GHG EMISSIONS PERFORMANCE: ALTERNATIVE ACCOUNTING APPROACHES FOR THE EUROPEAN UNION*

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Abstract

This study provides evidence on the probability of adopting an accounting approach for emission allowances and greenhouse gas emissions as a function of each company's GHG emissions performance. The different accounting treatments adopted by national standard-setters and the lack of specific guidance from the International Accounting Standard Board (IASB) allow identification of the use of multiple accounting approaches. Based on a sample of 85 companies registered with the Portuguese, Spanish, and French National Plans of Allocation, data collected from the annual reports were analysed for the period 2008–2014. The results suggest that the probability of adopting omission strategies is positively associated with better GHG emissions performances. It addresses the importance of introducing the transactions of the European Union Emissions Trading Scheme (EU ETS) in financial reporting as the visibility of the costs of polluting is one of the purposes of the market mechanism.

Keywords: Emission allowances, greenhouse gases, accounting approaches, content analysis, logistic regression
JEL Classifications: M40, M14, Q56

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1. Introduction

The importance of the accounting treatment of emission allowances (EA) and GHG emissions has increased with the development of regulated markets such as the EU ETS (PWC and IETA, 2007; Bebbington and Larrinaga-Gonzalez, 2008; KPMG, 2008; Cook, 2009; Giner, 2014). Although it is subject to disagreement (Gibson, 1996), there is empirical evidence that it has a significant influence in financial statements (Lovell *et al.*, 2013; Griffin *et al.*, 2017), whether it is regarding the nature or value of the transactions (Mateos and Bilbao, 2007; Warwick and Ng, 2012). Despite the much-discussed materiality (Busch and Hoffman, 2011; Lovell *et al.*, 2013), when adopting an accounting treatment that recognises the nature of the transactions, entities are allowing fair and transparent information between financial statements (Giner, 2014). However, the history of regulation of the financial reporting for EA and GHG emissions has been marked by consecutive IASB postponements and subjected to extensive criticism in the literature (Inchausti, 2007; Lovell *et al.*, 2010; Steenkamp, Rahman and Kashyap, 2011; Warwick and Ng, 2012; Black, 2013; Ayaz, 2017). As a reaction, some European national standard-setters introduced specific accounting treatments in the domestic regulations. It was the case of the *Autorité des Normes Comptables* (ANC), *Instituto de Contabilidad y Auditoría de Cuentas* (ICAC) and *Comissão de Normalização Contabilística* (CNC), in France, Spain and Portugal, respectively. This scenario created discrepancies in the financial reporting, generating multiple possibilities for the accounting treatment of the EA and GHG emissions that arise from the EU ETS.

From the perspective of discretionary disclosures, there are arguments for a relation between environmental performance and environmental disclosures (Patten, 2002; Cho and Patten, 2007; Clarkson *et al.*, 2008; Milanés-Montero and Pérez-Calderón, 2011; Liu *et al.*, 2016; Qian and Schaltegger, 2017), although there is strong evidence of no relation (Al-Tuwaijri *et al.,* 2004). Within mandatory reporting, Clarkson *et al.* (2008) pointed out that one of the subjects with little development in the field of environmental accounting is the relationship between the level of environmental disclosures and environmental performance. Larrinaga *et al.* (2002) and Llena *et al.* (2007) also suggested that the increase in environmental disclosures in annual reports is a response not just to mandatory regulation but also to a motivation for a less negative image to stakeholders. Relating the disclosure of a certain accounting approach with a measure of environmental performance contributes to increasing the transparency of the EU ETS transactions (Haupt and Ismer, 2011), as financial reporting has achieved with other environmental matters (Larrinaga *et al.*, 2002; Ortas, Gallego-Álvarez and Álvarez Etxeberria, 2015), and also to underline the importance

of more transparency in carbon disclosure, as necessary even in code law countries (Jaggi *et al.*, 2018).

Therefore, it is intended to develop that relation, specifically addressing the influence of GHG emissions performance on the probability of a transparently disclosed accounting approach. This study distinguishes itself from previous studies because: (1) it assumes the importance of incorporating EU ETS transactions in financial reporting; and (2) it relates the choice of a well-known accounting approach with a measure of environmental performance.

2. Background and Hypothesis

In 2005, the IASB decided to withdraw the International Financial Reporting Interpretations Committee (IFRIC) 3, arguing that there had been a misinterpretation of the urgency of the standard and that the prescribed accounting treatment created mismatches in the financial statements. The European Financial Reporting Advisory Group (EFRAG) and extensive previous literature (Bebbington and Larrinaga-González, 2008; Ertimur *et al.*, 2017; Veith *et al.*, 2009; Zhang-Debreceny *et al.*, 2009; Ernst & Young, 2010; Warwick and Ng, 2012; Black, 2013; Giner, 2014) pointed out that the mismatches introduced by the IFRIC 3 were due to the discordant measurement between the assets (the EA) and the liabilities (GHG emissions), which would result in an artificial volatility of reported earnings. The withdrawal of IFRIC 3 was the start of a permitted absence of international regulation on this topic.

To overcome that lack of guidance, some European national standard-setters introduced some guidance. It was the specific case of the ICAC in Spain, with the Resolution of 8 February 2006, updated by Royal Decree no. 602/2016 (which changed the nature of the EA held to comply with the obligation to settle the GHG emissions incurred); the CNC in Portugal, with Technical Interpretation no. 4, replaced in 2010 by an Appendix to Accounting and Financial Reporting Standard no. 26 (AFRS 26) 'Environmental Matters'; and the ANC in France, with the *Avis nº 2004-C du 23 mars du Comité de urgence* until 1 January 2013 replaced with the *Réglement no. 2012-03* of 4 October 2012. Nowadays, the first two standard-setters have chosen to adopt gross approaches to regulate transactions that arise from the EU ETS, and the last one switched to a net approach in 2012.

These different positions may justify the multiple accounting practices that are verified by previous descriptive empirical studies (PWC and IETA, 2007; Ernst & Young, 2010; Lovell *et al.*, 2010; Warwick and Ng, 2012; Black, 2013; Ayaz, 2017). Some of these studies identify a common ground (Veith *et al.*, 2009; Black, 2013): gross

approaches, such as the Portuguese and Spanish standards, influenced by IFRIC 3, and net approaches, such as the United States (US) generally accepted accounting principles (GAAP) and the French standard. Other studies, such as PWC and IETA (2007) and Lovell *et al.* (2010), concluded for an approach that is not regulated: costs with adjustments to market value, based on the carrying value of the EA held, granted and/or purchased, plus the market value of the EA that are necessary to cover actual GHG emissions. Ernst & Young (2009) identified the government grant approach as gaining acceptance by companies, an approach that is similar to both the IFRIC 3 accounting treatment and to Lovells' *et al.* (2010) "costs with balance at market value". On a different sample, Ernst & Young (2010) evidenced that companies that apply the US GAAP and participate in today's carbon emission programmes generally follow one of two different accounting practices: an intangible asset model or an inventory model. Such descriptive studies rely on differential databases. That of Lovell *et al.* (2010) is the result of a survey and telephone interviews among a sample of 26 companies, representing 68 installations and 25% of EU ETS total emissions in 2008, the first year of the EU ETS; Black (2013) started from the National Plans of Allocation (NPA) for phase II of Germany, Spain and the United Kingdom, the state-members with higher emissions, also only for one year – 2011, and selected allocations of over 150,000 EA, having reached a sample of 62 companies that have their parent companies located in 16 different countries. Both papers chose high emitters to ensure that EA and GHG emissions are economic transactions materially relevant presented in financial reporting, which is by itself difficult to assess without a proper content analysis of financial statements, more exactly, of the Notes.

Busch and Hoffman (2011) argued that the problem of introducing financial information regarding GHG emissions from a market based on the cap-and-trade system is the interpretation of the transactions as materially relevant, due to the grandfathering system considered in phases I, II and even phase III of the EU ETS, which may be the base for justifying the adoption of off-balance sheet policies (Criado-Jiménez *et al.*, 2008). As pointed out by Lovell *et al.* (2013), the materiality issue seems to be an inconsistent justification as the European market in EA is significant and disclosing the nature of the transactions may contribute to a key improvement in financial reporting. Therefore, including companies in the sample without considering materiality as an *a priori* condition is a point of interest and of difference with those descriptive studies that may influence the motivations to disclose financial information.

Regarding what motivates the choice of one accounting treatment over another, as materiality issues may be one justification offered by preparers, companies operating in the EU ETS should be more sensitive to adopting transparent policies that reflect their carbon performance (Jaggi *et al.*, 2018). Larrinaga *et al.* (2002) and Llena *et al.*

(2007) suggested that the increase in environmental disclosures in annual reports is not a response just to mandatory regulation but also to the motivation for a less negative image to stakeholders. This argument may have, however, two sides. As Larrinaga *et al.* (2002) argued, on the one hand, companies may neglect aspects of the regulation that it is not in their interest to report on, which in the context of GHG emissions may lead to the adoption of off-balance sheet policies; on the other hand, companies with better performance measures have a motivation to disclose more information, basing their reports on accounting approaches that provide related information. Al-Tuwaijri *et al.* (2004) concluded that good environmental performers disclose (within the context of their definition of environmental disclosure, which included information reported on Forms 10-K) more pollution-related environmental information than do poor performers. In this sense, the accounting approach on EA and GHG emissions may be a function of GHG emissions performance.

However, based on the significant absence of previous empirical studies that support the relation, we expect an absence of visibility of GHG emissions performance in the probability of adopting a specific accounting approach, and we formulate the following non-directional hypothesis:

H_1: The probability of adopting an accounting approach regarding EA and GHG emissions is not influenced by GHG emissions performance.

3. Research Method

3.1. Sample and data

Annual financial statements and the European Commission's report 'Verified emissions for 2014' (European Commission, 2017) have been used as the primary data sources. Annual accounts are the primary source for disclosing accounting practices to stakeholders (Patten, 2002; Gallego-Álvarez *et al.*, 2016) and the European Commission report is based on self-reported information to the Union Registry and it is a reliable source for obtaining data on allocated EA and verified GHG emissions.

The NPAs from Portugal, Spain and France were the starting point for determining the sample as it was the most complete source of installations subjected to the EU ETS. The selection of these countries was motivated by the purpose of the study, which consists of comparing two scenarios of transparency within guidelines based on the (in)existence of specific accounting principles, and taking into consideration the availability of comparable accounting information. Those installations were matched with the respective company owners. The period of the study covers the years 2008 to 2014, *i.e.*, all the five years

of phase II and the first two years of phase III, which includes the transition to auctioning. The final composition of the sample is an unbalanced panel regarding 85 companies: 540 observations, 352 for IFRS-based financial reporting and 188 for regulation-based national accounting. The representativeness of the sample may be questioned, as the data collected depended on the online availability of annual financial statements. The sample selection was reduced to this form since a large number of installations that are listed in the NPAs belong to transnational groups that incorporate companies that have installations in other European countries (not exclusively in Portugal, Spain or France). This was more significant for French installations. However, this does not invalidate the analysis as it can be assumed that the results apply to companies with the same characteristics as those in the sample.

3.2. Variables

Table 1 (panels A to C) describes the variables, their measurements and its sources. To assess the accounting policies adopted regarding EA and GHG emissions, we used a content analysis of year-end financial statements (Warwick and Ng, 2012; Rokhmawati *et al.*, 2015).

Panel A presents the eight accounting policies, collected from the Notes to the annual accounts, which are the basis for the formulation of the accounting approaches; Panel B shows the combinations of accounting policies that were used to identify the adopted accounting approach (if any); Panel C synthesises all the variables of the study.

Table 1: Variable definitions

Panel A - Accounting policies for recognition and measurement of EA and GHG emissions

Categorical variables	Abbreviation
I1. Initial recognition of EA	Rec EA
I2. Counterpart on the initial recognition of EA	Count EA
I3. Initial measurement of EA	Initial Meas EA
I4. Subsequent measurement of EA	Subseq Meas EA
I5. Recognition of GHG emissions	Rec GHG emissions
I6. Measurement of GHG emissions	Meas GHG emissions
I7. Recognition of GHG emissions over allocated EA	Rec GHGe over EA
I8. Recognition of EA acquired to cover GHG emissions over cap	Rec EA acq

Table 1: Panel B – Identification of accounting approaches

The accounting approach is a dichotomous variable that takes the value 1 if it is identified by the joint answers of each categorical variable (I1 to I7) – representing accounting policies, and 0 otherwise. Each categorical variable may present one or more possibilities to be considered that a certain accounting approach is being adopted. The possibilities/ disclosures of accounting policies that were identified in the content analysis on each categorical variable are expressed in the Appendix. The abbreviations for the identified accounting approaches are as follows: IFRIC 3 cost model (IFRIC3_cost), government grant approach (GovGrant) as exposed by Ernst & Young (2009), net liability approach (NetLiab), the French inventory approach (Inventory) as exposed by ANC in 2012, the Spanish approach exposed in Resolution 8 of February 2006 (ICAC), the Portuguese approach exposed in the appendix to AFRS 26, the approach of disclosing off-balance sheet policies (NoRec), and the approach of non-disclosure of EA or GHG emissions (NoDisc).

Approach	I1	I2	I3	I4	I5	I6	I7
IFRIC3_cost	1	3-5-6-7	3-4-5	3	3-6	4-7	–
GovGrant	1	3-5-6-7	3-4-5	3	3-6	9-11-12-13	–
NetLiab	–	–	1-6-7-99	–	7-0	–	1-2-3-4
Inventory	2	–	1-6-7	1-6	2-3	1-2-5-6-9-10-11-12-13 [a)]	–
ICAC	1	1-7	3-4-5	3	3-6	4-5-6-10	–
AFRS26 [b)]	1	1-7	2-3-4-5	2-4	–	2	–
NoRec	99	–	99	–	7	–	5
NoDisc	0	–	0	–	0	–	0

Notes:

a) I6 for inventory approach presents a variety of options in content analysis (1-2-5-6-9-10-11-12-13 in the Appendix), but there are only six observations that fulfil the previous criteria. It discloses I6 as the carrying amount of EA held.

b) I7 was not considered to identify the approach because the disclosure may not have happened if GHG emissions are below EA allocated for free and held for compliance.

Table 1: Panel C – Variable definitions

Variable	Type	Description	Measurement	Data source
IFRIC	Dependent variable (Accounting approach)	IFRIC 3 cost model	Dummy variables: take the value 1 if the approach is identified and 0 otherwise	Notes (Annual financial statements)
GovGrant		Government grant approach as conceptualised by Ernst & Young (2009); Modified IFRIC 3 cost model as identified by Lovell *et al.* (2010).		
NetLiab		IFRIC 3 revaluation model		
Inventory		Net liability approach		
ICAC		Approach prescribed in Resolution 8 of February 2006 by ICAC		
AFRS26		Approach prescribed in appendix to AFRS 26 by CNC		
NRec		Inventory approach as prescribed by ANC production model		
NDisc		No recognition of EA and GHG emissions		
GHGeP	Explanatory variable	GHG emissions performance	Logarithm of the ratio of net sales to GHG emissions (in € by metric ton)	Annual financial statements / Amadeus database + EC report - Verified Emissions 2014
Size	Control variables	Company size	Logarithm of total assets (in €)	Annual financial statements / Amadeus database
ROA		Return on assets	Ratio of EBIT to total tssets (in €)	
ROE		Return on equity	Ratio of net income to owners' equity (in €)	
ROS		Return on sales	Ratio of net sales to total assets (in €)	
DebtE		Debt to equity ratio	Ratio of total debt to owners' equity (in €)	
DebtTA		Debt to assets ratio	Ratio of total debt to total assets (in €)	
Audit		Presence of auditor's report in annual financial statements	Dummy variable: takes the value 1 if the annual accounts present an auditor's report and 0 otherwise	Annual financial statements

Source: Authors.

The accounting approaches identified were considered as defined by regulators or based on previous literature regarding their application (Ernst & Young, 2009; Lovell *et al.*, 2010). The identification of the approaches was made by combining some recognition and measurement accounting policies disclosed in the annual accounts notes. This study defines seven items that express those policies: I1, Initial recognition of granted EA; I2, Counterpart on the initial recognition of EA granted; I3, Initial measurement of EA; I4, Subsequent measurement of EA; I5, Recognition of GHG emissions; I6, Measurement of GHG emissions; I7, Recognition of GHG emissions over allocated EA.

GHG emissions performance (*GHGeP*) was defined as the ratio of net sales to GHG emissions, which reflects the sales value for each unit of GHG emissions. Ehrenfeld (2005) frames it as a measure of eco-efficiency because it is the ratio of an economic value added to an environmental impact measure. Previous literature (Busch and Hoffman, 2011; Qian and Schaltegger, 2017) uses carbon intensity, the inverted ratio of GHG emissions performance, which is also mentioned by Ehrenfeld (2005) as an eco-intensity measure. The GHG emissions performance ratio was logarithmized to avoid skewed parameters; this is in accordance with previous literature (Busch and Hoffman, 2011; Griffin *et al.*, 2017).

For control variables, we expect that size, profitability, financial risk and exposure to supervision of an auditor, provides good factors for assessing the probability of adopting an accounting approach that reflects exposure to the EU ETS. Company size is considered to be a positive influence on the disclosure of information, since it emphasizes that large firms are politically more sensitive, facing pressures that smaller entities do not have. Clarkson *et al.* (2008) conclude that large companies disclose more information related to GHG emissions. Like Giner (1997) and Gallego-Álvarez *et al.* (2016), we used the logarithm of total assets to proxy for the company's size. Profitability measures are often used as control variables, as better performers may be more transparent about their internal activities as stakeholders are not only concerned about obtaining profits but also on how they were obtained (Gallego-Álvarez *et al.,* 2016; Qian and Schaltegger, 2017). Several studies simultaneously use return on assets (ROA) and return on equity (ROE) to control for profitability: ROA reflects operating performance and ROE financial performance (Giner, 1997; Qiu *et al.*, 2016). We also introduced return on sales (ROS) because it represents a short-term return (Liu *et al*., 2016). Leverage ratios are used to inform about default risks that may lead to avoid investment and financing. They are often used as covenants, which leads managers to adopt accounting policies that avoid an inconvenient outcome (Freedman and Jaggi, 2011). There are also several measures used in the literature, and we choose to include two of them: debt-to-equity ratio (Ortas *et al.*, 2015; Gallego-Álvarez *et al.*, 2016) and debt-to-assets ratio (Busch and Hoffman, 2011).

The presentation of an independent auditors' report certifies the reliability and relevance of the accounting practice regarding EA and GHG emissions, thus providing greater credibility to the financial statements (Dechow, Ge and Schrand, 2010). It is expected that the presentation of an external auditor report has a positive impact on the adoption of an accounting approach. The variable Audit is a dichotomous variable that takes the value 1 if the annual report incorporates the auditor's report and the value 0 if not.

3.3 Model and econometric analysis

Our econometric model differentiates itself from previous literature by trying to assess whether an accounting approach has a higher probability of being adopted in function of the company's GHG emissions performance. Equation (1) was designed to verify the influence of GHG emissions performance on the choice of adopting an accounting approach.

$$AA_{it} = \beta_0 + \beta_1 GHGeP_{it} + \emptyset X_{it} + \varepsilon_{it} \quad (1)$$

where:

- i and t are, respectively, the company and the year;
- AA represents the respective accounting approach;
- $GHGeP$ is the measure for GHG emissions performance;
- X corresponds to control variables: *Size*, *Profitability* (*ROA*, *ROE* and *ROS)*, *Leverage* (debt-to-equity and debt-to-total assets), and *Audit* (presence of an independent auditors' report);
- ε is the error term.

To test Equation 1, a logistic regression model was considered. In order to estimate the parameters of these models (Verbeek, 2017), it is very common to use the maximum likelihood method, with the second-order conditions revealing an array of negative definite second-order derivatives, assuming that the regressors are not collinear. Consequently, the log likelihood function is globally concave and the convergence of the iterative maximum likelihood algorithm is guaranteed. In order to minimize the bias of the maximum likelihood estimation against a reduced sample – the frequencies for the accounting approaches regarding IFRIC 3 cost model and net liability are characterized as a rare event – we chose to use the Penalised Maximum Likelihood Estimation (Firth, 1993) because in cases of 'separation', it allows convergence for finite estimates. Although it is not of our knowledge that it can be applied in data panel scenarios, which was possible assuming the seven-year period of the sample, we chose to compromise the advantages of these models in order to obtain more reliable coefficients. This choice considered

that accounting policies and, consequently, accounting approaches, should be applied consistently and we expected minimal variability over time.

4. Results and Discussion

4.1 Univariate analysis

Tables 2 and 3 show the summary statistics and the correlation matrix between the model variables. Table 2 shows a reduced mean for all the approaches, but two 'opposite' approaches stand out: the government grant approach and the non-disclosure approach. This suggests that companies tend to disclose a gross approach that evidences the asset – EA, as well as the liability – GHG emissions or, as an alternative, do not disclose any information at all. In between, there is evidence that some companies choose to adopt approaches following the national regulator. Table 3 evidences a positive correlation between the GHG emissions performance and the approaches of IFRIC 3, non-recognition and non-disclosure. The government grant approach, the approach of AFRS 26 and the net liability approach are negatively correlated with the performance of GHG emissions. These results suggest that, on the one hand, the omission of financial information related with EA and GHG emissions is generally correlated with better GHG emissions performance ratios; on the other hand, the adoption of an accounting approach, whether a gross or net approach, is related to lower performance ratios. The analysis of these results indicate that companies with higher eco-efficiency ratios may consider that financial disclosure does not serve the purposes of relations with environmental performance measures, but also may be an indicator that those companies that achieve "good" environmental indicators do not see the purpose of including it in the financial reporting.

Regarding the correlation with control variables, it is to be noted that larger companies are positively correlated with the net liability approach and the government grant approach, indicating the duality that characterises the choice of accounting policies by larger companies. Leverage ratios are negatively correlated with non-disclosure, but positively correlated with the net liability approach or the inventory approach. This may indicate that more indebted companies adopt a disclosure posture but choose a net approach that discloses less information. The auditors seem to have a positive correlation in the disclosure, whether it is a gross or a net approach, or even in the disclosure of off-balance sheet policies. It also shows a negative correlation with the non-disclosure approach. The importance of such a figure – the auditor – seems to improve the act of disclosing financial information on the exposure to the emissions market. Although the correlations with profitability were introduced considering long-term *versus* short-term profitability, the results do not indicate a tendency or common ground.

Regarding the results for the independent variable with control variables, the GHG emissions performance is positively correlated with size and short-term performance and negatively correlated with long-term performance and auditors' report. This allows us to present some characteristics on the sample: on the one hand, larger companies with higher short-term profits and without an auditors' report show better GHG emissions performances; on the other hand, smaller companies, more profitable in the long-term, and those that are subjected to an auditors' report show lower GHG emissions performances.

Table 2: Summary statistics of study variables

	Obs	Mean	Std. dev.	Min	Max
IFRIC3	540	0.0130	0.1132	0	1
GovGrant	540	0.1538	0.3611	0	1
NetLiab	540	0.0519	0.2219	0	1
Inventory	540	0.0111	0.1049	0	1
ICAC	540	0.0352	0.1844	0	1
AFRS26	540	0.0519	0.2219	0	1
NRec	540	0.0352	0.1844	0	1
NDisc	540	0.1370	0.3442	0	1
GHGeP	540	7.4819	2.1174	3.1761	14.4616
Size	540	19.5453	1.9484	14.4998	24.5375
ROA	540	0.0517	0.1197	–1.2022	0.5791
ROE	540	0.1021	0.3392	–2.8407	4.0087
ROS	540	0.8227	0.5136	0.0082	3.0855
DebtE	540	1.7876	3.2518	–28.0376	33.1463
DebtA	540	0.5549	0.2765	–1.1387	1.5476
Audit	540	0.8407	0.3663	0	1

Note: See Table 1 for variable definitions.

Source: Authors.

Table 3: Spearman's correlation matrix

	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)	16)
1) IFRIC3	1.0000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2) GovGrant	−0.0495	1.0000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3) NetLiab	−0.0268	−0.1011**	1.0000	–	–	–	–	–	–	–	–	–	–	–	–	–
4) Inventory	−0.0121	−0.0458	−0.0248	1.0000	–	–	–	–	–	–	–	–	–	–	–	–
5) ICAC	−0.0219	−0.0825***	−0.0447	−0.0202	1.0000	–	–	–	–	–	–	–	–	–	–	–
6) AFRS26	−0.0268	−0.1011**	−0.0547	−0.0248	−0.0447	1.0000	–	–	–	–	–	–	–	–	–	–
7) NRec	−0.0219	−0.0825*	−0.0447	−0.0202	−0.0365	−0.0447	1.0000	–	–	–	–	–	–	–	–	–
8) NDisc	−0.0457	−0.1722*	−0.0932*	−0.0422	−0.0761***	−0.0932**	−0.0761***	1.0000	–	–	–	–	–	–	–	–
9) GHGeP	0.1156*	−0.1368*	−0.1644*	−0.0696	0.0433	−0.1419*	0.0945**	0.2239*	1.0000	–	–	–	–	–	–	–
10) Size	−0.0580	0.0888**	0.1268*	−0.1429*	−0.0204	−0.1343*	−0.0335	0.0262	0.1808*	1.0000	–	–	–	–	–	–
11) ROA	−0.0819***	0.1468*	−0.0277	0.0127	0.0739***	−0.1811*	0.0715***	−0.0373	−0.0863**	0.0157	1.0000	–	–	–	–	–
12) ROE	−0.0623	0.1399*	0.1025**	−0.0354	0.0194	−0.2119*	0.0802***	−0.0489	−0.1227*	0.0025	0.7730*	1.0000	–	–	–	–
13) ROS	0.1772*	−0.0817***	−0.1356*	0.1157*	0.1588*	−0.0574	−0.1403*	−0.0023	0.3416*	−0.3458*	0.1370*	0.0392	1.0000	–	–	–
14) DebtE	0.0833***	0.0587	0.1296*	−0.1484*	−0.0979**	0.0590	0.0672	−0.1402*	0.0273	0.1216*	−0.1220*	0.0304	−0.0859**	1.0000	–	–
15) DebtTA	0.0760***	0.0310	0.1146*	−0.1552*	−0.1102**	0.0440	0.0549	−0.0165	0.0538	0.1182*	−0.2085*	0.0872*	−0.0741***	0.8909*	1.0000	–
16) Audit	0.0499	−0.0620	0.1018**	0.0461	−0.1092**	−0.0580	0.0831***	−0.3122*	−0.1748*	0.0941**	−0.1118*	−0.0555	−0.2042*	−0.1129*	−0.0850**	1.0000

Note: See Table 1 for variable definitions. *, **, *** represent significance levels (two-tailed) at 1%, 5% and 10%, respectively.
Source: Authors.

4.2 Multivariate analysis

Table 4 shows the results for Equation (1), which focuses on the probability of adopting an accounting approach by influence of the ratio of GHG emissions performance.

The probability of adopting the government grant approach, the net liability approach and the AFRS 26 approach is negatively related with GHG emissions performance, suggesting that lower performance measures show a higher probability of obtaining financial disclosures that reflect information on exposure to the EU ETS. These results are not in line with the argument of Al-Tuwaijri *et al.* (2004), who suggested that good performers are also motivated to disclose more voluntary information, but are in line with the argument of Larrinaga *et al.* (2002) that companies may neglect aspects that it is not in their interest to report, as far as regulation allows or with some intention of dismissing it. Moreover, the results show that a higher ratio of GHG emissions performance is positively associated with the adoption of off-balance sheet approaches and non-disclosure. Thus, companies with higher GHG emissions performance are more likely to adopt an approach that embodies the reporting of less financial information or even no information, suggesting that good environmental performance does not have material implications on financial reporting or is not subjected to faithful representation of the information that reflects that the company is a participant in the EU ETS. Such results indicate that financial disclosures on the EU ETS transactions do not serve as a transparency measure that is in relation with environmental performance, and that this relation is more related with the guidelines on voluntary disclosure. Radu, Caron and Arroyo (2020) concluded that voluntary disclosures are more focused on reactive solutions, compliance and certifications, which is outside the scope of financial reporting. Nevertheless, under the existing conditions of financial reporting regulation, the results may also suggest that companies with good environmental performances adopt strategies of concealment of financial information through the adoption of off-balance sheet approaches and non-disclosure. These strategies may also be a dismissal of the standard (if one exists, as national regulations) such as the Spanish ICAC approach, that does not show a relation.

The contribution of control variables assesses that larger companies tend to adopt either the government grant approach or the net liability approach. This is problematic as the approaches mentioned show a distinct influence on financial reporting and are followed by companies that, due to their dimension, usually have a significant role as influencers of others. In addition, it seems that the figure of auditors contributes positively to the probability of adopting the net liability approach, which suggests a predisposition of the professionals not to account transactions that come from exposure to the EU ETS until the GHG emissions exceed the EA. Also, more indebted companies tend to choose

an approach such as an accounting treatment that does not influence the value of total liabilities or its presentation by nature when EA are allocated. Regarding profitability, disclosure of off-balance sheet policies is probably made mostly by companies that are profitable in the long term but not in the short term. Short-term profitability is also an influence for the probability of the practice of non-disclosure.

The results of penalized maximum likelihood estimation do partially support H_1, as it is verified. On the one hand, the probability of a better ratio of GHG emissions performance positively influences the disclosure of off-balance sheet policies or non-disclosure, and hence, the lack of an accounting treatment. On the other hand, a lower ratio of GHG emissions performance influences the probability of disclosing the adoption an accounting approach that does not follow common ground, as it can be based either on a gross approach or on a net approach. So, the probability of adopting or not an accounting approach may be influenced by GHG emissions performance.

Table 4: Influence of GHG emissions performance on accounting approaches

	(1) IFRIC		*(2) GovGrant*		*(3) NetLiab*		*(4) Inventory*		*(5) ICAC*		*(6) AFRS26*		*(7) NRec*		*(8) NDiv*	
	Coef.	**Std. err.**	**Coef.**	**Std. err.**	**Coef.**	**Coef.**	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**
GHGeP	0.2840	0.2470	−0.2528*	0.0780	−0.4456*	0.1490	−0.2490	0.3362	−0.1081	0.1449	−0.4438*	0.1445	0.4611*	0.1130	0.2995*	0.0742
Size	−0.0255	0.3041	0.1960**	0.0769	0.2927**	0.1252	−0.4214	0.3824	0.1504	0.1635	−0.2772**	0.1222	−0.3474**	0.1359	−0.0318	0.0835
ROA	−1.8184	3.7535	1.5951	1.1082	−0.4048	1.8192	−4.0635***	2.2770	−0.6170	1.9699	−1.3625	1.4532	5.4505**	2.3249	−1.5430	0.9668
ROE	0.8413	1.3057	0.8628**	0.3678	−0.1375	0.6071	−0.6841	1.5431	0.2786	0.7130	−1.3459*	0.4639	1.7870**	0.7394	−0.0986	0.3280
ROS	2.2690*	0.7678	−0.2384	0.3539	−0.1290	0.6567	1.0493	0.6711	1.0773**	0.4944	−0.7663	0.4919	−3.7214*	0.9517	−0.5981***	0.3286
DebtE	0.1206***	0.0628	0.0281	0.0364	−0.0116	0.0665	−0.2086	0.2235	−0.1019	0.0683	−0.1396***	0.0728	0.0298	0.0538	−0.1504**	0.0638
DebtA	−0.2658	1.4024	−0.3942	0.5262	2.4036**	1.1212	−2.6012**	1.0610	−0.9183	0.6195	1.5910	1.0038	0.3446	1.2162	0.1580	0.5260
Audit	1.7861	1.5075	−0.8142**	0.3270	1.9730	1.4492	1.0172	1.6822	−1.1641**	0.5308	−1.0771**	0.5318	1.6566	1.4623	−1.9911*	0.3026
_cons	−10.2506***	5.7185	−2.8985***	1.5793	−8.7708*	2.9399	4.9353	6.5842	−4.7823	3.1438	6.3782*	2.3583	0.0029	3.2386	−1.3790	1.6447
N	540	–	540	–	540	–	540	–	540	–	540	–	540	–	540	–
chi² (8)	20.16*	–	31.11*	–	25.53*	–	17.50**	–	15.17***	–	33.29*	–	33.07*	–	64.47*	–
Penalized log likelihood	−18.5764	–	−201.7017	–	−81.20	–	−16.0711	–	−65.7253	–	−79.8221	–	−51.71	–	−162.324	–

Note: See Table 1 for variable definitions. *, **, *** represent significance levels (two-tailed) at 1%, 5% and 10%, respectively.

Source: Authors.

The results obtained did not allow us to identify the adoption of an approach that expresses itself as an optimal instrument for the accounting treatment (Mateos and Bilbao, 2007) in relation to GHG emissions performance. The adoption of approaches that do not involve recognition and measurement procedures, such as non-recognition or even non-disclosure, may even be seen as corporate strategies of concealment of financial information that should allow stakeholders to identify the exposure to the EU ETS (Criado-Jiménez *et al.*, 2008). The proper disclosure of accounting approaches may present itself as small means of identification, through content analysis, as companies may neglect aspects that it is not in their interest to report, whether it is under specific guidance (Larrinaga *et al.*, 2002) or not. These types of approaches incorporate an amount of environmental information that may be expressed under measurements of a significant market – the EU ETS. The use of off-balance sheet policies or the lack of information through non-disclosure, is to withhold exposure to a possible strategy of climate change mitigation or its absence. This study concludes that the companies that mostly choose to adopt such strategies are those that have better GHG emissions performance. This may be understood as Busch and Hoffman (2011) state that the accounting professionals do not see the EU ETS transactions as materially relevant under a grandfathering system, although we understand it as a problem, as it compromises the transparency of financial reporting. It may also be perceived as a strategy engaged when companies have a worst GHG emissions performance and try to compensate it with the disclosure of more financial information, particularly when regulation does not enforce it (Larrinaga *et al.*, 2002; Llena *et al.*, 2007; Jaggi *et al.*, 2018). This may be a justification for the adoption of gross approaches such as the government grant approach. The results that non-recognition and non-disclosure approaches are positively influenced by higher performance figures end up rewarding an undesirable situation – the lack of information that may reflect good performance regarding the EU ETS exposure. Hence, companies with higher eco-efficiency ratios may disclose off-balance sheet policies, perhaps because they consider that performance is outside the standards of financial disclosure (Bewley and Li, 2000). However, in line with descriptive studies on accounting for GHG emissions (Lovell *et al.*, 2010; Warwick and Ng, 2012; Black, 2013; Llena *et al.*, 2007) the degree and level of disclosure is very heterogeneous, in quantity and quality, even in the presence of environmental regulation. As identified in previous literature (Cook, 2009; Veith *et al.*, 2009) companies choose the easier accounting process and with greater advantages in the stakeholder objective of decision making. In the context of adopting the IFRS, net approaches show higher probability of being applied either due to the influence of Uniform System of Accounts (USofA) 101.21 or within the scope of IAS 37 – Provisions, Contingent Liabilities and Contingent Assets. The probability of choosing one approach or not should not be

influenced by the interpretation of materiality as a characteristic if relevance (Busch and Hoffman, 2011), while ignoring the materiality of the price of EA on the market and the relevant nature of the transactions (Lovell *et al.*, 2013). This leads us to agree with Lovell *et al.* (2013) that the accountant has a difficult task in trying to stabilize multiple approaches, and not being limited to not disclosing or disclosing insufficient information that does not fit the necessities of environmentally conscious stakeholders or market risk awareness.

5. Conclusion

Emissions trading is an instrument proposed by the Kyoto Protocol that has generated some problems for financial reporting, namely with the recognition of the transactions of the cap-and-trade scheme, that were initially based on a grandfathering system. This was the foundation of the EU ETS in phases I and II, which created different opinions on the accounting treatment among regulatory agencies, accountants, auditors and stakeholders. Until this day, international standard-setters have not yet proposed a common solution, prevailing the ambiguity of interpretations that emerged. This study intended to relate GHG emissions performance with the accounting approaches that were identified in the annual reports of companies that are participants in the EU ETS. We provided empirical evidence that companies with lower eco-efficiency ratios on GHG emissions have higher probability of adopting known accounting approaches such as the government grant approach or the net liability approach; while higher performance ratios are associated with the disclosure of off-balance sheet policies or with non-disclosure. These outcomes may be interpreted as a strategy of disclosing more financial information in cases of a worst performance of GHG emissions, trying to reduce the effects of a possible negative image for the stakeholders. However, this choice is ambiguous and uncertain, harming comparability and faithful representation of financial information, which underlies the urgency of an international accounting treatment for cap-and-trade systems, as previous literature has been continuously asking for. In the meanwhile, companies force external stakeholders to distinguish the impacts of a lack of information from the impacts of disclosure and to compare their effectiveness of the GHG emissions performance as part of the company response to the threat of increasing levels of GHG emissions. Our research findings make contributions to the literature, providing additional evidence that it is important to regulate an accounting approach that provides more transparency to the financial reports. It also provides some insight into how companies use accounting approaches to provide or withhold information that is related with the performance of GHG emissions. This may be used in future studies that are within the scope of integrated reporting. A note of caution is needed because of inherent limitations. The first is related

with the availability of annual financial statements. Secondly, the use of content analysis may result in bias as sometimes it is necessary to make some subjective judgements; this was true for defining the sample, assessing the adopted accounting approaches as well as the cross-referencing between the verified emissions files with the reporting entity. Finally, we acknowledge that the use of all the companies listed in the NPA with available annual financial statements may potentially include information with lack of materiality that increases the adoption of policies of non-recognition and non-disclosure.

Appendix

Accounting policies regarding EA and GHG emissions

I1. Rec EA
1 - Intangible assets
2 - Inventory
3 - Financial assets
4 - Other current assets
0 - Not disclosed
99- Not applied
I2. Count EA
1 - Owners' equity
2 - Other non-current liability
3 - Liability
4 - Financial liability
5 - Liability - EA allocated
6 - Deferred income
7 - Government grant
8 - Grant reduced to asset carrying amount
9 - Income - Government grant
10 - Operational income
0 - Not disclosed
99 - Not applied

I3. Initial Meas EA
1 - Acquisition costs
2 - Fair value
3 - Market value
4 - Price
5 - Quoted average price
6 - Zero
7 - Symbolic value
0 - Not disclosed
99 - Not applied
I4. Subseq Meas EA
1 - Historical costs
2 - Costs less accumulated amortisations
3 - Costs less accumulated impairment losses
4 - Cost model
5 - *First in first out*
6 - Costs or net realisable value, the lower
7 - Fair value
8 - Revaluation model
9 - Net liability approach
10 - Net asset approach
0 - Not disclosed
99 - Not applied

Accounting policies regarding EA and GHG emissions (Continuation)

I5. Rec GHG emissions
1 - Amortization expenses
2 - Costs of consumed materials
3 - Other operational losses
4 - Liability
5 - Financial liability
6 - Provision
7 - No recognition
0 - Not disclosed
I6. Mens GHG emissions
1 - Costs
2 - *First in first out*
3 - Initial price
4 - Average price of EA
5 - Average costs of EA + Acq. costs of EA
6 - Average costs of EA + Best estimate to acquire
7 - Fuel consumption + average price of EA
8 - Cancelation of the obligation order
9 - Carrying amount (CA) of EA
10 - CA EA + average price of EA + best estimate
11 - CA EA + best estimate to acquire
12 - CA EA + price at closing
13 - CA EA + market value
0 - Not disclosed
99 - Not applied
I7. Rec GHGe over EA
1 - Expense accrual
2 - Liability
3 - Financial liability
4 – Provision
5 - No recognition
0 - Not disclosed
I8. Rec EA acq
1 - Intangible assets
2 - Inventory
3 - Never acquired EA
0 - Not disclosed

Source: Authors.

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