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An empirical examination of how the corporate governance and strategy affect GHG emissions efficiency

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Abstract

This study aims to empirically examine how environmental efficiency related to GHG emissions is affected by corporate governance and activities. This study uses data from CDP (former Carbon Disclosure Project) where the observations are 686 firms worldwide in 2013. As proxy for the environmental efficiency, this study adopts GHG emissions per employee. As independent variables, this study uses dummy variables made from CDP questionnaire. Regarding the corporate governance, this study finds that the amount of greenhouse gas emissions per employee is low (i.e., efficient) when direct responsibility for climate change is taken by individual/sub-set of the board and other and senior manager/officer. However, when companies engage directly or through trade associations on climate change, the companies are considered to be less efficient than other companies. On the other hand, regarding corporate activities, this study finds that environmentally inefficient companies (i.e., more greenhouse gas emissions per employee) are likely to participate in emissions trading schemes, take a verification/assurance status that applies to firm's Scope 3 emissions at the first year, and engage with customers.

Key words: climate change, corporate governance, corporate activity, CDP, environmental efficiency
JEL classification: G30, Q54, Q56

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1. INTRODUCTION

It has been widely recognized that a reduction in greenhouse gas (GHG) emissions is important in order to protect our environment. While some international agreements regarding GHG emissions have already been signed by countries all over the world, companies are currently required to decrease GHG emissions through their own inventive approaches. Specifically, to reduce GHG emissions, some kind of leadership such as governance and strategy are important, because GHG emissions often require company-wide consensus rather than a bottom-up approach. This study aims to empirically examine how environmental efficiency related to GHG emissions is affected by corporate governance and activities. Analyzing the corporate determinants of GHG emissions will be informative for companies to improve environmental efficiency. Also, this analysis is helpful for policymakers or investors to form expectations about the effect of corporate behaviors on corporate environmental performance.

This study uses data from CDP (former Carbon Disclosure Project), which gathered observations of 686 firms worldwide in 2013. As proxy for the environmental efficiency, this study adopts GHG emissions per employee. As independent variables, this study uses dummy variables made from the CDP questionnaire. The regression result shows that the amount of GHG emissions per employee is low when direct responsibility for climate change is taken by an individual/sub-set of the board and other and the senior manager/officer. Also, the result shows that the GHG amount is high when the company engages in activities through direct engagement and trade associations, when companies participate in any emissions trading schemes, when Scope-3 (i.e., GHG emissions of supply chain) emissions verification is incomplete and it is first year it has taken place, and when engagement is taken with corporate customers.

This paper is structured as follows. Section 2 presents some extant literature on corporate governance and environmental performance and explains CDP. Section 3 discusses the methodology focusing on a regression model and data. Specifically, in the regression model, this study uses the GHG emissions per employee as a dependent variable and the dummy variables from CDP questionnaire as the independent variables. Section 4 shows the results of the regression model. Section 5 concludes with a short summary of the result and a business implication for

firms' owners, managers, and policymakers.

2. BACKGROUNDS

2.1 Corporate governance and environmental performance

While more and more companies are facing pressure to reduce their GHG emissions in order to mitigate climate change risks, there are already several reasons to prove that corporate governance plays a key role in environmental performance. Weinhofer and Hoffmann (2010) build a generic corporate CO_2 strategy framework to examine and classify whether and how companies operate with environmental business operations. They use data of 91 companies from CDP questionnaires, which include the following information: their electricity production, CO_2 emissions data, and regional affiliation from companies' answers. Focusing on combinations of different corporate CO2 strategy types, the authors find that most firms operate from the viewpoint of long-term emissions management. Their research also shows that the corporate CO2 strategies are significantly different among countries.

Walls et al. (2012) argue that there is a link between the corporate governance/strategy and the company's owners, managers, boards of directors, and environmental performance. The sample of their study consisted of Standard & Poor's (S&P) 313 firms in 29 industries in the primary and manufacturing area between 1997 and 2005. The authors find that shareholders' concentration and activism can affect environmental performance and that board constructs are relevant for environmental performance. Their study also shows that firms with higher managerial incentives generally do less well in environmental performance.

Kock et al. (2012) try to build on a stakeholder–agency theoretical perspective to explore the impact of corporate governance mechanisms on firms' environmental performance. Focusing especially on a discussion of whether firms in polluting industries have a better environmental performance, the authors aim to analyze the effect of corporate governance on environmental performance with demands for better environmental performance from stakeholders. The authors use data of 377 US public companies with 657 firm-year observations from 1998 to 2000, obtained from Investor Responsibility Research Center (IRRC). The authors find that, when the corporate exposure is high in the market or in the legal and regulatory system, the firm's environmental performance level will be higher. The authors also show that, when stakeholders

are tough on the corporate board, the firm's environmental performance level will be higher and that the equity-based managerial incentives also affect the level of firms' environmental performance.

2.2 Corporate governance and corporate social responsibility

As reviewed above, the corporate governance is considered to have an effect on corporate environmental performance. Also, the literature discusses the relationship between corporate governance and corporate social responsibility (CSR). Ntim et al. (2013) investigate why corporate governance mechanisms drive CSR and how a firm's governance mechanisms drive its CSR practices based on the neo-institutional theory. The authors also examine why and how the CSR and corporate financial performance are associated with corporate governance. Data of their study consist of 291 non-financial firms listed on the Johannesburg Stock Exchange (600 firm-year observations) between 2002 and 2009 in five main industries: basic materials, consumer goods, consumer services, industrials, and technology/telecoms, obtained from annual and sustainability reports by the Perfect Information Database and DataStream. The authors find that positive association also exists between the following three relations: government ownership and CSR practices, institutional ownership and CSR practices, and board size and CSR practices. On the other hand, a negative relationship is found between block ownership and CSR practices. The researchers also found that, when a company has higher (lower) corporate governance quality, the relationship between CSR and financial performance will become more (less) intense.

Although the literature discussed that CSR is beneficial for corporate performance, the following question arises: Is CSR the activity specific to the largest companies? That is, when the company's size becomes larger, should the company relate to the interests of more stakeholders, which are the main target of CSR, as discussed in Jamali et al. (2008). The authors discuss the relationship between corporate governance and CSR in depth and investigate the managerial explanation and practical application of the relationship, using in-depth interviews with the top managers of eight corporations operating in Lebanon as a way of qualitative interpretive research methodology. From the interview, the authors notice that the majority of managers agree that

corporate governance is a necessary pillar for sustainable CSR and that companies in developing countries are starting to become interested in CSR.

As reviewed above, the environmental performance and corporate governance are often closely related to each other, and CSR activities have become popular in developing countries. This study aims to further examine what types of corporate governance and activities are related to environmental efficiency, using the dataset from CDP, as explained in the below section.

2.3 CDP

This sub-section introduces the CDP and some research performed using data from the CDP. The CDP is a private voluntary initiative designed to promote the improved management of carbon by pressuring firms to report their carbon emissions and describe their carbon strategies (Matisoff, 2012). CDP is a non-profit organization that began in 2000 and is headquartered in London, United Kingdom. CDP is the world's largest institutional investor collaboration, and the members signed a single global request for corporate disclosures of information on GHG emissions (Solomon et al., 2011). The CDP collaborates with 225 institutional investors with assets under management of more than 31 trillion dollars, and it surveys companies through an annual questionnaire on the business implications of climate change (Trucost, 2007). Through publishing reports and making disclosures available to the public, CDP tries to compel firms to disclose by increasing the benefits and reducing the costs of disclosing (Stanny, 2013). CDP can be seen as a "secondary stakeholder" that has facilitated collaborative engagement by institutional investors to increase corporate accountability in relation to climate change (Arenas et al., 2009).

CDP data has been used in several studies with different purposes. Stanny (2013) examines voluntary disclosures of GHG emissions based on the data of S&P 500 firms from the CDP, aiming at understanding general voluntary disclosures and particular emission disclosures. Matisoff (2012) uses data from CDP and Chicago Climate Exchange to examine GHG reduction in the United States' power plants, focusing on voluntary environmental policy. Cotter et al. (2011) assume a stakeholder engagement perspective to investigate the collective influence of institutional investors. The authors find that, in large companies, the influence of institutional

investors is associated positively with climate change disclosure. Rankin et al. (2011) explain voluntary corporate GHG reporting in the market governance system of climate change public policy. The authors find that, when the firm has a higher level of corporate governance quality and report publicly, the firm will have a larger environmental management system. Weinhofer et al. (2010) present a framework that focuses on one combination among CO2 compensation, CO2 reduction, and carbon independence.

We also note that the CDP data has some limitations. Firstly, answering the CDP questionnaire is not associated with a decrease of carbon dioxide emissions or electricity generation (Matisoff, 2012). These data relate to the current status toward the climate change issue. Secondly, most of the companies in the CDP's questionnaires are already considered to have high environmental consciousness. Therefore, analysis using CDP questionnaire may result in testing the responsiveness of already responsive companies to institutional investor pressures (Cotter, 2011).

3. METHODOLOGY

3.1 Model 1: Corporate governance

This study aims to examine what types of corporate governance and activities are related to environmental efficiency using a dataset from the CDP. Firstly, following the discussion in the literature, this study hypothesizes that the environmental efficiency is a function of corporate governance. Specifically, this study employs the corporate governance model. As proxy for environmental efficiency, this study uses GHG emission (Scope 1+2; direct and indirect emissions) divided by the full-time employees in the logarithm form (ln(GHG/Emp)) from CDP. On the other hand, as the independent variables proxy for corporate governance, this study uses 6 questionnaires (Questions 1 to 6) related to the corporate governance section from CDP. The corporate governance model is expressed as follows:

$$\ln\left(GHG/Emp\right) = \beta + \sum_k \beta_k{}^1 D_k{}^1 + \sum_k \beta_k{}^2 Dk^2 + \sum_k \beta_k{}^3 D_k{}^3 + \sum_k \beta_k{}^4 D_k{}^4 + \beta^5 D^5 \qquad (1)$$

$$+ \beta^6 D^6 + \beta_i + \beta_t + e$$

where D_k^j denotes a dummy variable of *k*-th answer in question *j* from CDP as explained in the below sub-section. When β_k^j is positively (negatively) significant, the corresponding corporate governance is considered to have a negative (positive) impact on environmental efficiency. β_i and β_t denote industry and year effects, respectively, and *e* denotes an error term.

3.2 Model 2: Corporate activity

Secondly, this study examines whether environmental efficiency is affected by the corporate activities with other organizations, hypothesizing that the environmental efficiency is a function of corporate activities. This study refers to the model as the corporate activity model. As the independent variables proxy for corporate activities, this study uses 4 questionnaires (Questions 7 to 10) related to performance section from CDP. The corporate activity model is expressed as follows:

$$\ln (GHG/Emp) = \beta + \sum_k \beta_k^7 D_k^7 + \beta^8 D^8 + \sum_k \beta_k^9 D_k^9 + \sum_k \beta_k^{10} D_k^{10} + \beta_i + \beta t + e \qquad (2)$$

where D_k^j denotes a dummy variable of *k*-th answer in question *j* from CDP. When β_k^j is positively (negatively) significant, the corresponding corporate activity is considered to be correlated negatively (positively) with the environmental efficiency.

3.3 Data

Data of this study in both corporate governance and activity models are firm-level data obtained from a questionnaire survey of CDP Supply Chain 2013 Information Request by CDP in 2013, based on three parts: management, risk and opportunities, and emissions. Table 1 shows the descriptive statistics of this study. The number of observations is 648, which includes 64 countries and 56 industry groups. The dependent variable is scope 1 and 2 emissions for the reporting year in metric tons of CO2 per full-time equivalent employee in the log-form (i.e., ln(GHG/Emp)).

The independent variables are based on questionnaires and all dummy variables that take 0 or 1. The corporate governance model uses 6 questionnaires of the CDP Supply Chain 2013 Information Request (original questionnaires are as follows: Governance: Q1.1; Strategy: Q2.1, Q2.2; Targets and initiatives targets: Q3.1, Q3.2, Q3.3). Question 1 asks what department has the greatest direct responsibility for climate change (1: Individual/Sub-set of the Board; 2: Other Manager/Officer; 3: Senior Manager/Officer; "No": baseline). Question 2 asks, "Please select the option that best describes your risk management procedures with regard to climate change risks and opportunities": (1: a specific risk management process; 2: Integrated into multi-disciplinary risk management processes; 3 Describe the process and outcomes; "No": baseline). Question 3 asks who engages in GHG emissions reduction (1: Direct engagement/other; 2: Funding research organizations; 3: Trade associations/other; 4: other; 'No': baseline). Question 4 asks, "Did you have an emissions reduction target that was active (ongoing or reached completion) in the reporting year?": (1: Absolute and intensity targets; 2: Absolute target; 3: Intensity target; "No": baseline). Question 5 asks, "Does the use of your goods and/or services directly enable GHG emissions to be avoided by a third party?" Question 6 asks. "Did you have emissions reduction initiatives that were active within the reporting year (this can include those in the planning and implementation phases)?"

On the other hand, corporate activity model uses 4 questionnaires from the CDP Supply Chain 2013 Information Request (original questionnaires are as follows: emissions trading: Q13.1, Q13.2; Scope 3 emissions: Q14.2, Q14.4). Question 7 asks, "Do you participate in any emissions trading schemes?" (1: Yes, we participate in emissions trading schemes; 2: No, but we anticipate doing so in the next 2 years). Question 8 asks, "Has your company originated any project-based carbon credits or purchased any within the reporting period?": (1: Yes, we have originated project-based carbon credits or purchased some within the reporting period; 2: No). Question 9 prompts, "Please indicate the verification/assurance status that applies to your Scope-3 emissions": (1: More than 0% but less than or equal to 20%; 2: More than 20% but less than or equal to 40%; 3: More than 40% but less than or equal to 60%; 'No': baseline). Question 10 asks, "Do you engage with any of the elements of your value chain on GHG emissions and climate change strategies?": (1: Our suppliers; 2: Our customers; 3: Other partners in the value chain; "No":

baseline).

4. RESULT

4.1 Corporate governance model

The corporate governance model regression results are shown in Table 2. We find that some coefficients of Questions 1 (direct responsibility for climate change) and 3 (engage in activities on climate change) are statistically significantly different from zero. In Question 1, all three answers are statistically significantly negative, indicating that direct responsibility for climate change is important to reduce GHG emissions. The largest effect (i.e., the lowest coefficient) on GHG emissions reduction occurs when another manager or officer takes direct responsibility for climate change. Both two options of Question 2 are not significant. Regarding Question 3, answer 1 (direct engagement) and answer 3 (trade association) are statistically significantly positive, indicating that companies implementing engagement with these two options are less environmentally efficient. Questions 4, 5, and 6 are not significant.

4.2 Corporate activity model

The corporate activity model regression results are shown in Table 3. Some coefficients of Questions 7, 9, and 10 are statistically significantly different from zero. Only Question 8 is not significant. In Question 7, answer 1 (yes, we participate in emissions trading schemes) is statistically significantly positive, indicating that companies implementing emissions trading schemes are inefficient in terms of GHG emissions. In Question 9, answer 2 (incomplete third-party verification or assurance: first year it has taken place) is statistically significant, indicating that companies which take the verification/assurance status of scope 3 emissions for the first time are inefficient in terms of GHG emissions. Regarding Question 10, answer 2 (engage with firm's customers) is statistically significantly positive, indicating that companies engaging with customers are environmentally inefficient. Question 8 (company originated any project-based carbon credits) is not significant with climate.

5. CONCLUSIONS

The purpose of this study is to examine the effects of corporate governance and activities on environmental performance. In the corporate governance model, this study finds that the amount of GHG emissions per employee is low (i.e., efficient) when direct responsibility for climate change is taken by an individual/sub-set of the board and the other and senior manager/officer. Secondly, when companies engage directly or through trade associations on climate change, the companies are considered to be less efficient than other companies. This suggests that these two engagements will be indications of inefficient companies. On the other hand, in the corporate activity model, this study finds that environmentally inefficient companies (i.e., more GHG emissions per employee) are likely to participate in emissions trading schemes, to take a verification/assurance status that applies to the firm's Scope-3 emissions at the first year, and to engage with customers.

Managers have increasingly begun to recognize the importance of corporate environmental performance. The findings of this study show that boards should make the responsibilities of various managers clear on environmental performance. This suggests that, to be more environmentally efficient, strong leadership is necessary. Also, this study suggests that environmentally inefficient companies are likely to engage directly or through trade associations on climate change or participate in emissions trading schemes. Therefore, these activities are informative signs for policymakers and investors to distinguish between efficient and inefficient companies.

Note that this research has several limitations. Our sample included companies from 64 countries, including developed countries and developing countries. Dividing samples into these groups may yield a different result. Secondly, the sample of CDP may include only environmentally efficient firms, and therefore, sample selection bias may occur. Finally, we find that environmentally inefficient companies are likely to engage with customers. Hence, the relationship between consumer concerns and corporate environmental performance could be investigated in future research.

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Table 1. Descriptive statistics

Variable	obs	Mean	S.D.	Min	Max
Dependent variable					
ln GHG/Emp (Scope 1 and 2 emissions in metric tons CO2 per unit)	686	2.8087	2.7240	−11.7566	16.7013
Independent variable					
Q1 Direct responsibility for climate change					
1 (Individual/Sub-set of the Board)	686	0.6706	0.4704	0	1
2 (Other Manager/Officer)	686	0.2915	0.1684	0	1
3(Senior Manager/Officer)	686	0.2697	0.4441	0	1
Q2 The option of risk management procedures					
1(A specific risk management process)	686	0.0730	0.2601	0	1
2(Integrated risk management processes)	686	0.7420	0.4379	0	1
Q3 Engage in activities on climate change					
1(Direct engagement)	686	0.3936	0.4890	0	1
2(Funding research organizations)	686	0.1910	0.3933	0	1
3(Trade associations)	686	0.5364	0.4990	0	1
4(Other/ Direct engagement)	686	0.2638	0.4410	0	1
Q4 Have an emissions reduction target					
1(Absolute and intensity targets)	686	0.1633	0.3700	0	1
2(Absolute target)	686	0.2609	0.4395	0	1
3(Intensity target)	686	0.2974	0.4574	0	1
Q5 GHG emissions avoided by goods/service	686	0.6399	0.4804	0	1
Q6 Emissions reduction initiatives	686	0.8717	0.3346	0	1
Q7 Participate in any emissions trading schemes					
1 (Yes, we participate in emissions trading schemes)	648	0.2377	0.4260	0	1
2 (No, but we anticipate doing so in the next 2 years)	648	0.0741	0.2621	0	1
Q8 Company originated any project-based carbon credits	648	0.1821	0.3862	0	1
Q9 Scope 3 emissions verification/assurance status					
1(Incomplete third party verification or assurance: Last year's statement available)	648	0.0309	0.1731	0	1
2 (Incomplete third party verification or assurance: First year it has taken place)	648	0.0334	0.1812	0	1
3 (Third party verification or assurance complete)	648	0.2515	0.4342	0	1
Q10 Engage on GHG emissions and climate change strategies					
1 (Engage with firm's suppliers)	648	0.5000	0.5004	0	1
2 (Engage with firm's customers)	648	0.5093	0.5003	0	1
3 (Engage with firm's other partners)	648	0.1914	0.3937	0	1

Table 2. Regression results (Corporate governance model)

	(1) ln(GHG/Emp)	
	Coef.	S.E.
Q1 Direct responsibility for climate change		
1 (Individual/Sub-set of the Board)	−1.1913*	(0.6673)
2 (Other Manager/Officer)	−1.6561*	(0.8455)
3(Senior Manager/Officer)	−1.3472**	(0.6560)
Q2 The option of risk management procedures		
1(A specific risk management process)	0.2433	(0.4612)
2(Integrated into multi-disciplinary risk management processes)	0.2798	(0.3225
Q3 Engage in activities on climate change		
1(Direct engagement)	0.5452**	(0.2445)
2(Funding research organizations)	−0.1145	(0.3036)
3(Trade associations)	0.6153**	(0.2426)
4(Other)	−0.2203	(0.2400)
Q4 Have an emissions reduction target in the reporting year		
1(Absolute and intensity targets)	−0.1120	(0.3998)
2(Absolute target)	0.2111	(0.3270)
3(Intensity target)	0.2947	(0.3288)
Q5 Goods or services directly enable GHG emissions to be avoided	0.0580	(0.2490)
Q6 Emissions reduction initiatives within the reporting year	−0.1949	(0.3643)
Constant	3.4842	(0.6610)
Country dummy	Yes	
Industry dummy	Yes	
Obs	686	
Year	2013	
R-squared	0.1952	

Note: ***, ** and * stand for statistically significant levels at 1%, 5% and 10%, respectively.

Table 3. Regression results (Activity model)

	(1) ln(GHG/Emp)	
	Coef.	S.E.
Q7 Participate in any emissions trading schemes		
1 (Yes, we participate in emissions trading schemes)	0.5470**	(0.2763)
2 (No, but we anticipate doing so in the next 2 years)	−0.2581	(0.4227)
Q8 Company originated any project-based carbon credits	0.1878	(0.2989)
Q9 Scope 3 emissions verification/assurance status		
1 Incomplete third party verification or assurance: Last year's statement available	0.1794	(0.6110)
2 Incomplete third party verification or assurance: First year it has taken place	1.2930**	(0.5715)
3 Third party verification or assurance complete	−0.1500	(0.2674)
Q10 Engage on GHG emissions and climate change strategies		
1(Engage with firm's suppliers)	0.1637	(0.2416)
2(Engage with firm's customers)	0.4450*	(0.2219)
3(Engage with firm's other partners)	−0.0448	(0.2772)
Constant	2.4051	(0.3103)
Country dummy	Yes	
Industry dummy	Yes	
Obs	648	
Year	2013	
R-squared	0.1059	

Note: ***, ** and * stand for statistically significant levels at 1%, 5% and 10%, respectively.

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