

ARTICLES

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NEW TRENDS IN CORPORATE REPORTING: INFORMATION ON THE CARBON FOOTPRINT IN SPAIN

Novas formas de relatório corporativo: Informação sobre a pegada de carbono na Espanha

Nuevas formas de reporting corporativo: Información sobre la huella de carbono en España

ABSTRACT

In accordance with the Kyoto Protocol, Spain has created a National Carbon Footprint Registry by Royal Decree 163/2014. This constitutes a pioneering initiative to help Spanish companies give visibility to their efforts in reducing their emissions of greenhouse gases (GHGs). Hence, this paper explores the motivation of Spanish companies to register their carbon footprints with a higher degree of scope. We identify the characteristics of the first Spanish companies that registered their carbon footprint through a logistic regression model (logit). The study concludes that organizations are more likely to register a higher scope if they do not belong to the manufacturing sector, if they are relatively new, and have a culture of environmental transparency.

KEYWORDS | Environmental performance, financial performance, environmental disclosure, carbon footprint, environmental accounting.

RESUMO

Em concordância com o Protocolo de Quioto, Espanha cria o “Registro Nacional de pegada de carbono, remuneração e projetos de absorção” por meio do Decreto Real 163/2014. Esta é uma iniciativa pioneira para incentivar as empresas espanholas a dar visibilidade ao seu compromisso de reduzir suas emissões de gases de efeito estufa (GEE). Neste contexto, a pesquisa atual explora os determinantes da adesão ao registro nacional espanhol de pegada de carbono. Um estudo exploratório das características das primeiras empresas espanholas que decidiram inscrever sua pegada de carbono foi realizado, através de um modelo de regressão logística (logit). O estudo conclui que as organizações que são mais propensas a registrar um maior alcance de sua pegada de carbono, caracterizam-se por fazer parte de um setor diferente da indústria de transformação, recém-criado e ter uma cultura ambiental transparente.

PALAVRAS-CHAVE | Desempenho ambiental, desempenho financeiro, divulgação ambiental, pegada de carbono, contabilidade ambiental.

RESUMEN

A raíz del Protocolo de Kioto, España crea el Registro Nacional de Huella de Carbono, Compensación y Proyectos de Absorción de Dióxido de Carbono mediante el Real Decreto 163/2014. Ello se constituye en una iniciativa pionera para potenciar que las empresas españolas den visibilidad a su compromiso en la reducción de sus emisiones de Gases de Efecto Invernadero (GEI). Bajo este contexto, la presente investigación explora los determinantes de la adhesión al Registro Nacional de Huella de Carbono español. Se realiza un estudio exploratorio de las características de las primeras empresas españolas que decidieron inscribir su huella de carbono, a través de un modelo de regresión logística (logit). El estudio concluye que las organizaciones que tienen mayor probabilidad de registrar un mayor alcance de su huella de carbono se caracterizan por pertenecer a un sector no manufacturero, ser de reciente creación y poseer una cultura ambiental transparente.

PALABRAS CLAVE | Desempeño ambiental, desempeño financiero, divulgación ambiental, huella de carbono, contabilidad ambiental.

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INTRODUCTION

In an environment of international concern about the adverse effects of climate change, many institutions and organizations have multiplied their conservation efforts and adopted measures that provide in-depth knowledge of the dynamics and impacts of greenhouse gases (GHGs). In this context, the carbon footprint is one of the most widely recognized indicators in the international sphere (Schneider & Samaniego, 2009). According to the Spanish Office for Climate Change (2015), carbon footprint (CF) is defined as “the totality of greenhouse gases emitted by direct or indirect effect by an individual, organization, event, or product.” The carbon footprint quantifies the GHGs (carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF₆)), which are expelled into the atmosphere, directly or indirectly, as a product of the various activities carried out by a company or a person or in the lifecycle of a product.

GHG emissions by a company can be measured at three levels (scope 1: direct emissions, scope 2: indirect emissions, and scope 3: related activity emissions). A company’s carbon footprint is recorded in the Registry by registering either “1 and 2” or “1, 2 and 3” scopes. For the purposes of this research, “1, 2 and 3” represents a carbon footprint measure with a greater scope. Therefore, this paper explores the probability that the decision of Spanish companies that have recorded their 2013 carbon footprint using this greater scope (1, 2 and 3) can be attributed to factors of a financial and environmental nature (Segura, Ferruz, Gargallo, & Salvador, 2013).

In this regard, to facilitate monitoring of compliance with the Kyoto Protocol, Spain has established the National Registry for Carbon Footprint, Offsetting, and Carbon Dioxide Absorption Projects under the Ministry of Agriculture, Food, and Environment, through Royal Decree 163/2014 (Ministry of the Presidency, 2014). It is a pioneering initiative in Spain and should provide the necessary measures for companies to reduce their emissions (Club Asturiano de Calidad, 2013).

Therefore, the purpose of this study is to analyze the characteristics of the first Spanish companies that used the National Carbon Footprint Registry to disseminate information. Additionally, through the study and analysis of the various pronouncements on climate change, this paper is intended to contribute, from an academic perspective, to the identification of opportunities to mitigate the adverse effects of GHG, focusing especially on the Spanish business sector. Consequently, this study sheds light on the transparency and sustainable behavior of companies through the identification of the characteristics

that allow organizations to be more transparent. Spain is an interesting setting for this study given that the literature has shown that its business fabric is very sensitive to issues of corporate social responsibility (Garrido-Miralles, Zorio-Grima, & García-Benau, 2016), and, therefore, it is expected that companies would also be inclined to adopt new corporate reporting policies, including disclosing their information through the National Carbon Footprint Registry. For countries in Latin America, with many natural resources and where a tendency already exists in some countries to disclose the carbon footprint of listed companies (Cordova et al., 2018), the creation of national registers such as the Spanish one could assist in extending this trend of respect for the environment among small- and medium-sized enterprises.

Based on the results, our study concludes that the companies that are more likely to register a calculation that measures the greater scope of their carbon footprint (scopes 1, 2 and 3) are characterized by not belonging to the manufacturing industrial sector, having existed only a relatively short time, and, mainly, having a culture of environmental transparency that is made explicit through the practice of annually disclosing a sustainability or corporate social responsibility report.

The rest of this paper is organized as follows. The following section describes the seriousness of the situation with respect to climate change and the emission of greenhouse gases as well as business strategies aimed at sustainable development. Next, we pay special attention to the market for GHG emission rights and the creation of the National Carbon Footprint Registry. The following sections describe the hypotheses, sample, and methodology of our empirical study. Following that, we present the results of the exploratory analysis and its interpretation. Finally, the main conclusions of this study, its limitations, and possible future lines of research are discussed.

CLIMATE CHANGE, GREENHOUSE GAS EMISSIONS, AND SUSTAINABLE BUSINESS STRATEGY

From a sustainability standpoint, humanity faces significant challenges that must be addressed, one of which is adaptation to climate change (IPPC, 2014; Córdova, Zorio-Grima, & Merello, 2018). Thus, of the nine planetary boundaries, climate change is considered to be the most important one, according to a report by the Intergovernmental Panel on Climate Change (IPCC) in November 2014. This document states, with a certainty of 95%,

that human beings have been responsible for the warming of the earth in recent decades and that temperatures will continue to rise if concrete measures are not taken to stop the current levels of pollution (Prieto, 2014).

The United Nations Framework Convention on Climate Change, (hereinafter, UNFCCC), an institution created in 1992, defines climate change in its Article 1 as “change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to the natural climate variability observed during comparable time periods.”

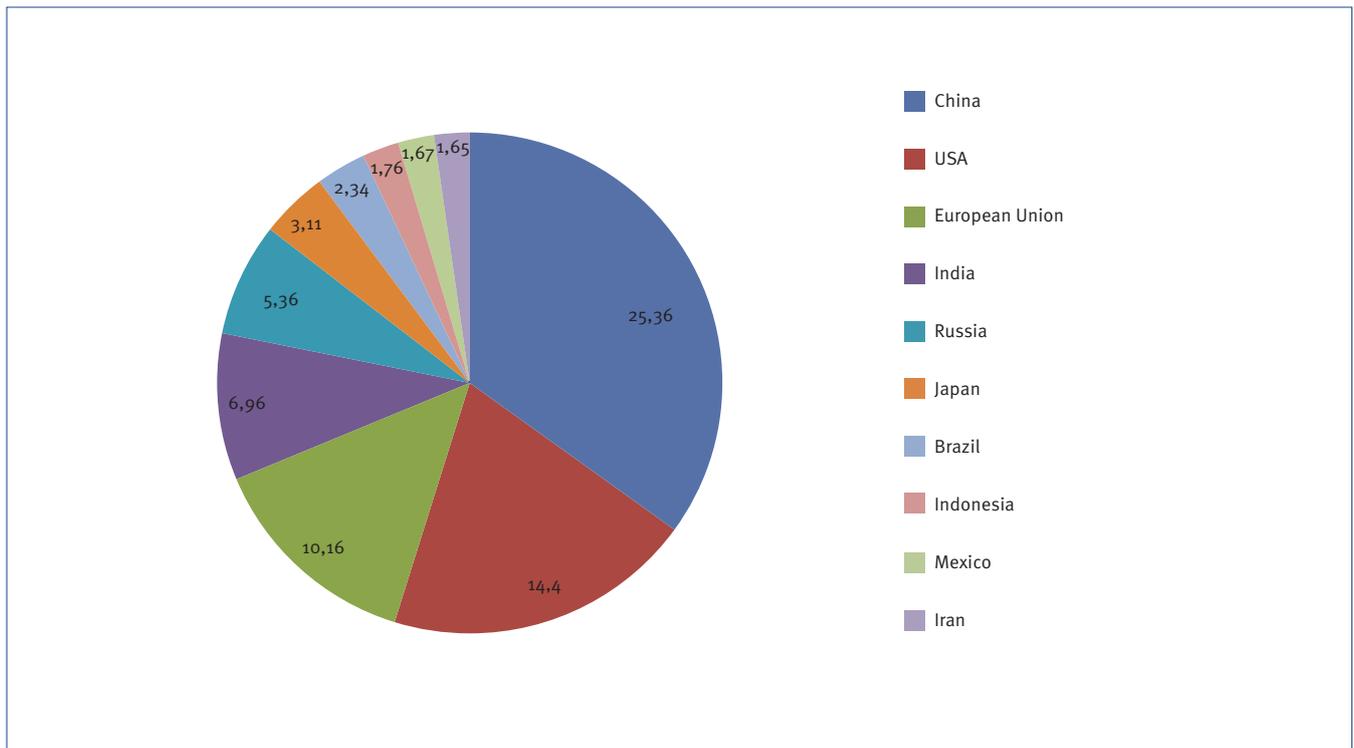
The purpose of this Convention is to ensure a balance of GHG concentrations in the atmosphere, so that dangerous human actions that harm the climate system can be avoided (UNFCCC, 1992). In this context, in December 1997, the Kyoto Protocol (which

was enacted in 2004) was established, constituting an important first step in the fight against GHG emissions.

Currently, China, the United States, and the European Union are the worst offenders in terms of GHG emissions, accounting for 50% of global emissions. In Spain, more than 80% of the annual GHG emissions are CO₂, mainly from the direct combustion of fuels to obtain energy and heat (PricewaterhouseCoopers, 2015). The main sources of GHG emissions are concentrated in the sectors of electricity, manufacturing, construction, transportation, and the combustion of other fuels (71%), followed by the agricultural sector (13%), and emissions due to changes in the use of soil (afforestation, deforestation, and reforestation, 6%), according to Frohmann and Olmos (2013).

The following graph shows the main GHG emitters and their emissions (Graph 1).

Graph 1. Main GHG emitters

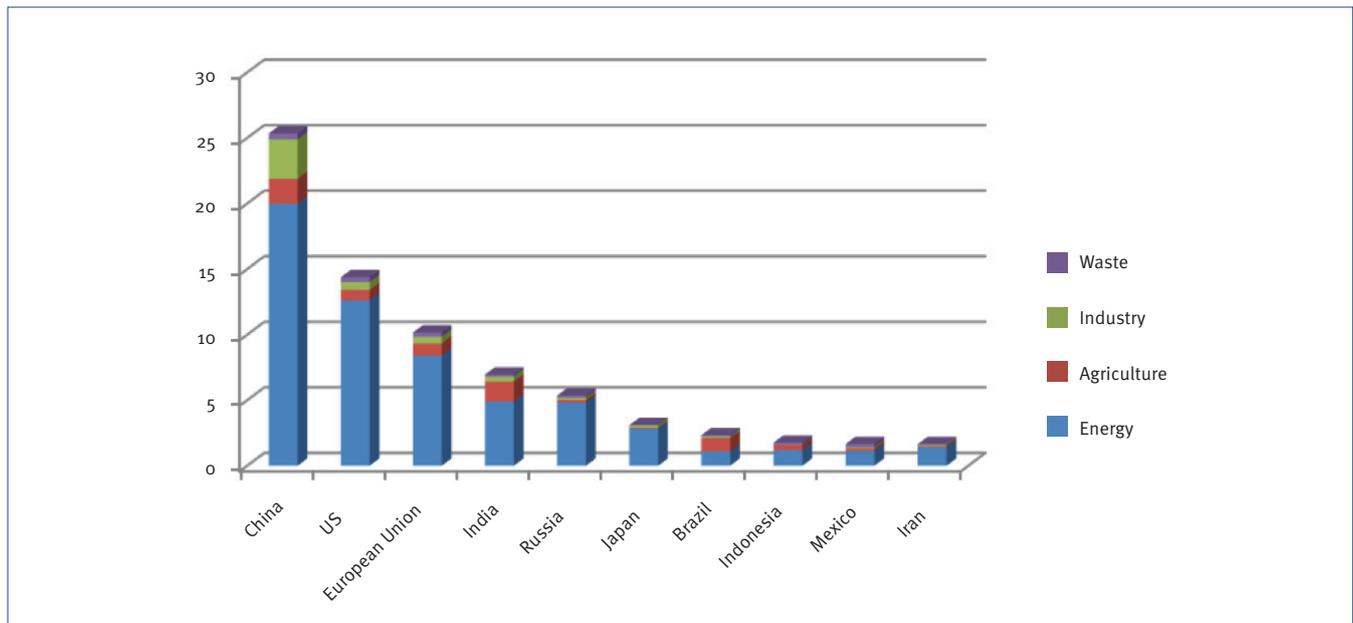


Source: Based on Friedrich, Ge, and Damassa (2015) Similarly, the following are the emissions by sector from the main GHG emitters (Graph 2):

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When analyzing GHG emissions from a business management perspective, it can be argued that investors are concerned about the carbon disclosure of organizations. Thus, in the last decade, interest in the risks caused by climate change has grown on a large scale among both internal and external investors (PricewaterhouseCoopers, 2012). The study by Taurigana and Chithambo (2014) reveals that GHG measurement and reporting procedures have had a positive effect on the disclosure of GHG emissions, and the results suggest that governance mechanisms, such as size and property concentration, as well as other variables, such as financial and industrial clearance, have had a significant effect on GHG disclosure.

Graph 2. Main GHG emitters by sector



Source: Based on Friedrich et al. (2015)

In fact, we are currently seeing growing pressure from investors and other interest groups, who demand complete information from companies that respond to climate change. This information is useful to investors in the decision-making process. Thus, companies have found new channels to transmit not only information related to economic operations, but also non-financial aspects related to carbon. In this sense, two well-known institutions, the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP), propose initiatives to organize and better guide approaches to the information requested from companies at the economic, social, and environmental levels (Matsumura, Prakash, & Vera-Muñoz, 2014).

The GRI has become one of the major protocols for the preparation of sustainability reports, and there are numerous studies that use company social responsibility reports that apply the GRI as a reference. Therefore, the preparation of these reports has clearly enabled organizations to demonstrate their social and environmental commitments to the community (Zorio, García-Benau, & Sierra-García, 2013; Sierra-García, García-Benau, & Zorio, 2014; Sierra-García, Zorio-Grima, & García-Benau, 2015). Dhaliwal, Li, Tsang, and Yang (2011) emphasize the importance of preparing sustainability reports as a way to reduce the differences between managers and investors as well as maximize the value of companies and reduce capital costs. Zuraida, Houque, and Zijl (2016) indicate that, in line with the theory of disclosure, companies that reveal more social

and environmental information are valued more. The theory of disclosure refers to the expectation that the market values companies that provide better non-financial information (Healy & Palepu, 2001), i.e., those that are more transparent.

In turn, the CDP (founded in London in the year 2000) has been a pioneer in the creation of a global information system based on a questionnaire open to economic agents. Kolk, Levy, and Pinkse (2008) describe the CDP as one of the most relevant initiatives for investors to learn the implications of climate change. Their study shows that CDP responses have been used successfully by investors to persuade companies to disclose information about their activities related to climate change. Stanny (2013) emphasizes that the CDP's major efforts in 2000 focused on two objectives: informing managers of investor concerns about climate change and alerting investors to the risks associated with it.

EMISSION RIGHTS MARKET

The trading of emission rights, considered to be one of the flexible reduction mechanisms proposed in Kyoto, was introduced in Spain as a result of the creation of the European Emission Rights Market in 2005, under the EU Emissions Trading Scheme (EU ETS) (Ministry of the Presidency, 2012). This scheme is the first and most important international initiative for the trading of GHG

emission rights. Its launch attracted global attention to climate change and translated into a policy that could and should be recognized within the context of financial accounting (Lovell, Bebbington, Larrinaga, & Sales de Aguiar, 2013).

The EU ETS System was established in three phases, currently placing Spain in the third phase, which covers the period 2013-2020. After a major revision in 2009, as of 2013, a community approach, along with other aspects, was adopted, both in the amount and in the methodology for assigning GHG emission rights, setting out two forms of allocation: auction and assignment free of charge (Ministry of the Presidency, 2012). The new allocation approach proposes that organizations will have to buy their rights in an auction. This is because the European Union has announced that it is planning to phase out free allocation by 2027, considering that auctions would be the most transparent allocation procedure, according to the “polluter pays” principle (European Commission, 2013).

CARBON FOOTPRINT REGISTRY

The Carbon Disclosure Project 2009 report (Ecodes, 2015) acknowledges that the three mechanisms of the Kyoto Protocol, the clean development mechanism (CDM), joint implementation, and emissions trading, have been established in a framework to combat climate change. However, it underlines that the CDM has attracted criticism for leaving aside the so-called diffuse sectors (households, services, waste, agriculture, and transportation). In the European Union, almost 60% of GHG emissions emanate from these sectors, which is why Decision 406/2009/EC of the European Parliament and Council suggests that member states establish policies and strategies to reduce the diffuse sectors by 10% in the year 2020 in relation to 2005 (Ministry of the Presidency, 2014).

In this context, governments are considering the need to create other national registers that facilitate the collection of information related to carbon emissions. In this sense, as part of monitoring compliance with the reduction mechanisms of the Kyoto Protocol, and based on decision 406/2009/EC of the European Parliament and the Council, specifically in Spain, the National Registry of Carbon Footprint, Offsetting, and Carbon Dioxide Absorption Projects, under the Ministry of Agriculture, Food, and Environment, was set up through Royal Decree 163/2014 (Ministry of the Presidency, 2014). It is a pioneering initiative in Spain, which will provide the necessary measures for companies to reduce their emissions (Club Asturiano de Calidad, 2013).

The aim of the Spanish Registry, in line with the commitments made, and with the collaboration of public and private entities, is to raise awareness in the community in general of the fight against climate change. Participation in the Registry is voluntary, allowing participation of natural persons or legal entities, public or private, as well as self-employed workers. Additionally, considering their low resources and the important role they play, small-and medium-sized enterprises (SMEs) have also been allowed to join the Registry (Ministry of the Presidency, 2014). In fact, this Registry is mainly aimed at SMEs. Participation is currently voluntary, but it seems that in the near future, companies that wish to establish contracts with the government will be required to be part of this Registry and will need to have a plan to reduce their carbon footprint, as indicated in Article 10 of Royal Decree 163/2014.

In the Carbon Footprint Registry, GHGs emitted into the atmosphere are reported according to scopes 1, 2, and 3. Scope 1 emissions are direct GHG emissions that come from combustion in boilers, furnaces, and vehicles owned or controlled by the company. Scope 2 comprises indirect GHG emissions associated with the generation of electricity purchased and consumed by the company. Finally, scope 3 corresponds to other indirect emissions that arise from the extraction and production of materials required by the organization, work trips, and the transportation of raw materials, the latter being the most difficult to measure due to the volume of products and services used by organizations and the impossibility of knowing the emissions of these products or services if they are not provided by their producer (Spanish Office for Climate Change, 2015).

An increasing number of governments are developing corporate disclosure schemes, both mandatory and voluntary. In fact, in countries of the European Union, policies for reducing and mitigating emissions have been promoted, including initiatives and action plans related to the use of the carbon footprint, both for products and organizations. For example, Germany promoted the PCF Project (Product Carbon Footprint Project) in 2007, with the aim of developing a standard for calculating the carbon footprint of a product based on PAS2050; the United Kingdom established the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme, a mandatory program since April 2010, with the aim of mitigating the emissions of large private and public companies not subject to existing regulatory systems; Switzerland is preparing a regulation that introduces a multi-criteria evaluation of the life cycle of products and a way to communicate it to consumers; and Japan, South Korea, Australia, and Canada are using Life Cycle Analysis (LCA) approaches in policy formulation. Similarly,

in the United States, the Environmental Protection Agency has proposed the Sustainability Consortium, as one of the largest private initiatives related to the communication of the environmental footprint of products, followed by the creation of the Sustainability Accounting Standards Board ([Club Asturiano de Calidad, 2013](#)).

Given the above, we deemed it appropriate to take advantage of the opportunity provided by the recent disclosure of the scope of the carbon footprint reported by Spanish companies registered in the new Spanish Registry to explore whether, as indicated in the literature and explained below, there are explanatory variables for this transparent behavior.

METHODOLOGY

This is an empirical survey, based on the exploration of the characteristics of Spanish companies that published their carbon footprint in the Spanish National Carbon Footprint Registry. This disclosure is considered one of the most relevant indicators of the fight against climate change, whose calculation is reflected in the recording of a “1 and 2” or “1, 2 and 3” scope.

This study used the database of the Spanish National Carbon Footprint Registry, which, as of May 2015, reported a list of 150 carbon footprints from 125 organizations, each of which report their respective sector, “1 and 2” or “1, 2 and 3” scope, year, and type of footprint. This information is summarized in Table 1. It should be noted that some organizations have registered their carbon footprint for several years, so the number of registered organizations does not match the number of registered carbon footprints. For the purposes of this analysis, the information for the 2013 period was extracted, as it is the most reported period. Subsequently, organizations that did not report their financial information were omitted, which left a sample of 55% of registered companies remaining, equivalent to 69 organizations in the manufacturing, construction, energy transportation, and other sectors.

Based on this sample, the carbon footprint scope record (dependent variable) was identified. The information related to the environmental behavior of these firms (independent variables of the econometric model for the determination of the environmental information disclosure index) was obtained directly from the reports published on their websites and was supplemented with the financial information published in the SABI database, i.e., the other independent variables of the study. The variables associated with each of these companies are summarized in the descriptive statistics of Table 2.

Table 1. Description of the Spanish Carbon Footprint Registry (1st quarter of 2015)

Registered Organizations	125
Registered carbon footprints	150
Carbon Footprint Scope “1 and 2”	117
Carbon Footprint Scope “1, 2 and 3”	33

Hypotheses

This study collects evidence from similar studies in order to establish the *a priori* relationship between the “scope” of the carbon footprint report and certain variables that characterize the companies registered in the Spanish Carbon Footprint Registry, into which registration is voluntary. The independent variables used were the industry to which the companies belong, their profitability, the degree of leverage, an index of disclosure of their environmental behavior, and the age and size of the firm, measured according to their volume of assets. Although there is evidence of the type of relationship between the mentioned variables, as described below, these were only taken as a reference, as the hypotheses of this study have a more descriptive than confirmatory purpose.

In related studies ([Amran, Periasamy, & Zulkafli, 2014](#); [Rosa, Lunkes, Hein, Vogt, & Degenhart, 2014](#)), evidence has been found that companies in potentially polluting sectors tend to declare more details of their environmental behavior. The causes that underlie this behavior can be associated with the existence of more demanding regulatory frameworks in these industrial branches, the public scrutiny to which companies are exposed for the same event, and the purpose of demonstrating responsible behavior as a strategy for competitiveness and legitimacy in the community ([Burgwal & Vieira, 2014](#)).

In our study, 66.7% of Spanish companies are identified as being in the manufacturing sector, so the first hypothesis of the study is:

H1: Companies that belong to the manufacturing industry are more likely to report a greater scope (1, 2 and 3) of their carbon footprint.

Based on the scientific literature, it is considered important to explore the theoretical relationship between the profitability of firms and their disclosure of environmental information. The results are inconclusive ([Hahn & Kühnen, 2013](#)). The investigations by [Neu, Warsame, and Pedwellet \(1998\)](#) and [Cormier and Magnan \(2003\)](#) show a positive relationship between profitability and the level of

environmental disclosure; Gray, Owen, and Maunders (1987) point out that organizations with greater profitability tend to disclose higher levels of social and environmental information voluntarily. Ahmadi and Bouri (2017) obtained empirical evidence of a positive relationship between the level of environmental disclosure, environmental performance indicators, and financial attributes. Montabon, Sroufe, and Narasimhan (2007) show a significant relationship between the financial performance of companies and their environmental management practices, suggesting that there are probably commercial advantages derived from more transparent environmental behavior. Nevertheless, other studies show the absence of a positive association between a company's level of environmental disclosure and profitability (Cormier & Magnan, 1999; Al-Tuwaijri, Christensen, & Hughes, 2004; Pahuja, 2009; Saha & Akter, 2013; Andrikopoulos & Krikłani, 2013; Burgwal & Vieira, 2014). Thus, in this study, we expect the relationship between the profitability of the firms and their level of reporting will be direct and significant. This hypothesis is expressed as follows:

H2: Companies with a higher Return On Equity (ROE) have a propensity to report a greater scope (1, 2 and 3) of their carbon footprint.

The relationship between leverage and the degree of carbon footprint reporting is presumed to be a determining factor in greater environmental reporting because, as companies require more financing, investors demand that they be kept more informed of operations, including performance and environmental information (Andrikopoulos & Krikłani, 2013). In addition, it has been suggested that companies with higher leverage are more likely to increase disclosure volume to lower their agency costs (Ho & Taylor, 2007). Although no conclusive evidence has been found indicating any consensus regarding the relationship between both variables (Akbas, 2014), there are specific cases such as those of Hibbit (2003) and Orij (2007), which find a positive relationship between the disclosure of social-environmental responsibility and leverage. Following the empirical evidence, the hypothesis of the relationship mentioned above, for this study, is expressed as follows:

H3: More leveraged companies are more likely to report a greater scope (1, 2 and 3) of their carbon footprint.

Intuitively, it can be expected that companies that have a tradition of disclosing some variables of their environmental behavior (i.e., they have a transparent environmental culture) when calculating their carbon footprint are likely to report a greater scope compared to companies that normally do not disseminate indicators of their environmental behavior. In fact, as can be seen in Table 1, companies that publish reports on sustainability or

Corporate Social Responsibility are rated as the most transparent in the dissemination of environmental issues. Rankin, Windsor, and Wahyuni (2010) reveal that the voluntary disclosure of GHG emissions by companies is attributed to the presence of an environmental management system and the reporting of social and environmental issues in the GRI and CDP reports. On the other hand, the evidence indicates that one of the main determinants of corporate reporting in a given year is prior reporting (Stanny, 2013). The determinants of the quality of the information have also been studied (something similar to what was tested in this study with the disclosure indicator). These studies observed that high quality reporting is primarily associated with the largest companies and their membership as well as industries related to publicly known environmental impacts (Brammer & Pavelin, 2008). In this sense, the following hypothesis is raised:

H4: Companies are more likely to report a greater carbon footprint (1, 2 and 3) if they have disclosed it in other types of media.

Gómez and Aleixandre (2014) considered the calculation and disclosure of the carbon footprint to be a behavior of contemporary companies as well as the result of process and management innovations. They considered age to be a factor of business innovation and hypothesized that younger companies are more likely to internalize such innovations. More specific studies have been carried out on this subject, regarding the age of companies and their degree of disclosure (Bhattacharyya, 2014; Akbas, 2014), but their conclusions have not been significant. In this paper, the relationship between these variables is again tested for the case of Spain, proposing the hypothesis described below:

H5: Younger companies tend to report a greater reach (1, 2 and 3) of their carbon footprint.

Numerous studies have related the size of a firm and the degree of carbon footprint reporting, finding similar results (Udayasankar, 2008; Tagesson, Blank, Broberg, & Collin, 2009; Zeng, Xu, Yin, & Tam, 2012; Andrikopoulos & Krikłani, 2013; Amran et al., 2014; Akbas, 2014; Juhmani, 2014; Burgwal & Vieira, 2014). A direct and statistically significant relationship has been found in most cases. The rationale underlying this type of relationship suggests the largest companies attract more attention and, therefore, suffer greater pressure to be consistent with what is expected of them (Amran et al., 2014). With this evidence, the hypothesis presented is as follows:

H6: Larger companies are more likely to report a greater reach (1, 2 and 3) of their carbon footprint.

A logistic regression model (logit) was applied to contrast the hypotheses. Equation 1 summarizes the approach of the model as a function of the hypotheses:

$prob. \text{ huella de alcance completo (1 + 2 y 3)} = f(+industria, + reantabilidad, + sapalacamiento, divulgaciones previa - edad + tamaño)$ <p style="text-align: center;"> ↑ apalancamiento ↑ previas </p>	(1)
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Given the dichotomous nature of the model-dependent variable, a logit econometric specification was used, which allows the relationship between this type of variable to be analyzed (Gujarati & Porter, 2009). The econometric specification was raised as described in equation 2:

$logit(Y) = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6$	(2)
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Therefore,

$$\pi = prob. (Y = ALCANCE | X_1 = SECTOR, X_2 = ROE, X_3 = RFPF, X_4 = DIVULG, X_5 = EDAD, X_6 = LNACTIVOS =$$

$\frac{e^{\alpha + \beta_1 SECTOR + \beta_2 ROE + \beta_3 RFPF + \beta_4 DIVULG + \beta_5 EDAD + \beta_6 LN ACTIVOS}}{1 + e^{\alpha + \beta_1 SECTOR + \beta_2 ROE + \beta_3 RFPF + \beta_4 DIVULG + \beta_5 EDAD + \beta_6 LN ACTIVOS}}$ <p style="text-align: center;">↑ In Activos</p>	(3)
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where π is the probability that companies will calculate their carbon footprint in a larger range (1, 2 and 3), α is the Y-intercept, β are the coefficients of the regression, and X are the predictors, represented by the independent variables.

In the first-instance analysis of the descriptive statistics (Table 2), the dependent variable of the model is the scope of the carbon footprint registry, according to which, the majority of companies (78.30%) have a lower reach (1 and 2), while a minority (21.70%) have registered a greater reach of their carbon footprint (1, 2 and 3), even though the registration is voluntary. This behavior was represented as a dichotomous variable, as shown in Table 2. One of the explanatory variables proposed for this carbon footprint report was the industry in which a company operates. It should be noted that 66.7% of these companies are associated with the manufacturing and processing of raw materials. Conversely, the variables are also described individually, showing the mean values and standard deviation, maximum and minimum values for the continuous variables, and the frequency of the dichotomous variables.

As an independent variable for the economic model, an index of environmental performance was created (Exhibition 1), which also represents the previous disclosures of the organizations.

The collection of the different levels of diffusion and visibility in terms of the environmental behavior of the companies was based on a search for related information on their websites. The index gives the highest score in the scale to companies that have reported their environmental behavior in an annual sustainability report, which represents the greater disclosure effort it implies with respect to less complex dissemination channels (articles, news, infographics, etc.).

Exhibition 1. Scale of the disclosure index (transparent environmental culture proxy)

Score	Qualitative scale
1	Does not disclose anything.
2	Discloses the behavior in one parameter: consumption of water, energy, paper, waste, or CO2
3	Discloses the behavior in 2 parameters
4	Discloses the behavior in 3 or more parameters
5	Discloses a sustainability report or CSR

Table 2. Descriptive statistics of the variables

Variables		Categories	Descriptive statistics	
Dependent	<i>Y</i> : Carbon footprint FOOTPRINT C	Scope 1 and 2 (o)	Frequency	78.30 %
		Scope 1, 2 and 3 (1)	Frequency	21.70 %
Independent	<i>X</i> ₁ : Industry SECTOR	Manufacturing (1)	Frequency	66.7 %
		Other sectors (o)	Frequency	33.3 %
	<i>X</i> ₂ : ROE		Mean	5.71 %
			Typical Dev.	9.48 %
			Maximum	37.74
			Minimum	-19.13 %
	<i>X</i> ₃ : RFPF Liabilities/Equity		Media	177.79 %
			Typical Dev.	214.31 %
			Maximum	930.09 %
			Minimum	-521.88 %
	<i>X</i> ₄ : Disclosure index (1-5 scale) DISCL.		Media	1.51
			Typical Dev.	1.29
			Maximum	5
			Minimum	1
<i>X</i> ₅ : Company age AGE		Media	27.83	
		Typical Dev.	23.66	
		Maximum	127	
		Minimum	3	
<i>X</i> ₆ : Company size (assets, millions of euro).		Media	358.31	
		Typical Dev.	1711.17	
		Maximum	13595.96	
		Minimum	0.6	

RESULTS

The results of the estimation (Table 3) mainly associate the scope of the carbon footprint calculation of the companies (dependent variable) with the degree of financial leverage (RFPF), the index of disclosure of their environmental behavior (DISCL.), and the age of the companies (AGE).

Table 3. Results of the estimate

Logistic regression		Number of obs. = 69 Wald chi2 (6) = 21.80 Prob > chi2 = 0.0013 Pseudo R2 = 0.3049				
Log pseudo-likelihood = -25.113255						
FOOTPRINT C	Coef.	Robust Std. Err.	z	P> z	[95 % Conf. Interval]	
SECTOR	-0.4254522	0.8154179	-0.52	0.602	-2.023642	1.172738
ROE	0.0357085	0.030067	1.19	0.235	-0.0232217	0.0946386
RFPF	0.0047489	0.0015281	3.11	0.002	0.0017538	0.0077439
DISCL.	0.5882607	0.3377239	1.74	0.082	-0.073666	1.250187
AGE	-0.0353117	0.0205056	-1.72	0.085	-0.075502	0.0048786
IN ASSETS	3.41e-07	7.95e-07	0.43	0.668	-1.22e-06	1.90e-06
_cons	-3.056155	1.184995	-2.58	0.010	-5.378703	-0.733608

The only variable with 5% statistical significance is the ratio of indebtedness, i.e., liabilities/equity, while with greater flexibility (at 10% significance), the disclosure index and age of the companies could be accepted as determining variables of the carbon footprint record. The other variables, which were expected *a priori* (hypotheses H1, H2, and H6) and which explain the probability of companies registering a calculation with a greater scope of their carbon footprint, were not significant.

The adjustment indicators of the pseudo-R2 model (30.49%) and chi square ($p = 0.0013$) suggest that the set of variables are statistically different from zero and are useful in explaining approximately 30.49% of the probabilities that companies will register a greater scope calculation of their carbon footprint. The calculated R2 count statistic also indicates that 86% of the predictions of the model are correct; therefore, the model is useful to describe the relationship between the variables.

From the analysis of the signs of the significant correlation coefficients, it is also deduced that the probability that Spanish companies will register a calculation with a greater scope of their carbon footprint (1, 2 and 3) in the National Registry of Carbon Footprint is favorably affected by its level of leverage (RFPF) and by its transparency with the community, expressed in the disclosure

index of environmental behavior; this probability is negatively affected by age, that is, it is the youngest companies that register the greatest scope of their carbon footprint.

DISCUSSION

The hypotheses proposed were partially accepted. There was not enough evidence to accept the H1, H2, and H6. Only H3 (leverage) was accepted with a 5% significance, while H4 and H5 were accepted with a 10% significance.

The inability to accept the first hypothesis implies that in the Spanish Carbon Footprint Registry, the empirical relationship found by other authors is not met (Bhattacharyya, 2014; Akbas, 2014; Tagesson et al., 2009; Burgwal & Vieira, 2014). These authors find that there is a greater propensity by companies in sensitive sectors (highly polluting) to deploy greater efforts to publicize their environmental behavior, especially because their interest groups include institutional funders.

On the other hand, despite having a direct relationship with the dependent variable as established in H2, financial profitability (measured by the ROE) was not statistically significant. This confirms, for the Spanish case, the findings

of similar studies for other countries (Andrikopoulos & Krikiani, 2013; Burgwal & Vieira, 2014), in which the evidence for accepting the hypothesis of the relationship between the profitability of firms and their degree of environmental disclosure was also not demonstrated.

H3, which shows the relationship between the degree of disclosure of the carbon footprint and the leverage index, was accepted with a 5% significance, according to the results of the estimation. Hibbit (2003) and Orij (2007) found similar results when relating the disclosure of social-environmental responsibility and the degree of leverage of the firms. In this case, there is no additional information to attribute with certainty the causes of this correlation; however, in accordance with the related literature, it could be associated with the practice of certain highly leveraged companies of preparing reports on operations and social responsibility in order to keep their creditors informed and reduce agency costs. Hahn, Reimsbach, and Schiemann (2015), however, report that most of the studies reviewed in their research did not obtain evidence of the impact of leverage.

In relation to H4, which associates the degree of prior disclosure of the environmental behavior of companies with their efforts to calculate the carbon footprint, a direct relationship was found, although to be considered significant, its level of significance should be lowered to 10%. Following this reasoning, the tradition of companies with greater transparency in their environmental behavior would explain their inclination to record a calculation of carbon footprint with a greater scope.

H5 of the study (accepted with a 10% significance) suggests that younger companies are prone to report a greater scope of carbon footprint, compared to the oldest companies. This relationship could be explained by the recent validity of the environmental concern, which has not yet been echoed by the most traditional companies due the voluntary nature of the carbon footprint record. This logic would imply that, in order to achieve a greater commitment by more traditional companies to the official carbon footprint registration, the induction of motivations additional to those currently in existence is required.

Finally, H6, which posited a direct correlation between the carbon footprint record and the size of the firm, could not be accepted as the degree of association of the variables was not statistically significant. Although the evidence suggests that larger companies attract more attention and, therefore, are more pressured to be consistent with what is expected of them at the environmental level (Amran et al., 2014; Hahn et al., 2015), for the Spanish case, this relationship is not fulfilled according to our data sample.

CONCLUSIONS

As stated in Decision 406/2009/EC of the European Parliament and Council, despite the efforts to reduce GHG emissions in the sectors affected by the EU Emissions Trading Scheme, a substantial reduction of emissions in other sectors of the economy is still essential. To this end, the awareness-raising role that can be played in this field by voluntary registration of companies in the National Carbon Footprint Registry and dissemination of the different scopes of the footprint is crucial. This information can be taken into consideration by a large group of stakeholders, thus affecting their decision-making processes.

Focusing on this aspect, this survey pioneers in exploring the factors that motivate Spanish companies to register a greater scope (1, 2 and 3) of carbon emissions in the Carbon Footprint Registry. This Registry has been recently created by Royal Decree 163/2014, which highlights the originality and timeliness of this investigation.

The logit estimation allowed the identification of a positive correlation among the degree of carbon footprint registration with profitability, leverage, previous disclosures, and size of the firms, while a negative relationship was identified with the manufacturing sector and the age of the companies. Nevertheless, based on these relationships, only the relationships of the scope of the footprint with the leverage, index of disclosure, and age were significant.

The results are consistent with previous studies (Ho & Taylor, 2007; Andrikopoulos & Krikiani, 2013; Akbas, 2014), which found a positive association (although in different proportions) between leverage and the degree of disclosure of the companies. On the other hand, the hypothetical relationship suggested by Gómez and Alexandre (2014), in which younger companies are more prone to adopt process innovations (in reporting, in this case), is confirmed. The strongest and most evident relationship was found between the disclosure index and the scope of the registry, which is surely associated with the theoretical propensity of companies to maintain a culture of disclosure over time (Stanny, 2013).

In all, our study is a relevant contribution for different stakeholders. On the one hand, legislators from other countries, taking the Spanish case as a reference, may consider the convenience of carrying out similar initiatives. Moreover, this type of research can assist in raising the degree of knowledge about this tool in the fight against climate change, so that more and more companies adhere to the Registry. On the other hand, the scientific community could explore whether similar initiatives that are carried out in other countries or regions (e.g., in autonomous

communities of Spain such as Andalusia, Murcia, Catalonia, and the Basque Country) have a greater or lesser impact.

One limitation of our study lies in the limited sample size that, while sufficient for the application of the applied methodological technique, discourages the generalization of results. Note, however, that the purpose of this study was only exploratory. Future researchers will no longer have problems of this type as the number of companies registered in the National Registry has grown almost tenfold in its first four years (CincoDías, 2018).

Registration in the Spanish National Carbon Footprint Registry implies a commitment by companies to reduce their emissions. The reduction objectives that Spanish organizations have proposed in their plans are highly variable. They have a mean reduction goal of 6.7%, but they fall within a range between 0.01% to 40%. This last striking figure can be explained by the intention to acquire certificates that guarantee the origin of renewable energy in the purchase of electricity and by the forecast that there will be a change in technology that will create significant energy savings and a consequent decrease in emissions (MAGRAMA—Ministry of Agriculture, Food, and Environment, 2015).

For the registration of their accounting entries related to GHG emission rights, Spanish companies rely on the normative reference proposed by the Instituto de Contabilidad y Auditoría de Cuentas (ICAC). Nevertheless, the analysis by Haupt and Ismer (2013) regarding accounting under the EU ETS, in light of the current regulatory gap in the International Financial Reporting Standards (IFRS), calls for an urgent harmonization of accounting policies in order to reflect the financial situation of companies.

We hope that, in the near future, governments and regulatory agencies committed to the environment will define standards and policies that encourage and ensure the presentation of information to facilitate the adoption of measures that guarantee increased sustainable behavior. This will favor the possibility of carrying out more in-depth investigations on this subject, which is currently of great relevance and is the focus of global attention.

Our study on the initial registration of companies in this initiative opens up interesting avenues for future research. New research that includes more years of information from the Registry, will be able to study whether there is a learning effect, i.e., mimetic isomorphism, and whether the types of emissions reported vary. This new research will also be able to assess the evolution in contamination by these companies.

It is very important, in this sense, to appeal to the ethics of organizations in order to avoid fraud, such as the recent case of Volkswagen, and to encourage mechanisms for external verification or assurance of achievements in sustainability (Zorio et al., 2013;

Sierra-García et al., 2014, 2015). Similarly, an approach based on the decision-making process from within organizations (as suggested by Correa & Larrinaga, 2015) should help future research complement the vision obtained in their studies.

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