

Article

Accounting Treatment for Carbon Emission Rights

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Abstract: In light of the growing demand for sustainable behavior and the special interest that has emerged regarding the social and environmental impact of firms, the purpose of this research is to analyze the determinants of the accounting treatment of emission rights. To achieve that purpose, we use a sample composed of 119 firms worldwide from different countries and activity sectors for the period 2011. Our findings show different accounting treatments depending on a series of factors. Specifically, firms pertaining to countries that have adopted Environmental Trading Schemes (ETS) tend to account for emission rights through provisions, investments, or as inventory. For their part, firms that issue indicators that appear in the report drawn up by KPMG and GRI (2007) tend to account for these entries as expenses, especially as R + D expenses. Finally, firms located in countries that signed the Kyoto protocol have a tendency to not account for carbon emission rights. The findings of this work can be considered of great interest on the international level because our research contributes to the scant previous literature regarding the accounting treatment of emission rights.

Keywords: emission rights; accounting treatment; emission trading scheme; sustainability; Kyoto Protocol

1. Introduction

Environmental issues have become more and more important in recent years, not only in the business world and in society at large, but also in academic research. In fact, many firms have been criticized for their negative impact in regard to social and environmental issues, instead of their technological and economic outcomes [1]. Society is therefore increasingly focusing on these issues, and in particular the disclosure of information about sustainability has increased notable in the last few years [2,3].

According to [4], a significant number of relevant agencies, worldwide, have recommended the inclusion of environmental and social reporting in the annual company report [5–7]. Company information regarding the environment has become a strategic element to be taken into account by the different stakeholders, especially in the decision making of financial stakeholders [1,8–10], which now focus not only on the magnitudes and trends of profits but also how they were obtained [11–13].

Among the various environmental topics, in this paper we focus on greenhouse gas emissions, which have been in the spotlight since the Kyoto Protocol opened up a debate over the publication of different regulations both on the international and national levels. It established emissions trading as a means to control global gas emissions. Since then, there had been an increase in trading regimes and proposals [14]. Indeed, recently a milestone has been occurred in Paris, where 195 countries agreed to limit their CO₂ emissions (Paris agreement 2015), including the USA that was one of the most reticent countries to appoint to those agreements. However, one important aspect that still must be resolved is how to reflect greenhouse gas emissions in accounting. These agreements establish that the Parties

shall define the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading, but international standards are still undeveloped.

The term *carbon accounting* is being developed to refer to accounting treatment for carbon emission rights [15–17], or the accounting methods for carbon emission for financial reporting purpose, as opposed to scientific carbon accounting which is intended to measure and quantify amount of physical GHG emissions. Without accounting standards or interpretations that specify how to account for emission rights (*i.e.*, IASB or FASB) it is hard to compare financial statements. In general there are a multiplicity of ways to perform this task [18], according to the different interpretations of general principles of accounting (International Financial Reporting Standards IFRS) [17]. Some firms classify emission rights as intangible assets, others as inventory assets, others as R&D, and so on, but the fact is that there is no common standard for different institutional contexts.

This absence of an international accounting standard regarding emission rights has been addressed in previous works such as those by [19–23]. However, very few studies have empirically analyzed the determinants of the different ways to account emission rights. We think that it is important to take the different accounting treatments into account because of the difficulties accountants have in capturing emission rights under existing standards. The aim of this paper is thus to analyze the determinants of the different accounting treatments of emission rights worldwide. Concretely, we focus on Emission Trading Schemes (ETS), GRI indicators, and the appointment to the Kyoto protocol. To do so, we use a sample comprising 119 firms from different countries that operate in different activity sectors for the period 2011.

The paper is structured as follows: in Section 2, we describe the theoretical background and review previous literature. In Section 3, the research hypotheses are posited in relation to the factors that may influence accounting treatment. Methodological issues (sample, model and variables) are described in Section 4. In Section 5, the results of the empirical analysis are provided and then discussed. Section 6 summarizes the main findings and consequences and presents the conclusions.

2. Theoretical Background

The Kyoto Protocol created CO₂ emission rights and obligations on states, resulting in a market on which carbon is traded. It translates ecological and environmental concerns into the economic phenomena, and then, this affects the accounting practice [20]. However, the special and complex character of emission rights makes that the traditional accounting of assigning asset/liability status can only worsen the situation with greenhouse gas abatement [24]. Following [25], there are three main features that make emission rights especial: there is a costless activity that becomes costly, governments try to mitigate that cost, and marketable allowances are the way of mitigation. In addition, accountants and accounting standard-setters lack a full appreciation of the production process of carbon credits [26].

At the end of 1994, the IFRIC provide a guidance on the accounting treatment of emission rights, (IFRIC-3), but some months after, it was withdrawn due to various inconsistencies [25]. From then, there has been no international guidance on how to account for emission rights. Carbon accounting sits between various accounting standards, such as IAS 20 (government grants), IAS 38 (intangible assets), and IAS 39 (financial instruments), which results in a controversial and ambiguous situation for accountants [25–27].

In the absence of authoritative guidance by the IASB, several approaches have developed that IFRS preparers use to account for the effects of emissions trading schemes. A survey by PwC and the International Emissions Trading Association [28] identified as many as fifteen variations to account for carbon emission rights. Based on the accounting standards of the FASB [29] proposed and discussed the positive and negative sides of three solutions—allowance as an inventory, marketable security or intangible. They also advocated reporting allowances at fair value for the needs of internal planning and control, whereas for external needs they supported historical cost valuation.

Another way of treating these allowances was suggested by [30]. These authors recommended that pollution allowances should be treated as donated assets, which are valued at market price when

received, with a “corresponding increase in contributed capital”. They suggested that the book value of the allowances be considered as a part of the cost of production when they are used to compensate for pollution. Such treatment allows recognition of the allowances, which helps by providing a more effective estimation of the cost of pollution on financial statements.

In addition, Ref. [31] opened a discussion of proposed methods of accounting for emissions allowances with a review of current practices by international standard setters. The most popular views are intangible asset and provisions treatment. For example, Ref. [32] showed that six Greek firms debited the acquisition of emission rights in their intangible assets accounts, seven firms monitored their greenhouse emissions with provisions accounts, no firm fully applied the IFRIC 3 approach, while the majority of the firms did not make any accounting entry, recognizing the allowances granted at nil value. These findings are close to those produced by the PwC-IETA (2007) survey; in that case, 65% of the respondents recognized the allowances granted within intangible assets, 5% of the respondents applied the IFRIC 3 approach, while 30% recognized the granted allowances at nil value.

Accounting standards for carbon emissions are extremely important because accounting makes reporting comparable and increasing the quality of information [33]. The divergence in practice worsens the comparability of financial statements, which results in a harder decision-making process. This would respond to increasing societal concerns about climate change in general and CO₂ emission in particular [34]. Despite these advantages, there are not international standards that specify how to account for emission rights, which leads firms to make decision as to how to enter them (if they decide to account for them). In general, there are multiple ways for accounting CO₂ emission rights, according to the different interpretations of IFRS. For instance, some firms classify emission rights as intangible assets, others as inventory assets, others as R&D, and so on. This decision can be considered as an accounting choice, justified mainly by the theoretical paradigm associated with the Positive Accounting Theory.

Positive Accounting Theory

Quite often, and not only in the case of emission rights, in financial accounting it is usual to have a choice between alternative accounting methods to account for a particular transaction or event, especially when there is no compulsory accounting standard to apply. In this respect, the Positive Accounting Theory is built on agency theory to explain accounting practice, focusing on the role of accounting to aid the relationships between different stakeholders (e.g., owners-manager, managers-financial entities, etc.). As [35] state, the Positive Accounting Theory “*is concerned with explaining accounting practice. It is designed to explain and predict which firms will and which firms will not use a particular method . . . but it says nothing as to which method a firm would use*”. These authors developed this theory with the main idea that the actions of all individuals are based on their own interest, and that these individuals will act opportunistically to increase their wealth. For instance, it may explain how managers, whenever they are faced with a choice between rival accounting methods, will prefer to adopt or support certain accounting methods over others, depending on the accounting circumstances.

In this context, Ref. [35] affirm that the particular attributes of an organization can also affect the choice managers make to support or oppose a certain accounting requirement. This also occurs in the case of accounting for emission rights, where a standard regarding their accounting treatment is lacking. On the one hand, global accounting standards will help financial users as well as employees to analyze the carbon credit as a net position or gross position. In this case, institutional theory would apply to this advantage because it accounts for carbon emissions in a way that other industries would apply them as well [36]. In this situation the new accounting standards applied would benefit financial reports that add value to the organization and reduce financial risk and the costs applied to accounts would be the same for all organizations. On the other hand, according to the Australian Environment Business Network (2007), the implementation of a new system increases costs for monitoring, maintaining, controlling and allocating resources. The standards would be difficult to implement and it would take

some time for the organization to train employees and increase their skill set and familiarize them with the new financial and accounting areas; therefore, this will reduce the quality of the financial reports.

Given the existence of advantages and disadvantages, and the lack of a global accounting treatment for carbon emission rights, we wonder what are the determinants of the different accounting treatments applied in different firms. In this regard, we pose four hypotheses in the following section to be empirically tested.

3. Research Hypotheses

The aim of the present study is to determine the factors affecting the accounting treatment of emission rights. We have identified three relevant factors for the accounting decision analyzed: (i) belonging to a Emission Trading Scheme (ETS); (ii) the homogenization of indicators of greenhouse gas emissions in line with the KPMG and GRI standards; and (iii) ratification of the Kyoto Protocol.

3.1. Emission Trading Scheme

By Emission Trading Schemes (ETS) we mean the system that allows firms to be assigned quotas for greenhouse gas emissions according to the objectives of their respective governments in environmental policy. It is a practical and highly utilized system since it allows firms to surpass their quota of emissions on the condition that they find other firms producing fewer emissions that are willing to sell them their quotas. On the one hand, this system offers certain flexibility while still protecting the environment. On the other, it fosters the development of new technologies: motivated by the benefits they can obtain from selling their emissions rights, firms will develop and use cleaner technologies.

The principle of quotas is not new, and has been applied within the frame of environmental policy (Montreal Protocol), and Europe's common agricultural (milk quotas) and fishing (catch quotas) policies. The firms that participate in the emissions quotas system are regulated by their respective national authorities or by the European Commission in the case of Europe, in line with the principle of subsidiary.

On a global level, the trading of emissions rights among governments has been established as one of three flexible mechanisms in the Kyoto Protocol, and at the national level many industrialized countries, both among those that have ratified it and those that have not, have introduced or are considering introducing an emissions trading scheme [37].

According to [38], emission quota trading requires firms to carry out their activities in a new way in order to develop new knowledge and skills within the organization. Likewise, firms need to develop organizational routines for negotiating emissions rights and representing this new objective in the firm's accounting system. This same author also affirms that there are two main types of ETS: on the one hand, cap-and-trade schemes and on the other, project-based schemes. In a cap-and-trade scheme, emission reduction goals are set, emission rights can be bought and sold, and the organizations that are sources of emissions must own enough quotas to cover their emissions [25]. Such a choice is good because the alternative systems (credit-based) involve high transaction costs, since firms need to demonstrate that emissions reductions for each project have reached a bottom line of reference. Verifying that means that the administrative load will be quite a bit higher in this system. Furthermore, the bottom line must be negotiated with the different sectors [38], which also means higher administrative and transaction costs.

In any case, the trading of emissions quotas is meant to guarantee equal treatment regarding emissions rights for firms of comparable size, reduce to a minimum the possibilities of distortion in competition, guarantee synergy with the prevailing regulations, and guarantee the effective application of the system and its compatibility with the system stipulated in the Kyoto Protocol. In short, it is a market instrument through which economic incentives or disincentives are created in the pursuit of environmental benefits: to get a set of industrial plants to collectively reduce their greenhouse gas emissions.

Authors such as [39] consider emission trading schemes in their research study of 291 firms pertaining to different sectors of activity and to different countries. Their findings show a positive and statistically significant relation between emission trading schemes and accounting for carbon information, and they point out that this relation can help improve the image of these firms.

In light of the above arguments, we propose the following working hypothesis.

H1: The adoption of Emission Trading Schemes will influence a firm's decision to account for emission rights through different entry items in their accounting and financial statements.

3.2. Greenhouse Gas Emissions Disclosure

The lack of a standardized accounting framework has also an effect on financial reports [19–21,23]. The divergence in the ways emissions rights are accounted for undermines the comparability of financial statements, making it harder for stakeholders to make appropriate decisions [17]. Because of these difficulties, firms need to explain their accounting policies to investors and other stakeholders [17,40].

Carbon disclosures are included in the Global Reporting Initiative (GRI) guidelines. This information is an important part of the GRI indicators, and therefore we posit that there is a relationship between the accounting of emission rights and the standardization of CSR reports, since more comparable and useful information about CSR practices (including greenhouse emission rights) is related to high quality financial reporting [41–44]. According to [45] “the global reporting typifies the outside-in approach and offers guidelines for supply of externally published corporate sustainability reports”, and [46] consider that the GRI is the best-known set of guidelines for producing sustainability reports worldwide.

Also considered were the climate change indicators obtained from a report drawn up by KPMG and the GRI (2007) [47] on climate change. The issues studied are structured in four sections and have to do with background information related to climate change, opportunities arising from climate change, risks arising from climate change, and issues that can be both risks and opportunities.

Section 1 of this survey on climate change refers to information related to climate change such as: target to reduce greenhouse gas emissions, specific statement from the CEO or company chairman that mentions climate change, consideration of climate change by the board of directors, the words “climate change” or “global warming”, use of energy (electricity use, coal, diesel petrol, gas), section devoted to climate change or global warming, a target to reduce energy use or improve energy efficiency, management responsibility for climate change specifics and greenhouse gas or carbon dioxide emissions from the firm with quantities in units such as kg and tones, among others.

Section 2 includes opportunities arising from climate change such as: business opportunities from climate change, for example related to products, services or technologies, involvement in emissions trading, such as buying or selling emissions allowances under the European Union (EU), opportunities for setting up a carbon fund or engaging in emissions brokering (within the EU emissions trading scheme), credits for Clean Development Mechanism projects under the Kyoto protocol, and credits from Joint Implementation projects under the Kyoto Protocol.

Section 3 refers to risks arising from climate change, including potential future litigation, claims or legal action related to climate change, increased forest fires, and implications of rising sea levels.

Finally, Section 4 deals with issues that can be both risks opportunities, such as weather derivatives to manage future climate change, potential future emissions trading schemes and carbon taxes, potential future fuel tariffs, and the links between climate change and firm reputation or brand value.

Table 1 shows the greenhouse gas emission and climate change indicators proposed by the GRI (from I1 to I5) and climate change indicators obtained from the report drawn up by KPMG and the GRI (2007) on climate change (from I6 to I20).

In line with these indicators the following hypotheses are proposed:

H2: The disclosure of information on climate change according to the indicators proposed by the Global Reporting Initiative will influence a firm's decision to account for emissions rights through different entry items in their accounting and financial statements.

H3: The disclosure of information on climate change according to the indicators proposed by KPMG and the Global Reporting Initiative will influence a firm's decision to account for emissions rights through different entry items in their accounting and financial statements.

Table 1. Greenhouse gas emission and climate change disclosure.

I1. Total direct and indirect greenhouse gas emissions by weight
I2. Other relevant indirect greenhouse gas emissions by weight
I3. Initiatives to reduce greenhouse gas emissions and reductions achieved
I4. Emissions of ozone-depleting substances by weight
I5. NO, SO and other significant air emissions by type and weight
I6. Target to reduce greenhouse gas emissions
I7. Specific statement from the CEO or company chairman that mentions climate change
I8. Consideration of climate change by the board of directors
I9. Mention of the words “climate change” or “global warming”
I10. Business opportunities from climate change, for example related to products, services or technologies
I11. Use of energy (electricity use, coal, diesel petrol, gas <i>etc.</i>
I12. Section devoted to climate change or global warming
I13. Involvement in emissions trading, such as buying or selling emissions allowances under the EU
I14. A target to reduce energy use or improve energy efficiency
I15. Opportunities for setting up a carbon fund or engaging in emissions brokering
I16. Management responsibility for climate change specifics
I17. Credits for Clean Development Mechanism (CDM) projects under the Kyoto protocol
I18. Credits from Joint Implementation (JI) projects under the Kyoto Protocol
I19. Increased forest fires
I20. Greenhouse gas or carbon dioxide (CO ₂) emissions from the firm with quantities in units such as kg and tones

Source: The authors, based on the GRI (2006) and the KPMG and GRI (2007).

3.3. Kyoto Protocol

In the mid-1990s, the United Nations Framework Convention on Climate Change (UNFCCC) noticed the need of limiting CO₂ emission. In 1997 they passed the well-known Kyoto Protocol, in an attempt to decrease greenhouse gas emissions and favoring a redistribution of the costs associated with climate change by moving them from poor countries to the firms that are really responsible for the emissions and who profit from them. However, Kyoto Protocol entered into force in 2005 and it was signed by only 37 developed countries (excluding the USA and China, which were the most polluting countries). The compliance of the first period ended in 2012, and the second period of the Kyoto Protocol began in 2013, but the number of countries attached to the Protocol is still very low, and they are only developed countries. However, a great milestone has occurred recently in Paris. At the end of 2015, the most of the countries in the world (including the USA and China) signed the called Paris Agreement that substitutes the Kyoto Protocol. Between “Kyoto” and “Paris” have been several Climate Change Conferences (Nairobi, Copenhagen, Cancún, Durban, and Lima), but they failed. Paris Agreement is a global agreement to reduce CO₂ emissions. The main advantages of this new agreement are the obligation to create an inventory that shows the amount of net emissions; commitment to keep the global warming below the 2 °C; it is focused on the net emissions; increasing in financial funding provided by the most developed and industrialized countries; maintenance of the global emission trading.

As a consequence, such agreements must be taken into consideration in determining the accounting method for emission rights. In this study, we are focused on the Kyoto Protocol, since we analyze the year 2011, when the Paris Agreement was not still signed. Similarly, Ref. [48] include this variable in their model, arguing that as “large expenditures may be required to meet the protocol’s requirements, it is important that these firms provide detailed disclosures of their efforts

and achievements in reducing greenhouse gas emissions to assist investors in assessing the tradeoff between risk and return". These same authors also consider this variable in a subsequent research study analyzing whether greenhouse gas emission pollution differs within the countries ratifying the Protocol, particularly among the countries setting the limits on greenhouse gas emission and countries not setting these limits [49].

The results of previous research have usually led to a positive and statistically significant association between accounting reporting and a variable which differentiates between Kyoto and non-Kyoto firms. Firms with their headquarters in countries that have ratified the Kyoto Protocol display more information on pollution, greenhouse gas emissions and global warming.

Therefore, the following hypothesis is established:

H4: The fact that the country of origin of a firm has ratified the Kyoto Protocol will influence that firm's decision to account for emissions rights through different entry items in its accounting and financial statements.

4. Methodology

4.1. Sample Description

We selected as the target population firms from different countries worldwide and sought to represent both countries that have not ratified, approved, adhered to or accepted the Kyoto Protocol, and countries that have. The database used is that of the Fortune Global 500 in the year 2011, because it compiles the largest firms worldwide, classified by activity sectors.

The activity sectors selected to undertake this research are consistent with those established in the *Green Paper on Greenhouse Gas Emissions Trading* within the EU [50] and in the *Kyoto Protocol*: Aerospace and Defense; Airlines; Chemicals; Energy; Forest and Paper Products; Industrial and Farm Equipment; Metals; Mining, Crude-Oil Production; Motor Vehicles and Parts; Petroleum Refining and Utilities. These sectors are considered as the most sensitive to greenhouse gas emissions and therefore are those that should consider it important to somehow reflect greenhouse gas emissions in their annual reports.

Thus, the sample used corresponds to 119 firms from different countries and industries (see Table 2) pertaining to different sectors of activity considered the most sensitive to greenhouse gas emissions.

Table 2. Number of firms by sector and country.

Sector	Number of Firms	Accounting Treatment	Accounting Treatment (%)
Aerospace and defense	10	8	80
Airlines	5	5	100
Chemical	8	7	87.5
Energy	4	2	50
Forest and paper products	3	2	66.7
Industrial and farm equipment	6	3	50
Metals	11	8	72.7
Mining, crude-oil production	7	3	42.9
Motor vehicles and parts	28	14	50
Petroleum refining	25	17	68
Utilities	12	8	66.7
Country			
Australia	1	0	0
Austria	1	1	100
Brazil	1	0	0
Canada	4	1	25
China	7	3	42.9
Finland	1	1	100

Table 2. Cont.

Sector	Number of Firms	Accounting Treatment	Accounting Treatment (%)
France	10	8	80
Germany	12	9	75
Italy	4	2	50
Japan	23	10	43.5
Luxembourg	1	1	100
Netherlands	3	3	100
Norway	2	1	50
Portugal	1	1	100
South Korea	3	1	33.3
Spain	3	3	100
Sweden	1	1	100
Switzerland	1	0	0
UK	7	5	71.4
USA	33	26	78.9

An important number of sectors are included in the sample: Aerospace and defense (10 firms), Airlines (5), Chemical (8), Energy (4), Forest and paper products (3), Industrial and farm Equipment (6), Metals (11), Mining, crude-oil production (7), Motor vehicles and parts (28), Petroleum refining (25), and Utilities (12).

Appendix I focus on analyzing how companies of different industries account for carbon emission rights.

4.2. Explanatory Model and Variables for the Analysis

To test the hypotheses proposed in this paper, we propose a dependency model in which the dependent variable represents the different accounting treatment of gas emission rights and independent variables represent the factors that have an impact on this treatment, as we proposed in the hypotheses (Emission Trading Schemes, GRI indicators, Kyoto protocol). Results are also controlled by size, leverage, profitability, and sector.

The model can be empirically estimated with Equation:

$$ACCOUNTANT_i = \beta_0 + \beta_1 ETS_i + \beta_2 IGRI_i + \beta_3 INOGRI_i + \beta_4 KYOTO_i + \beta_5 Size + \beta_6 Leverage_i + \beta_7 Profitability_i + \beta_8 Sector_i + \varepsilon_i$$

$ACCOUNTANT_i$ is the dependent variable that represents the different ways of accounting treatment for gas emission rights. This takes the value 1 if the firm treats them as an expense; 2 when they are treated as an intangible asset; 3 when treated as a provision; 4 if treated as R&D expenses; and 5 when treated as other entry items (investment, inventory or loan). Since the dependent variables represents different types of accounting treatment, this model is multinomial and it will be empirically estimated by using Stata software.

ETS_i is a dummy variable which takes the value 1 if the firm belongs to a country that has established emissions trading schemes and 0 otherwise. With this variable we will test the hypothesis H1.

$IGRI_i$ is a variable representing the number of indicators about greenhouse gas emissions and climate change published by the firm according to the GRI guidelines. To create this variable, we analyzed the content of the sustainability reports of the firms in the sample, focusing on information about total direct and indirect greenhouse gas emissions by weight (EN16 indicator of the GRI Guidelines); other relevant indirect greenhouse gas emissions by weight (EN17 indicator of GRI); initiatives to reduce greenhouse gas emissions and reductions achieved (EN18); emissions of

ozone-depleting substances by weight (EN19) and NO_x, SO_x, and other significant air emissions by type and weight (EN20).

Similarly, $INOGRI_i$ is a variable representing the number of indicators about greenhouse gas emissions and climate change published by the firm according to the report drawn up by KPMG and the GRI (2007). We analyzed the content of the sustainability reports of the firms in the sample, focusing on the 20 indicators showed on Table 1. IGRI and INOGRI variables are used to test the hypotheses H2 and H3.

$KYOTO_i$ is a dummy variable that takes the value 1 if the firm pertains to a country that has signed the Kyoto and 0, otherwise. This variable allows us to test the hypothesis H4.

In addition, results are controlled by entering the following variables: $Size_i$ is the size of the firm measured as the logarithm of assets; $Leverage_i$ is firm's leverage, established as the ratio between total debt and stockholders' equity; $Profitability_i$ is firm's profitability measured by EBIT [51]; and $Sector_i$ is a multinomial variable which represents the different activity sectors most involved with greenhouse gas emissions. In our sample, firms operate into the following sectors: aerospace and defense, airlines, chemical, energy, forest and paper products, industrial and farm equipment, metals, mining and crude-oil production, motor vehicles, petroleum, refining and utilities. We code them into a variable that takes values from 1 to 11.

5. Results

5.1. Descriptive Analysis

As regards the dependent variable, the frequencies of the different ways of accounting treatment are shown in Table 3.

Table 3. Frequencies of dependent variable.

ACCOUNT	Frequency	Percent	Cumulative
0	46	38.66	38.66
1	9	7.56	46.22
2	16	13.45	59.66
3	20	16.81	76.47
4	15	12.61	89.08
5	13	10.92	100
Total	119	100	

The accounting treatment most used to account for emission rights is through a provision (ACCOUNT = 3), also considering them an intangible asset (ACCOUNT = 2) or an R + D expense (ACCOUNT = 4). The rest of the firms either do not account for them or enter them as another type of expense, such as inventory, investment, *etc.*

Many firms choose to treat emission rights as intangible assets, owing to the monetary benefit they could bring in if they were sold [24]. In the case of provisions (liability) they are calculated at their market price, which could give rise to an increase in revenue in periods of negative carbon returns, or to expenses otherwise [52].

Table 4 shows the descriptive statistics of the variables included in the dependency model to test the hypotheses. As can be seen, 67.22% of the sample firms pertain to a country that has established an emission trading scheme. In addition, the mean values of IGRI and INOGRI show that in general, firms tend to disclose more indicators about climate change and gas emissions that are shown in the report drawn up by KPMG and the GRI (2007) than indicators that only pertain to the GRI guidelines, since the mean value of INOGRI is higher than the mean value of IGRI. However, the standard deviation of INOGRI is high, representing differences among the firms of the sample. Furthermore, 72.27% of the firms are from countries that have signed the Kyoto Protocol. On average, firms are highly

leveraged because the mean value of Leverage is higher than 1, meaning that debts are higher than stockholders equity.

Table 4. Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
ACCOUNT	119	1.89916	1.815167	0	5
ETS	119	0.6722689	0.4713709	0	1
IGRI	119	3.294118	1.398261	0	5
INOGRI	119	7.193277	3.296833	0	14
KYOTO	119	0.7226891	0.4495642	0	1
Size	119	24.54811	0.8536989	22.81858	26.51047
Leverage	119	3.030887	4.716546	0.328	48.6205
Profitability	119	6.67E + 09	1.02E + 10	−3.75E + 09	5.91E + 10
Sector	119	7.378151	3.170285	1	11

5.2. Explanatory Analysis

Table 5 shows the results of the empirical analysis. Differences can be observed between the accounting treatments of gas emission rights. The base value of the dependent variable with which to compare the results obtained is ACCOUNT = 0, that is, “No accounting treatment of emission rights”.

Table 5. Empirical results.

ACCOUNTANT Values	ACCOUNT = 1 (Expense)	ACCOUNT = 2 (Intangible)	ACCOUNT = 3 (Provision)	ACCOUNT = 4 (R + D)	ACCOUNT = 5 (Others)
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
ETS	1.170638	18.45163	3.702575 *	0.9447854	2.703819 **
IGRI	−2.339419 ***	0.885562	−0.3399562	−2.217921 **	0.2313345
INOGRI	5.430694 **	−1.106428	−0.3667192	1.919635 **	0.7116263
KYOTO	−4.518522 **	1.681209	−0.5716272	1.254937	−0.4267376
Size	−0.2726449	−1.742469 *	−0.6861952	−0.9877878 **	−1.298435 **
Leverage	−0.6225815	0.0401039	0.0214874	−0.0318913	0.045151
Profitability	−1.674007	−3.557014	−10.38646	−0.9017114	−5.200821
Sector	−0.2015668	0.3489873 **	0.0537711	−0.1334337	0.1324796
_cons	1.364202	21.75191	15.20085	21.48851 **	26.95892 **

*, **, *** represent statistical relevance at 90%, 95% and 99% respectively; N = 119 observations; ACCOUNT is the dependent variable that represents the different ways of accounting treatment for gas emission rights. This takes the value 1 if the firm counts them as an expense; value 2, when they are accounted for as an intangible asset; a value of 3 if they are treated through a provision; value 4 if they are considered an R + D expense; and value 5 when they are treated as other entry items (investment, inventory or loan); ETS is a dummy variable which takes the value 1 if the firm belongs to a country that has established an emissions trading scheme and 0 otherwise; IGRI is a variable that represents greenhouse gas emission and climate change indicators presented according to the Global Reporting Initiative; INOGRI is a variable that represents greenhouse gas emission and climate change indicators presented by the firm in line with the KPMG and GRI (2007) report; KYOTO is a dummy variable that takes the value 1 if the firm pertains to a country that has signed the Kyoto Protocol, and 0, otherwise; Size is firm size measured as the logarithm of assets; Leverage is a firm's leverage, established as the ratio between total debt and stockholders' equity; Profitability is a firm's profitability, measured by EBIT; Sector is a multinomial variable which represents the different activity sectors involved in greenhouse gas emissions.

The first column shows the results when the dependent variable ACCOUNT takes a value of 1. The coefficients reflect the greater or lesser probability of accounting treatment of emission rights as an expense instead of not entering them at all. In this case, the statistically significant independent variables are IGRI, for a confidence level of 90% and INOGRI and KYOTO for a confidence level of 95%. IGRI and KYOTO negatively affect the dependent variable. This means that firms that disclose information using indicators of climate change and gas emissions according to the GRI guidelines and that have their headquarters in a signatory country of the Kyoto Protocol are more likely to not account for them than to treat them as an expense. In contrast, firms that disclose indicators that appear in the

report drawn up by KPMG and the bGRI (2007) are more likely to treat them as expenses than not to account for them at all.

When the dependent variable takes a value of 2, the coefficients show the greater or lesser probability of accounting for emission rights as an intangible asset instead of not entering them at all. In this case, none of the factors is statistically significant.

When emission rights are entered as a provision (ACCOUNT = 3), the only relevant explanatory variable is ETS, for a confidence level of 99%. Its effect on ACCOUNT is positive, which means that firms in countries that have established an emissions trading scheme are more likely to account for emission rights as a provision rather than not to account for them.

When the dependent variable takes a value of 4, which represents accounting treatment of emission rights as an R+D expense, the results show that the variables IGRI and INOGRI are relevant. They are both significant for a confidence level of 95%, but the impact of each one is different: IGRI shows a negative effect on ACCOUNT whereas INOGRI affects it positively. As in the first case (ACCOUNT = 1), firms that disclose indicators appearing not only in the GRI guidelines but also in the report by KPMG are more likely to treat emission rights as an R+D expense than not to account for them, whereas firms that disclose indicators only from the GRI will most likely not account for emission rights.

Finally, the variable ACCOUNT takes a value of 5 to represent the other forms of accounting treatment for emission rights indicated above. According to the estimated coefficients, the only relevant factor is ETS, for a confidence level of 95%. ETS have a positive impact, meaning that firms in countries that have established an emissions trading scheme will tend to enter emission rights in their annual accounts as an investment, in inventory or as a loan, instead of not treating them at all.

In short, the empirical results show that firms in countries that have established an ETS will tend to account for emission rights, as posited in our H1, specifically as a provision or through other entry items such as investments, loans or as an inventory. We can thus accept H1. The reason for this may be that through accounting, firms can be viewed in a more positive light [39] as regards their environmental practices, especially in countries where the trading of emission rights is important. These markets manage to improve competition and the effective application of the regulations in this respect, thus motivating firms to treat emission rights in their accounting.

Nonetheless, the firms disclosing a larger number of the indicators on climate change and gas emissions appearing not only in the GRI guidelines but also in the report published in conjunction with KPMG (2007) will tend to account for emission rights as an R + D expense or as any other kind of expense, rather than not treating them at all in their accounting. This shows that the more standardized the indicators and the more international bodies supporting them, the higher the degree of information transparency, with a tendency to account for emission rights. The same as we observed previously, the disclosure of indicators in accordance with the GRI or KPMG positively affects the decision to afford accounting treatment to emission rights. The evidence therefore allows us to accept our H3.

Furthermore, firms pertaining to countries that signed the Kyoto Protocol will tend not to account for them rather than entering them as an expense, although there is not empirical evidence regarding other means of accounting treatment (as intangible assets, provision, R + D, investment, *etc.*). We therefore cannot accept H4, since ratification of the Kyoto Protocol does not directly affect the accounting treatment of emission rights. These results appear to contradict the previous evidence, which showed that in general firms with their headquarters in countries that have ratified the Kyoto Protocol display more information on pollution, greenhouse gas emissions and global warming [44]. Again, our findings may be explained by the difference between disclosure and accounting treatment. Firms can disclose environmental information in a general and qualitative way, but when it comes to accounting for it monetarily and exactly, they tend not to do so because it could damage their image.

In regard to the control variables, large firms are more likely not to account for emission rights than to treat them as intangible assets, R + D expenses or as other entry items such as investments, loans or inventory. This can be deduced from the statistically significant negative coefficients at a confidence

level of 95 or 99% for the variable Size, when the dependent variable takes the values 2, 4 and 5. This result is in accordance with the evidence found by [22] for a sample of 157 international firms.

The variable representing the firm's sector of activity shows a statistically significant positive coefficient at the 95% confidence level when firms treat emission rights as an intangible asset. As we pointed out earlier, these sectors are considered as the most sensitive to greenhouse gas emissions and therefore are the ones that grant the most importance to accounting treatment of greenhouse gas emissions in their annual accounts. Similar results were found by [22], since in the energy generators sector and the cement sector most of the firms tend to treat emission rights as intangible assets.

The rest of the variables were not found to be relevant in the model, but they help us to control the effects of the business characteristics that could bias the results of the independent variables. Ref. [22] did not find statistical significance for the variables representing leverage and profitability either, the same as in our research.

Our results point to great diversity when it comes to the accounting treatment of emission rights in the annual accounts of firms, and is in agreement with the scant number of prior research studies to this end [22,28,32].

6. Concluding Remarks

At the present time we find ourselves immersed in national and international contexts in which good business and financial practices are not enough. It is becoming increasingly important for firms to behave in a manner that is environmentally sustainable and efficient in managing resources with a view to guaranteeing the sustainability of present and future generations. As a result, the demand for information regarding sustainability in the business world has swelled enormously, particularly in relation to environmental issues due to the important role they play in business decisions.

Thus, this research study has focused on the accounting treatment of emission rights or quotas. Given the absence of studies attempting to determine the causes of accounting choices for the treatment of emission rights, the aim of this study was to attempt to respond to the following question: what factors determine the different accounting treatments of emission rights on an international level? More specifically, our analysis was carried out with a sample of 119 international firms pertaining to different sectors of activity in 2011. We proposed a dependence model to consider the role that certain factors (Kyoto Protocol, GRI and Non-GRI indicators, Emission Trading Schemes) could play in the different accounting treatments of greenhouse gas emission rights.

Our findings show that firms pertaining to countries that have established Emissions Trading Schemes tend to account for emission rights, specifically as a provision or through other entry items such as investments, loans or as inventory. Likewise, firms that disclose information on the indicators of climate change and gas emissions that are included in the report drawn up by KPMG and the GRI (2007) will tend to treat emission rights as an R + D expense or as some other kind of expense, rather than not account for them at all. Moreover, firms pertaining to countries that signed the Kyoto Protocol will tend to leave it out of their accounts instead of entering them as an expense, and no empirical evidence could be found of other forms of accounting treatment (intangibles, provision, R + D, investment, *etc.*).

These results show a large divergence in the accounting treatment of emission rights as a function of certain factors. The negative effect of such diversity on stakeholders, who find it difficult to make decisions due to a lack of comparable data, has fostered attempts at standardizing an international norm for the accounting treatment of greenhouse emission rights. Stakeholders should take these differences into account when they take decisions, since the several measurement methods may cause relevant divergences in financial statements.

The standardization of accounting entries is a prerequisite for comparability of corporate performance [32]. We encourage international bodies (such as the FASB and IASB) to find a consensus and issue a definitive standard that will put an end to the inconsistency currently prevailing in the treatment of assets, liabilities, and expenses deriving from emission rights [53]. Without consistent

accounting practices, it can be hard to compare financial statements. New accounting standards will help financial users, as well as employees and other stakeholders, to analyze the emission rights as a net position or gross position. It would benefit financial reports that add value to the organization, reduce financial risk, and homogenize the costs applied to accounts for all organizations. For this, several aspects should be addressed, such as initial measurement and recognition, gain recognition and deferral, measurement and recognition of purchased allowances, related parties, impairment, costing methods, classification, presentation, disclosures, etc.

In this respect our research has contributed to the scant previous literature regarding the accounting treatment of emission rights, as it is one of the first studies to analyze the factors determining the choice of different mechanisms to account for them. In addition, it has implication for international regulators, auditors, and investors in general, since our findings suggest differences in financial statements regarding with emission rights. The question here is why managers, when confronted with a choice between competing accounting methods, would choose to adopt or support particular accounting methods in preference to others depending on the accounting, financial, or organizational circumstances [35]. These three agents should take into account whether such decision is taken on the managers' self-interest, leading to monitoring and control mechanisms to avoid opportunistic behaviors.

Nonetheless, our work has a series of limitations that when overcome could lead to more progress in this relatively new and unknown research field. For instance, study could be made of how different factors outside the firm affect the accounting treatment of emission rights, such as the adoption of the IFRS by a firm's country of origin or the different levels of corruption in each country. Future studies could also consider possible moderating factors of the relations found here, increase the number of firms in the sample or take into account a longer time period, all of which would help to generalize these findings.

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