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Effectiveness of Business Practices Related to Climate Change as a Driver for Improving Environmental Performance

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Abstract: This study explores the relationship between business practices related to climate change and environmental performance. Using an international sample of analysis from 2013 to 2017, the paper examines how managerial incentives, public policy, disclosure, and responsibilities to executives on climate change, as corporate governance factors, affect a firm's environmental performance. By employing several regression analyses, our independent variables-incentives, public policy, disclosure, and responsibilities-show to improve the environmental performance in terms of reduction of GHG emissions. In addition, results show that stakeholders' engagement seems less relevant in the US concerning other countries, this could be related to the US public opinion which exerts lower pressures on companies to deal with climate change. This study contributes to the environmental governance literature, where the impact of governance practices on environmental problem solving has not been widely studied.

Keywords: Corporate Governance, Sustainable Development, Environmental Performance, Climate Change

Introduction

The Sustainable Development Goals (SDGs) recognize that businesses are the main engine of sustainable and economic development and therefore play a key and decisive role. The 2030 Agenda, which includes 17 objectives, clearly judges the unsustainability of the current development model, not only at an environmental level but also at an economic and social level. In this way, the idea that sustainable development is only an environmental problem was finally overcome, affirming the overall vision of the different dimensions of development (Martínez-Ferrero and García-Meca, 2020). Pursuing the Sustainable Development Goals will certainly benefit the private sector because companies will have new business opportunities and the ability to strengthen relationships with stakeholders.

One of the great challenges that companies face is to connect the new development to the core business. At this stage, it is essential to build on already solid foundations, orienting each new project towards sustainable development. Shortly, the private sector will become an ever-growing part of global development, which is why companies must be progressively involved with international agencies to develop a comprehensive and shared vision on how to monitor and coordinate all stakeholders.

Under the Paris Agreement on climate change, countries are committed to reducing their Greenhouse Gas (GHG) emissions through Nationally Determined Contributions (NDCs) (Rogelj *et al.*, 2016). Under NDCs some countries are instituting cap and trade policies or voluntary commitments from private sectors that require firms to actively manage their GHG emissions (Richards *et al.*, 2016). In addition, some businesses have voluntarily committed to reducing GHG emissions in the absence of government initiatives (Borghesi *et al.*, 2018).

Companies are responding to the problem of climate change in several ways: Purchasing carbon offsets, improving supplier engagement to reduce their emissions, and applying several technological solutions. For example, Bansal (2019) shows that oil and gas companies attempted to use new technologies in their production process to reduce their carbon footprint. Van Vuuren *et al.* (2018) examine the rapid implementation of the best technologies for a deep reduction of GHG emissions. Perry *et al.* (2008) show that the results of renewable technologies consequently reduced the release of CO₂.

Another type of effort to reduce firms' GHG emissions has been placed on corporate governance practices (Aguilera *et al.*, 2018). L'Oréal, for example, created managerial incentives to address climate change by tying executive compensation to GHG reporting scores from CDP, which runs annual greenhouse gas emission disclosures on

behalf of institutional investors. Unilever considers motivating its business divisions by attaching financial and non-financial incentives to the agenda of reducing its carbon footprint. Nestlé ensures managerial sustainability and oversees the long-term succession planning of the Board by the Nomination and Sustainability Committee (NSC).

However, empirical evidence on the relationship between governance practices toward climate mitigation and a firm's environmental performance in terms of GHG emissions is lacking in the literature. Therefore, in this study, we are attempting to answer the following question:

RQ: Are the level of a firm's GHG emissions and the governance practices climate change-related? We examine the relation between corporate governance practices and environmental performance for a sample of 1,612 individual firms across 56 countries. We used both Scope 1 (direct emissions) and Scope 2 (indirect emissions) GHG emissions data from the Carbon Disclosure Project (CDP). We measure corporate governance practices using firms' voluntary responses to the CDP annual questionnaire.

The remainder of the paper proceeds as follows. The next section presents climate change and the private sector. The third section describes the relevant literature on corporate governance and environmental performance. The fourth section discusses the research design. The fifth section presents the empirical results. The last section presents the discussion and conclusion.

Theoretical Background

Climate Change and Private Sector

Business sustainability is based on the idea that companies must take responsibility for the environmental, social, and economic impacts generated by their activities, even at the expense of their stakeholders. The reason for the expansion of the company's responsibilities lies in recognizing the connection between long-term profitability and the socio-economic-environmental context in which it is located (Jadoon *et al.*, 2021).

In 1997, the Greenhouse Gas Protocol (GHGP) was born. It was the result of an initiative by the World Resource Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), which recognized the need for an international accounting standard for greenhouse gas emissions. The WRI and WBCSD believed this would be necessary to track the evolution of international policies on global climate change.

After almost four years, the first edition of the GHGP was published under the name, "Corporate Accounting and Reporting Standards". The GHGP aims to provide companies with a set of tools and methodologies that can be used to calculate their GHG. According to the reporting standards, the emissions must be reported and divided into three categories, called scopes.

Scope 1 emissions are direct emissions that come

from owned or controlled sources by the company. Scope 2 includes indirect emissions that come from the generation of purchased electricity. Scope 3 emissions are all indirect emissions (not included in scope 2) that subsume all other indirect emissions (such as transportation or extraction of purchased materials).

The increase in average global temperature has consequences on the world's ecosystem, leading to a progressive rise in sea levels, the retreat of glaciers and snow cover, and an increase in intensity and frequency of extreme weather (Lanfranchi *et al.*, 2014). These issues not only affect the environment but also the economies and the health and mobility of the country's citizens.

If action is not taken, by the end of the century, global warming could exceed the 2°C thresholds set as a target by the international agreement reached in Paris, France in 2015 (COP 21) and referred to by the UN in the 2030 Agenda. The COP 21 commits European states to continue their efforts to limit the temperature increase to just 1.5°C, while still keeping it below 2°C globally. Europe has already achieved its goal of reducing greenhouse gas emissions by 2020, with industry and energy contributing the most.

The most important corporate sustainability initiative was conceived in 1999, when the then Secretary-General of the United Nations (UN), Kofi Annan, addressed the business community in Davos, Switzerland. There he proposed an initiative called the "Global Compact" for sustainability. This pact was launched the following year in New York, NY. The Global Compact was and still is a momentous step for the United Nations, as it not only recognizes the role of businesses as partners in a more sustainable and inclusive developmental environment but it directly activates the UN in this private sector engagement project. However, this poses two key questions: How can one distinguish between strategic and tactical choices? And, how can join the Global Compact as the result of an opportunistic choice based on exclusively reputational needs be avoided?

The main answers to these questions are closely linked to the Global Compact's mission. The first, internal, is related to the fact that sustainability must be strategically integrated into the business's core by its executives. The second, external and more demanding, concerns the commitment that the company must put to providing a significant contribution to global goals, defined internationally by the UN.

Currently, several countries are adopting the 17 Sustainable Development Goals defined in the 2030 Agenda. The Agenda, which addresses all countries to implement its SDGs, aims to unify nations in the pursuit of creating a more sustainable global environment, regardless of socio-economic-political status. To achieve this, nations must work together with businesses to develop cleaner energy sources, universal access to clean water, improve infrastructure, and the development of a circular economy.

From here we can understand how businesses are called to create value: First, by proposing solutions for a smarter and cleaner economy, and secondly, by paying

particular attention to the quality of development.

Particularly, climate change is a key challenge in terms of sustainable development. The warming of the earth's atmosphere is causing changes in the global climate system that threatens all countries. From the survival of large sections of the population in under-developed countries to infrastructure and select economic sectors in developed regions. Furthermore, changes in precipitation and temperature cycles are also affecting ecosystems, such as Forests, farmland, mountain regions, oceans, as well as the people living there. Global carbon dioxide (CO₂) increased by over 50% between 1990 and 2012.

Climate change is a global issue affecting all nations and the action of governments and their institutions alone will not be enough to provide a remedy. The private sector must play a primary role in combating climate change. Businesses must take responsibility for reducing emissions in a way that is both cost-effective and in line with their corporate mission and values.

Business benefits go far beyond reducing emissions, companies that can assess and understand the risks and opportunities related to the climate will be able to make better decisions over the long term, leading to new business opportunities (Trollman and Colwill, 2021). In addition to communicating the dangers of exposure to harmful emissions (carbon exposure), companies all over the world should predict the future and what risks they will face. In this context, entrepreneurs must carry out "stress tests" so that the losses related to climate change can be assessed, both in terms of production processes and policies introduced by the company to curb the emissions of GHG.

Hypotheses Development

Climate change and firms' strategies for managing GHG emissions have been discussed in the context of corporate governance (Lee, 2012; Naciti *et al.*, 2021). Kolk and Pinkse (2005) discuss business strategies as a choice between economic interest and a firm's responsibility to climate change. The authors identify three strategic options for climate change: Process improvement, product development, and new product/market combinations. Jeswani *et al.* (2008) identify the strategies adopted by firms in different sectors focusing on energy efficiency. Investigate sustainability disclosure tools of Australian firms concerning corporate governance practices. Their results show that low levels of disclosure of climate change-related corporate governance practices are associated, among other factors, with a lack of proactive stakeholder engagement. Sullivan and Gouldson (2017) examine the effect the external government pressures on corporate strategies and actions related to climate change. Their study shows that internal governance processes on climate change strategies are influenced by external government

pressures. However, firms will be willing to pursue climate change strategies only if financial benefits are expected to exceed related costs.

The effectiveness of these climate change strategies in achieving reductions in GHG emissions, however, has not been addressed by the literature.

Here we build hypotheses on the relationship between corporate governance practices and environmental performance based on the stakeholder-agency paradigm (Hill and Jones, 1992).

In the traditional paradigm of agents and principals, the stakeholders' interests can diverge from managers' strategies to allocate the firm's resources (Lee, 2012). Accordingly, the literature on corporate governance and environmental management suggests that stakeholders' interests and corporate governance's preferences may diverge because stakeholders show a greater interest in climate change than the interest shown by managers (Bansal, 2005; Sharma and Henriques, 2005; Cordova *et al.*, 2021). Nevertheless, according to Hill and Jones (1992), managers have to propose strategic decisions and allocate resources to guarantee stakeholders' interests are addressed. In short, managers are understood as agents of stakeholders within an implicit contractual relationship and the corporate governance process is the main mechanism through which conflicting interests are solved (Hill and Jones, 1992). Following the stakeholder-agency paradigm, corporate governance practices reduce the gap between the interests of agents and principals, increasing the willingness of managers to satisfy the environmental preferences of stakeholders. In this study, four specific practices for climate change and the reduction of GHG emissions were considered: (1) Instituting managerial incentives, (2) engaging in public policy on climate change, (3) disclosure of the organization's response to climate change and GHG emissions and (4) assigning climate change-related responsibilities to executives.

Incentives are the most diffused corporate governance practices to align the interests of stakeholders with those of the managers (Zajac and Westphal, 1994; Nakazato *et al.*, 2011). Several studies have examined the role of managerial incentives on a firm's performance (Agarwal *et al.*, 2009; Hall and Murphy, 2003; Coles and Li, 2018; Villena and Dhanorkar, 2020; Galletta *et al.*, 2021). Banerjee and Homroy (2018) analyzed the effect of managerial incentives in alignment with the strategic objectives of managers and stakeholders and found that ownership structure affects the incentives optimizing strategies on a firm's performance. Castellaneta (2016) investigates the relationship between incentives and competitive advantage through capability building. The study shows how managerial incentives affect three different areas of firm capabilities, which are the main drivers of competitive advantage. Moreover, Cao *et al.* (2019) show how managerial incentives are related to compensation

policy and firm performance. In particular, the study finds that promotion in a career exhibits a strong positive relationship with firm performance.

In the context of climate change, we hypothesize that these effects of managerial incentives improve the propensity of managers in making decisions on environmental issues. On the one hand, an improvement in environmental performance is often associated with improved financial performance (Chen *et al.*, 2006; Gök and Peker, 2017). On the other, managerial incentives also increase the ability of stakeholders to exert pressure on managers regarding environmental issues. Therefore, we hypothesize that:

H1: The presence of managerial incentives for climate change is positively related to a firm's environmental performance

Public policy is an important driver to align managerial and stakeholder interests (Hill and Jones, 1992; Osemeke and Adegbite, 2016, Čábelková *et al.*, 2021). While new climate change policies, such as carbon tax or emissions cap, may negatively affect the company's financial performance (Fankhauser *et al.*, 2016), they create a responsibility for managers to comply with the new policy, which enables stakeholders to assert their interests (Hillman and Hitt, 1999). For example, the Sarbanes-Oxley Act of the U.S., also known as Public Company Accounting Reform and Investor Protection 2002, has made managers' responsibilities grow exponentially, including environmental responsibility. In this case, exposure to new policies that are aligned with stakeholders' interests allows managers to act on behalf of the stakeholders to reduce the risk associated with their responsibility (Lankoski, 2006). Therefore, we hypothesize that:

H2: Exposure to public policies on climate change is positively related to a firm's environmental performance

According to Ullmann (1985), stakeholder power is an important consideration in the firm's operation, such that stakeholders can influence business objectives. Active engagement of stakeholders represents an important corporate governance mechanism (Graziano and Luporini, 2003), which is being used to influence corporate governance in the social, and environmental areas (Solomon and Solomon, 2006; Gonzalez-Urango and García-Melón, 2018). The process of stakeholder involvement concerns specifically the communication and iterations between the company and the stakeholders (Pulejo *et al.*, 2017; Calveras and Ganuza, 2018). The involvement of investors, in particular, has substantial effects on corporate governance practices and corporate reputation (Foster and Jonker, 2005). The involvement of stakeholders brings immediate advantages in terms of

image, improving the reputation of the company with undisputed commercial and relationship benefits. In the context of climate change, managers can modify the firm's strategic direction under the pressure of some specific stakeholder groups, who can press on their environmental interests to influence the firm's behavior. Therefore, we hypothesize that:

H3: The presence of initiatives that engage climate change-related stakeholders is positively related to a firm's environmental performance

The board of directors has the legitimacy to exert pressure on managers in monitoring stakeholders' interests (Fama and Jensen, 1983; Jensen and Meckling, 1976). Independent directors, for example, should act to protect shareholders' interests as well as the other stakeholders' preferences. Several studies have shown that certain compositions of a board of directors can influence a firm environmental and social performance (Arena *et al.*, 2015; Jizi, 2017; Cucari *et al.*, 2018; Pucheta-Martínez and Chiva-Ortells, 2018; Naciti, 2019). Post *et al.* (2015) show that a board of directors with a higher presence of independent directors has a higher regard for environmental issues.

Moreover, Kassinis and Vafeas (2002) argue that some directors, who do not directly represent a specific stakeholder, will probably defend the interest of environmental stakeholders. If the responsibility for the climate change issue is entrusted to the board of directors, the degree of pressure that stakeholders exert on managers may grow in the presence of directors who represent the interests of stakeholders. Therefore, we hypothesize that:

H4: The presence of responsibility for climate change entrusted to the board of directors is positively related to the firm's environmental performance.

Research Design

Sample and Data

Following prior research (Stanny, 2013; Kim, 2015; Matisoff *et al.*, 2013, Blanco *et al.*, 2020), we use Carbon Disclosure Project (CDP) dataset from the years 2013-2017, which contains 8,060 unique firm-year observations from 1,612 individual firms across 56 countries. CDP is a private, not-for-profit organization launched in 2000; it runs a system that offers companies and countries the possibility of measuring, detecting, managing, and sharing information on their greenhouse gas emissions at a global level to improve their carbon footprint. Companies that want to be classified in the CDP must respond to a questionnaire that detects the actions taken, objectives, and strategies in the field of climate change management. Furthermore, answering the

questionnaire and obtaining a good score brings companies great visibility on a global level, thus stimulating the interest of the increasing number of institutional investors who include ESG (Environmental, Social, and Governance) issues in their investment choices. Since 2003, CDP has annually distributed questionnaires to the largest listed firms around the world, such as listed firms of the S and P 500 index and Global 500 index (Kolk *et al.*, 2008). The questionnaire is organized into categories such as governance, strategy, risk management, and emissions performance and it consists of a series of questions to which a firm responds by selecting a discrete choice from a drop-down menu or providing numerical data and text in detail about its policy or strategy.

From the questionnaires, we have extracted information regarding the quantity of GHG emissions produced (Scope 1 and Scope 2) and the corporate governance practices implemented. We complemented these data with financial data from the same period extracted from Compustat. The collected information has allowed us to build a panel dataset.

Variables and Model

Table 1 describes the dependent, independent, and control variables.

Dependent Variable

Environmental performance is the independent variable. For each reporting year, companies responding to CDP questionnaires provided information on gross global Scope 1 and 2 (combined and non-combined) emissions, measured in metric tons of CO₂ per unit currency of total revenues. It was not possible to include Scope 3 due to the paucity of data. In line with previous studies (Wang *et al.*, 2014; Marcotullio *et al.*, 2013), the logarithmic form of the total Scope 1 and 2 GHG emissions was utilized.

Independent Variables

To test the hypotheses, following prior studies four questions from the CDP questionnaire were selected (see appendix):

- Incentives is a dummy variable that is equal to 1 if the firm provides incentives for the management to address climate change and GHG emissions and 0 otherwise
- Public Policy is a dummy variable that takes the value of 1 if the firm engages in activities that could influence public policy on climate change and 0 otherwise. This variable represents a proxy of the influence that climate-related policies have on firms, under the assumption that firms engage in climate-related activities to influence public policies if they are affected by existing policies or

expect to be affected by future policies

- Disclosure is a dummy variable that takes the value of 1 if the firm publishes information about the organization's response to climate change other than in CDP response and 0 otherwise. This variable represents a proxy of stakeholders' engagement, which is stimulated by the firm's effort to communicate and disclose information about the firm's actions to address climate change
- Responsibility is a dummy variable that takes the value of 1 if the highest level of direct responsibility is entrusted to the board of directors or the senior manager and the value of 0 if there are no individual board members or committees with overall responsibility for climate change

Control Variables

This study controls for several variables affecting the company's GHG emissions.

Consistent with previous studies (Brammer and Pavelin, 2008; Stanny and Ely, 2008; Clarkson *et al.*, 2008), controls were placed on Size, Leverage, and Price-to-Book. Size has been measured by taking the natural log of total assets; Leverage is calculated by the Debt-to-equity ratio and Price-to-Book is estimated as market value divided by the book value of equity. Following the study, the control for the industry was introduced by creating a High-carbon dummy variable that takes the value of one, if a firm belongs to a high-carbon-impact industrial sector (automobiles and components, chemicals, forest products, gas, and electrical utilities, oil and gas, mining, pipelines, precious metals, steel, and transportation) and zero otherwise. Moreover, we account for organization fixed effects and control for time dummy variables.

Model

The model examines the effects of corporate governance practices addressing climate change by focusing on GHG emissions. To examine such effects, several variations of cross-sectional time-series data are used. The following multivariate analysis model is used:

$$Y = \alpha + \sum_j \beta_j CGPractice_j + \sum_k \gamma_k Control_k + \varepsilon \quad (1)$$

where:

- Y = Natural logarithm of firm's GHG emissions
- A = intercept
- β_j, γ_k = Coefficients to be estimated
- CG_Practices = Set of corporate governance practices
- Controls = Set of firm-level controls
- ε = Error term

Table 1: Variables description

Variable	Description	Source
Envperf	Calculated as the logarithm of total emissions	CDP questionnaires
Incentives	Dummy variable that is equal to 1 if the firm provides an incentive for the management	CDP questionnaire
Public POLICY	Dummy variable that is equal to 1 if the firm engages in activities that could influence public policy	CDP questionnaires
Disclosure	Dummy variable that is equal to 1 if the firm publishes information about the organization's response to climate other than in CDP response?	CDP questionnaires
Responsibility	Dummy variable that is equal to 1 if the highest level of direct responsibility is entrusted to the board or senior manager	CDP questionnaires
Size	Natural log of total assets	COMPUSTAT
Leverage	Debt-to-equity ratio.	COMPUSTAT
Price-to-book	Price to book value of equity.	COMPUSTAT
High-carbon	Dummy variable that is equal to 1 if the firm belongs to a high carbon impact industrial sector	CDP questionnaires

Results

Descriptive Statistics

Table 2 presents several companies, emissions, and firm sizes with industry breakdowns. The sample comprises 1,612 firms across 11 industries. Among them, the sector Industrials with 339 companies represents 21% of the sample, followed by Materials with 12%, which also has the highest level of emissions. Banks and Financials industries represent 18% of the total sample, with lower emissions on average as compared to other industries.

Multivariate Analysis

The relationship between corporate governance practices and GHG emissions was estimated by Eq (1). Table 3 reports the outcomes of the multivariate regression for the pooled sample in the span period 2011-2015. Model 1 shows the basic regression, where year-fixed effects are not considered. We can see that Incentives, Responsibility, and Disclosure are negative and statistically significant at the 5% level, suggesting that firms that apply these types of practices produce lower GHG emissions. The variable Public Policy is statically insignificant. When year effects were included in Model 2, the variables Incentives, Responsibility, and Disclosure remain negative and statistically significant at the 5% level.

Furthermore, Models 3 and 4 show regression results by separating firms into US and non-US, respectively. Results show that in US firms only Incentives and Responsibility are significantly and negatively associated with GHG emissions at the 5% level. While looking at non-US firms, Incentives, Responsibility, and Disclosure continue to be negative

and statistically significant at the 5% level. Moreover, unlike Models 1-3, Public Policy comes out to be negative and statistically significant at the 10% level. These findings provide weak support for Hypothesis 3, suggesting that engaging in activities to influence public policies on climate change is associated with lower GHG emissions in some countries, but not in others, depending on the sensitivity of the country's political system to respond to pressures from interest groups.

This table reports regression results of environmental performance on variables representing corporate governance practices and all others are control variables. The sample consists of 8,060 firm-year observations from 56 countries over the period 2011-2015. Environmental performance is the dependent variable, estimated as the logarithm of total GHG emissions. Standard errors are clustered at the individual level in parentheses. *** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$. To ensure the robustness of the results, several sensitivity tests were performed (Table 4). The basic equation was re-run by using quantile regression to better control for the presence of outliers (Model 1 Table 4) and a panel fixed effects regression to control for the unobserved fixed effects that are associated with each firm (Model 2 Table 4). Namely, when the unobserved effect is correlated with the independent variable, pooled OLS produces estimators that are biased and inconsistent. In corporate governance studies, De Andres and Vellelado (2008) suggest using either the first differences or the fixed effects (within) estimators. Using either the quantile regression or fixed effects regressions does not affect the results.

Another problem inherent to the empirical analysis is the endogeneity issue. Endogeneity refers to situations in which an explanatory variable is correlated with the error term. This can arise from three

common causes: Reverse causality, omitted variables, and measurement errors. Reverse causality means two variables are jointly determined. For example, if we have two variables X and Y and they are jointly determined, then it means X causes Y and Y causes X (Baltagi, 2008). To check whether the regression suffers from reverse causality, the best solution is to re-estimate the model using lagged independent variables. If the sign of the independent variables changes and is significant, this means that the regression suffers from reverse causality; if there are no changes in the sign of the independent variables, then we can rule out reverse causality.

In line with previous studies (Busch *et al.*, 2012; Lewandowski, 2017; Delmas *et al.*, 2015; Trumpp and

Guenther, 2017), the independent variables were lagged by one year to address the presence of endogeneity (Model 3 Table 4). When we estimate the regression with lags t-1 of independent variables as instruments, the core results remain qualitatively unaffected.

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Table 2: Industry descriptive data

Industry	No. of companies	Size	Log GHG emissions
Banks	114	12.46	4.65
Consumer Discretionary	188	11.65	5.40
Consumer Staples	110	14.38	6.18
Energy	97	11.43	6.46
Financials	182	15.12	4.72
Health Care	96	15.68	5.79
Industrials	339	10.67	6.11
Information Technology	141	12.55	5.66
Materials	192	14.72	6.73
Telecommunication Services	51	10.46	4.77
Utilities	102	10.27	5.71
Sample	1,612	12.67	5.65

Table 3: Corporate governance practices and GHG emissions

Model	1	2	3	4
Incentives	-0.768 ** (0.145)	-0.813** (0.094)	-0.437** (0.072)	-0.673** (0.089)
Public policy	-0.076 (0.003)	-0.050 (0.002)	-0.092 (0.001)	-0.166* (0.002)
Disclosure	-0.437** (0.041)	-0.672** (0.037)	-0.361 (0.027)	-0.382** (0.040)
Responsibility	-0.326** (0.016)	-0.546** (0.021)	-0.316** (0.013)	-0.268** (0.015)
Size	2.561 (0.172)	2.536* (0.164)	2.167* (0.128)	2.376* (0.164)
Leverage	0.146 (0.010)	0.184** (0.034)	0.201** (0.018)	0.143* (0.024)
Price-to-book	1.076 (0.181)	1.074 (0.172)	1.041 (0.134)	1.069* (0.183)
High-carbon	0.076** (0.011)	0.135** (0.018)	0.137** (0.012)	0.214** (0.016)
Constant	0.161*** (0.042)	0.134*** (0.036)	0.163*** (0.037)	0.142*** (0.055)
Year fixed effect	No	Yes	Yes	Yes
Adj.R2	0.424	0.432	0.322	0.394
N. obs	8,060	8,060	1,980	6,080

Table 4: Robustness check

Model	1	2	3
Incentives	-0.347*** (0.006)	-0.484** (0.034)	
L. Incentives			-0.322** (0.156)
Public policy	-0.349 (0.011)	-0.088 (0.174)	
L. public policy			-0.139 (0.192)
Disclosure	-0.347* (0.012)	-0.523** (0.239)	
L. disclosure			-0.111* (0.135)
Responsibility	-0.463*** (0.005)	-0.375** (0.155)	
L. responsibility			-0.234** (0.125)
Size	3.648 (0.001)	2.636* (0.034)	2.492 (0.051)
Leverage	0.137** (0.063)	0.364* (0.031)	0.137* (0.074)
Price-to-book	1.149** (0.042)	1.124 (0.137)	1.346* (0.137)
High-carbon	0.522*** (0.006)	0.471* (0.012)	0.267* (0.023)
Constant	0.234*** (0.016)	0.326*** (0.037)	0.367*** (0.022)
Fixed effect	Yes	No	Yes
R2	0.367	0.436	0.367
N. OBS	8,060	8,060	6,448

Conclusion

In this study, we analyzed the relationship between corporate governance practices and climate change using a multivariate analysis applied to the 2011-2015 GHG emissions dataset from 1,612 firms across 56 countries in 11 industries. Overall, the analyses provide meaningful results. First, we find that firms that provide incentives to their management to address climate-related issues are negatively related to the amount of firms' GHG emissions. This result is in line with Jensen and Meckling (1976) and Kock *et al.* (2012) who showed a positive relationship between managerial incentives and a firm's environmental performance.

Secondly, we find that the companies that involve stakeholders in the formulation of their policies or corporate strategies are negatively related to GHG emissions. This negative relationship is in line with the study by Foster and Jonker (2005), which showed that sustainability is a business management model that, through stakeholder engagement, improves firm performance by maximizing reputation and value. Moreover, the results show that firms in which the highest level of direct responsibility is entrusted to the board or senior manager are negatively related to GHG emissions. This finding is in line with Fama and Jensen (1983), who argued that the board acts in favor

of protecting and managing stakeholders' interests.

Overall, research outcomes suggest that a firm's governance practices on climate change and the amount of GHG emissions or the GHG emissions intensity are closely related.

A further analysis was conducted by dividing the full sample into US and non-US firms. When we estimate the regression only with US firms the coefficients for Incentives and Responsibility remain negative and statistically significant, but the independent variable Disclosure is not significant. By contrast, when we estimate the regression considering only non-US firms, all the independent variables are negative and statistically significant. Since Disclosure measures whether a company informs its stakeholders about activities performed in response to climate change, the results suggest that the relevance of stakeholders' engagement is country-specific. In particular, stakeholders' engagement seems less relevant in the US concerning other countries (Table 3 model 3), either because the overall information system is more developed in the US (and thus individual companies' communication activity is less relevant), or because the US public opinion exerts lower pressures on companies to deal with climate change.

The study contributes to the literature on corporate governance and climate change in several ways. First, the study offers evidence that firms' GHG emissions

and governance practices are related. Previous studies (Hussain *et al.*, 2018; Bassen and Kovacs, 2020; Kassinis and Vafeas, 2002; Centorrino and Naciti, 2019) were focusing on the relationship between corporate governance and general sustainability performance, but, to the best knowledge, the relationship between firms' GHG emissions and governance practices has not been addressed.

Second, by taking a stakeholder-agency theory perspective proposed by Hill and Jones (1992), the paper confirms the existence of a direct link between stakeholders and corporate governance. The threat of damaging activism that can be brought on by stakeholders influences the decision-maker's environmental strategies, which in turn are influenced by corporate governance practices. Overall, the study contributes to stakeholder-agency literature by exploring how corporate governance practices mitigate conflicts between stakeholders and managers concerning environmental issues.

Third, we found a difference between US and non-US firms. One potential reason for this finding is that the political system and the authority of government can influence the decisions of managers (Galbreath, 2010; Ammons and Roenigk, 2020). For Example, European governments have been more involved in sustainable activity addressed to climate change (Aguilera *et al.*, 2018). Also, the US shareholder model of corporate governance tends to place profit maximization as the main business goal rather than a commitment to social activities such as climate change. Moreover, according to the institutional theory, organizational practices become spread and homogenized due to three forces, namely coercive, mimetic and normative. By examining the presence of these three forces it is possible to explain convergence in organizational practices and behavior.

Furthermore, the study contributes to the environmental governance literature (Kassinis and Vafeas, 2002; Kock *et al.*, 2012), where the impact of governance practices on environmental problem solving has not been widely studied. The results show that instituting certain corporate governance mechanisms can address the climate change problem.

However, these results should be interpreted in the context of their limitations. First, the sample includes only large firms, since it is limited to CDP respondents. As most academic climate change databases that offer information mainly for listed companies, in CDP small and medium-sized enterprises are limited since they show a series of difficulties in implementing strategies on climate change. Furthermore, CDP respondents voluntarily respond to the survey, so the sample could suffer from self-selection bias (Luo and Tang, 2016). However, future

research could investigate both CDP respondents and companies that do not follow a CDP approach.

Sec we did not consider the possibility that other variables could intervene in the associations between corporate governance practices and GHG emissions. It is possible, for example, that other corporate governance dimensions influence the causal links among the model variables.

Moreover, the sample includes companies from 56 countries that differ in their government policies and initiatives addressed to climate change. However, future studies could take into account the effect of institutional environments and differences based on different cultural aspects.

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Author's Contributions

This study is the result of a joint effort of all the authors who contributed to the following parts of the manuscript.

Valeria Naciti: Theoretical Background; Research Design and Results.

Giovanna Centorrino: Introduction and Conclusion

Ethics

This article is original and to the best knowledge of the author has not been published before. The authors declared that there are no ethical issues that may arise after the publication of this manuscript.

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