

ORIGINAL ARTICLE

How does Voluntary Carbon Disclosure (VCD) Induce Changes in Carbon Performance? With the Role of Management Capability

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Abstract

While there is a growing interest in Voluntary Carbon Disclosure (VCD), comparatively little is discussed whether the improved quality of voluntary carbon disclosure can lead to subsequent changes in a company's carbon reduction performance. Drawing on companies under the Korean Emission Trading Scheme (ETS) with the contents analysis of their sustainable reports, the present research seeks to address the existing knowledge gaps in the current literature on environmental disclosure. Findings empirically show that an increase in the voluntary carbon disclosure score is positively transformed into changes in carbon performance and further develop that the effect of voluntary carbon disclosure on carbon performance varies depending on changes in management capability with the moderation effect.

Key words : Voluntary carbon disclosure, Carbon reduction performance, Management capability, Sustainable report, Carbon emission intensity

1. Introduction

Amid the ever-increasing interest surrounding Environmental, Social and Governance (ESG) ratings based on voluntarily reported data among Korean businesses, it is reasonable and warranted to again focus on voluntary corporate disclosures, particularly in the Korean business landscape. In doing so, we can better characterize current trends of corporate disclosure practices among Korean companies and encourage them to conduct better disclosure going forward.

Starting in the mid-2000s, companies worldwide began to provide information on their greenhouse gas (GHG) emission as well as their goals and strategies to

reduce emissions (Pinkse and Kolk, 2009). Such data reporting has been called “voluntary carbon disclosure (VCD)”. Since then, VCD has become a highly critical factor for companies given the growing importance on carbon reduction performance and its association with companies' financial performance. In fact, investors highly value companies' reliable and transparent carbon data reporting (Porter and van der Linde, 1995; Al-Tuwaijri et al., 2004). Particularly, investors' growing focus on climate-related financial risks necessitates a more specific type of carbon data that better indicate those risks and guide rational investment decisions (The Economist, 2017). Accordingly, businesses face mounting pressure to reduce their GHG emissions and disclose related information.

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Climate performance evaluation (Burritt et al., 2011; Sullivan and Gouldson, 2012) mainly depends on a company's ability to account for its GHG emissions and to disclose reliable data (Talbot and Boiral, 2018). In this sense, the introduction of the Emission Trading Scheme (ETS) in Korea in 2015 has resulted in driving affected companies to improve on additionally disclosing carbon information in terms of quantity and quality. Such trend is consistent with previous studies that have already demonstrated the positive correlation between ETS and VCD (Comyns, 2014; Rahman et al., 2019).

1.1. Purpose

In this context, the question as to whether VCD has any influence on the improvement of carbon performance (Qian and Schaltegger, 2017) is noteworthy. Thus far, the legitimacy perspective has been dominant in this area of studies by intensely paying attention to who discloses information and why they do so. This rationale claims that poorer performers are inclined to disclose more as a way to find excuses for their poor performance, earning from the society (Freedman and Jaggi, 2010; Cho et al., 2012). Once disclosure has been used effectively as a legitimizing tool for low performance, companies become less incentivized to improve their carbon performance (Patten, 2015).

The purpose of the present research is not to immerse into the long-standing debate on who are more likely to voluntarily disclose carbon information, or whether disclosure is associated with their real reduction performance. Rather, the main objective is to examine whether VCD can lead to better carbon performance. To this end, while analyzing sustainable reports of Korean companies that fall under the ETS, the present study mainly explores two contrasting theoretical views: legitimacy and management-oriented perspectives. Institutional theory is also discussed to provide a complementary

background.

1.2. Hypotheses

Generally, the legitimacy view emphasizes on the link between public and political pressure and voluntary environmental disclosure (Alrazi et al., 2016), alongside the claim that companies increase their disclosure of social and environmental information in order to respond to social expectations and various stakeholder pressures (Al-Tuwaijri et al., 2004; Branco and Rodrigues, 2006; Clarkson et al., 2008). As climate change gained worldwide attention in the 2000s, the legitimacy perspective was deemed highly rational as it argued that high carbon emitters undergo greater public regulatory scrutiny and thus have greater urgency to justify themselves and maintain reputation through disclosure. Accordingly, it implies that VCD is not used by leading companies to promote achievements and improvements, but as a legitimacy instrument for under-performers (Cho et al., 2012).

Companies may disclose information to manipulate or educate stakeholders to obtain their support or approval, as it is often easier to manage a company's image than to make a tangible progress in reducing carbon emission. Consequently, studies that criticize VCD highlight the significant gap between a company's public image and its actual commitment to climate change. Milne et al. (2009) argue that reporting only reflects rhetorical claims of action maintaining the image that businesses are "doing" sustainability. Similarly, Lyon and Maxwell (2011) indicate that the growing voluntary social and environmental disclosures are merely viewed as greenwash or suspicion of conspiracy to mislead. However, regardless of true motivations of corporate disclosure, VCD is indeed highly important, and reliable information reporting is becoming critical. Accordingly, empirical studies have increasingly aimed to assess the gap, by analyzing whether disclosure reflects actual corporate performance (Font et al., 2012).

With greater carbon regulatory pressures since the Paris Agreement, the institutional perspective claims that national carbon regulations, such as the ETS, lead to companies' pronounced VCD improvement by impacting its substantive carbon management and reduction performance. This view has paved way for the corporate proactive and strategic carbon management approach. Institutional theory is based on the concept that organizations are influenced by their surrounding institutional environment (both tangible and non-tangible elements) and are required to conform to collective norms and beliefs of the environment. In other words, organizations must fit their institutional image to gain legitimacy and, hence, access to resources; therefore, the survival of organizations depends on adherence to institutionally defined rules and norms (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Oliver, 1991; Scott, 2002). One main component of this approach is "institutional isomorphism", or the extent to which organizations have to conform to institutional norms and become similar to other organizations to gain legitimacy (DiMaggio and Powell, 1983).

Such reactivity and isomorphism suggest that companies are more likely to first conform to institutional pressure and internalize, thereafter adapting to and seeking improvement in their overall sustainability (Clementino and Perkins, 2020). This means that with time, companies acknowledge the importance of sustainability and develop more sophisticated ways of responding. Similar observations have been made from studies on Corporate Social Responsibility (CSR) which have recognized that stakeholder expectations of appropriate behavior change over time (Altura et al., 2019) and companies adjust to the CSR practices through learning and adapting (Egels-Zanden, 2014). This suggests that companies may move from an initial passive position to proactive one to create opportunities and enhance competitiveness (Clementino and Perkins, 2020).

Combining with all those stated factors, Luo(2019) empirically argues that, ultimately, the legitimation intention of corporates' using VCD is compromised in strong carbon-regulated institutional contexts, such as the ETS. That is because more stringent carbon policies are likely to place additional constraints on corporates' green washing purpose, thus increasing the credibility and value relevance of the disclosed information (Luo, 2019).

Against this backdrop, the management-oriented perspective regarded as a strategy- based view, underscores the changes in the environmental performance of companies. This perspective proposes that companies can involve proactively in climate change issue by improving carbon performance (Qian and Schaltegger, 2017). According to this rationale, no matter what the purpose of disclosure is, it can play a role as management motivation for subsequent changes and a source to achieve carbon reduction and performance improvement. A reason for such phenomenon is that the benefits of disclosure may outweigh the costs. By taking these rationales a step further, management may take a risk-averse approach and companies can boost their reputation for sustainability.

Following the management-oriented view, stakeholder dialogs and reporting in response to public demands are considered potentially useful in helping companies develop their emission measurement and management activities, and can subsequently drive improvement in corporate sustainability performance (Burrit and Schaltegger, 2010), and can be called an 'outside-in' approach (Schaltegger and Wagner, 2006). In this view, communication with stakeholders, such as voluntary disclosure can help companies understand stakeholder expectations and evolve performance measures and accounting approaches. Simply stating, the starting point of any performance measurement and management is to communicate with stakeholders. That is why voluntary disclosure matters.

The process of disclosure practice in the “outside-in” view can support the “infiltration” of stakeholder norms and expectations into companies to promote change and improve performance (Boons and Strannergard, 2000). For example, Salo’s (2008) empirical analysis on corporate governance and environmental performance shows that when companies disclose non-financial performance information, managers are likely to become increasingly concerned with managing those performance areas that have been disclosed. Overall, companies may initially react in response to public pressures and information demands, environmental disclosure and sustainability reporting may nevertheless foster the opportunity to influence decision-making and motivate companies to perform better (Burrit and Schaltegger, 2010).

Although the two main competing theories provide opposite rationales on the relationship between VCD and carbon reduction performance, the Korean ETS is expected to create a more strategic carbon management environment. In accordance with the main research question, the following is hypothesized:

Hypothesis 1: The Voluntary carbon disclosure (VCD) of affected companies in the Korean ETS will lead to positive changes in carbon reduction performance.

Several studies provide evidence that higher environmental performance is associated with better financial performance. For instance, managers may choose to improve their company’s environmental performance when they have an especially profitable year (King and Lenox, 2001). In general, excess returns (i.e., profits above the industry average) result from differences in the underlying fixed characteristics of companies. In these companies, managers may possess unique resources or capabilities (Hart, 1997), such as innovation, efficiency or management capability that enable them to employ profitable strategies that are

difficult to imitate, i.e., establishing a company’s competitiveness. In other words, certain capabilities may be required to generate a positive environmental performance which will result in better financial gains. This rationale recognizes those additional benefits of known unique or strategic capabilities and suggests how companies should approach sustainability initiatives by developing certain competencies.

Drawing on a company’s unique capabilities, it is noted that management capability provides clear evidence of a relationship between underlying capabilities of a company and its environmental practices. A company’s management capability reflects its ability and willingness to invest in environmental issues, and a greater management capability is more likely lead to proactive long-term investment strategies (Sharma and Vredenburg, 1998). Sales growth has been used to represent management talent or capability in creating financial value (King and Lenox, 2001). Sales growth has also been used as an indicator to assess the improvement in environmental performance (de Villiers et al., 2011). Accordingly, the current study highlights the indispensable role of management capability among company’s capabilities and evaluates how management capability serves as a moderator between disclosure and subsequent changes in carbon reduction performance.

Hence, hypotheses are developed as follows:

Hypothesis 2: Management capability of companies that fall under the Korean ETS will lead to positive changes in carbon reduction performance.

Hypothesis 3: Management capability will moderate the relationship between changes in carbon disclosure and carbon reduction performance such that companies will likely have positive change when management capability is higher.

2. Methodology

2.1. Sample

The Korean companies analyzed in this study were (a) part of the Korean ETS and Target Management System (TMS) from 2015 to 2019, (b) listed on the Korean Exchange (KRX), and (c) have published a sustainable report during the same period. VCD was considered as the independent variable, and analysis of contents of sustainable reports from the same period was adopted as a way of measuring.

In total, the sample comprised of 422 reports issued by 94 companies during 2015 - 2019. The companies belonged to 9 industries; materials, industrials, energy, consumer discretionary, consumer staples, IT, telecommunications, healthcare and finance in accordance with the Global Industry Classification Standard (GICS) classification. The final sample of companies had at least one sustainable report available during the period 2015-2019. 94 companies did not have such report available for each year of the study. Therefore, 422 reports were initially subject to content analysis. However, as this study required change measures of the dependent variable and needed to analyze the time-lagged effect which ended up reducing the sample size, 252 observations in total were analyzed.

To attain the study's objectives, hierarchical Ordinary Least Square (OLS) regression analysis was used to infer causality and assess what factors are mainly influencing companies' changes in carbon performance.

2.2. Measures

2.2.1. Voluntary Carbon Disclosure (VCD)

The independent variable, i.e., the quality of VCD, was derived from sustainable reports of Korean companies under the ETS (including those under the TMS as well). Reports for the financial years of 2015-2019 were selected because the Korean ETS was

initiated in 2015, and the chosen period would help to compare the carbon performance (management) practices of companies. They are solely standalone reports listed on the companies' websites. Mainly, the section on climate change from the sustainable reports was analyzed based on the content analysis criteria which were derived from the Carbon Disclosure Project (CDP) and further modified (Choi et al., 2013). The criteria and individual items are listed in Annex. The CDP is not-for-profit organization created in 2000 at the initiative of a group of institutional investors interested in incorporating information on business' carbon emissions into their analyses and assessments (Depoers et al., 2016).

Each criterion was scored on a scale of 0, 1, or 2 depending on whether the criterion was deemed to be "non-disclosed", "partially disclosed", or "fully disclosed", respectively. Scoring was performed according to a set of predefined rules for each criterion, which were then aggregated to obtain an overall disclosure quality score. As per the index, the maximum score that a company could obtain was 36, given the 18 items. Finally, the range of raw score varied 0 to 36.

2.2.2. Carbon Reduction Performance

In order to measure the dependent variable, carbon reduction performance, the Korean Greenhouse Gas Inventory and Research Center database was used as a source on companies affected under the Korean ETS. As the Korean ETS regulates scope 1 and 2 emission data, this study focuses on the carbon reduction performance of direct/Scope 1 and indirect/Scope 2 emissions.

This study measures carbon performance based on Carbon Emission Intensity (CEI). A higher value for CEI suggests that a company uses its resources, particularly energy, inefficiently, making it a poor performer (Porter and van der Linde, 1995). CEI is calculated as the ratio of total GHG emissions of Scope 1 and 2 to total sales of a company, reflecting the

efficiency of its production processes. The use of total sales as the scale is consistent with prior environmental studies (Patten, 2002; Clarkson et al., 2008; Sutantoputra et al., 2012). The CEI was then measured as the percentage of improvement over time. In this sense, the lead-lag method was used because changes in carbon disclosure (leading) in the preceding year could lead to a decreased carbon performance improvement (lagging) in a subsequent year. The lead-lag relationship analysis was used for the model prediction; the five-year panel data generated a four-time-period change analysis. Hence, the measure describing the improvement of the CEI achieved by a company over time is shown as follows in Equation 1:

$$CRP_{i,t} = \frac{EMI_{i,t}}{S_{i,t}} - \frac{EMI_{i,t-1}}{S_{i,t-1}}$$

where denotes the carbon reduction performance of company i in time t , $EMI_{i,t}$ denotes its carbon emissions and $S_{i,t}$ denotes its sales.

2.2.3. Management Capability

Sales growth has been used to represent management talent or capability to create financial value (King and Lenox, 2001) and improve environmental performance (de Villiers et al., 2011). The current study highlights the role of a company's management capability among company's capabilities and evaluates its moderating effect on the relationship between disclosure and subsequent changes in the carbon reduction performance, which is measured as the change in sales divided by the sales of the beginning period (Qian and Schaltegger, 2017).

2.2.4. Control Variables

This study controls for factors that could systematically confound the relationship between VCD and corporate carbon performance.

Many previous studies (Gray et al., 2003; Amran et al., 2014) have found company size to be a key

detrimental for the relationship between disclosure and carbon performance. As larger companies are subject to higher political and regulatory pressures, they may be more incentivized to disclose more. This study uses a natural logarithm of total assets as a proxy to control for size as many prior studies have done (Comyns, 2016).

Prior studies have demonstrated that the level of environmental performance and disclosure of a company may be positively affected by the company's financial performance. Thus, this study controls for financial performance by using an accounting-based variable, Return On Assets (ROA) (Bansal and Clelland, 2004).

Companies are more likely to care demand for information when their leverage levels increase so that they can manage the impression of creditors (de Villiers et al., 2011). This study uses the ratio of a company's total debt to its total assets as a proxy for leverage.

Liquidity shows the ability of a company to achieve its financial goals and having a positive impact on the company's environmental strategy as well. Companies with a fair cash flow, they tend to deploy more resources to environmental projects, thus, improving environmental performance (de Villiers et al., 2011). In this study, liquidity is measured as the net cash flow from operations divided by the beginning period total assets (Clarkson et al., 2011).

Capital intensity is known to measure a company's effectiveness in its asset allocation. Also it is frequently employed to predict a company's financial performance (King and Lenox, 2001) and environmental performance. Therefore, it is claimed that companies with higher capital intensity tend to achieve higher environmental performance by investing more in environmental issues (Clarkson et al., 2008). This study calculated it as the ratio of capital expenditures to total sales revenue (Clarkson et al., 2011; de Villiers et al., 2011).

Table 1. Descriptive Statistic

| Variables | Min | Max | Mean | Std.dev. |
|------------------------------|-----------|----------|------------|------------|
| Carbon reduction performance | -6.741 | 4.323 | -0.035 | 0.554 |
| Disclosure | 7 | 31 | 15.192 | 3.756 |
| Management capability | 0.043 | 14.755 | 1.154 | 1.044 |
| Size | 11.592 | 20.130 | 15.562 | 1.569 |
| Leverage | -0.000254 | 0.491544 | 0.002875 | 0.034990 |
| Liquidity | -0.17970 | 2.86039 | 0.086771 | 0.223027 |
| ROA | -35.410 | 142.370 | 2.950 | 9.215 |
| Capital intensity | -11.615 | 45.774 | -0.19362 | 2.998170 |
| R&D intensity | 0.00001 | 0.62590 | 0.02267 | 0.058115 |
| Emission amount | 5280 | 80597292 | 2332265.55 | 8501343.39 |

N = 252

Note. Industry, Year dummy variables are excluded from the table.

R&D intensity can be viewed as a company's management innovation level. An innovative management team is more likely to pursue proactive investment strategies, like environmental investment strategies (Clarkson et al., 2011). It is calculated as total R&D expenses divided by total assets.

To serve the needs of the nine industries which differ in their level of pollution, three dummy variables were set in this study, with the financial industry as the base group (Reid and Toffel, 2009). Industrial, material and energy sectors are categorized into Group 1, Group 2 includes consumer discretionary, consumer staples and In Group 3, and there are IT, telecommunication and healthcare. If a company belonged to a certain group, it was assigned a value of 1, and 0 otherwise (Cormier and Gordon, 2001; Dawkins and Fraas, 2011).

Three dummy variables indicating the four years of the sample, Year 2016, Year 2017, year 2018, with Year 2019 as the base year, were used to control the time-specific factor. Although the sample period 2015-2019, the data of the year 2015 was not considered as carbon reduction performance was gauged by the percent improvement in carbon emissions intensity over a year. For instance, in

accordance with equation 1, each sample company has 3 data for dependent variable, carbon reduction performance over years (2015-2019).

Previous studies on disclosure and carbon reduction performance have already supported the fact that the amount of GHG emissions plays a crucial role in corporate carbon management. As larger emitters have been under increasing pressure, they have become highly involved in environmental management. It is consistent with the characteristics of larger companies. Accordingly, this study controls for company's total GHG direct/ indirect (Scope 1 and Scope 2) emissions in the fiscal year.

3. Result and Analysis

3.1. Descriptive analysis

This study first describes the overall statistics for sample companies during the period of 2015-2019 including disclosure score and carbon performance profile.

Table 1 indicates that carbon reduction performance has a negative mean value of -0.035, indicating that the average decreases of carbon emissions intensity are 0.035 tons (35 kg) per one million KRW of sales.

Table 2. Correlation coefficient

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---------------------------------|-----------|-----------|---------|-----------|----------|---------|-----------|----------|-----------|-----------|----------|-----------|-----------|--------|--------|----|
| 1. Carbon Reduction Performance | 1 | | | | | | | | | | | | | | | |
| 2. Size | 0.060 | 1 | | | | | | | | | | | | | | |
| 3. Leverage | 0.003 | -0.158*** | 1 | | | | | | | | | | | | | |
| 4. Liquidity | 0.005 | -0.038 | -0.009 | 1 | | | | | | | | | | | | |
| 5. ROA | 0.370*** | -0.033 | -0.007 | 0.057 | 1 | | | | | | | | | | | |
| 6. Capital Intensity | 0.248*** | -0.053 | -0.020 | -0.285*** | 0.622*** | 1 | | | | | | | | | | |
| 7. R&D Intensity | 0.000 | -0.042 | 0.000 | 0.165*** | -0.019 | -0.09* | 1 | | | | | | | | | |
| 8. Emission Amount | 0.022 | 0.257*** | -0.020 | -0.015 | 0.007 | -0.031 | -0.048 | 1 | | | | | | | | |
| 9. IND group1 | -0.048 | -0.275*** | 0.047 | -0.197*** | -0.052 | 0.104** | -0.206*** | 0.139** | 1 | | | | | | | |
| 10. IND group2 | 0.026 | -0.109 | -0.025 | -0.037 | 0.023 | -0.024 | 0.168*** | -0.108** | -0.530*** | 1 | | | | | | |
| 11. IND group3 | 0.031 | 0.235*** | -0.030 | 0.056 | 0.080 | -0.046 | 0.092* | -0.044 | -0.626*** | -0.184*** | 1 | | | | | |
| 12. Y2016 | 0.047 | 0.073 | -0.033 | 0.017 | -0.057 | -0.035 | -0.049 | 0.008 | 0.019 | -0.033 | -0.012 | 1 | | | | |
| 13. Y2017 | 0.043 | 0.014 | -0.037 | -0.043 | 0.046 | -0.024 | -0.077 | -0.002 | 0.016 | -0.017 | 0.014 | -0.301*** | 1 | | | |
| 14. Y2018 | -0.007 | -0.054 | 0.104* | -0.009 | 0.091* | 0.048 | 0.059 | -0.007 | -0.013 | 0.022 | -0.003 | -0.314*** | -0.355*** | 1 | | |
| 15. Disclosure | -0.032*** | 0.532*** | -0.095* | 0.027 | 0.073 | 0.014 | 0.096* | 0.476*** | -0.113** | -0.081* | 0.179*** | 0.042 | -0.057 | -0.047 | 1 | |
| 16. Management Capability | -0.462 | -0.057 | 0.000 | 0.010 | -0.027 | -0.078 | -0.010 | -0.020 | 0.026 | 0.010 | -0.032 | -0.082* | -0.045 | 0.066 | 0.082* | 1 |

Note. Correlation is significant at *p < 0.10, **p < 0.05, ***p < 0.01.

Given the previous study's finding that shows the mean value of 0.011 from 284 companies of Fortune 500 companies during 2008-2012 (Qian and Schaltegger, 2017), the general movement of reduction performance over the five-year study period, which was the very initial stage of the Korean ETS can be seen as fairly encouraging.

On the other hand, the mean value of VCD over the five-year period is 15.2, indicating that on average companies consistently maintained their disclosure scores around 15 (out of 36) per year. Such trend suggests that regardless of companies' motivations, the Korean ETS affected companies have maintained a moderate level of disclosure quality over the period. It is possible that the adoption of the ETS may have played a role in raising the average trend of VCD. On top of that, it is also noted that the minimum score is observed to be 7, which draws a fair limited level by affected companies in the ETS. By and large, the range of score does not seem to exhibit a wide dispersion of VCD levels.

Correlations of variables are summarized in Table 2 below, presenting the results of correlation statistics between the dependent variable (carbon reduction performance) and independent variables. Results show that the overall co efficiency is moderate and low. The sign of correlation between carbon reduction performance and disclosure is negative, given that better carbon reduction performers show negative results compared to the previous year, this negative relation is warranted. But, it is not proven statistically significant. In line with, the moderating variable, management capability and interaction variable are also significantly correlated in a negative direction. These results imply that management capability can enhance the level of relationship between disclosure and carbon reduction performance through a moderation effect.

3.2. Regression analysis

Table 3 shows the results of the hierarchical regression analyses with carbon reduction performance as the dependent variable. Model 1 in Table 3 includes the main independent variable, Disclosure, and the control variables. The model confirms that company's voluntary carbon disclosure significantly influence a company's carbon reduction performance; the yearly improvement in a company's carbon reduction performance is negatively associated with more disclosure. The actual carbon reduction performance should be read as the inverse of the variable since the study has deducted the CEI of the preceding year from that of the relevant year to calculate CEI changes. In other words, a smaller measure accounts for better the carbon performance of the company.

Thus, Hypothesis 1 ($\beta = -0.121$, $t = -1.687$, $p < 0.10$) is supported. Interestingly, most of the control variables don't affect carbon performance except for ROA, the financial performance; this suggests that, across industries, companies are able to improve their carbon performance through disclosure practice or environmental management regardless of their size and debt ratio, emission amount and sector. Conversely, company's disclosure tendency is more likely to positively influence its carbon reduction than any other variables except for its financial performance. These empirical results and interpretation can lay the foundation for Hypothesis 2, which predicted that management capability leads to a positive change in carbon performance. Model 2 shows that the main effect of management capability is significant, but the sign is negative ($\beta = -0.447$, $t = -9.049$, $p < 0.01$) as expected. It suggests that when the companies' management capability is high, companies are more likely to yield improvements in carbon performance.

On the premise of this, hypothesis 3 predicted that the relationship between the quality of disclosure and carbon reduction performance would be (negatively)

Table 3. Regression results

| Variables | Model 1 | Model 2 | Model 3 |
|------------------------------------|-------------------|--------------------|--------------------|
| Disclosure | -0.174** (-2.164) | -0.079 (-1.090) | -0.191*** (-2.804) |
| Management capability | | -0.438*** (-8.135) | 0.606*** (3.780) |
| Disclosure * Management capability | | | -1.087*** (-6.846) |
| Size | 0.153* (1.770) | 0.086 (1.118) | 0.122* (1.732) |
| Leverage | 0.021 (0.351) | 0.014 (0.254) | -0.006 (-0.125) |
| Liquidity | 0.007 (0.097) | -0.013 (-0.193) | -0.010 (-0.165) |
| ROA | 0.361*** (4.361) | 0.380*** (5.186) | 0.381*** (5.680) |
| Capital Intensity | 0.046 (0.539) | -0.017 (-0.222) | 0.023 (0.333) |
| R&D Intensity | 0.038 (0.613) | 0.015 (0.278) | 0.044 (0.859) |
| Emission Amount | 0.046 (0.723) | 0.028 (0.443) | 0.036 (0.626) |
| Industry: | | | |
| Group1 | 0.018 (0.096) | -0.007 (-0.040) | 0.031 (0.202) |
| Group2 | 0.040 (0.279) | 0.019 (0.151) | 0.032 (0.281) |
| Group3 | 0.019 (0.128) | -0.019 (-0.148) | 0.010 (0.088) |
| Y2016 | 0.079 (1.108) | 0.036 (0.566) | 0.040 (0.697) |
| Y2017 | 0.041 (0.558) | 0.013 (0.199) | 0.019 (0.316) |
| Y2018 | -0.007 (-0.098) | 0.002 (0.033) | 0.026 (0.439) |
| Constant | -0.814 (-1.178) | -0.262 (-0.425) | -0.834 (-1.464) |
| F-static | 3.402*** | 8.461*** | 12.403*** |
| Adj. R ² | 0.118 | 0.308 | 0.421 |
| N | 252 | 252 | 252 |

Note. t-statistics in parentheses. *p < 0.10, **p < 0.05, ***p < 0.01

moderated by management capability. The Model 3 in Table 3 shows that the main effect of disclosure is significant, but the sign is still negative ($\beta = -0.145$, $p < 0.05$). Additionally, the main effect of management capability is also significant but the sign has flipped and now is positive ($\beta = 0.388$, $p < 0.05$). The interaction effect is significant but negative ($\beta = -0.881$, $p < 0.01$). These findings are strongly consistent with the earlier stated rationales. Furthermore, as F-statistic is significant (15.201, $p < 0.01$) with the fair value of adjusted R², the model 3 is fully validated.

The result empirically suggests that companies with

high management capability are able to reduce more carbon emission compared to the previous year driven by the improvement of disclosure. Put it differently, the downward or negative relation describes the effect of disclosure on carbon reduction performance when the company's management capability is high. To facilitate the interpretation of carbon performance, the study reverses the sign of the main effect of disclosure on carbon performance for stating the relationship direction. Together, these findings support Hypothesis 2, 3, as the effect of disclosure on carbon performance varies depending on changes in sales growth

(management capability).

4. Conclusion

This research was initially motivated by a lack of discussion on actual effects of disclosure on environmental performance. Yet the study was further developed by ongoing questions on whether such an increase can change the carbon reduction performance. Specifically, the main objectives were to (1) investigate whether an increase in a company's VCD can manifest a change in the carbon reduction performance and (2) examine whether and to what extent a company's management capability influences the relationship between VCD and carbon performance.

Given the rising demand for carbon information both within and outside the boundaries of business operations, VCD process can and should lead to changes in corporate carbon management behavior and performance. In practice, when considering disclosure quality improvements, whether the change in disclosure leads to subsequent changes in performance can be a more crucial factor for company managers and governmental regulators to weigh on (Qian and Schaltegger, 2017). In this regard, two contrasting theories have provided distinct perspectives. From the legitimacy theory, corporations are traditionally regarded as entities that adapt to social pressures including climate change (Qian and Schaltegger, 2017). Carbon disclosure has thus been posited as a mere legitimizing tool that is unlikely to foster real improvement in environmental performance. On the other hand, the 'outside-in' management oriented view argues that overtime, businesses can act proactively and strategically when facing environmental challenges. Thus, carbon disclosure can be used as a catalyst to drive changes and enable companies to achieve actual carbon performance improvement (Qian and Schaltegger, 2017). In addition, the institutional

theory implies that the strong carbon-regulated institutional contexts, like the Korean ETS play a role in negating the company's legitimation intention and imposing constraints on companies' green washing practices.

The study's empirical findings validate three hypotheses. Besides having a main effect, management capability further strengthens the positive relationship between carbon performance and carbon disclosure through an interaction effect. In other words, the results indicate that changes in carbon disclosure levels are positively associated with subsequent changes in carbon performance, seen in the positive role of disclosure level in subsequent carbon reduction. Essentially, if carbon disclosure quality improves, companies are motivated and capable of using disclosure as an 'outside-in' opportunity to create change and improve their carbon performance. Notably, such phenomenon occurs regardless of the industry type. This reflected in that within the Korean ETS, which positively influences the overall quality of disclosure, the level of disclosure effect on carbon performance varies depending on a company's sales growth, management capability, not on industry type. This rationale is empirically consistent with the findings on moderation effects.

Additionally, the results imply that companies move from seeking legitimacy and compensation to achieving real carbon reductions. These findings also lay the foundation for the argument that corporate sustainability is being integrated into core businesses, and that the real purpose of collecting and disclosing environmental information is moving toward provide information for problem solving and decision making by business managers (Qian and Schaltegger, 2017). In this way, this study has practical implications for business corporations: carbon disclosure could be a strategy for companies to create momentum in the organization to improve, signal improved social and environmental performance (Branco and Rodrigues,

2006), create value and benefit (including enhancing images and reputation) (Hooghiemstra, 2000) and distinguish themselves from competitors in global competitions (Hasseldine et al., 2005).

This research will be useful for both corporate managers to understand whether disclosure pressure can be leveraged to enhance and motivate carbon performance improvement and academic scholars to recognize whether VCD can be deemed as a legitimating tool to narrow the gap between the real performance and stakeholder's believe.

In conclusion, the growing interest in VCD can positively contribute to businesses' carbon performance. In the end, once such a notion becomes prevalent in mainstream business management, improved carbon performance could potentially save companies' costs in the capital market and mitigate environmental damage imposed on society.

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Annex. Contents analysis index for scoring a sustainable report

| Categories | Items |
|---|--|
| 1. Climate Change risks and opportunities | CC1 assessment/description of the risks(regulatory, physical or general) relating to climate change and actions taken or to be taken to manage the risks |
| | CC2 assessment/description of current (and future) financial implications, business implications and opportunities of climate change |
| 2. GHG emissions | GHG1 description of the methodology used to calculate GHG emissions (e.g. GHG protocol or ISO) |
| | GHG2 existence external verification of quantity of GHG emission – if so by whom and on what basis |
| | GHG3 total GHG emissions – metric tonnes CO ₂ e emitted |
| | GHG4 disclosure of Scopes 1 and 2, or Scope 3 direct GHG emissions |
| | GHG5 disclosure of GHG emissions by source (e.g. coal, electricity, etc.) |
| | GHG6 disclosure of GHG emissions by facility or segment level |
| | GHG7 comparison of GHG emissions with previous years |
| 3. Energy consumption | EC1 total energy consumed (e.g. tera-joules or peta-joules) |
| | EC2 quantification of energy used from renewable source |
| | EC3 disclosure by type, facility or segment |
| 4. GHG reduction and cost | RC1 detail plans or strategies to reduce GHG emissions |
| | RC2 specification of GHG emissions reduction target level and target year |
| | RC3 emission reductions and associated costs or savings achieved to date as a result of the reduction plan |
| | RC4 costs of future emissions factored into capital expenditure planning |
| 5. GHG emission accountability | ACC1 indication of which board committee (or other executive body) has overall responsibility for actions related to climate change |
| | ACC2 description of mechanism by which the board (or other executive body) reviews the company's progress regarding climate change actions |

Note. The index is entirely described by Choi et al. (2013)