Components of Countries' Regulative Dimensions and Voluntary Carbon Disclosures

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Abstract: The previous literature has demonstrated that countries' regulative contexts positively influence voluntary corporate carbon disclosures. However, little research has been conducted into the relationship between the different components of the regulative dimension of institutions and voluntary carbon disclosure. Drawing on the theoretical framework of New Institutional Sociology (NIS), this study examines the influence of the different components of the regulative context (rules; monitoring mechanisms and punishments; rewards) both on firms' propensity to disclose carbon information and on the quality of disclosures. Based on a global sample of 2176 companies that participated in the 2015 Carbon Disclosure Project (CDP) climate report, this paper uses the Heckman two-stage approach in an attempt to model firms' decisions as to whether to disclose carbon information, as well as the quality of said disclosures. The results show that the regulative components positively influence firms' decisions to voluntarily disclose carbon data. They also show that the quality of disclosures is positively affected by climate-related rules and rewards, but that it is not influenced by monitoring mechanisms and punishments related to climate change. This paper is the first to take the step of addressing the components of the climate-related regulative pillar of institutions in the same regression setting.

Keywords: carbon disclosure; climate-related regulation; corporate sustainability; Heckman model; institutional theory

1. Introduction

With the increase in disclosures of carbon-related information by companies in recent years, voluntary carbon disclosure has become a prominent research topic. Prior literature suggests that different factors motivate companies to voluntarily disclose carbon information. These determinants can be related to different reasons: economic (e.g., profitability, leverage, size); ecological (e.g., level of emissions, carbon-intensive industry); disclosure-related (e.g., corporate environmental reports, companies' Carbon Disclosure Project response); regulative (e.g., Kyoto Protocol, Greenhouse Gases-specific regulation, carbon pricing mechanisms) [1–5].

Although there has been considerable research into the factors influencing voluntary carbon disclosure, there is still very little scientific understanding of the institutional pressures involved, especially those related to the regulative dimension. In this regard, previous studies have found that the regulative context plays a crucial role in influencing voluntary carbon disclosure on the part of companies [6,7]. Prior investigation has found that climate-related laws contribute to increased visibility of climate change challenges in society. This in turn contributes to the generation of social expectations as regards appropriate environmental behavior of firms subject to these laws as well as those that are not [7]. Hence, according to institutional theory, firms may participate in voluntary carbon disclosure in order to adapt to social expectations generated by climate-related

rules [8]. Until now, however, no research has identified and investigated the effect of the different components of the regulative pillar of institutions as identified by Scott [8] (rules; monitoring mechanisms and punishments; rewards), particularly those related to climate change issues. Therefore, this paper serves to fill this gap by identifying and measuring the different components of the regulative pillar, and by studying whether they influence companies' voluntary carbon disclosure behavior. More specifically, this research analyzes whether different components of the regulative dimension of institutions influence both firms' propensity to voluntarily disclose carbon data as well as the quality of their disclosures. In this sense, the originality of this paper lies in its inclusion of climate-change-related regulative indicators within the study of voluntary carbon disclosures.

In order to develop its predictions, this study builds on New Institutional Sociology (hereinafter NIS) theory, which predicts that organizational behavior may be influenced by the institutional environment in which organizations operate. Scott [8] identified three institutional pillars that affect an organization's behavior: regulative, normative, and cultural-cognitive. More specifically, with regard to regulative pressures, Scott [8] states that the main components of the regulative pillar are rules; monitoring mechanisms and punishments; rewards. These components may influence companies' carbon disclosure behavior, since they contribute to the generation of social expectations, which exert pressure on companies to voluntarily disclose carbon information. Hence, this study predicts that the components of climate-related regulation will positively impact voluntary carbon reporting on the part of companies.

The sample is composed of 2176 companies that were invited to participate in the 2015 CDP climate survey. Data from the CDP have been used in several prior studies in order to examine firms' propensity to disclose carbon information [1,9,10], as well as to study the quality of disclosures [3,11]. This paper uses a Heckman two-stage research approach [5,6].

Taken together, the results suggest that the components of countries' climate-related regulative pillars positively influence firms' participation in voluntary carbon disclosures. Therefore, companies are more likely to voluntarily disclose carbon-related information in those countries where specific climate-change-related regulation exists, compliance with which is monitored, resulting in punishments for non-compliance with the regulation, and in rewards for behavior in line with the regulation. Moreover, the components of rules and rewards positively and significantly influence the quality of carbon information disclosed, while climate-related monitoring mechanisms and punishments are not significantly related to the quality of carbon data. The findings of this study have implications for investors, managers, regulators, and policymakers in that they will be better able to understand how the different components of climate-related regulation exert influence on corporate carbon disclosure behavior.

This study contributes to the existing literature in several ways. Firstly, unlike previous studies, which consider generic environmental regulative components [1,5,9], this paper identifies and measures the different components of countries' climate-related regulative contexts. Secondly, it examines the pressure exerted by the different regulative components on voluntary carbon disclosure on the part of companies, again in contrast to previous studies, which either focus on countries' regulative pillars as a whole [1,5,9,12], or center on one specific component, e.g., climate-related rules [7]. Thirdly, it demonstrates which countries present higher levels of pressure from said regulative dimensions. Thus, countries with higher levels of pressure may reflect a greater commitment to the fight against climate change. Finally, instead of solely considering larger companies or those listed on principal international indices such as the Global 500 [1,2,12,13], this study takes into account all the companies included in the 2015 CDP climate report for each of the sample countries.

The paper is organized as follows. Section 2 presents the conceptual framework and the development of hypotheses. Section 3 describes the empirical model, methodology, and data construction. Section 4 includes the descriptive analysis; the correlation analysis; the empirical results; the robustness analysis. Section 5 details the conclusions and provides a guide for future lines of research.

2. Literature Review and Development of Hypotheses

This study is situated within the research field of corporate social responsibility disclosures [14–16] and, more specifically, within that of carbon accounting and reporting [1,3,17,18]. Over recent decades, carbon accounting and reporting has been widely studied, particularly so following the signature of the Kyoto Protocol in 2005. Carbon disclosure and its related subjects have been studied from different theoretical approaches, which may be classified in three different groups: sociopolitical theories; economics-based theories; institutional theory [19].

Sociopolitical theories of disclosure claim that companies disclose carbon information due to pressures from their stakeholders or from society as a whole. In this sense, two main theoretical frameworks can be identified within this group: stakeholder theory and legitimacy theory [19]. The main difference between them lies in their focus on actors. Thus, while stakeholder theory focuses on demands from different interest groups related to a company [15,20], legitimacy theory addresses pressures that come from society in general [4,21,22]. Stakeholder pressures exert a positive influence on corporate carbon information disclosure [12,21,23]. Legitimacy theory establishes a negative relationship between carbon performance and carbon disclosure [24]. Several studies have drawn on these theories to explain the determinants of corporate carbon disclosure [1,23,25].

Economics-based theories of disclosure [26] argue that firms' decisions to voluntarily disclose carbon information are based on a cost–benefit evaluation [4]. Thus, companies will carry out carbon reporting activities if the benefits and positive effects outweigh the costs of preparing said information [27]. Within this group of theories, it is possible to identify two predominant approaches, namely voluntary disclosure theory and signaling theory [19], both of which have similar arguments. In fact, Luo and Tang [28] refer to signaling theory as voluntary disclosure theory, claiming that firms with high carbon performance are more likely to voluntarily disclose carbon information. These theories establish that environmental performance is positively associated with environmental disclosures. Thus, firms that invest in improving their environmental performance are more likely to voluntarily disclose environmental information in order to keep current and potential investors informed as regards their improvements, thereby distinguishing themselves from their competitors [4,29].

Institutional theory also explains the determinants of voluntary carbon disclosure [19,30]. This theory stresses that apart from economic and social factors, carbon disclosures are influenced by the institutional environment in which organizations operate [31]. Meyer and Rowan [32] introduced this theory during the study of organizations. They highlight the fact that organizations that incorporate socially legitimized elements into their formal structures will gain legitimacy, which is necessary for their future survival. Thus, organizations that operate in highly institutionalized environments will gain legitimacy by becoming isomorphic with other organizations in their environment [33]. DiMaggio and Powell [33] defined isomorphism as the process by which organizations are likely to adopt organizational structures and behaviors similar to those of their peers. They identified three isomorphic processes that favor isomorphism among organizations, which share the same institutional environment: coercive, normative, and mimetic isomorphism.

Isomorphic processes were considered by Scott [8] to be the underlying mechanisms of the three analytical elements or pillars that comprise institutions, namely regulative, normative, and cultural-cognitive. Although they are underpinned by different philosophical concepts and mechanisms, Scott [8] points out that each element plays an important role in driving organizational behavior, and that they may be studied separately. Despite the fact that both the normative and the cultural-cognitive pillars can exert influence on voluntary carbon disclosure [34], this study focuses solely on the regulative pillar of institutions because:

(1) Regulative systems present higher values as regards obligation, precision, and delegation than normative and cultural systems [8].

(2) While the regulative system has been widely examined in previous studies related to voluntary carbon disclosure, only a single regulative component has been considered (rules and laws) [1,7,29,35], and thus the remainder of the regulative components (overseeing mechanisms and punishments; rewards) has not been explored.

(3) The regulative system works through coercive mechanisms, which represent the most obvious and direct pressure on corporate environmental activities [36,37].

In particular, this research is based on the state-centric view of the regulative pillar of institutions, which encompasses those rules and processes arising from legal mechanisms promulgated by governmental bodies. Focusing on the state-centric view of the regulative pillar is important because governments play an important role in developing and implementing climate-related rules [8,38]. In fact, according to Nachmany et al. [38], climate action at the national level has continued to increase since 1997. Many nations worldwide are now enhancing their climate-related legal architecture by including more stringent rules concerning environmental reporting [38].

Scott [8] identified the regulative pillar of institutions as those explicit processes involving rule setting, compliance monitoring, and enforcement actions (rewards and punishments) aimed at influencing the future behavior of organizations. The basis for compliance with the regulative pillar is expedience, since organizations adapt their behavior to the pressures exerted by this pillar in order to avoid punishments or to seek the corresponding rewards. Furthermore, the legitimate basis of this institutional dimension is "legally sanctioned", since it considers whether organizations are legally established and whether they are acting in accord with relevant laws and regulations (Scott [8] (p. 74)). Thus, empirical indicators of the regulative dimension of institutions are to be found in evidence concerning rules and laws; monitoring mechanisms; sanctioning power (rewards and punishments). Unlike previous studies that consider the regulative dimension as a whole [1,7,35], or that do not take into account the individual components of regulative pressures, this study considers each one of the components of the regulative pillar as highlighted by Scott [8]. It subsequently analyzes the influence that each of the said regulative components exerts on firms' voluntary carbon disclosure.

According to NIS, the environment in which companies operate may affect their carbon disclosure behavior. In this sense, the regulative pressures established in a certain country may influence companies' voluntary carbon disclosure. Climate-change-related regulation, which forms part of a country's regulative pillar, establishes a set of mandatory rules that oblige those companies involved to report carbon-related information. By complying with the regulation, companies will gain legitimacy and avoid the imposition of formal punishments. However, climate change regulation also contributes to the generation of social expectations that can affect the behavior of companies both subject and not to said regulation [8,33]. The adaptation of companies to these social expectations leads them to voluntarily disclose carbon-related information through widely known instruments such as the CDP questionnaire. In this regard, NIS theory suggests that the greater the number of adopters of a certain practice, the broader its social acceptance and the greater the legitimacy it provides [39].

Furthermore, climate-change-related regulation establishes requirements for organizations about which they must subsequently report. Therefore, for example, it is customary for regulations to require organizations to control and reduce their carbon emissions. Organizations may develop various strategies in order to comply with said requirements, and they must also compose their emission inventory in order to report their results. In this sense, regulation does exert pressure on organizations to maintain a certain level of quality in their climate change disclosure, since organizations must report on different aspects considered relevant by said regulation. This level of quality as required by regulation may constitute, in a particular country, a benchmark for information that is voluntarily disclosed by organizations. As specifically regards the CDP, the previous literature has considered the score provided by the CDP for each responding firm as a measure of the quality of its climate change disclosure [3,11,40].

Additionally, a country's regulative pressures refer to the power of regulators to establish rules and laws that oblige companies headquartered in said country to disclose environmental information. By way of example, the EU established the European Union Emission Trading Scheme (EU-ETS) that requires energy companies to disclose their greenhouse gas emissions [41]. This study is more specifically focused on the state-centric approach of regulative pressures, which includes the rules and laws that have been legally enforced by the government. We have adopted this perspective, since coercion is an important element of the regulative pillar, one which implies authority and capacity on the part of the actor exerting pressure, and on whom organizations depend, to sanction others. In this case, the state is the main actor and is considered as such in this paper [8]. Governments play a central role in creating rules and laws, as well as in monitoring and sanctioning activities [8]. In addition, many governments worldwide continue to articulate climate-related rules [38,42], which provides further relevance and scope for our research.

In the research field of environmental disclosures and, more specifically, voluntary carbon disclosure, previous studies have considered regulative determinants as a whole or have focused on generic environmental regulations, such as common law countries [1] or the ratification of the Kyoto Protocol [1,12,29]. Certain authors have gone further still and explored the influence of other specific carbon regulations on corporate carbon disclosures, such as the carbon trading market [6,43]; other regulations regarding carbon emission reporting [44]; climate-related regulations [7]. The majority of these studies demonstrated a significant and positive relationship between regulative institutional factors and voluntary carbon disclosures on the part of companies.

However, the relationship between each of the different components of the regulative dimension of institutions (rules; monitoring mechanisms and punishment; rewards) and voluntary carbon disclosure has not yet been explored. More specifically, research to date has not yet determined whether the rewards component of the climate-related regulative pillar influences voluntary carbon disclosures on the part of companies. This paper serves to fill this gap by incorporating the individual components of the regulative pillar of institutions—specifically those related to climate change issues—into the study of voluntary corporate carbon reporting. This is, therefore, the first study to consider the components of the regulative pillar of institutions within the study of voluntary carbon disclosure. Analysis of the different components of regulative systems is extremely important, especially that of sanctioning power, given that on occasion rules are not complied with and subsequently a punishment is enacted [8]. In addition, identifying and studying the components of the regulative pillar is central to determining which component exerts the greatest pressure on organizations as regards the voluntary disclosure of carbon information.

Hence, apart from examining the rules and laws related to climate change [7], it is also essential to consider monitoring mechanisms and punishments, along with rewards, since each contributes to reinforcing both what is required by the regulation as well as the social expectations generated by said regulation in a certain context. In this sense, it is expected that companies will participate in the CDP survey and that they will disclose high-quality carbon information in those countries where:

(1) Specific climate-change-related regulation exists [7].

(2) Compliance is monitored, and punishments exist for non-compliance with the regulation.

(3) Rewards exist for behavior in line with the regulation.

In this sense, based on the NIS perspective, a positive association between voluntary carbon disclosure and the different components of the regulative dimension of institutions is expected. Therefore, the following hypotheses are proposed:

Hypothesis H1a: *Countries' climate-related rules and laws positively influence firms' decisions to voluntarily disclose carbon information.*

Hypothesis H1b: *Countries' climate-related rules and laws are positively associated with the quality of voluntary carbon disclosures.*

Hypothesis H2a: *Countries' climate-related monitoring mechanisms and punishments are positively related to firms' propensity to voluntarily disclose carbon information.*

Hypothesis H2b: *Countries' climate-related monitoring mechanisms and punishments positively influence the quality of voluntary carbon disclosures.*

Hypothesis H3a: *Countries' climate-related rewards positively affect companies' decisions to participate in voluntary carbon disclosures.*

Hypothesis H3b: *Countries' climate-related rewards positively influence the quality of voluntary carbon disclosures.*

In this paper, countries' regulatory factors are used to define climate-related regulative pressures within the national context. This concept is consistent with the socially embedded perspective, which explains how individuals and organizations are affected by the social environment in which they operate [45]. Thus, this study measures countries' regulatory contexts with specific focus on the area of climate change issues, and by considering all three of this dimension's empirical indicators (rules and laws; monitoring mechanisms; sanctioning power), as highlighted by Scott [8].

3. Research Design

3.1. Sample Selection

The initial sample consisted of 2877 companies taken from the 2015 CDP climate reports, from countries with data available regarding their climate-related regulative components. More specifically, the countries under consideration in this study are Australia, Canada, France, Germany, India, Indonesia, Italy, Japan, South Korea, the United Kingdom, and the United States of America. We only consider this single year of data in the study due to the lack of data regarding countries' climate-related monitoring mechanisms and punishments. Furthermore, the variable used to measure this pressure was only available until 2015 [7]. In addition, we based our analysis on the CDP climate report from 2015, since this was the last year in which the CDP evaluated companies using a numeric score (ranging from 0 to 100), which allowed us to better determine the quality of voluntary carbon disclosures. Subsequently, in line with prior research [1,6], 559 financial companies were eliminated because their financial statements structure presented specific characteristics influenced by industry-specific regulatory requirements, and therefore, their financial ratios were not comparable with those of companies in other sectors. From the remaining sample, a further 29 companies were eliminated because the 2015 CDP questionnaire was covered by their parent companies [6]. In addition, six firms that were found to be duplicated in the 2015 CDP climate reports were also removed. Furthermore, 107 observations were excluded due to the lack of relevant financial information. Hence, the final sample was composed of 2176 firms, of which 1091 companies responded to the 2015 CDP climate survey and made their responses public, and 1085 companies did not participate, declined to respond, or did not make their responses public. These companies operate in different sectors, as based on the Global Industry Classification Standard (GICS): consumer discretionary; consumer staples; energy; health care; industrials; information technology; materials; telecommunications; utilities. The final sample of 2176 companies was used to analyze the probability of participation in the CDP, while the sample of 1091 firms that did respond to the CDP questionnaire was considered in order to study the quality of the information disclosed.

3.2. Empirical Models

The theoretical framework presented above shows that companies' decisions to voluntarily report carbon information, as well as the quality of disclosures, is a function of a set of pressures (social, financial market, and regulative). Based on these pressures, this paper performs a two-step research approach to analyze both companies' propensity to disclose climate-related information and the quality of the data disclosed [5,46]. The first model analyzes the propensity for firms to voluntarily disclose carbon information through the CDP, while the second model measures the quality of the carbon information disclosed. We use a Heckman two-step model, because this allows for the correction of the self-selection bias introduced in the second model due to the consideration of a subsample of firms that responded to and made public the CDP climate questionnaire [5,47,48].

The first stage is based on a probit model, which examines the determinants of voluntary carbon disclosure considering the whole sample of 2176 firms. The initial model is as follows (1):

$$
\begin{aligned}
\text{DisCDP15} = \beta_0 &+ \beta_1 \text{Laws} + \beta_2 \text{EPSI} + \beta_3 \text{Rewards} + \beta_4 \text{Size} + \beta_5 \text{TobinQ} \\
&+ \beta_6 \text{Beta} + \beta_7 \text{Lev} + \beta_8 \text{ROA} + \beta_9 \text{CDP}_{t-1} + \beta_{10\text{-}17} \text{Sectors} + \varepsilon
\end{aligned}
\tag{1}
$$

As shown in Table 1 below, the majority of the companies that answered the 2015 CDP questionnaire obtained a high CDP disclosure score. The average CDP disclosure score is relatively high (85.77 points) for these companies. In fact, more than 70 per cent of the companies in the sample obtained a CDP disclosure score greater than 85 points. It would, therefore, appear that those firms that decided to participate in the 2015 CDP climate survey disclosed high-quality climate-related information, as evidenced by their high CDP disclosure score. Furthermore, there is a considerable variation in the CDP score for responding companies, ranging from 2 to 100 points, with a mean (median) of 85.77 (93) points.

Table 1. Distribution of the 2015 Carbon Disclosure Project (CDP) score of responding firms.

Range	Number of Firms	Percent (%)	Mean	Median	Min	Max
0 < = CDP score < 30	30	2.75	16.47	16.00	2.00	28.00
30 < = CDP score < 50	47	4.31	39.74	40.00	30.00	49.00
50 < = CDP score < 70	82	7.52	61.02	61.00	50.00	69.00
70 < = CDP score < 85	146	13.38	77.69	78.00	70.00	84.00
CDP score > = 85	786	72.04	95.25	96.00	85.00	100.00
Total firms	**1091**	**100**	**85.77**	**93.00**	**2.00**	**100.00**

The second model analyzes the quality of the carbon disclosures, which is measured by the CDP score [11,40], which summarizes the quality and comprehensiveness of the carbon information voluntarily provided through the CDP climate survey [3]. In line with Tang and Luo [13], the sample median (93) is used to distinguish those companies that voluntarily disclosed high-quality carbon data from those that did not. This allows us to analyze whether regulative indicators impact the quality of corporate carbon disclosures. The second model only considers a sub-sample of firms that responded to the 2015 CDP climate survey and made their response public (1091). Focusing solely on responding firms may introduce self-selection bias into our analysis [47], hence to address this issue, the Heckman correction factor (Lambda) is calculated and included in the second model [48]. This factor represents the inverse Mill's ratio and deals with any selectivity bias in the

sample. The inclusion of Lambda allows us to make the second model conditional on positive participation in the CDP climate survey [5]. Model 2 is as follows (2):

$$\text{HighCDP15} = \beta_0 + \beta_1 \text{Laws} + \beta_2 \text{EPSI} + \beta_3 \text{Rewards} + \beta_4 \text{Size} + \beta_5 \text{TobinQ} + \beta_6 \text{Beta}$$
$$+ \beta_7 \text{Lev} + \beta_8 \text{ROA} + \beta_9 \text{CDP}_{t-1} + \beta_{10} \text{Lambda} + \beta_{11-18} \text{Sectors} + \varepsilon \tag{2}$$

3.3. Variables Definitions

Table 2 below reports the variables used in both statistical models, explaining how they are measured, as well as their predicted sign based on the hypotheses previously formulated.

Table 2. Summary of variables.

Variables	Definition	Predicted Sign	Sources
Dependent variable			
DisCDP15	An indicator variable that equals one if the company responded to the 2015 CDP climate questionnaire and made its response public, and zero otherwise.		CDP
HighCDP15	A dichotomous variable that equals one if the company obtained a CDP disclosure score greater than 93 points, and zero otherwise.		CDP
Independent variables			
Laws	The number of climate-related laws of a country.	+	Nachmany et al. [38]
EPSI	Environmental Policy Stringency Index (EPSI). It represents countries' climate-related regulative stringency. It is ranked from 0 to 6, with 0 indicating the lowest degree of stringency, and 6 the highest.	+	OECD
Rewards	This index represents the country's investments in clean energy. It is measured as a percentage of the gross domestic product.	+	BNEF
Control variables			
Size	The natural logarithm of total revenues.		Datastream
TobinQ	TobinQ is the total market capitalization of the firm, plus the book value of preferred shares, the book value of long-term debt, and current liabilities, divided by book value of total assets.		Datastream

Table 2. *Cont*.

Variables	Definition	Predicted Sign	Sources
Beta	A measure of systematic risk of the companies, which is based on 23 to 35 consecutive end-of-month price percentage changes, and their relativity to the local market index.		Datastream
Lev	Total debt divided by total assets.		Datastream
ROA	Return on Assets (ROA). Net income before extraordinary items/preferred dividends, divided by total assets.		Datastream
CDP_{t-1}	An indicator variable that equals one if the company participated in the 2014 CDP survey and zero otherwise.		CDP
Lambda	The Heckman correction factor.		Heckman [48]

CDP = Carbon Disclosure Project; OECD = Organization for Economic Co-operation and Development; BNEF = Bloomberg New Energy Finance.

The dependent variables are DisCDP15 and HighCDP15. DisCDP15 is a dichotomous variable of voluntary carbon disclosure. This variable is introduced in Model 1 and equals one if the company answered the 2015 CDP climate questionnaire and made their response public, and zero otherwise. This study considers companies' decisions both to respond and to publish in the same model because the majority of companies in the sample that did reply to the CDP survey also made their response public. In Model 2, the dependent variable is HighCDP15, which takes a value of one if the company obtained a CDP disclosure score of no less than the median of the sample (93), and zero otherwise. The CDP disclosure score is ranked from 0 to 100, with those companies with the highest levels of disclosure being rated at 100. It encapsulates the quality and comprehensiveness of carbon information reported by companies through the annual CDP reports [3,40]. The CDP score has been widely used in previous studies to examine companies' carbon disclosure behavior [3,6,7,49].

Data from both dependent variables were manually collected from the 2015 CDP climate reports for each of the countries considered in the sample. The number of papers that rely on CDP data have increased over the last decade [19], and it has been used in several relevant publications [1,3,7,10,50]. The CDP maintains the largest database regarding climate-related corporate information, and it provides information on reporting activities and environmental performance [51,52], both of which offer a basis for comparison across countries, companies, and industries. These reports are publicly available on the CDP's website [53]. The information contained in CDP climate change reports can help users to understand how companies are addressing the climate problem, as well as the strategies they are implementing in order to mitigate their carbon emissions.

The independent variables are laws, Environmental Policy Stringency Index (EPSI), and rewards. These variables measure each one of the different components of countries' regulative context (rules; monitoring mechanisms and punishments; rewards), which may influence voluntary corporate carbon disclosure.

Laws. This variable reflects the number of climate-related laws that a country has passed. It has been taken from the study by Nachmany et al. [38], which reviews the evolution of climate-related legislation at the global level. Given that certain countries have broad and integrative laws while others have legislation of a narrower scope, the number of climate-related laws may not constitute a perfect measure of a country's response to climate change. Nonetheless, the number of climate-related laws may be a reliable measure for determining how committed a country is in its efforts to mitigate climate change [42].

According to NIS theory, it is expected that companies headquartered in countries with a greater number of climate-related laws will be under higher pressure to report their carbon emissions. Therefore, these companies will be more likely to participate in the CDP climate survey, as well as to disclose high-quality carbon information, given that these are the patterns that are followed in their environment.

EPSI. This variable measures the degree of stringency of countries' environmental policy instruments and is specifically focused on those related to climate change and air pollution [54]. In this case, stringency should be understood as the degree to which environmental policy instruments put a price (explicit or implicit) on carbon emissions, such as carbon taxes or emissions trading schemes [55]. Data from the EPSI variable were collected from the Organization for Economic Co-operation and Development (OECD). Given that it considers both climate-related monitoring systems and mechanisms that place a price on contamination, this index is used to measure the monitoring mechanisms and punishment component of the regulative pillar. This index has a range of values from 0 (not stringent) to 6 (most stringent). Given its consistency, EPSI has been widely used in previous studies to represent countries' environmental policies [56,57]. More specifically, this index has been employed in previous studies on voluntary carbon disclosure in order to measure countries' climate-related regulative pressures [7]. From the NIS perspective, it is expected that companies from countries with a stringent monitoring mechanism in place for their climate change laws, along with a specific system of punishments for behavior contrary to said laws, will be more likely to participate in voluntary carbon disclosures and will report higher-quality carbon information.

Rewards. This indicator represents countries' new investments in clean energy, as obtained from the Bloomberg New Energy Finance (BNEF) database. It is represented as a percentage of the gross domestic product (GDP). This variable is used to measure the reward component of the regulative pillar, since according to NIS, firms based in countries with a rewards system in place for behavior in line with climate-related regulation will be more likely to participate in the CDP questionnaire and to receive a higher CDP score. The greater the investments made by countries in clean energy, the greater the rewards that companies will receive. Therefore, rewards encourage companies to make new investments as well as to adopt measures to mitigate their carbon emissions, which may positively contribute to voluntary carbon disclosure and to the quality of the information disclosed.

Based on previous studies, six firm-level control variables are included in this paper: Size, TobinQ, Beta, Lev, Return on Assets (ROA), and CDP_{t-1}. These variables have been introduced into the model, since they have been found to be associated with voluntary corporate carbon disclosure [17,19,58]. Financial data necessary for the calculation of firm-level control variables (Size, TobinQ, Beta, Lev, and ROA) were collected from the Datastream database, specifically from the end of fiscal year 2014, since the CDP surveys companies taking into account carbon information from the previous year [1,17]. Thus, the 2015 CDP climate report contains carbon emissions data referring to 2014. Data from the CDP_{t-1} variable were gathered from the 2014 CDP climate report.

Size. The literature suggests that larger firms are more likely to voluntarily disclose environmental information because they are more visible and are, therefore, subject to greater social pressure [14,59]. Furthermore, prior evidence is consistent with finding a positive association between company size and the quality of environmental disclosures [40,60]. In this sense, it is expected that the size of a firm will have a positive and significant impact on both voluntary carbon disclosure and on the quality of the information disclosed. Size is defined in this study as the natural logarithm of the firm's total revenues [21].

TobinQ is the proxy used to control for firms' future growth expectations [1]. Firms with a higher TobinQ are more likely to voluntarily disclose carbon information so as to allow investors to calculate their value as well as their intangibles. However, prior research failed to show a conclusive relationship between TobinQ and voluntary carbon reporting [4,49,61]. This variable is measured as the market capitalization of the firm plus

the book value of preferred shares, the book value of long-term debt and current liabilities, divided by the book value of total assets [4].

Beta. Companies with a high level of business risk are more likely to voluntarily disclose carbon information [1], as well as to provide high-quality environmental information in order to inform their stakeholders with regard to their environmental activities [13,49]. Beta is used in this study to control for companies' business risk, which is based on 23 to 35 consecutive end-of-month price percentage changes, and their relativity to their local market index [49].

Lev. Highly leveraged firms will be more likely to participate in voluntary carbon disclosures [61]. Furthermore, leveraged companies tend to provide high-quality environmental information in order to keep their investors and creditors informed, thereby avoiding higher costs of capital and improving their financial flexibility [6,13,62]. In this sense, it is expected that firms with higher leverage ratios will be more likely to voluntarily disclose environment-related information, as well as to report high-quality information [4]. The Lev variable is measured as the company's total debt to total assets ratio [6,61,63].

ROA. Firms with good financial performance are more likely to voluntarily disclose information regarding their carbon emissions and climate change strategies [61]. Profitable firms have more resources with which to afford the costs related to voluntary carbon disclosures [64]. However, prior research is not consistent as regards the influence of a firm's profitability on the probability of its disclosing carbon information [5,6,25], or on the quality of its disclosures [7,40]. ROA is measured as the company's net income before extraordinary items/preferred dividends divided by total assets [6].

CDP_{t-1} is the proxy used to control for firms' prior CDP participation. This variable is included because previous studies have found that firms' prior carbon disclosure behavior positively and significantly influences future carbon disclosures [17,61].

4. Empirical Results

This section provides an overview of the components of countries' regulative contexts, along with statistics corresponding to firms' participation in the CDP survey and the average CDP score by country. It also presents the descriptive analyses, the regression results, and robust tests.

4.1. Overview of the Components of Countries' Climate-Related Regulative Contexts

Table 3 below presents the distribution of the components of countries' climate-related regulative contexts, as well as the participation of companies in the 2015 CDP survey by country, showing their respective CDP disclosure score.

With regard to the rules component of the regulative pillar, it can be seen from the data in Table 3 that the United Kingdom, Italy, and Indonesia are the sample countries with the highest number of climate-change-related laws. For their part, the countries with the lowest number of climate-change-related laws are Canada, Australia, France, Japan, and the United States, all of which have less than ten pieces of regulation related to climate change. However, these countries do have stringent climate-related regulation, as demonstrated by their high EPSI index. Table 3 also shows the different dimensions of the regulatory pillar for each country. It can be seen that Italy, France and Germany—despite being countries of the European Union and sharing the same European guidelines—are significantly different from each other in terms of number of laws, EPSI, and rewards.

Table 3. Distribution of the components of the regulative context and CDP participation by country.

Countries	Laws	EPSI	Rewards	N	%	Responding Firms	%	CDP Score
Australia	9	3.17	0.18	179	8.23	63	35.20	81.48
Canada	3	3.28	0.25	134	6.16	79	58.96	84.56
France	9	3.58	0.15	210	9.65	77	36.67	86.73
Germany	15	3.13	0.50	144	6.62	76	52.78	74.83
India	11	1.82	0.39	142	6.53	30	21.13	93.07
Indonesia	19	1.08	0.03	40	1.84	4	10.00	53.00
Italy	22	3.28	0.12	69	3.17	36	52.17	86.00
Japan	9	3.17	0.96	397	18.24	206	51.89	89.23
South Korea	12	3.07	0.17	207	9.51	45	21.74	94.62
United Kingdom	23	3.83	0.83	261	11.99	205	78.54	84.49
United States	9	2.69	0.34	393	18.06	270	68.70	86.42
Total				**2176**	**100.00**	**1091**	**50.14**	**85.77**

N = total sample firms. CDP score represents the proportion of the CDP disclosure score by country, which is calculated as the total CDP disclosure score of responding firms divided by the total number of responding firms in the country. Laws, EPSI, and rewards variables are defined in Table 2.

The countries with the greatest level of climate-related rewards are Japan, the United Kingdom, and Germany, which present values of 0.96, 0.83, and 0.50, respectively. Conversely, the countries with the lowest level of investments in clean energy are Indonesia, Italy, and France. Table 3 also presents the number of firms surveyed by country. The sample contains 11 countries, with Japan proportionally the largest (18.24 per cent of the total sample). The United States and the United Kingdom make up the second and third largest groups in terms of the number of companies surveyed by the CDP, accounting for 18.06 and 11.99 per cent of the study sample, respectively.

Table 3 shows that the countries with the highest response rate to the CDP questionnaire are the United Kingdom, the United States, and Canada, with values of 78.54, 68.70, and 58.96 per cent, respectively. In terms of the quality of carbon disclosures, companies from South Korea, India, and Japan display the highest levels of quality, as shown by their high average CDP disclosure score.

4.2. Descriptive Statistics and Correlation Analysis

Table 4 provides the descriptive statistics for each of the variables included in the models. More precisely, it presents the number of observations; mean; standard deviation; percentiles (25, 50, and 75); minimum and maximum.

Table 4. Descriptive statistics.

Panel A. Whole Sample.

Variables	N	Mean	S.D.	Minimum	P25	Median	P75	Maximum
DisCDP15	2176	0.50	0.50	0.00	0.00	1.00	1.00	1.00
HighCDP15	2176	0.25	0.43	0.00	0.00	0.00	0.00	1.00
Laws	2176	11.72	5.39	3.00	9.00	9.00	12.00	23.00
EPSI	2176	3.07	0.55	1.08	2.69	3.17	3.28	3.83
Rewards	2176	0.46	0.31	0.03	0.18	0.34	0.83	0.96
Size	2176	14.78	1.81	7.84	13.76	14.86	15.97	18.69
TobinQ	2176	1.88	1.53	0.49	0.99	1.36	2.14	9.76
Beta	2176	0.91	0.42	0.05	0.63	0.87	1.14	2.36
Lev	2176	0.24	0.17	0.00	0.10	0.22	0.35	0.72
ROA	2176	0.05	0.07	−0.29	0.02	0.04	0.08	0.28
CDP_{t-1}	2176	0.45	0.50	0.00	0.00	0.00	1.00	1.00

Panel B. Sub-sample of responding companies.

Variables	N	Mean	S.D.	Minimum	P25	Median	P75	Maximum
DisCDP15	1091	1.00	0.00	1.00	1.00	1.00	1.00	1.00
HighCDP15	1091	0.49	0.50	0.00	0.00	0.00	1.00	1.00
Laws	1091	12.26	6.15	3.00	9.00	9.00	15.00	23.00
EPSI	1091	3.16	0.47	1.08	2.69	3.17	3.58	3.83
Rewards	1091	0.52	0.31	0.03	0.25	0.34	0.83	0.96
Size	1091	15.53	1.58	7.84	14.55	15.60	16.58	18.69
TobinQ	1091	1.70	1.15	0.49	1.02	1.33	2.01	9.76
Beta	1091	0.96	0.42	0.05	0.67	0.93	1.18	2.36
Lev	1091	0.25	0.15	0.00	0.14	0.24	0.35	0.72
ROA	1091	0.05	0.06	−0.29	0.02	0.05	0.08	0.28
CDP_{t-1}	1091	0.83	0.37	0.00	1.00	1.00	1.00	1.00

Panel C. Sub-sample of non-responding companies.

Variables	N	Mean	S.D.	Minimum	P25	Median	P75	Maximum
DisCDP15	1085	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HighCDP15	1085	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Laws	1085	11.18	4.44	3.00	9.00	9.00	12.00	23.00
EPSI	1085	2.98	0.61	1.08	3.07	3.17	3.28	3.83
Rewards	1085	0.40	0.31	0.03	0.17	0.34	0.50	0.96
Size	1085	14.03	1.73	7.84	13.17	14.17	15.07	18.69
TobinQ	1085	2.06	1.82	0.49	0.97	1.42	2.32	9.76
Beta	1085	0.86	0.43	0.05	0.59	0.81	1.08	2.36
Lev	1085	0.22	0.18	0.00	0.06	0.21	0.34	0.72
ROA	1085	0.05	0.08	−0.29	0.02	0.04	0.08	0.28
CDP_{t-1}	1085	0.06	0.24	0.00	0.00	0.00	0.00	1.00

N = Number of firms. P25 and P75 are the 25th and the 75th percentiles of the variables respectively. S.D. = standard deviation. Responding companies are those which responded to the CDP survey and made their response public. Non-responding companies are those firms that did not respond, declined to participate, or did not publish the CDP questionnaire.

In order to mitigate the impact of extreme values, all continuous independent variables were winsorized at the 1st and 99th percentiles. Table 4 Panel A shows the descriptive statistics for the whole sample, while Panels B and C report the same statistics for sub-samples of responding and non-responding firms, respectively. As may be seen in Table 4 Panel A, the mean of DisCDP15 is 0.5, indicating that 50 per cent of the sample (1091 of 2176 companies) answered the 2015 CDP climate survey and made their response public. With regard to regulative components, the mean of the laws variable is 11.72 with a standard deviation of 5.39, which indicates that the gap between the number of climate-related laws is relatively large. The mean of the EPSI variable is 3.07 and its standard deviation is 0.55, suggesting that the variation between the stringency levels of the countries' environmental policies is not overly high. The mean of the rewards variable stands at 0.46, which indicates that average clean energy investments represent 0.5 per cent of the GDP, while the standard deviation of rewards is 0.31, indicating that differences among countries' clean energy investments are not high. The Size and Beta variables present a mean of 14.78 and 0.91,

respectively, for the whole sample, which is similar to that found in previous studies [1,49]. The mean of TobinQ (1.88) is consistent with that found by Luo et al. [1]. For their part, Lev and ROA present a mean of 0.24 and 0.05, respectively, which is comparable to the findings of Clarkson et al. [4] and Luo [6].

The mean of CDP_{t-1} is 0.45 for the whole sample, suggesting that 45 per cent of companies in the sample responded to the CDP questionnaire in the previous year. This variable appears to be very closely related to CDP participation, since its mean is higher (0.83) for the sub-sample of responding companies (see Table 4 Panel B), which indicates that more than 80 per cent of these companies responded to the CDP survey the previous year. As shown in Table 4 Panel B, the mean of HighCDP15 is 0.49, suggesting that approximately 50 per cent of the sub-sample of responding firms (539 of 1.091 companies) obtained a CDP score of no less than 93 points. In fact, this occurs because we coded as one those companies that obtained a CDP score greater than the median of the sub-sample of responding companies, namely 93.

After comparing the descriptive statistics of Panels B and C, it would appear that, on average, responding companies are larger and present higher levels of risk and leverage than non-responding companies. Additionally, on average, responding companies operate in countries with a higher number of climate-related laws. Furthermore, these firms belong to countries that have more stringent environmental policy instruments, as evidenced by the higher mean of the EPSI variable. Responding companies also operate in countries that present a slightly higher rate of clean energy investments.

Table 5 below details the correlation analysis of dependent and independent variables. More specifically, the Pearson (parametric) and Spearman (non-parametric) correlation coefficients have been calculated.

Table 5. Correlation matrix.

Variables	1	2	3	4	5	6	7	8	9	10	11
DisCDP15 (1)	1	0.57 ***	0.01	0.12 ***	0.18 ***	0.44 ***	-0.04 *	0.13 ***	0.10 ***	0.02	0.78 ***
HighCDP15 (2)	0.57 ***	1	0.01	0.03	0.12 ***	0.47 ***	−0.07 ***	0.09 ***	0.13 ***	−0.02	0.53 ***
Laws (3)	0.10 ***	0.04 **	1	0.11 ***	0.06 ***	−0.17 ***	0.04 *	−0.15 ***	−0.05 ***	0.04 *	0.02
EPSI (4)	0.17 ***	0.06 ***	0.26 ***	1	0.07 ***	−0.19 ***	−0.14 ***	−0.18 ***	−0.06 ***	−0.17 ***	0.05 ***
Rewards (5)	0.18 ***	0.12 ***	0.24 ***	0.29 ***	1	0.19 ***	0.03	0.10 ***	−0.10 ***	0.07 ***	0.13 ***
Size (6)	0.41 ***	0.43 ***	−0.09 ***	−0.06 ***	0.16 ***	1	−0.16 ***	0.24 ***	0.26 ***	−0.03	0.46 ***
TobinQ (7)	−0.12 ***	−0.10 ***	0.03	−0.22 ***	−0.06 ***	−0.22 ***	1	−0.08 ***	−0.20 ***	0.62 ***	−0.03
Beta (8)	0.11 ***	0.07 ***	−0.17 ***	−0.09 ***	0.01	0.18 ***	−0.07 ***	1	0.06 ***	−0.04 *	0.13 ***
Lev (9)	0.08 ***	0.11 ***	−0.03	−0.06 ***	−0.10 ***	0.23 ***	−0.21 ***	0.08 ***	1	−0.32 ***	0.11 ***
ROA (10)	0.04 *	0.01	0.06 ***	−0.15 ***	0.05 **	0.15 ***	0.44 ***	−0.08 ***	−0.24 ***	1	0.01
CDP_{t-1} (11)	0.78 ***	0.53 ***	0.07 ***	0.11 ***	0.12 ***	0.42 ***	−0.11 ***	0.12 ***	0.09 ***	0.02	1

Pearson (Spearman) correlation coefficients are presented below (above) the diagonal. *, **, *** represent coefficients significant at the 0.1, 0.05, and 0.01 levels, respectively (two-tailed). All variables are described in Table 2.

As shown in Table 5, cross-correlations among pairs of independent variables are not elevated or significant, indicating that multicollinearity should not be an issue. Moreover, the analysis of the variable inflation factors (VIF) suggests that collinearity is not a serious problem. The largest single VIF is 1.6 and the mean VIF is less than 1.40, thus again suggesting that multicollinearity does not appear to be an issue.

4.3. Regression Results

Table 6 below presents the results of the initial probit model. The chi-square value of 1665.21 is significant at the maximum level, indicating that the model was able to distinguish those sample firms that voluntarily disclosed carbon information via the CDP from those that did not. Table 6 also shows that the model correctly predicted the outcome of the disclosure decision for more than 80 per cent of the companies in the sample. The pseudo-R^2 of the model is 0.552, which is comparable to previous voluntary disclosure literature [5,61].

Table 6. Probit regression on CDP participation.

Variables	Predicted Sign	Coefficients	Standard Errors	z-Stat	Marginal Effects
Laws	+	0.013 *	0.007	1.69	0.005 *
EPSI	+	0.474 ***	0.089	5.29	0.188 ***
Rewards	+	0.410 ***	0.128	3.19	0.163 ***
Size		0.176 ***	0.027	6.41	0.07 ***
TobinQ		−0.015	0.035	−0.45	−0.006
Beta		0.031	0.102	0.31	0.012
Lev		0.139	0.255	0.55	0.055
ROA		1.406 **	0.682	2.06	0.558 **
CDP_{t-1}		2.374 ***	0.084	28.06	0.754 ***
Constant		−5.678 ***	0.550	−10.32	-
Chi-square		1665.21 ***			
Log likelihood		−675.67			
Pseudo R^2		0.552			
% Correctly predicted		88.79%			
Number of observations		2176			
Control of sector effects		yes			

*, **, *** coefficients are significant at the 0.1, 0.05, and 0.01 levels, respectively (two-tailed). Marginal effects for CDP_{t-1} represent the discrete change from the base level. All variables are described in Table 2.

As shown in Table 6, the rules component of the regulative pillar (as represented by the laws variable) shows a positive and significant relationship with companies' decisions to disclose carbon information (0.013, p-value < 0.10). On average, however, its impact on the probability of responding to the CDP questionnaire is quite limited, since this variable has an impact of 0.5 per cent increase in the probability of responding for each unit increase in the value of this factor.

Pressures originating from monitoring mechanisms and punishments are measured by the EPSI variable, which reflects countries' climate-change-related regulative stringency. This variable is positively and significantly associated with firms' participation in the CDP questionnaire. This supports hypothesis H2a. More specifically, the estimated coefficient of EPSI is 0.474, which is significant at the maximum level, indicating that monitoring mechanisms and punishments related to climate change positively and significantly affect companies' voluntary carbon disclosure behavior.

The coefficient of rewards is also found to be positive and significant at the maximum level (0.410, p-value < 0.01), which provides support for hypothesis H3a and suggests that companies' propensity to voluntarily report carbon data increases in line with countries' reward mechanisms related to climate change.

With respect to the control variables, Size is positively related to firms' propensity to disclose environmental information, with a significant coefficient at the 1 per cent level. Similarly, the ROA variable positively and significantly impacts companies' participation in the CDP survey (1.406, p < 0.05). CDP_{t-1} presents a positive and significant coefficient at the maximum level, which suggests that companies that participated in the CDP survey in the previous year are more likely to voluntarily participate in the CDP questionnaire. More precisely, the predicted probability of responding to the CDP survey in year t is 0.75 greater for those firms that disclosed carbon information to the CDP in year t-1. For their

part, the coefficients for TobinQ, Beta, and Lev are not significantly associated with firms' propensity to voluntarily disclose carbon data.

The results of the second model are presented in Table 7 below. This model is based on a sub-sample of 1091 companies, which both responded to the 2015 CDP climate survey and made their response public. The dependent variable is an indicator variable equal to one if the company obtained a CDP disclosure score greater than 93 (the median CDP score of responding companies), and zero otherwise. The likelihood-ratio chi-square value of 282.82 is significant at $p < 0.01$, which indicates that our model as a whole fits significantly. Table 7 also shows that our model correctly predicted the outcome of disclosure quality for 69 per cent of the companies in the sample. The inverse Mills ratio was included at this stage as an additional independent variable (Lambda), so as to account for sample selection bias. As can be seen, the Lambda coefficient is not significant, indicating that there is no selectivity bias of any note in the sample.

Table 7. Probit model on the quality of disclosures for a sub-sample of responding firms.

Variables	Predicted Sign	Coefficients	Standard Errors	z-Stat	Marginal Effects
Laws	+	0.016 *	0.008	1.92	0.006 *
EPSI	+	0.037	0.135	0.28	0.014
Rewards	+	0.393 **	0.161	2.44	0.156 **
Size		0.431 ***	0.044	9.77	0.172 ***
TobinQ		0.038	0.051	0.75	0.015
Beta		−0.150	0.113	−1.32	−0.059
Lev		0.600 **	0.298	2.01	0.239 **
ROA		−0.629	0.920	−0.68	−0.250
CDP_{t-1}		1.001*	0.594	1.68	0.359 *
Lambda		0.496	0.482	1.03	0.197
Constant		−8.446 ***	1.547	−5.46	-
Chi-square		282.82 ***			
Log likelihood		−631.74			
Pseudo R^2		0.1645			
% Correctly predicted		69.20%			
Number of observations		1091			
Control of sector effects		yes			

*, **, *** coefficients are significant at the 0.1, 0.05, and 0.01 levels, respectively (two-tailed). Marginal effects for CDP_{t-1} represent the discrete change from the base level. All variables included in the model are presented in Table 2.

Consistent with the initial probit on participation, the estimated laws coefficient is significantly positive (0.016, $p < 0.10$), indicating that the number of climate-related laws enacted by a country positively influences the quality of firms' carbon disclosure. This provides support for hypothesis H1b, which suggests that the quality of carbon information disclosed by companies increases with the number of climate-related laws of the country in which they operate.

Contrary to our expectations, monitoring mechanisms and punishments (as measured by the EPSI variable) are not significantly associated with the quality of carbon disclosures. Thus, the empirical evidence is not fully consistent with our predictions as made in H2b. Consistent with hypothesis H3b, the rewards coefficient (0.393, $p < 0.05$) is significant with a predicted positive sign showing that climate-related reward mechanisms encourage firms to disclose high-quality carbon information.

With regard to the control variables, the estimated coefficient of size is significantly positive (0.431, $p < 0.01$). Firm leverage is also positive and significantly related to the quality of carbon disclosure (0.600, $p < 0.05$). Furthermore, we find a positive and significant association between participating in the CDP survey in year t−1 and the quality of carbon information reported to the CDP in year t. Conversely, coefficients for TobinQ, Beta, and ROA are not significantly associated with the quality of carbon data.

4.4. Robust Tests

Three additional sensitivity checks were carried out in order to ascertain whether the results of this study are valid. Firstly, further probit models were performed in which the measurement of the Size variable was replaced by the natural logarithm of total assets. The results (which are not tabulated) are quantitatively similar to those presented in both Tables 6 and 7. Secondly, additional probit analyses were performed to examine whether the results were sensitive to the winsorization operation. Using unwinsorized data to run probit regressions, the statistic results (not reported) for both participation probit and quality disclosures probit were similar to those presented in Tables 6 and 7. Finally, Models 1 and 2 were analyzed using ordinary least squares regression (not tabulated), and the independent variables presented similar levels of significance. No significant values were observed in the residuals eliminated in each of the observations in the t test at 95 per cent, which could be suggestive of the existence of outliers.

5. Discussion

This study finds that the rules component of the regulative pillar is positively and significantly associated with voluntary carbon disclosure. This result is consistent with the first hypothesis (H1a), thus suggesting that the number of climate-change-related laws of countries does influence the level of participation of firms in said countries in the CDP survey. This supports the NIS idea that climate-related laws, apart from placing pressure on target companies, contribute to the generation of social expectations concerning companies' environmental behavior, which may affect the behavior of companies both subject and not to said laws. Thus, companies will voluntarily disclose carbon-related information in order to adapt themselves to the social expectations prevalent in their institutional context [8]. The result for this regulative component is consistent with prior studies [1,12], despite their being based on generic environmental regulations.

The results show that companies in countries with stringent monitoring mechanisms and punishments related to its climate laws are more likely to voluntarily participate in the CDP survey. This finding is similar to that of Mateo-Márquez et al. [7], who concluded that companies in countries with strict climate-related regulations are more likely to participate in voluntary carbon reporting.

The rewards component of the climate-related regulative pillar is positively and significantly related to firms' likelihood to voluntarily disclose carbon information through the CDP. This finding highlights how rewards contribute to reinforcing the regulative dimension of institutions [8]. Similarly, the results show that companies headquartered in countries that have implemented a rewards system for behavior in line with established climate change regulation will be more likely to disclose carbon information.

Countries' climate-related rules and laws are positively and significantly associated with the quality of the information reported to the CDP. This result is in line with previous studies in the field of voluntary carbon disclosures, despite their measuring the regulative pillar with a single variable [1,7].

Contrary to our initial expectations, we find that countries' climate-related monitoring mechanisms and punishments do not significantly influence the quality of voluntary carbon disclosures. This result may occur because in spite of the fact that monitoring mechanisms and punishments have been implemented in the majority of the sample countries, they are not effective enough to encourage firms to voluntarily disclose high-quality carbon information. Organizations gain legitimacy by participating in the CDP. Higher levels of quality in carbon information requires an "extra effort" on the part of organizations [65,66], an effort, which for its part, is not influenced by monitoring mechanisms and penalties, since these serve rather to reinforce the coercive character of regulation. This in turn exerts less pressure on those organizations participating in the CDP, given that the CDP is in fact a vehicle for the voluntary disclosure of information.

Our research shows that countries' climate-related rewards positively and significantly influence the quality of voluntary carbon information. Therefore, companies in countries

with a rewards system for behavior in line with established climate change regulation are more likely to provide high-quality carbon information.

With regard to the firm-level control variables, we find that larger firms are more likely to participate in the CDP survey as well as to provide high-quality carbon information. This finding is consistent with previous studies [1,67]. Larger firms are more likely to disclose high-quality carbon information in order to legitimize their operations in response to their social exposure [1,23,25]. Furthermore, these firms have more resources with which to account for, verify, and reduce their carbon emissions [40], which in turn helps them to disclose high-quality carbon information. Consistent with Stanny [17], we find that that firms' prior CDP reporting behavior is positively and significantly associated with future participation in the CDP climate survey. Highly leveraged firms are also more likely to report high-quality carbon information so as to allow their investors and creditors to evaluate their environmental behavior [3,6]. In addition, we find that firms' profitability is positively associated with voluntary carbon disclosure. This result is also consistent with the previous literature, which indicates that highly profitable firms are more likely to voluntarily disclose carbon-related information, since they may have more resources with which to afford the costs related to voluntary carbon disclosures [64]. However, firms' profitability is not related to the quality of the information disclosed. Moreover, participating in the CDP survey in year t-1 is positive and significantly related to the quality of carbon information reported to the CDP in year t. TobinQ and Beta are not significantly associated with firms' propensity to voluntarily disclose carbon data nor with the quality of the information reported.

6. Conclusions

This study sets out to investigate whether the components of countries' regulative pillars influence the probability of companies' voluntarily disclosing carbon data as well as the quality of the information disclosed. From the perspective of NIS theory, this paper hypothesizes that the components of the regulative pillar of institutions (rules; monitoring mechanisms and punishment; rewards) are positively related to both companies' propensity to disclose carbon information and to the quality of the information. This paper uses the standard Heckman two-stage approach in order to model data from 2176 companies that that were invited to participate in the 2015 CDP climate survey.

The results obtained reveal that the probability of voluntary carbon reporting is explained by the components of countries' regulative pressures (rules; monitoring mechanisms and punishment; rewards). Therefore, companies headquartered in countries where (1) specific climate-change-related regulation exists; (2) monitoring mechanisms for compliance have been implemented, and punishments exist for non-compliance with the regulation; (3) rewards exist for behavior in line with the regulation will be more likely to voluntarily disclose carbon information. These findings are consistent with NIS theory as regards the regulative dimension, which provides explanations for the impact of the different components of climate-related regulations on voluntary carbon disclosure [8,32,33].

As regards the quality of disclosures, this paper finds that climate-related rules and rewards do positively influence the quality of carbon information disclosed by companies. However, contrary to our expectations, neither climate-related monitoring mechanisms nor punishments are significantly related to the quality of carbon information. This could be due to the fact that monitoring mechanisms and punishments reinforce the coercive character of regulation and, therefore, are not as effective in encouraging companies to voluntarily disclose high-quality carbon information.

Taken together, the findings of this study suggest that climate-related rules, monitoring mechanisms and punishments, and rewards positively influence companies' decisions to respond to the CDP climate survey. However, as regards the disclosure of high-quality carbon information, only climate-related rules and rewards appear to be significant. Furthermore, and consistent with prior studies, we find that companies that disclose better-quality carbon information are larger and more leveraged than companies that only respond to the

CDP questionnaire. Larger firms are more likely to report high-quality carbon information, because they are more visible and have more resources with which to account for and disclose carbon emissions [6,40]. Additionally, leveraged companies are also more likely to voluntarily report high-quality carbon information due to pressures from their investors and creditors to evaluate their carbon-related risks [3,6].

Several studies measure the regulatory pillar with a single variable, such as the ratification of the Kyoto Protocol [2,68] or participation in a carbon market [6,69]. This can conceal the influence that the different components of the regulative pillar may exert as well as the compensation of the effects occurring between them. In this regard, the results of our study confirm that all the components have a similar influence on the decision of companies to voluntarily disclose carbon information. However, in terms of the quality of the information disclosed, the monitoring and punishment components do not have a statistically significant influence. Among the implications that this research may have, we can highlight the fact that regulators could, for example, achieve more in terms of the quality of the information voluntarily disclosed by companies through the implementation of rewards as opposed to closer monitoring and the application of penalties, as the results of our study show.

This study provides the first comprehensive assessment of the components of the climate-related regulative pillar and their influence on both the response to the CDP climate survey as well as on the quality of disclosures. Thus, this study makes several contributions to the existing literature. Firstly, it has taken the innovative approach of investigating the different components of countries' regulative pillars as highlighted by Scott [8] and specifically related to climate change, which previous studies in the field of voluntary carbon disclosure have neglected [1,2,7,35]. Secondly, it demonstrates which countries present greater levels of pressure from these regulative dimensions. Thirdly, unlike previous studies on voluntary carbon disclosures, which focus on larger companies [1,2,12] or those listed on specific indices [3,70], this study takes into account all the companies included in the 2015 CDP climate report for each of the sample countries. Finally, as opposed to considering generic climate-change-related regulations [2,12,35], this paper focuses on specific climate-related regulations and disaggregates them in order to identify the different individual components.

The findings of this study have implications for investors, managers, and regulators in that they will be better able to understand how the different components of climate-related regulation influence corporate carbon disclosure behavior. For example, this study offers investors and managers insights into evaluating voluntary carbon disclosures. The results may be taken into account in order to design country-specific reporting strategies and investment decisions. Last but not least, the results may also be of interest to regulators and policymakers in order to better understand the effects of the components of the climate-related regulative pillar on voluntary carbon disclosure, as well as for the development of guidelines to encourage firms to disclose high-quality carbon information.

This research is subject to certain limitations. First of all, the paper focuses on one institutional pillar only (regulative), thus caution should be exercised when extrapolating the findings to other institutional dimensions [8]. Secondly, it is centered on coercive pressures, i.e., pieces of regulation implemented by governments. Thirdly, the time period under analysis is relatively short (namely one year) as compared to previous studies [6,43]. Nonetheless, the multinational approach—11 countries including 2176 companies operating in different sectors—helps to compensate for this limitation. In this regard, further studies could analyze the elements of other institutional pillars, i.e., normative and cultural-cognitive, as well as examining their relationship with voluntary carbon disclosure. Furthermore, future research may also consider exploring the value relevance of voluntary carbon reporting and the moderating role of the different components of countries' regulative pillars, as well as analyzing the interplay between each component of the regulative dimension of institutions.

References

1. Luo, L.; Lan, Y.C.; Tang, Q. Corporate Incentives to Disclose Carbon Information: Evidence from the CDP Global 500 Report. *J. Int. Financ. Manag. Account.* **2012**, *23*, 93–120. [CrossRef]
2. Prado-Lorenzo, J.-M.; Rodríguez-Domínguez, L.; Gallego-Álvarez, I.; García-Sánchez, I.-M. Factors influencing the disclosure of greenhouse gas emissions in companies world-wide. *Manag. Decis.* **2009**, *47*, 1133–1157. [CrossRef]
3. Lemma, T.T.; Feedman, M.; Mlilo, M.; Park, J.D. Corporate carbon risk, voluntary disclosure, and cost of capital: South African evidence. *Bus. Strat. Environ.* **2019**, *28*, 111–126. [CrossRef]
4. Clarkson, P.M.; Li, Y.; Richardson, G.D.; Vasvari, F.P. Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Account. Organ. Soc.* **2008**, *33*, 303–327. [CrossRef]
5. Rankin, M.; Windsor, C.; Wahyuni, D. An investigation of voluntary corporate greenhouse gas emissions reporting in a market governance system. *Account. Audit. Account. J.* **2011**, *24*, 1037–1070. [CrossRef]
6. Luo, L. The influence of institutional contexts on the relationship between voluntary carbon disclosure and carbon emission performance. *Account. Financ.* **2019**, *59*, 1235–1264. [CrossRef]
7. Mateo-Márquez, A.J.; González-González, J.M.; Zamora-Ramírez, C. Countries' regulatory context and voluntary carbon disclosures. *Sustain. Account. Manag. Policy J.* **2020**, *11*, 383–408. [CrossRef]
8. Scott, W.R. *Institutions and Organizations: Ideas, Interests, and Identities*, 4th ed.; Sage: Thousand Oaks, CA, USA, 2014; ISBN 1452242224.
9. Reid, E.M.; Toffel, M.W. Responding to public and private politics: Corporate disclosure of climate change strategies. *Strat. Manag. J.* **2009**, *30*, 1157–1178. [CrossRef]
10. Akbaş, H.E.; Canikli, S. Determinants of voluntary greenhouse gas emission disclosure: An empirical investigation on Turkish firms. *Sustainability* **2019**, *11*, 107. [CrossRef]
11. Hsueh, L. Voluntary climate action and credible regulatory threat: Evidence from the carbon disclosure project. *J. Regul. Econ.* **2019**, *56*, 188–225. [CrossRef]
12. Freedman, M.; Jaggi, B. Global warming, commitment to the Kyoto protocol, and accounting disclosures by the largest global public firms from polluting industries. *Int. J. Account.* **2005**, *40*, 215–232. [CrossRef]
13. Tang, Q.; Luo, L. Transparency of Corporate Carbon Disclosure: International Evidence. 2011. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1885230 (accessed on 10 February 2021).
14. Cho, C.H.; Patten, D.M. The role of environmental disclosures as tools of legitimacy: A research note. *Account. Organ. Soc.* **2007**, *32*, 639–647. [CrossRef]
15. Roberts, R.W. Determinants of corporate social responsibility disclosure: An application of stakeholder theory. *Account. Organ. Soc.* **1992**, *17*, 595–612. [CrossRef]
16. Fondevila, M.M.; Moneva, J.M.; Scarpellini, S. Environmental disclosure and Eco-innovation interrelation. The case of Spanish firms. *Rev. Contab. Account. Rev.* **2019**, *22*, 73–87. [CrossRef]
17. Stanny, E. Voluntary Disclosures of Emissions by US Firms. *Bus. Strateg. Environ.* **2013**, *22*, 145–158. [CrossRef]
18. Gulluscio, C.; Puntillo, P.; Luciani, V.; Huisingh, D. Climate Change Accounting and Reporting: A Systematic Literature Review. *Sustainability* **2020**, *12*, 5455. [CrossRef]
19. Hahn, R.; Reimsbach, D.; Schiemann, F. Organizations, Climate Change, and Transparency: Reviewing the Literature on Carbon Disclosure. *Organ. Environ.* **2015**, *28*, 80–102. [CrossRef]
20. Clarkson, M.E. A Stakeholder Framework for Analyzing and Evaluating Corporate Social Performance. *Acad. Manag. Rev.* **1995**, *20*, 92–117. [CrossRef]
21. Cotter, J.; Najah, M.M. Institutional investor influence on global climate change disclosure practices. *Aust. J. Manag.* **2012**, *37*, 169–187. [CrossRef]
22. Guthrie, J.; Parker, L.D. Corporate Social Reporting: A Rebuttal Of Legitimacy Theory. *Account. Bus. Res.* **1989**, *19*, 343–352. [CrossRef]

23. Liu, X.; Anbumozhi, V. Determinant factors of corporate environmental information disclosure: An empirical study of Chinese listed companies. *J. Clean. Prod.* **2009**, *17*, 593–600. [CrossRef]

24. Li, D.; Huang, M.; Ren, S.; Chen, X.; Ning, L. Environmental legitimacy, green innovation, and corporate carbon disclosure: Evidence from CDP China 100. *J. Bus. Ethics* **2018**, *150*, 1089–1104. [CrossRef]

25. Chu, C.I.; Chatterjee, B.; Brown, A. The current status of greenhouse gas reporting by Chinese companies. *Manag. Audit. J.* **2012**, *28*, 114–139. [CrossRef]

26. Verrecchia, R.E. Discretionary disclosure. *J. Account. Econ.* **1983**, *5*, 179–194. [CrossRef]

27. Diamond, D.W.; Verrecchia, R.E. Disclosure, Liquidity, and the Cost of Capital. *J. Financ.* **1991**, *46*, 1325–1359. [CrossRef]

28. Luo, L.; Tang, Q. Does voluntary carbon disclosure reflect underlying carbon performance? *J. Contemp. Account. Econ.* **2014**, *10*, 191–205. [CrossRef]

29. Freedman, M.; Jaggi, B. Global Warming and Corporate Disclosures: A Comparative Analysis of Companies from the European Union, Japan and Canada. *Adv. Environ. Account. Manag.* **2010**, *4*, 129–160. [CrossRef]

30. Bansal, P.; Roth, K. Why companies go green: A model of ecological responsiveness. *Acad. Manag.* **2000**, *43*, 717–736. [CrossRef]

31. Tolbert, P.S.; Zucker, L.G. The Institutionalization of Institutional Theory. In *Handbook of Organization Studies*; Clegg, S., Hardy, C., Nord, W., Eds.; Sage: London, UK, 1996; pp. 175–190.

32. Meyer, J.W.; Rowan, B. Institutionalized Organizations: Formal Structure as Myth and Ceremony. *Am. J. Sociol.* **1977**, *83*, 340–363. [CrossRef]

33. DiMaggio, P.J.; Powell, W.W. The iron cage revisited: Institutional and collective rationality in organizational fields. *Am. Sociol. Rev.* **1983**, *48*, 147–160. [CrossRef]

34. Mateo-Márquez, A.J.; González-González, J.M.; Zamora-Ramírez, C. The influence of countries' climate change-related institutional profile on voluntary environmental disclosures. *Bus. Strat. Environ.* **2021**, *30*, 1357–1373. [CrossRef]

35. Jira, C.; Toffel, M.W. Engaging Supply Chains in Climate Change. *Manuf. Serv. Oper. Manag.* **2013**, *15*, 559–577. [CrossRef]

36. Qian, W.; Burritt, R. The development of environmental management accounting: An institutional view. In *Environmental Management Accounting for Cleaner Production*; Springer: Dordrecht, The Netherlands, 2008; pp. 233–248.

37. Bebbington, J.; Larrinaga-González, C. Carbon Trading: Accounting and Reporting Issues. *Eur. Account. Rev.* **2008**, *17*, 697–717. [CrossRef]

38. Nachmany, M.; Fankhauser, S.; Davidová, J.; Kingsmill, N.; Landesman, T.; Roppongi, H.; Schleifer, P.; Setzer, J.; Sharman, A.; Singleton, C.S. *The 2015 Global Climate Legislation Study: A Review of climate Change Legislation in 99 Countries: Summary for Policymakers*; GLOBE International and the Grantham Research Institute, London School of Economics: London, UK, 2015.

39. Deephouse, D.L.; Suchman, M. Legitimacy in organizational institutionalism. In *The Sage Handbook of Organizational Institutionalism*; Greenwood, R., Oliver, C., Suddaby, R., Sahlin, K., Eds.; Sage: London, UK, 2008; pp. 49–77.

40. Ben-Amar, W.; McIlkenny, P. Board Effectiveness and the Voluntary Disclosure of Climate Change Information. *Bus. Strat. Environ.* **2014**, *24*, 704–719. [CrossRef]

41. Perrault-Crawford, E.; Clark-Williams, C. Should corporate social reporting be voluntary or mandatory? Evidence from the banking sector in France and the United States. *Corp. Gov. Int. J. Bus. Soc.* **2010**, *10*, 512–526. [CrossRef]

42. Townshend, T.; Fankhauser, S.; Aybar, R.; Collins, M.; Landesman, T.; Nachmany, M.; Pavese, C. How national legislation can help to solve climate change. *Nat. Clim. Chang.* **2013**, *3*, 430. [CrossRef]

43. Liesen, A.; Hoepner, A.G.; Patten, D.M.; Figge, F. Does stakeholder pressure influence corporate GHG emissions reporting? Empirical evidence from Europe. *Account. Audit. Account. J.* **2015**, *28*, 1047–1074. [CrossRef]

44. Scholtens, B.; Kleinsmann, R. Incentives for subcontractors to adopt CO2 emission reporting and reduction techniques. *Energy Policy* **2011**, *39*, 1877–1883. [CrossRef]

45. Kostova, T. Country institutional profiles: Concept and measurement. *Acad. Manag. Proc.* **1997**, *1997*, 180–184. [CrossRef]

46. Bouten, L.; Everaert, P.; Roberts, R.W. How a two-step approach discloses different determinants of voluntary social and environmental reporting. *J. Bus. Financ. Account.* **2012**, *39*, 567–605. [CrossRef]

47. Breen, R. *Regression Models: Censored, Sample Selected, or Truncated Data*; Sage: Thousand Oaks, CA, USA, 1996; ISBN 0803957106.

48. Heckman, J.J. Sample selection bias as a specification error. *Econometrica* **1979**, *47*, 153–161. [CrossRef]

49. González-González, J.M.; Zamora-Ramírez, C. Voluntary carbon disclosure by Spanish companies: An empirical analysis. *Int. J. Clim. Chang. Strateg. Manag.* **2016**, *8*, 57–79. [CrossRef]

50. Galán-Valdivieso, F.; Saraite-Sariene, L.; Alonso-Cañadas, J.; Caba-Pérez, M.d.C. Do Corporate Carbon Policies Enhance Legitimacy? A Social Media Perspective. *Sustainability* **2019**, *11*, 1161. [CrossRef]

51. Truant, E.; Corazza, L.; Scagnelli, S.D. Sustainability and risk disclosure: An exploratory study on sustainability reports. *Sustainability* **2017**, *9*, 636. [CrossRef]

52. Córdova, C.; Zorio-Grima, A.; Merello, P. Carbon emissions by South American companies: Driving factors for reporting decisions and emissions reduction. *Sustainability* **2018**, *10*, 2411.

53. CDP CDP-About Us. Available online: https://www.cdp.net/en/info/about-us (accessed on 10 December 2017).

54. Botta, E.; Koźluk, T. Measuring Environmental Policy Stringency in OECD Countries: A Composite Index Approach. *OECD Econ. Dep. Work. Pap.* **2014**. [CrossRef]

55. OECD Environmental Policy: Environmental Policy Stringency Index. Available online: https://stats.oecd.org/Index.aspx?DataSetCode=EPS (accessed on 20 January 2019).

56. Andersson, F.N.G. International trade and carbon emissions: The role of Chinese institutional and policy reforms. *J. Environ. Econ.* **2018**, *205*, 29–39. [CrossRef] [PubMed]

57. Rosati, F.; Faria, L.G.D. Addressing the SDGs in sustainability reports: The relationship with institutional factors. *J. Clean. Prod.* **2019**, *215*, 1312–1326. [CrossRef]

58. Wegener, M.; Elayan, F.A.; Felton, S.; Li, J. Factors influencing corporate environmental disclosures. *Account. Perspect.* **2013**, *12*, 53–73. [CrossRef]

59. Solomon, A.; Lewis, L. Incentives and Disincentives for Corporate Environmental Disclosure. *Bus. Strateg. Environ.* **2002**, *11*, 154–169. [CrossRef]

60. Cormier, D.; Magnan, M.; Van Velthoven, B. Environmental disclosure quality in large German companies: Economic incentives, public pressures or institutional conditions? *Eur. Account. Rev.* **2005**, *14*, 3–39. [CrossRef]

61. Stanny, E.; Ely, K. Corporate environmental disclosures about the effects of climate change. *Corp. Soc. Responsib. Environ. Manag.* **2008**, *348*, 338–348. [CrossRef]

62. Wasara, T.M.; Ganda, F. The relationship between corporate sustainability disclosure and firm financial performance in Johannesburg Stock Exchange (JSE) listed mining companies. *Sustainability* **2019**, *11*, 4496. [CrossRef]

63. Nasih, M.; Harymawan, I.; Paramitasari, Y.I.; Handayani, A. Carbon emissions, firm size, and corporate governance structure: Evidence from the mining and agricultural industries in Indonesia. *Sustainability* **2019**, *11*, 2483. [CrossRef]

64. Bewley, K.; Li, Y. Disclosure of environmental information by Canadian manufacturing companies: A voluntary disclosure perspective. *Adv. Environ. Account. Manag.* **2000**, *1*, 201–226. [CrossRef]

65. González-González, J.M.; Zamora-Ramírez, C. Organisational communication on climate change: The influence of the institutional context and the adoption pattern. *Int. J. Clim. Chang. Strat. Manag.* **2016**, *8*, 286–316. [CrossRef]

66. Hess, D.; Warren, D.E. The meaning and meaningfulness of corporate social initiatives. *Bus. Soc. Rev.* **2008**, *113*, 163–197. [CrossRef]

67. Patten, D.M. Media Exposure, Public Policy Pressure, and Environmental Disclosure: An Examination of the Impact of Tri Data Availability. *Account. Forum* **2002**, *26*, 152–171. [CrossRef]

68. Luo, L.; Tang, Q.; Lan, Y. Comparison of propensity for carbon disclosure between developing and developed countries. *Account. Res. J.* **2013**, *26*, 6–34. [CrossRef]

69. Luo, L.; Tang, Q. Determinants of the quality of corporate carbon management systems: An international study. *Int. J. Account.* **2016**, *51*, 275–305. [CrossRef]

70. Eleftheriadis, I.M.; Anagnostopoulou, E.G. Relationship between Corporate Climate Change Disclosures and Firm Factors. *Bus. Strat. Environ.* **2015**, *24*, 780–789. [CrossRef]