prevails. Companies having better carbon disclosure in preceding years consistently improve their carbon performance subsequently. Putting these findings together, there may be a continuum between carbon disclosure and performance. The pattern may be that at first, poorer carbon performers try to achieve higher levels of carbon disclosure to legitimise and compensate their poor performance. Then once their disclosure is improved, they are motivated to use disclosure as an “outside-in” opportunity to create change and improve their carbon performance. This implies carbon disclosure is used as a “legitimacy” as well as a “management” tool.

However, cautions need to be taken when interpreting the results of this study. The investigation in this research only covers limited time periods from 2008 to 2011. There may be bias in selecting companies whose carbon disclosure and emission data are publicly available during these time periods. In particular, only large companies are examined in the study where they are generally considered bearing higher political costs and more likely to be subject to legitimacy threats. Future research that extends carbon performance measures to carbon efficiency and investigates the association between carbon efficiency levels and disclosure are encouraged.

6. REFERENCES

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